PRELIMINARY DETERMINATION

Permit Renewal

U.S. Army/Redstone Arsenal
IMRE-PWE
4488 Marin Road
Redstone Arsenal, Alabama 35898

Redstone Arsenal Landfill
Permit No. 45-03

February 12, 2026

The U.S. Army Garrison/Redstone Arsenal has submitted to the Alabama Department of Environmental Management (ADEM) an application to renew the permit for the Redstone Arsenal Landfill (Permit No. 45-03). The waste stream for the Redstone Arsenal Landfill would remain nonputrescible and nonhazardous construction and demolition waste, rubbish as defined by Rule 335-13-1-.03, and friable and non-friable asbestos waste. The service area for the Redstone Arsenal Landfill would remain the Redstone Arsenal Boundary Area. The maximum average daily volume of waste disposed of at the Redstone Arsenal Landfill would remain 900 tons per day. All conditions of the current permit for the Redstone Arsenal Landfill, including previously approved variances and special conditions have been requested and would be granted in the renewed permit.

The Redstone Arsenal Landfill is described as being located in Sections 14 and 23, Township 16 North, Range 5 West. The Redstone Arsenal Landfill facility consists of approximately 75.96 acres with 43.55 acres approved for disposal.

The Land Division has determined that the permit renewal application complies with the requirements of ADEM's Administrative Code Division 13 regulations for a construction and demolition waste landfill.

Technical Contact:

Mr. Jonathan Crosby
Solid Waste Engineering Section
Land Division

SOLID WASTE DISPOSAL FACILITY PERMIT

PERMITTEE:	**U.S. Army Garrison/Redstone Arsenal**
FACILITY NAME:	**Redstone Arsenal Landfill**
FACILITY LOCATION:	**Southeast ¼ of Section 5, Township 5 South, Range 1 West in Madison County, Alabama. The facility consists of 75.96 acres with 43.55 acres approved for disposal.**
PERMIT NUMBER:	**45-03**
PERMIT TYPE:	**Construction and Demolition**
WASTE APPROVED FOR DISPOSAL:	**The Permittee may accept for disposal nonputrescible and nonhazardous construction and demolition waste, rubbish as defined by ADEM Admin. Code 335-13-1-.03, and friable and non-friable asbestos waste.**
APPROVED WASTE VOLUME:	**Average Daily Volume of 900 tons per day**
APPROVED SERVICE AREA:	**Redstone Arsenal Boundary Area**

In accordance with and subject to the provisions of the Solid Wastes and Recyclable Materials Management Act, as amended, Code of Alabama 1975, SS 22-27-1 to 22-27-27 ("SWRMMA"), the Alabama Environmental Management Act, as amended, Code of Alabama 1975, SS 22-22A-1 to 22-22A-15, and rules and regulations adopted thereunder, and subject further to the conditions set forth in this permit, the Permittee is hereby authorized to dispose of the above-described solid wastes at the above-described facility location.

ISSUANCE DATE:	XXXXXXXXXXX
EFFECTIVE DATE:	XXXXXXXXXXX
EXPIRATION DATE:	XXXXXXXXXXX

Alabama Department of Environmental Management

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
SOLID WASTE PERMIT

Permittee:	U.S. Army Garrison/Redstone Arsenal IMRE-PWE 4488 Martin Road Redstone Arsenal, Alabama 35898
Landfill Name:	Redstone Arsenal Landfill
Landfill Location:	Southeast ¼ of Section 5, Township 5 South, Range 1 West Madison County, Alabama
Permit Number:	45-03
Landfill Type:	Construction and Demolition

Pursuant to the Solid Wastes and Recyclable Materials Management Act, Code of Alabama 1975, §§22-27-1, *et seq*., as amended (the "Act"), and attendant regulations promulgated there under by the Alabama Department of Environmental Management (ADEM), this permit is issued the U.S. Army Garrison/Redstone Arsenal (hereinafter called the Permittee), to operate a solid waste disposal facility, known as the Redstone Arsenal Landfill.

The Permittee must comply with all terms and conditions of this permit. This permit consists of the conditions set forth herein (including those in any attachments), and the applicable regulations contained in 335-13-1 through 335-13-16 of the ADEM Administrative Code (hereinafter referred to as the "ADEM Admin. Code"). Rules cited are set forth in this document for the purpose of Permittee reference. Any rule that is cited incorrectly in this document does not constitute grounds for noncompliance on the part of the Permittee. Applicable ADEM Admin. Codes are those that are in effect on the date of issuance of this permit or any revisions approved after permit issuance.

This permit is based on the information submitted to ADEM on August 3, 2023, and as amended, for permit renewal and known as the Permit Application (hereby incorporated by reference and hereinafter referred to as the Application). Any inaccuracies found in this information could lead to the termination or modification of this permit and potential enforcement action. The Permittee must inform ADEM of any deviation from or changes in the information in the Application that would affect the Permittee's ability to comply with the applicable ADEM Admin. Code or permit conditions.

This permit is effective as of **XXXXXXXXX** and shall remain in effect until **XXXXXXXXXXXX**, unless suspended or revoked.

____ __________________
Alabama Department of Environmental Management Date Signed

SECTION I. STANDARD CONDITIONS.

A. Effect of Permit. The Permittee is allowed to dispose of nonhazardous solid waste in accordance with the conditions of this permit and 335-13. Issuance of this permit does not convey property rights of any sort or any exclusive privilege, nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local laws or regulations. Except for actions brought under the Act, compliance with the conditions of this permit shall be deemed to be compliance with applicable requirements in effect as of the date of issuance of this permit and any future revisions.

B. Permit Actions. This permit may be suspended, revoked or modified for cause. The filing of a request for a permit modification or the notification of planned changes or anticipated noncompliance on the part of the Permittee, and the suspension or revocation does not stay the applicability or enforceability of any permit condition.

C. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

D. Definitions. For the purpose of this permit, terms used herein shall have the same meaning as those in ADEM Admin. Code 335-13, unless this permit specifically provides otherwise; where terms are not otherwise defined, the meaning associated with such terms shall be as defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

1. "EPA" for purposes of this permit means the United States Environmental Protection Agency.

2. "Permit Application" for the purposes of this permit, means all permit application forms, design plans, operational plans, closure plans, technical data, reports, specifications, plats, geological and hydrological reports, and other materials which are submitted to ADEM in pursuit of a solid waste disposal permit.

E. Duties and Requirements.

1. Duty to Comply. The Permittee must comply with all conditions of this permit except to the extent and for the duration such noncompliance is authorized by a variance granted by ADEM. Any permit noncompliance, constitutes a violation of the Act and is grounds for enforcement action, permit suspension, revocation, modification, and/or denial of a permit renewal application.

2. Duty to Reapply. If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit. The renewal application must be submitted to ADEM at least 180 days before this permit expires.

3. Permit Expiration. This permit and all conditions therein will remain in effect beyond the permit's expiration date if the Permittee has submitted a timely, complete application as required by Section I.,E.,2., and, through no fault of the Permittee, ADEM has not made a final decision regarding the renewal application.

4. Need to Halt or Reduce Activity Not A Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

5. Duty to Mitigate. In the event of noncompliance with this permit, the Permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

6. Proper Operation and Maintenance. The Permittee shall at all times properly operate and maintain all facilities and systems of control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with the conditions of this permit.

7. Duty to Provide Information. If requested, the Permittee shall furnish to ADEM, within a reasonable time, any information that ADEM may reasonably need to determine whether cause exists for denying, suspending, revoking, or modifying this permit, or to determine compliance with this permit. If requested, the Permittee shall also furnish ADEM with copies of records kept as a requirement of this permit.

8. Inspection and Entry. Upon presentation of credentials and other documents as may be required by law, the Permittee shall allow the employees of ADEM or their authorized representative to:

   a. Enter at reasonable times the Permittee's premises where the regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

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

   c. Inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

   d. Sample or monitor, at reasonable times, any substances or parameters at any location for the purposes of assuring permit compliance or as otherwise authorized by Code of Alabama 1975, §§22-27-1 *et seq*.

9. Monitoring, Corrective Actions, and Records.

   a. Samples and measurements taken for the purpose of monitoring or corrective action shall be representative of the monitored activity. The methods used to obtain representative samples to be analyzed must be the appropriate method from 335-13-4 or the methods as specified in the Application attached hereto and incorporated by reference. Laboratory methods must be those specified in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, latest edition), Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA Publication SW-846, latest edition), other appropriate EPA methods, or as specified in the Application. All field tests must be conducted using approved EPA test kits and procedures.

   b. The Permittee shall retain records, at the location specified in Section I.,I., of all monitoring, or corrective action information, including all calibration and maintenance records, copies of all reports and records required by this permit, and records of all data used to complete the application for this permit for a period of at least three years from the date of the sample, measurement, report or record or for periods elsewhere specified in this permit. These periods may be extended by the request of ADEM at any time and are automatically extended during the course of any unresolved enforcement action regarding this facility.

   c. Records of monitoring and corrective action information shall include.

      i. The exact place, date, and time of sampling or measurement.

      ii. The individual(s) and company who performed the sampling or measurements.

      iii. The date(s) analyses were performed.

      iv. The individual(s) and company who performed the analyses.

v. The analytical techniques or methods used.

vi. The results of such analyses.

d. The Permittee shall submit all monitoring and corrective action results at the interval specified elsewhere in this permit.

10. Reporting Planned Changes. The Permittee shall notify ADEM, in the form of a request for permit modification, at least 120 days prior to any change in the permitted service area, increase in the waste received, or change in the design or operating procedure as described in this permit, including any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

11. Transfer of Permit. This permit may be transferred to a new owner or operator. All requests for transfer of permits shall be in writing and shall be submitted on forms provided by ADEM. Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of this permit.

12. Certification of Construction. Before the Permittee may commence disposal of waste in any new cell or phase:

a. The Permittee must submit a letter to the Department signed by both the Permittee and a professional engineer stating that the facility has been constructed in compliance with the permit.

b. The Department must inspect the constructed cells or phases unless the permittee is notified that the Department will waive the inspection.

c. The Permittee may not commence disposal activities in any cells or phases until approval of the new cells or phases is granted by the Department.

13. Noncompliance. The Permittee shall report all instances of noncompliance with the permit at the time noncompliance is discovered.

14. Other Information. If the Permittee becomes aware that information required by the Application was not submitted or was incorrect in the Application or in any report to ADEM, the Permittee shall promptly submit such facts or information. In addition, upon request, the Permittee shall furnish to ADEM, within a reasonable time, information related to compliance with the permit.

F. Design and Operation of Facility. The Permittee shall maintain and operate the facility to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of contaminants (including leachate and explosive gases) to air, soil, groundwater, or surface water, which could threaten human health or the environment.

G. Inspection Requirements.

1. The Permittee shall comply with all requirements of ADEM Admin. Code 335-13-4-.21(1)(b).

2. The Permittee shall conduct random inspections of incoming loads.

3. Records of all inspections shall be included in the operating record.

H. Recordkeeping and Reporting.

1. The Permittee shall maintain a written operating record at the location specified in Section I.,I. The operating record shall include:

a. Documentation of inspection and maintenance activities.

b. Daily Volume reports.

c. Personnel training documents and records.

d. Solid/Hazardous Waste Determination Forms for Industrial Wastes, and associated ADEM disposal approval correspondence for industrial waste and special waste.

e. Groundwater monitoring records.

f. Explosive gas monitoring records. (See Section VII Variances)

g. Surface water and leachate monitoring records.

h. Copies of this Permit and the Application.

i. Copies of all variances granted by ADEM, including copies of all approvals of special operating conditions.

2. Quarterly Volume Report. Beginning with the effective date of this permit, the Permittee shall submit, within thirty (30) days after the end of each calendar quarter, a report summarizing the daily waste receipts for the previous (just ended) quarter. Copies of the quarterly reports shall be maintained in the operating record.

3. Monitoring and Corrective Action Reports. The Permittee shall submit reports on all monitoring and corrective action activities conducted pursuant to the requirements of this permit, including, but not limited to, groundwater, surface water, explosive gas and leachate monitoring. The groundwater monitoring shall be conducted in March and September of each year, and the groundwater reports shall be submitted to ADEM within ninety (90) days of the sampling event, or as directed by ADEM. The reports should contain all monitoring results and conclusions from samples and measurements conducted during the sampling period. Copies of the groundwater reports shall be maintained in the operating record.

4. Availability, Retention, and Disposition of Records.

a. All records, including plans, required under this permit or ADEM Admin. Code 335-13 must be furnished upon request, and made available at reasonable times for inspection by any officer, employee, or representative of ADEM.

b. All records, including plans, required under this permit or ADEM Admin. Code 335-13 shall be retained by the Permittee for a period of at least three years. The retention period for all records is extended automatically during the course of any unresolved enforcement action regarding the facility, or as requested by ADEM.

c. A copy of records of waste disposal locations and quantities must be submitted to ADEM upon closure of the facility.

I. Documents to be Maintained by the Permittee. The Permittee shall maintain, at U.S. Army Garrison/Redstone Arsenal, the following documents and amendments, revisions and modifications to these documents until an engineer certifies closure of the permitted landfill.

1. Operating record.

2. Closure Plan.

J. Mailing Location. All reports, notifications, or other submissions which are required by this permit should be sent via signed mail (i.e. certified mail, express mail delivery service, etc.) or hand delivered to:

1. Mailing Address.
Chief, Solid Waste Branch, Land Division
Alabama Department of Environmental Management
P.O. Box 301463
Montgomery, AL 36130-1463

2. Physical Address.
Chief, Solid Waste Branch, Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd.
Montgomery, Alabama 36110-2400

K. Signatory Requirement. All applications, reports or information required by this permit, or otherwise submitted to ADEM, shall be signed and certified by the owner as follows:

1. If an individual, by the applicant.

2. If a city, county, or other municipality or governmental entity, by the ranking elected official, or by a duly authorized representative of that person.

3. If a corporation, organization, or other legal entity, by a principal executive officer, of at least the level of Vice President, or by a duly authorized representative of that person.

L. Confidential Information. The Permittee may claim information submitted as confidential pursuant to ADEM Admin. Code 335-1-1-.06.

M. State Laws and Regulations. Nothing in this permit shall be construed to preclude the initiation of any legal action or to relieve the Permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation.

SECTION II. GENERAL OPERATING CONDITIONS.

A. Operation of Facility. The Permittee shall operate and maintain the disposal facility consistent with the Application, this permit, and 335-13.

B. Open Burning. The Permittee shall not allow open burning within the boundaries of the Redstone Arsenal Landfill without prior written approval from ADEM and other appropriate agencies. A burn request should be submitted in writing to ADEM outlining why that burn request should be granted. This request should include, but not be limited to, specifically what areas will be utilized, types of waste to be burned, the projected starting and completion dates for the project, and the projected days and hours of operation. The approval, if granted, shall be included in the operating record.

C. Prevention of Unauthorized Disposal. The Permittee shall follow the approved procedures, as provided in the application, for detecting and preventing the disposal of free liquids, dead animals, toxic or radioactive wastes, regulated hazardous wastes, PCB's, regulated medical waste and other unauthorized waste streams at the facility.

D. Unauthorized Discharge. The Permittee shall operate the disposal facility in such a manner that there will be no water pollution or unauthorized discharge. Any discharge from the disposal facility or practice thereof may require a National Pollutant Discharge Elimination System permit under the Alabama Water Pollution Control Act.

E. Industrial Waste Disposal. The Permittee shall not dispose of industrial process waste at this landfill. Only those wastes shown in Section III, Paragraph B, are allowed for disposal in this landfill.

F. Boundary Markers. The Permittee shall ensure that the facility is identified with a sufficient number of permanent boundary markers that are at least visible from one marker to the next.

SECTION III. SPECIFIC REQUIREMENTS FOR CONSTRUCTION/DEMOLITION WASTE LANDFILLS.

A. Waste Identification and Management.

1. Subject to the terms of this permit, the Permittee may accept for disposal the nonhazardous solid wastes listed in III.B. Disposal of any other wastes is prohibited, except waste granted a temporary or one time waiver by the Director.

2. The total permitted area for the Redstone Arsenal Landfill is approximately 75.96 acres with approximately 43.55 acres permitted for disposal operations.

3. The maximum average daily volume of waste disposed at the facility shall not exceed 900 tons/day. Should the average daily volume exceed this value by 20% or 100 tons/day, whichever is less, for two (2) consecutive quarters the permittee shall be required to modify the permit in accordance with ADEM Admin. Code 335-13-5-.06(2)(b)2. The average daily volume shall be computed as specified by ADEM Admin. Code 335-13-4-.23(2)(f).

B. Waste Streams.

The Permittee may accept for disposal non-putrescible and nonhazardous construction and demolition waste, rubbish as defined by ADEM Admin. Code 335-13-1-.03, and friable and non-friable asbestos waste.

C. Service Area. The Permittee is allowed to receive waste from the Redstone Arsenal Boundary Area.

D. Waste Placement, Compaction, and Cover. All waste shall be confined to an area as small as possible within a single working face and placed onto an appropriate slope not to exceed 4 to 1 (25%). All waste shall be spread in layers two feet or less in thickness and thoroughly compacted weekly with adequate landfill equipment prior to placing additional layers of waste or placing weekly cover. A minimum of six inches of compacted earth or other alternative cover material approved by the Department shall be added at the conclusion of each week's operation unless a variance is granted in Section VIII. The Permittee has been approved to utilize a 50/50 mix of green waste to soil as an alternate cover. (See Section VIII.2.)

E. Liner Requirements. At this time, the Permittee shall not be required to install a liner system. The base of the landfill shall be a minimum of five (5) feet above the highest measured groundwater level as determined by ADEM Admin. Code 335-13-4-.11(2)(a).

F. Security. The Permittee shall provide artificial and/or natural barriers, which prevent entry of unauthorized vehicular traffic to the facility.

G. All Weather Access Roads. The Permittee shall provide an all-weather access road to the dumping face that is wide enough to allow passage of collection vehicles.

H. Adverse Weather Disposal. The Permittee shall provide for disposal activities in adverse weather conditions.

I. Personnel. The Permittee shall maintain adequate personnel to ensure continued and efficient operation of the facility.

J. Environmental Monitoring and Treatment Structures. The Permittee shall provide protection and proper maintenance of environmental monitoring and treatment structures.

K. Vector Control. The Permittee shall provide for vector control as required by ADEM Admin. Code 335-13.

L. Bulk or Noncontainerized Liquid Waste. The Permittee shall not dispose of bulk or noncontainerized liquid waste, or containers capable of holding liquids, unless the conditions of ADEM Admin. Code 335-13-4-.23(1)(j) are met.

M. Empty Containers. Empty containers larger than 10 gallons in size must be rendered unsuitable for holding liquids prior to disposal in the landfill unless otherwise approved by ADEM.

N. Other Requirements. ADEM may enhance or reduce any requirements for operating and maintaining the landfill as deemed necessary by the Land Division.

O. Other Permits. The Permittee shall operate the landfill according to this and any other applicable permits.

P. Scavenging and Salvaging Operations. The Permittee shall prevent scavenging and salvaging operations, except as part of a controlled recycling effort. Any recycling operation must be in accordance with plans submitted and approved by ADEM.

Q. Signs. If the landfill is available to the public or commercial haulers, the Permittee shall provide a sign outlining instructions for use of the site. The sign shall be posted and have the information required by ADEM Admin. Code 335-13-4-.23(1)(f).

R. Litter Control. The Permittee shall control litter.

S. Fire Control. The Permittee shall provide fire control measures.

SECTION IV. GROUNDWATER MONITORING REQUIREMENTS.

A. The Permittee shall install and/or maintain a groundwater monitoring system, as specified below.

1. The permittee shall maintain the groundwater monitoring wells and piezometers identified in Table 1 at the locations specified in the Application, and any other groundwater monitoring wells which are added during the active life and the post closure care period.

2. The Permittee shall install and maintain additional groundwater monitoring wells as necessary to assess changes in the rate and extent of a plume of contamination or as otherwise deemed necessary to maintain compliance with the ADEM Admin. Code 335-13.

3. Prior to installing additional groundwater monitoring wells, the Permittee shall submit a plan to ADEM with a permit modification request specifying the design, location and installation of additional monitoring wells. This plan shall be submitted at least one hundred and twenty (120) days prior to the installation which, at a minimum, shall include.

   a. Well construction techniques including proposed casing depths, proposed total depth, and proposed screened interval of well(s);

   b. Well development method(s);

   c. A complete analysis of well construction materials;

   d. A schedule of implementation for construction; and

   e. Provisions for determining the lithologic characteristics, hydraulic conductivity and grain-size distribution for the applicable aquifer unit(s) at the location of the new well(s).

B. Groundwater Monitoring Requirements.

1. The Permittee shall determine the groundwater surface elevation at each monitoring well and piezometer identified in Table 1 each time the well or piezometer is sampled and at least semi-annually throughout the active life and post-closure care period.

2. The Permittee shall determine the groundwater flow rate and direction in the first zone of saturation at least annually or each time groundwater is sampled and submit as required by 335-13.

3. Prior to the initial receipt of waste at the facility, the Permittee shall sample, and analyze for the parameters listed in Appendix I of ADEM Admin. Code 335-13-4-.27, in all monitoring wells identified in Section IV.A.2. to establish background water quality and/or as directed by ADEM Admin. Code 335-13-4-.27(2)(j) and ADEM Admin. Code 335-13-4-.27(2)(a)(1).

4. The Permittee shall sample, and analyze all monitoring wells identified in Table 1 for the parameters listed in Appendix I of ADEM Admin. Code 335-13-4-.27(3), on a semi-annual basis throughout the active life of the facility and the post-closure care period in accordance with ADEM Admin. Code 335-13-4-.27(3). Sampling shall be conducted during March and September of each year, beginning with the effective date of this permit. **The facility shall submit to ADEM the semi-annual groundwater reports within ninety (90) days of the March and September sampling events.**

5. In addition to the requirements of Sections IV., B.1., B.2., B.3. and B.4., the Permittee shall record water levels, mean sea level elevation measuring point, depth to water, and the results of field tests for pH and specific conductance at the time of sampling for each well.

C. Sampling and Analysis Procedures. The Permittee shall use the following techniques and procedures when obtaining and analyzing samples from the groundwater monitoring wells described in Section IV.A. to provide a reliable indication of the quality of the groundwater.

1. Samples shall be collected, preserved, and shipped (when shipped off-site for analysis) in accordance with the procedures specified in the Application. Monitoring wells shall be bailed or pumped to remove at least four times the well volume of water. Slow recharge wells shall be bailed until dry. Wells shall be allowed to recharge prior to sampling.

2. Samples shall be analyzed according to the procedures specified of the Application, Standard Methods for the Examination of Water and Wastewater (American Public Health Association, latest edition), Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA Publication SW-846, latest edition), or other appropriate methods approved by this Department. All field tests must be conducted using approved EPA test kits and procedures. **The Permittee has been approved for inter-well statistical analysis.**

3. Samples shall be tracked and controlled using the chain-of-custody and QA/QC procedures specified in the Application.

D. Recordkeeping and Reporting Requirements.

1. Recording of Results. For each sample and/or measurement taken pursuant to the requirements of this permit, the Permittee shall record the information required by Section I.E.9.c.

2. Recordkeeping. Records and results of all groundwater monitoring, sampling, and analysis activities conducted pursuant to the requirements of this permit shall be included in the operating record required by Section I.I.1.

E. Permit Modification. If the Permittee or ADEM determines that the groundwater monitoring system no longer satisfies the requirements of 335-13-4-.14 or Section IV.A. of this permit, the Permittee must, within 90 days, submit an application for a permit modification to make necessary and/or appropriate changes to the system.

TABLE 1
GROUNDWATER MONITORING WELLS.

Monitoring Well Number	Top of Casing (feet msl)	Part Monitored
	Upgradient Wells	
RS083A	626.49	Entire Landfill
	Downgradient Wells	
RS079	607.94	Entire Landfill
RS080	5 71.18	Entire Landfill
RS229	587.95	Entire Landfill

SECTION V. GAS MONITORING REQUIREMENTS

The Department has granted a variance from ADEM Admin. Code 335-13-4-.16 requiring explosive gas monitoring. If at any time the Department determines that an explosive gas monitoring system is deemed necessary for the protection of human health and the environment, the Permittee must, within 90 days, submit an application for permit modification for the installation of an explosive gas monitoring system that meets the proper regulatory requirements of the Alabama Department of Environmental Management. (See Section VIII.1.)

SECTION VI. SURFACE WATER MANAGEMENT REQUIREMENTS

The permittee shall construct and maintain run-on and run-off control structures. Any discharges from drainage control structures shall be permitted through a discharge permit issued by the ADEM Water Division.

SECTION VII. CLOSURE AND POST-CLOSURE REQUIREMENTS

The Permittee shall close the landfill and perform post-closure care of the landfill in accordance with ADEM Admin. Code 335-13.

A. Final Cover. The Permittee shall grade final soil cover such that surface water does not pond over the permitted area as specified in the Application.

B. Vegetative Cover. The Permittee shall establish a vegetative or other appropriate cover, as approved by the Department, within 90 days after completion of final grading requirements in the Application. Preparation of a vegetative cover shall include, but not be limited to, the placement of seed, fertilizer, mulch, and water.

C. Notice of Intent. The Permittee shall place in the operating record and notify the Department of their intent to close the landfill prior to beginning closure.

D. Completion of Closure Activities. The Permittee must complete closure activities of each landfill unit in accordance with the Closure Plan within 180 days of the last known receipt of waste.

E. Certification of Closure. Following closure of each unit, the Permittee must submit to the Department a certification, signed by a registered professional engineer, verifying the closure has been completed according to the Closure Plan.

F. Post-Closure Care Period. Post-closure care activities shall be conducted after closure of each unit throughout the life of this permit and continuing for a period of thirty (30) years following closure of the facility. The Department may shorten or extend the post-closure care period applicable to the solid waste disposal facility.

G. Post-Closure Maintenance. The Permittee shall provide post closure maintenance of the facility to include regularly scheduled inspections. This shall include maintenance of the cover, vegetation, monitoring devices and pollution control equipment and correction of other deficiencies that may be observed by ADEM. Monitoring requirements shall continue throughout the post closure period as determined by the Department unless all waste is removed and no unpermitted discharge to waters of the State have occurred.

H. Post-Closure Use of Property. The Permittee shall ensure that post closure use of the property never be allowed to disturb the integrity of the final cover, liner, or any other component of the containment system. This shall preclude the growing of deep-rooted vegetation on the closed area.

I. Certification of Post-Closure. Following post-closure of each unit, the Permittee must submit to the Department a certification, signed by an independent registered professional engineer, verifying the post-closure has been completed according to the Post-Closure Plan.

J. Recording Instrument. The Permittee must provide documentation of compliance with the requirements of the Uniform Environmental Covenants Program in ADEM Admin. Code 335-5 and shall execute the following:

1. Record a notation onto the land deed within 90 days from the certification of closure. This notation shall state that the land has been used as a solid waste disposal facility, the name of the Permittee, type of disposal activity, location of the disposal facility, and beginning and closure dates of the disposal activity.

2. File the covenant at the courthouse where the land deed is held within thirty (30) days of receipt of the covenant signed by ADEM's Land Division Chief.

3. The Permittee shall submit a certified copy of the recording instrument to ADEM within 120 days after permit expiration, revocation, or as directed by ADEM as described in the Application.

K. Removal of Waste. If the Permittee, or any other person(s), wishes to remove waste, waste residues, or any liner or contaminated soils, the owner must request and receive prior approval from the Department.

SECTION VIII. VARIANCES

1. The Department has granted a variance from ADEM Admin. Code 335-13-4-.16 requiring explosive gas monitoring. If at any time the Department determines that an explosive gas monitoring system is deemed necessary for the protection of human health and the environment, the Permittee must, within 90 days, submit an application for permit modification for the installation of an explosive gas monitoring system that meets the proper regulatory requirements of the Alabama Department of Environmental Management. (See Section V.)

2. The Permittee has been approved to utilize a 50/50 mix of green waste to soil as an alternate cover. At the conclusion of each month's operation, the Permittee shall be required to cover all exposed waste with six inches of compacted earthen cover. (See Section III.D.)

Any variance granted by the Department may be terminated by the Department whenever the Department finds, after notice and opportunity for hearing, that the petitioner is in violation of any requirement, condition, schedule, limitation or any other provision of the variance, or that operation under the variance does not meet the minimum requirements established by state and federal laws and regulations or is unreasonably threatening the public health.

PERMIT APPLICATION

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON, REDSTONE
4488 MARTIN ROAD
REDSTONE ARSENAL, ALABAMA 35898-5000

JUL 26 2023

Received
AUG 03 2023
Land Division

Environmental Management Division

Mr. Jonathan Crosby
Alabama Department of Environmental Management
Solid Waste Branch/Landfill Division
Post Office Box 301463
Montgomery, Alabama 36130-1463

Dear Mr. Crosby:

The U.S. Army Garrison – Redstone (USAG-Redstone) is submitting a Construction/Demolition Landfill permit renewal application for permit 45-03, in accordance with the Alabama Department of Environmental Management Division (ADEM) 335-13. The $5,400 fee payment was paid online on July 6, 2023.

In addition to the Permit Application Package immediately following this letter, Redstone is submitting the following Enclosures:

1. A list and map of adjacent landowners.

2. A USGS 7.5-minute series location map with the legal property description and a location map of permitted and disposal areas.

3. A map of the 100-year floodplain.

4. Information on the methane monitoring variance.

5. Information on the alternate cover variance of a 50/50 mix of green waste to soil.

6. A proposed asbestos pit location map.

Documentation of the variance from methane monitoring, Enclosure 4, is limited to an email exchange from 2012, as this variance has been in place for decades. Documentation of the variance for utilization of green waste is more robust.

In accordance with 40 CFR 61.154, RSA is required to: "maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area."

The existing Operation Plan for RSAs Construction/Demolition Landfill states: "This facility will allow both handling [of asbestos] at the bottom of the operating face and in specially designated asbestos pits." To comply with 40 CFR 61.154, RSA proposes to utilize a series of 100 square feet ($ft^{2)}$ asbestos pits in the center portion of the landfill. A map of the proposed asbestos pits is included in the attachments. Asbestos would be covered immediately upon placement in the pit. Once a 100 ft^2 pit is filled, the next pit would be utilized, from south to north. Global Positioning System (GPS) would be used to identify asbestos pit boundaries. Other construction and demolition debris would be placed along a working face adjacent to the asbestos pits.

My point of contact for this action is Ms. Valerie Mason, Environmental Management Division, Directorate of Public Works, at 256-876-1899, or email: valerie.a.mason2.civ@army.mil.

Sincerely,

BRIAN M. COZINE
COL, LG
Commanding

Enclosures

SOLID WASTE DISPOSAL FACILITY

PERMIT APPLICATION PACKAGE

January 16, 2018

MEMORANDUM

TO: Applicants Seeking a Permit for Solid Waste Facilities

FROM: Stephen A. Cobb, Chief
Land Division
Alabama Department of Environmental Management

RE: Processing Solid Waste Permits by ADEM

Any permit issued by ADEM must be in accordance with §22-27-48 and §22-27-48.1 Code of Alabama. This section indicates that ADEM may not consider an application for a new or modified permit unless such application has received approval by the affected unit of local government having an approved plan. ADEM, therefore, will require the following before it can process a new or modified permit application:

1. The local government having jurisdiction must approve the permit application in accordance with §22-27-48 and §22-27-48.1 Code of Alabama.

2. Local governments should follow the procedures outlined in §22-27-48 and §22-27-48.1 Code of Alabama and the siting standards included in the local approved plan in considering approval of a facility.

This procedure applies to applications for new or modified permits. ADEM cannot review an application unless it includes approval from the affected local government. This procedure shall not apply to exempted industrial landfills receiving waste generated on site only by the permittee.

Please contact the Solid Waste Branch of ADEM at (334) 274-4201 if there are any questions.

SAC/sss/abj

SOLID WASTE APPLICATION

PERMIT APPLICATION
SOLID WASTE DISPOSAL FACILITY
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
(Submit in Triplicate)

1. **Facility type:**

   ___ **Municipal Solid Waste Landfill (MSWLF)**
   _ **Industrial Landfill (ILF)**
   _x_ **Construction and Demolition Landfill (C/DLF)**
   ___ **CCR Landfill (CCRLF)**
   _ **CCR Surface impoundment (CCRSI)**
   ___ **Other (explain)**_______________

2. **Facility Name** Redstone Arsenal Landfill

3. **Applicant/Permittee:**

   Name: COL. Brian M. Cozine

   Address: U.S. Army Garrison - Redstone Arsenal
   4488 Martin Rd
   Redstone Arsenal. AL 35898

   Telephone: (256) 876-8861

   If **applicant/permittee is a corporation, please list officers:**

   ____

   ____

4. **Location: (include county highway map or USGS map)**

   Township 5 South **Range** 1 West
   Section 5 **County** Madison

5. **Landowner:**

   Name: Federal Government

   Address: ______________________________

   ____

   ____

   Telephone: ______________________________

   (Attach copy of agreement from landowner if applicable.)

Solid Waste Permit Application
Page2

6. **Contact Person:**

Name Valerie Mason

Position or Affiliation Environmental Engineer

Address: 4488 Martin Rd
Redstone Arsenal AL 35898

Telephone: (256) 876-1899

7. **Size of Facility:** 75.96 **Acres**

Size of Disposal Area(s): approximately 46 **Acres**

8. **Identify proposed service area or specific industry that waste will be received from:**

Redstone Arsenal boundary area

9. **Proposed maximum average daily volume to be received at landfill (choose one):**

900 **Tons/Day** ____________ **Cubic Yards/Day**

10. **List all waste streams to be accepted at the facility (i.e., household solid waste, wood boiler ash, tires, trees, limbs, stumps, etc.):**

Non-hazardous construction/demolition and asbestos wastes including waste building materials, packaging, and rubble from construction, remodeling, or demolition operations; concrete and masonry wastes; sand; sheetrock; plaster; treated lumber; roofing waste; insulation; fiberglass; scrap metal; wood waste; soil; rock; yard trimmings; leaves; waste asphalt; ash from wood combustion; and similar types of waste

SIGNATURE (Responsible official of permit applicant):

TITLE: Garrison Commander

COL. Brian M. Cozine **DATE:** 20230725

(Please print or type name)

ADDITIONAL REQUIRED INFORMATION

Applicants seeking to obtain a permit to construct and/or continue to operate a municipal solid waste (MSW) landfill, industrial landfill, construction and demolition (C/D) landfill, coal combustion residuals (CCR) landfill, or CCR surface impoundment are required to submit additional information as part of the Solid Waste Disposal Facility Permit Application. These additional information requirements vary depending on the facility type.

For new and existing landfill units, refer to ADEM Admin Code 335-13-5-.02 for a list of additional information to be submitted in the permit application. Some requirements apply only to MSW landfills and CCR landfills, while other requirements apply to industrial landfills and C/D landfills. You need only to address the requirements that pertain to your type landfill. For new and existing CCR surface impoundments, refer to ADEM Admin Code 335-13-15-.09 for additional information to be submitted in the permit application.

Each rule that is applicable to your type landfill or surface impoundment must be addressed in detail in the operational narrative and/or engineering drawings before the review process can be completed. All operational narratives, engineering drawings, survey maps and legal descriptions are to be prepared by licensed engineers or surveyors registered in the State of Alabama and with their stamp or seal on each drawing/map and cover of the narrative.

Act No. 89-824 Section 9(a) states "The department may not consider an application for a new or modified permit for a facility unless such application has received approval by the affected unit of local government having an approved plan." This document must be received by the Department prior to processing the application.

The referenced rules are covered in greater detail in ADEM's Administrative Code, Division 13. Clarification can be obtained by reviewing the regulations. Copies of the ADEM Administrative Code, Division 13 regulations, can be obtained for a fee by contacting ADEM's Permits and Services Division. If the Department can answer any questions, please contact the Solid Waste Branch at (334) 274-4201.

Enclosure 1:
Adjacent Landowners and Map

Adjacent Landowners:

Mr. Richard Ingram
Refuge Manager
Wheeler National Wildlife Refuge
2700 Refuge Headquarters Road
Decatur, AL 35603
(256) 353-7243 ext. 46142

Mr. Robert Champion
Director, Office of Center Operations
Marshall Space Flight Center
Mail Stop AS01
Marshall Space Flight Center, AL 35812
(256) 544-0478

2023

Landfill Boundary (Legal Description)
Disposal Area
Marshall Space Flight Center
Wheeler Wildlife Refuge

0 150 300 600 900
Feet
1:7,676

Map Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Grid Coordinate System: State Plane Coordinates, Alabama East
Planar Distance Units: Survey Feet (U.S.)

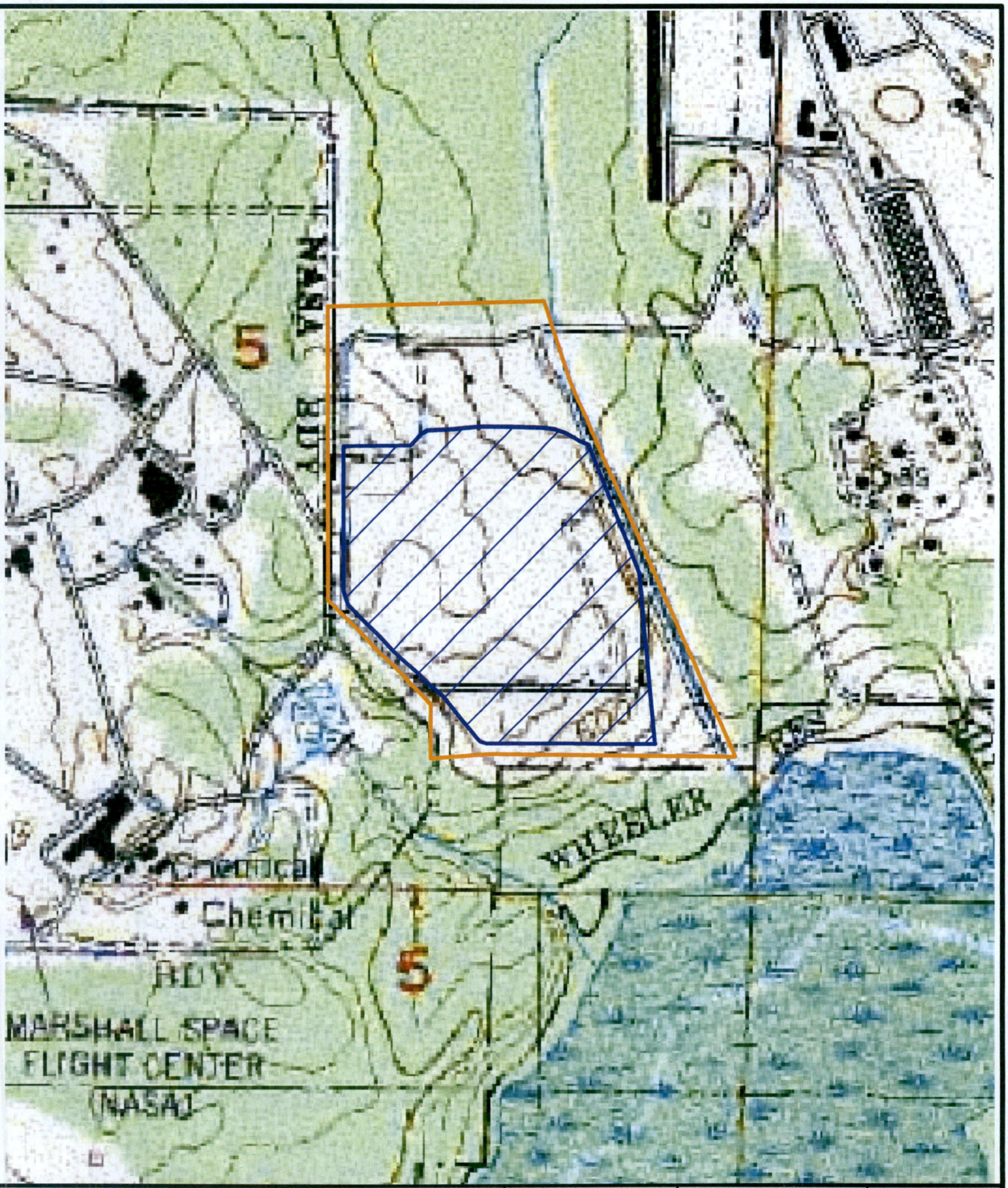
Date Saved: 5/10/2023 9:00:00 AM	Name: Adjacent Landowners
Unclassified Limited Distribution	For general location purposes only.
For official use.	

Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5682

Directorate of Public Works - Environmental Mgt
US Army Garrison - Redstone
Redstone Arsenal, AL 35898

Path: T:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Adjacent Landowners.mxd

Enclosure 2:
Location Map USGS 7.5 Minute Series
Legal Property Description
Location Map Boundary Plat of Permitted and Disposal Areas



2023

Landfill Boundary (Legal Description)

Disposal Area

0 150 300 600 900

Feet

1:7,676

Map Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Grid Coordinate System: State Plane Coordinates, Alabama East
Planar Distance Units: Survey Feet (U.S.)

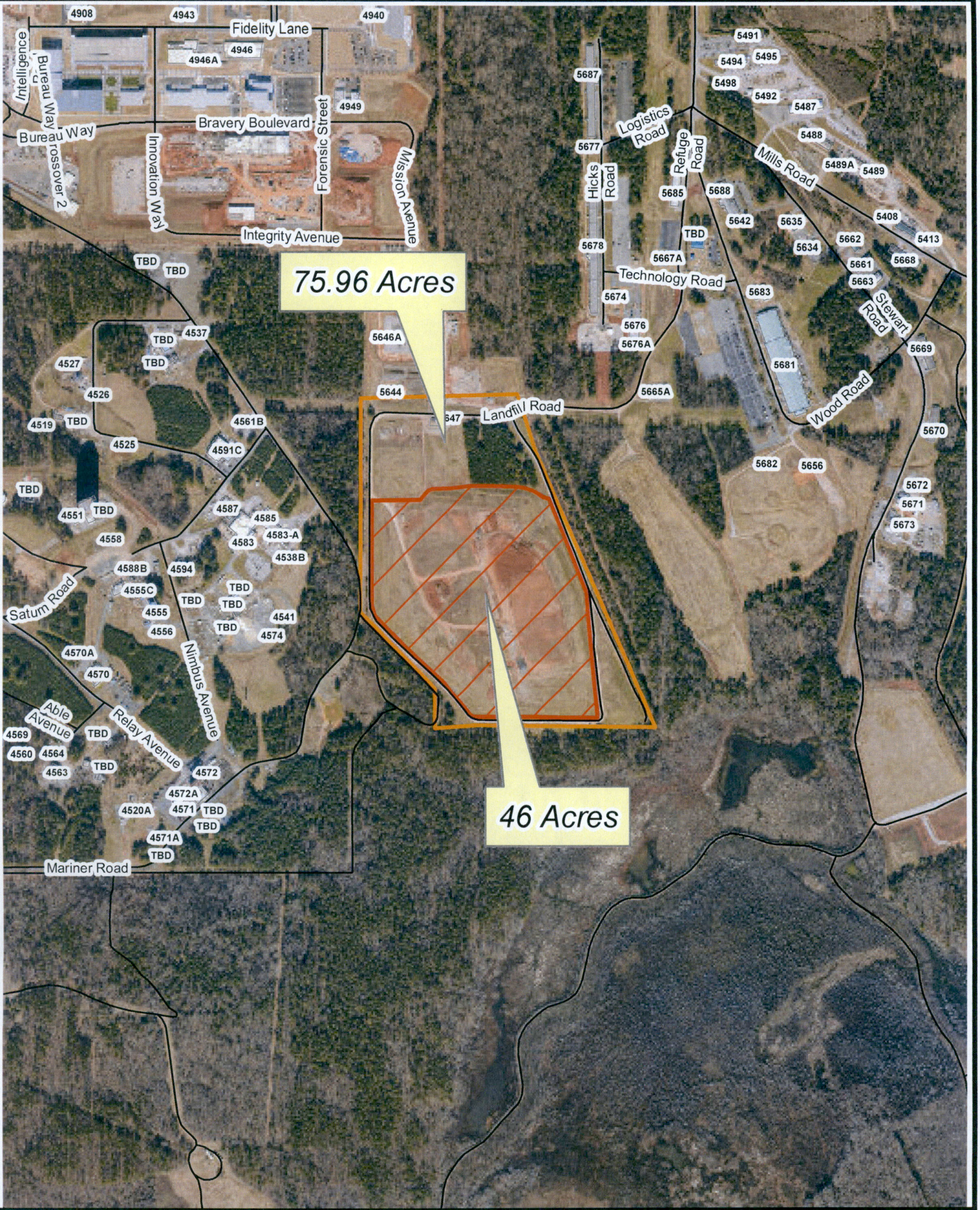
Date Saved: 5/10/2023 9:09:30 AM	Name: Location Map
Unclassified Limited Distribution	For general location purposes only.
For official use.	
Map Author: Lawrence Crawford US Army Garrison-Redstone (256) 876-5682	

Directorate of Public Works - Environmental Mgt
US Army Garrison - Redstone
Redstone Arsenal, AL 35898

Path: T:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Location Map.mxd

Legal Property Description

Commence at the Southwest corner of the Southeast ¼ of Section 5, Township 5 South, Range 1 West, thence North of 01º 19' 14" East a distance of 696.12 feet to the point of beginning, thence South 85º 34' 14" West a distance of 741.08 feet, thence North 0º 03' 29" East a distance of 1474.14 feet, thence North 88º 33' 21" East a distance of1106.86 feet, thence South 18º 15' 47" East a distance of 427.16 feet, thence South 24º 02' 19" East a distance of 2063.70 feet, thence North 89º 25' 46" West a distance of 1260.00 feet to the point of beginning said parcel containing 75.96 acres more or less.



2023

Landfill Boundary (Legal Description)
Disposal Area

0 150 300 600 900
Feet
1:10,322

Map Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Grid Coordinate System: State Plane Coordinates, Alabama East
Planar Distance Units: Survey Feet (U.S.)

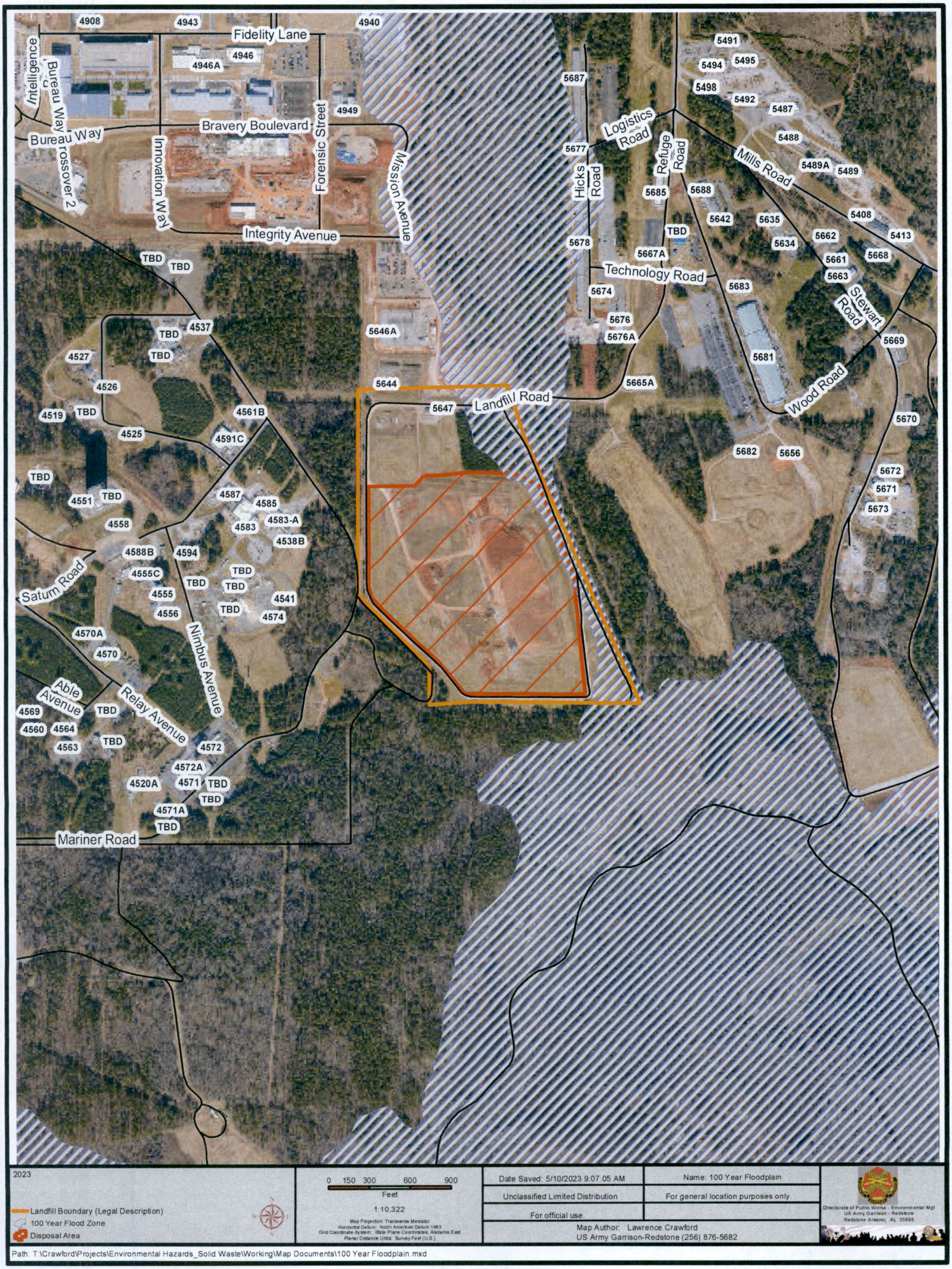
Date Saved: 5/10/2023 9:05:01 AM	Name: Legal Description
Unclassified Limited Distribution	For general location purposes only.
For official use.	

Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5682

Directorate of Public Works - Environmental Mgt
US Army Garrison - Redstone
Redstone Arsenal, AL 35898

Path: T:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Legal Description.mxd

Enclosure 3:
100-Year Floodplain Map


Fidelity Lane
Bravery Boulevard
Bureau Way
Bureau Way Crossover 2
Intelligence
Innovation Way
Forensic Street
Mission Avenue
Integrity Avenue
Logistics Road
Hicks Road
Refuge Road
Mills Road
Technology Road
Stewart Road
Wood Road
Landfill Road
Saturn Road
Nimbus Avenue
Able Avenue
Relay Avenue
Mariner Road
4908
4943
4940
4946
4946A
4949
5687
5677
5678
5674
5676
5676A
5646A
5644
5647
5665A
5685
5688
5667A
5683
5681
5491
5494
5495
5498
5492
5487
5488
5489A
5489
5408
5413
5642
5635
5634
5662
5668
5661
5663
5669
5670
5682
5656
5672
5671
5673
4537
4527
4526
4519
4525
4561B
4591C
4551
4558
4587
4585
4583
4583-A
4538B
4588B
4594
4555C
4555
4556
4541
4574
4570A
4570
4569
4560
4564
4563
4572
4572A
4571
4520A
4571A
TBD
2023
Landfill Boundary (Legal Description)
100 Year Flood Zone
Disposal Area
0 150 300 600 900
Feet
1:10,322
Map Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Grid Coordinate System: State Plane Coordinates, Alabama East
Planar Distance Units: Survey Feet (U.S.)
Date Saved: 5/10/2023 9:07:05 AM
Name: 100 Year Floodplain
Unclassified Limited Distribution
For general location purposes only.
For official use.
Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5682
Directorate of Public Works - Environmental Mgt
US Army Garrison - Redstone
Redstone Arsenal, AL 35898
Path: T:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\100 Year Floodplain.mxd

Enclosure 4:
Methane Monitoring Variance Documentation

Ingram, Margaret A Mrs CIV USA IMCOM

From: Ingram, Margaret A Mrs CIV USA IMCOM
Sent: Thursday, January 05, 2012 10:55 AM
To: Musel, Daniel Mr CIV USA IMCOM
Cc: Noriega, Christine CIV USA; Walters, Paul F CIV USA IMCOM; Taylor, Misty F CIV USA
Subject: OPORD 12-009 Landfill Screening for Methane Recovery (USAG-3470) (UNCLASSIFIED)
Signed By: margaret.ingram@us.army.mil

Classification: UNCLASSIFIED
Caveats: NONE

Dan,

Our subject matter expert, Mr. Matt Wade, sent the below message to Mr. Jason Bray (the POC on the questionnaire).
This should be sufficient to complete this tasker for Redstone.

Thank You,
Margaret A. Ingram
Environmental Protection Assistant
Environmental Management Division
(IMSE-RED-PWE, Room A323)
4488 Martin Road
Redstone Arsenal, AL 35898
256-842-8799 / FAX: 876-0887

Visit our Redstone Environmental Management Division Website at:
www.environmental.redstone.army.mil

Please rate your experience with the Environmental Management Division! How did we do?
http://ice.disa.mil/index.cfm?fa=card&service_provider_id=118678&site_id=513&service_category_id=5

-----Original Message-----
From: Wade, Matt B CIV USA
Sent: Thursday, January 05, 2012 10:05 AM
To: Stierwalt, Michael J CIV USA
Cc: Seaver, Danny R CIV USA IMCOM
Subject: Methane recovery

Mike,

I spoke with Mr. Jason Bray the Project Manager for the tasker on Landfill Screening for Methane Recovery. He stated that for now an email response explaining our methane production or lack thereof would suffice.

The Redstone Arsenal landfill switched from a Municipal Landfill to a Construction & Demolition landfill around 1990 or 1991. This was because of a state decision to only renew the permit for C&D operations. Prior to this wells had been installed to monitor the methane generation of the landfill unit. The wells were monitored up until the issuance of the current landfill permit which was issued in April of 2008. Prior to the wells being removed from the permit they were no longer producing methane in measurable quantities. Current operations that are being carried out on top of the municipal landfill are only C&D operations. The methane monitoring covered the municipal operations and the first 18 years or so of the C&D operations.

Matt Wade
Environmental Protection Specialist
IMSE-RED-PWE
Environmental Management Division
Directorate of Public Works
US Army Garrison - Redstone
Office: 256-876-9598
Fax: 256-876-0887
email: matt.b.wade@us.army.mil

Classification: UNCLASSIFIED
Caveats: NONE

Enclosure 5:
Alternate Cover Variance Documentation

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON, REDSTONE
4488 MARTIN ROAD
REDSTONE ARSENAL, ALABAMA 35898-5000

October 7, 2021

Environmental Management Division

Mr. Jonathan Crosby
Alabama Department of Environmental Management
Solid Waste Branch/Landfill Division
P.O. Box 301463
Montgomery, Alabama 36130-1463

Dear Mr. Crosby:

The US Army Garrison – Redstone Arsenal is submitting the Redstone Arsenal Construction and Demolition Landfill permit modification application (45-03) in accordance with ADEM Division 335-13. The $1,460 fee payment is currently in the process of being paid.

The US Army Garrison – Redstone Arsenal is requesting modification of permit 45-03 to include the following:

1. Use of soil recycled through a bioremediation process as cover material. Redstone Arsenal is currently in the process of permitting a soil recycling facility that would utilize a product such as Oil Gator® to eliminate hydrocarbon contaminants in soil.

2. Use of fifty percent green waste and fifty percent soil as an alternate cover material. Redstone Arsenal would like to reduce the amount of green waste buried in the landfill by mulching and utilizing the soil/mulch combination as an alternate cover material.

For further information, please contact Valerie Mason of the Environmental Management Division, Directorate of Public Works, at 256-876-1899, or email Valerie.a.mason2.civ@army.mil.

Sincerely,

Glenn O. Mellor
Colonel, US Army
Garrison Commander

Enclosure

SOLID WASTE DISPOSAL FACILITY

CONSTRUCTION/DEMOLITION LANDFILL PERMIT APPLICATION PACKAGE

CONSTRUCTION AND DEMOLITION LANDFILL
SITING AND HYDROGEOLOGICAL EVALUATION SHEET
(SUPPLEMENT TO C/D APPLICATION)

All of the following items should be included with a construction and demolition landfill permit application:

1. •Local Approval
   •Fees

2. Map showing flood prone areas.

3. Evaluation of land use:
   •Wetlands determination by U.S.A. Corps of Engineers
   •Endangered species determination by U.S. Fish and Wildlife Service
   •Habitat
   •Archaeologically sensitive areas determined by Alabama Historical Commission.

4. Site geology using borings, exploration pits, or hydrogeologic mapping for the purposes of determining the minimum 5-foot separation between groundwater and the cell bottom.

5. Location of borings, pits, and sections on a map.

6. Log of pits and borings.

7. A map showing geology and structural features such as sink holes and faults.

8. Engineer's stamp on plans.

9. A Certification Letter, signed by a registered professional engineer, verifying the accuracy of the submitted permit application.

SECTION III:

LANDFILL OPERATOR:

Name: (I) Jacob Rodenberry (2)

Address: 5435 Refuse Road
Redstone Arsenal, AL 35898

Telephone: 256-876-4199

SECTIONN:

CONTACT PERSON(S):

Name: (1) Valerie Mason (2) Jason K. Braxton

Address: Environmental Management Division, AMIM-REP-EC Environmental Management Division, AMIM-REP-E

4488 Martin Road 4488 Martin Road
Redstone Arsenal, AL 35898 Redstone Arsenal, AL 35898

Telephone: 256-876-1899 256-876-8607

SECTIONV:

LANDOWNER(S):

Name: (I) Federal Government (2)

Address:

Telephone:

Attach copy of agreement from landowner giving permission to use site for disposal if landowner is different from applicant.

SECTION VI:

ADJACENT LANDOWNER(S):

a. Submit a list of all adjacent landowners including name and current mailing address.

b. Submit a drawing/map identifying the proposed disposal site and the properties of all adjacent landowners listed in "a" above.

SECTION VII:

LOCAL APPROVAL: No Required (Yes or No)

Date Received if needed (attach copy of resolution and proof of publishing public notice)

d. Will solid waste be disposed in any location which will significantly degrade wetlands, beaches, or dunes?

NO: X YES: ____

e. Will the proposed landfill be located outside the boundaries of the coastal area? (If not, then all demonstrations should be submitted to the Department for review.)

NO: ____ YES: X

Groundwater Elevations:

Has a minimum five-foot separation between the floor of the disposal cell and the groundwater been established? NO: ____ YES: X

SECTION XI:

GENERAL COMMENTS:

All materials listed in Rules 335-13-4-.12 to 335-13-4-.17, Rules 335-13-4-.19 to 335-13-4-.20, and Rule 335-13-4-.23 shall be kept at the landfill office along with a copy of the engineering drawings which must be submitted to the Department for review.

The applicant/permittee is responsible for obtaining a copy of the Division 13 regulations and complying with all Rules related to construction/demolition landfill units.

SECTION XII:

CERTIFICATION OF LOCAL GOVERNMENT APPROVAL:

Upon submittal of this application, we the undersigned certify that local approval has been obtained from not applicable (city/county). Evidence of this local approval is contained in documents which are on file at the permit applicant's business address.

CERTIFICATION OF COMPLIANCE:

Upon submittal of this application, we the undersigned certify that this document and all attachments submitted are to the best of our knowledge and belief, true, accurate, and complete. We also understand that if any of the material certified to above has not been received, or is not complete or is not accurate, that shall be grounds for the Department to revoke the landfill permit if issued.

SIGNATURE (Responsible official of permit applicant):

TITLE: Garrison Commander

Col. Glenn O. Mellor DATE: ____
(please print or type name)

SIGNATURE (Certifying Engineer):

TITLE: Environmental Engineer

Jason K. Braxton, P.E. DATE: 10/7/21
(please print or type name)

FIRM: US Army Garrison - Redstone STAMP OR SEAL:

Attachment 1 (Section VI) – Adjacent Landowners and Site Map with Adjacent Landowners

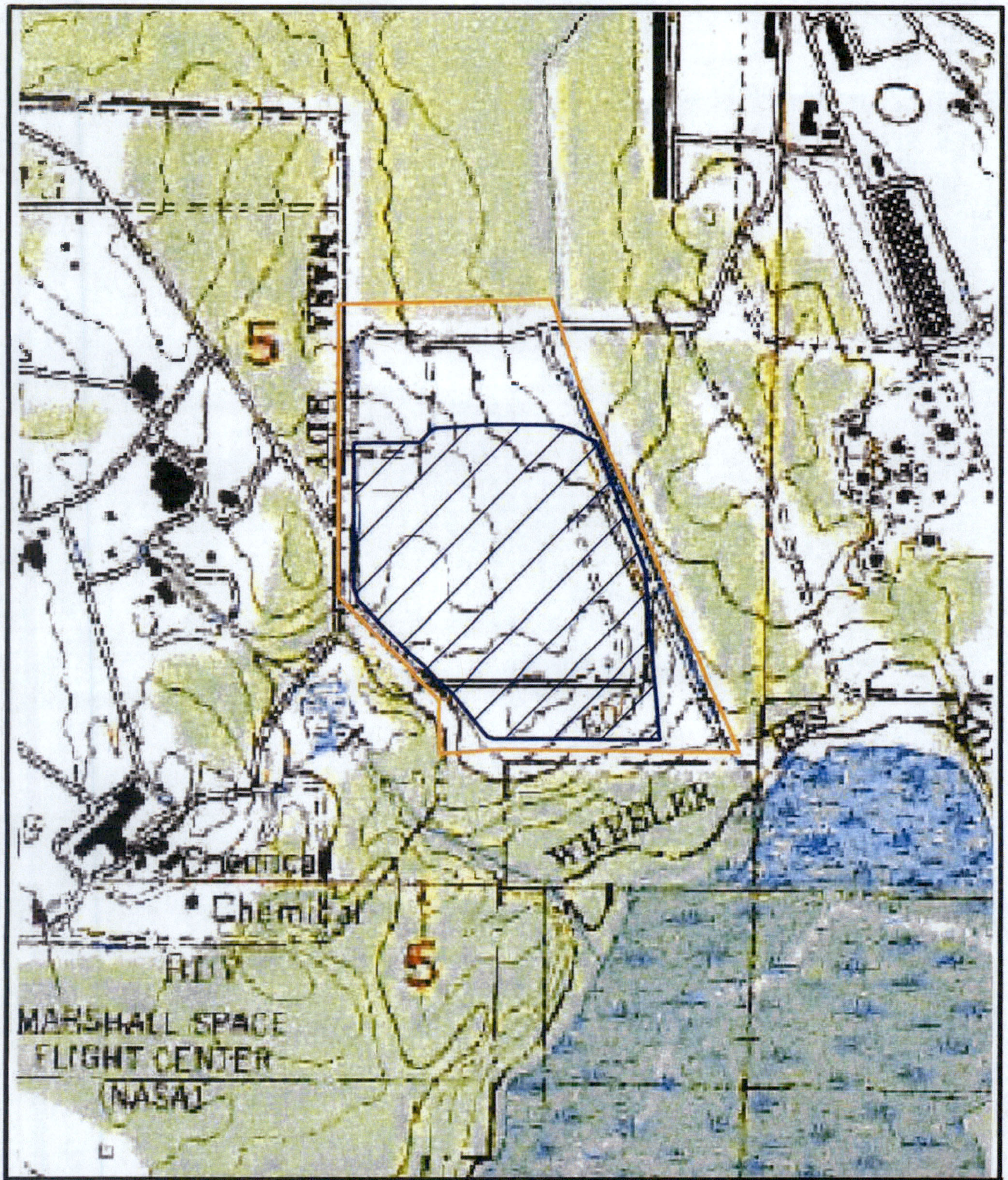
Section VI(a): Adjacent Landowners

1. Mr. Richard Ingram
   Refuge Manager
   Wheeler National Wildlife Refuge
   2700 Refuge Headquarters Road
   Decatur, Alabama 35603
   (256) 350-6639 ext. 23

2. Mr. Roy W. Malone
   Director, Office of Center Operations
   Marshall Space Flight Center
   Mail Stop AS01
   Marshall Space Flight Center, Alabama 35812
   (256) 544-0506


Redstone Arsenal Landfill
Marshall Space Flight Center
Wheeler Wildlife Refuge
2018
0 150 300 600 900
Feet
1:7,676
Landfill Boundary (Legal Description)
Disposal Area
Marshall Space Flight Center
Wheeler Wildlife Refuge
Date Saved: 4/18/2018 3:00:48 PM
Name: Enclosure2
Unclassified Limited Distribution
For general location purposes only.
For official use
Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5582
Path: N:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Enclosure2.mxd

Attachment 2 (Section IX) – Location Map USGS 7.5 Minute Series, Legal Property Description, and Location Map Boundary Plat of Permitted and Disposal Areas



Landfill Boundary (Legal Description)
Disposal Area
2018

0 150 300 600 900
Feet
1:7,576

Date Saved: 4/17/2018 2:30:15 PM	Name: Enclosure5
Unclassified Limited Distribution	For general location purposes only.
For official use.	

Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5662

Path: N:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Enclosure5.mxd

Section IX(c): Legal Property Description

Commence at the Southwest corner of the Southeast ¼ of the Southeast ¼ of Section 5, Township 5 South, Range 1 West, thence North of 01° 19' 14" east a distance of 696.12 feet to the point of beginning, thence South 85° 34' 14" West a distance of 297.61 feet, thence North 0° 25' 09" west a distance of 274.56 feet, thence North 44° 58' 51" West a distance of 741.08 feet, thence North 0° 03' 29" East a distance of 1474.14 feet, thence North 88° 33' 21" East a distance of 1106.86, thence South 18° 15' 47" East a distance of 427.16 feet, thence South 24° 02' 19" east a distance of 2063.70, thence North 89° 25' 46" West a distance of 1260.00 feet to the point of beginning said parcel containing 75.96 acres more or less.

2018

Landfill Boundary (Legal Description)

Disposal Area

0 150 300 600 900

Feet

1:10,322

Date Saved: 4/18/2018 5:05:14 PM

Name: Enclosure3

Unclassified Limited Distribution

For general location purposes only.

For official use.

Map Author: Lawrence Crawford

US Army Garrison-Redstone (256) 876-5682

Path: N:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Enclosure3.mxd

Attachment 3 (Section X.a) – Site Map with 100 Year Flood Plain

04940
04945
04946
05687
05677
Logistics Road
Hicks Road
Mills Road
05499
05494
05495
05498
05492
05487
05488
05489
05685
05688
05642
TBD
05678
5667A
Technology Road
05674
05676
5676A
GRLB56A
GRLB56B
GRLB56C
05683
05681
05664
05662
05661
05663
05408
05412
05668
Stewart Road
05669
Wood Road
05670
05682
05656
05672
05671
05673
05560
Refuge Road
05644
05645
TBD
04531
04530
04527
04526
04519
04522
4581A
04525
04561
04549
04550
04551
04559
04584
04585
04583
4583-A
4583B
04558
04596
4588B
04554
Saturn Road
04555
04597
04539
04540
04541
4555B
04574
4570A
04570
Nimbus Avenue
Relay Avenue
Able Avenue
04560
04564
04582
04517
04563
4553B
04572
4572A
4572B
04520
4571A
Mariner Road
04595
2016
Landfill Boundary (Legal Description)
100 Year Flood Zone
Disposal Area
0 150 300 600 900
Feet
1:10,322
Date Saved: 4/19/2018 2:21:19 PM
Name Enclosure4
Unclassified Limited Distribution
For general location purposes only
For official use
Map Author: Lawrence Crawford
US Army Garrison-Redstone (256) 876-5682
Path: N:\Crawford\Projects\Environmental Hazards_Solid Waste\Working\Map Documents\Enclosure4.mxd

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

ADEM

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

December 14, 2022

Ms. Valerie Mason
US Army Garrison - Redstone Arsenal
Environmental Management Division, AMIN-REP-EC
4488 Martin Road
Redstone Arsenal, Alabama 35898

RE: Minor Permit Modification
Redstone Arsenal Landfill
Permit No. 45-03

Dear Ms. Mason:

Enclosed is the modified permit for the Redstone Arsenal Landfill, Permit No. 45-03. The minor permit modification is effective December 13, 2022 and the expiration date will remain February 5, 2024.

If you should have any questions, please contact Mr. Jonathan Crosby of the Solid Waste Engineering Section at (334) 270-5644.

Sincerely,

Jason Wilson, Chief
Solid Waste Branch
Land Division

JW/jc

FINAL DETERMINATION

Minor Permit Modification

U.S. Army/Redstone Arsenal
4488 Martin Road
Redstone Arsenal, Alabama 35898

Redstone Arsenal Landfill
Permit No. 45-03

December 13, 2022

The U.S. Army Garrison/Redstone Arsenal has submitted to the Alabama Department of Environmental Management (ADEM) an application to modify the permit for the Redstone Arsenal Landfill (Permit No. 45-03). The U.S. Army Garrison/Redstone Arsenal requests to utilize a 50/50 mix of green waste to soil as an alternate daily cover at the Redstone Arsenal Landfill. At the conclusion of each month's operation, the U.S. Army Garrison/Redstone Arsenal will cover all exposed waste with six inches of compacted earthen material. The requested alternate cover is approved in the EPA's guidance as outlined in the report titled: *The USE of Alternate Daily Covers at Municipal Solid Waste Landfills (September 1993).* All previously approved conditions shall remain unchanged.

A public comment period was announced by ADEM on November 2, 2022 and ended on December 7, 2022. The permit application and draft permit was available for inspection at the Alabama Department of Environmental Management and on the Alabama Department of Environmental Management Website. The Department received no comments during the comment period.

The Solid Waste Branch has determined that the permit application complies with the requirements of ADEM's Administrative Code Division 13 regulations for a construction and demolition waste landfill.

Technical Contact:

Mr. Jonathan Crosby
Solid Waste Engineering Section
Land Division
(334) 270-5644

Enclosure 6:
Proposed Asbestos Pit Location Map

Landfill
Asbestos Pit

0 50 100 200 300
Feet

1:959

Map Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Grid Coordinate System: State Plane Coordinates, Alabama East
Planar Distance Units: Survey Feet (U.S.)

Asbestos Pit Areas - Redstone Arsenal, AL

Name: Landfill	Date Saved: 6/22/2023 10:58:58 AM
Map Author: Lawrence Crawford US Army Garrison-Redstone (256) 876-5682	Classification: Unclassified Limited Distribution
For general location purposes only	For official use

Path: T:\Crawford\Garrison Projects\Valerie Mason\2023\June\Map Documents\Landfill.mxd

Directorate of Public Works - Environmental Mgt
US Army Garrison - Redstone
Redstone Arsenal, AL 35898

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON, REDSTONE
4488 MARTIN ROAD
REDSTONE ARSENAL, ALABAMA 35898-5000

Environmental Management Division 07 NOV 24

Mr. Jared D. Kelly
Alabama Department of Environmental Management
Solid Waste Engineering Section, Land Division
Post Office Box 301463
Montgomery, Alabama 36130-1463

Dear Mr. Kelly:

The U.S. Army Garrison – Redstone (USAG-Redstone) is submitting the following documents in response to the letter **"Request for Additional Information"** received on **09 MAY 2024** pertaining to the Construction/Demolition Landfill permit renewal application for permit 45-03, in accordance with the Alabama Department of Environmental Management Division (ADEM) 335-13.

1. The most recent operations plan for the Redstone Construction and Demolition Landfill (updated NOV 24) with current waste screening procedures (Appendix A of Operations Plan)
2. The most recent Groundwater Monitoring Plan (updated OCT 24).
3. The most recent Closure Plan (Appendix C of Operations Plan)
4. The most recent permit drawings (Drawings C01-13, updated 2024)
5. Boundary Plat and legal property description (drawing C02)

My point of contact for this action is Mr. Gregory Hicks, Environmental Management Division, Directorate of Public Works, at 256-313-3258, or email: gregory.l.hicks22.civ@army.mil.

Sincerely,

Jason K Braxton
US Army Garrison-Redstone Arsenal
Chief, Environmental Division

Enclosures

OPERATION PLAN
FOR
CONSTRUCTION/DEMOLITION WASTE
RSA LANDFILL PERMIT NO. 45-03

SOLID WASTE MANAGEMENT FACILITY
SUPPORT ACTIVITIES

REDSTONE ARSENAL
MADISON COUNTY, ALABAMA
RSA EPA ID NO. AL7210020742

Prepared for:

US Army Garrison
Redstone, Directorate of Public Works
Environmental Division

Prepared by:

Aptim Environmental & Infrastructure, LLC.

Contract No. W91278-20-D-0021
Task Order W9127822F0118
Project No. 501722

NOVEMBER 2024

Eric K Kramer
07-Nov-2024

Table of Contents

1.0 INTRODUCTION

The Redstone Arsenal Construction/Demolition Landfill is located on base at Redstone Arsenal, Alabama. The facility is located on approximately 43.55 acres of previously closed landfill units. These units consist of sanitary cells, rubble cells, and disposal units for various discreet waste streams. Since this is a military base, no zoning ordinance is in existence. The facility is bordered on the north by Soil Borrow Area No. 16, on the east by a large drainage ditch, by the Wheeler Reservoir (a U.S. Fish and Wildlife Service – Wildlife Refuge) on the south, and by a managed test area (operated by NASA as the George C. Marshall Space Flight Center) on the west.

This documentation discusses the site, the operation, and the facility closure. The documentation includes this operation plan along with facility drawings labeled "Design & Operation Plan, Redstone Arsenal Landfill". Together, these documents provide the information needed to operate this facility in compliance with the Alabama Department of Environmental Management (ADEM or the Department) Rules.

As designed, this facility will be constructed above ground (grade) in an area fill manner. Only Construction/Demolition Waste will be acceptable for disposal. By definition, this waste includes: "waste building materials, packaging, and rubble resulting from construction, remodeling, repair or demolition operations on houses, commercial buildings, and other structures. Such waste include, but are not limited to, masonry materials, sheet rock, roofing waste, insulation (not including asbestos, scrap metal, and wood products)".

Additionally, friable asbestos will be disposed of at this facility along with uncontaminated concrete, soil, brick, waste asphalt paving, ash resulting from combustion of untreated wood, rock, yard trimmings, leaves, stumps, limbs, and similar materials. Other special wastes may be accepted by the landfill, subject to ADEM approval (see Section 17.0 and Appendix A for detailed procedures).

2.0 LANDFILL UNIT SITING STANDARDS (ADEM Rule 335-13-4-.01)

New or existing landfill units shall comply with the following standards in order to prevent adverse effects on health or the environment. As part of the application, the owner/ operator must submit documentation addressing to the satisfaction of the Department the following siting standards.

1. Location Standards

   a. A facility located in a floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste, so as to pose a hazard to human health and the environment.

      As previously demonstrated, this facility operation is located above the floodplain elevation of 572.5 MSL.

   b. A facility shall be located in consideration of the following:

      1. A facility shall not jeopardize the continued existence of endangered or threatened species protected under the Endangered Species Act of 1973.

      2. The facility shall not result in the destruction or adverse modification of critical habitats protected under the Endangered Species Act of 1973.

         As previously demonstrated, this is an expanded landfill on an existing site so threatened or endangered species will not be impacted.

   c. A MSWLF unit shall not be sited within 10,000 feet of any airport runway end. Owners or operators proposing to renew existing or site new MSWLF units located within a five-mile radius of any airport runway must notify the affected airport and the Federal Aviation Administration (FAA).

      As previously demonstrated, the Redstone Arsenal Airfield (Non-Commercial) is approximately 3.5 miles northwest of the Construction/Demolition Landfill. The Huntsville International Airport is 5.5 miles west of the Construction/Demolition Landfill. Both of these exceed the 10,000 foot regulatory limit for landfills.

   d. Zones of active faults, seismic impact zones and unstable areas shall be avoided in locating facilities and practices unless a site specific evaluation as described below, demonstrates minimum potential for adverse effects upon waters of the State.

      1. Site specific evaluations for geology and hydrogeology shall comply with 335-13-4-.11 through 335-13-4-.14.

2. Site specific evaluation shall include minimum design parameters necessary to protect the waters of the State and human health to include minimum requirements of 335-13-4-.15 through 335-13-4-.24.

3. Landfill units shall not be located within 200 feet of a fault that has had displacement within the Holocene epoch unless the owner or operator demonstrates to the Department that an alternative setback distance of less than 200 feet will not result in damage to the structural integrity of the facility and will be protective of human health and the environment.

   As previously demonstrated, this landfill facility is not within 200 feet of a fault that has had displacement within the Holocene Epoch.

4. Landfill units shall not be located in seismic impact zones, unless the owner or operator demonstrates to the Department that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

   The definition of seismic impact zone is an area where there is a greater than 10 percent probability that the horizontal acceleration will exceed 0.1 g in 250 years. Data for this exact comparison was not available. However, the "Frequence of Damaging Earthquake Shaking Around the U.S." dated 2022 from the United States Geologic Survey (USGS) website indicates that the earthquake frequency in northern Alabama would be relatively low, on the order of 10-20 damaging earthquakes in 10,000 years (or 1 per 500-1,000 years). In addition, there are no containment structures, liners, leachate collection systems or surface water control systems that would be affected by earthquake response.

5. Landfill units shall not be located in an unstable area unless engineering measures have been incorporated in the design of the facility to ensure that the integrity of the structural components of the facility will not be disrupted. The following factors, at a minimum, must be considered when determining whether an area is unstable:

   i. On-site or local soil and subsurface conditions that may result in significant differential settling;

   ii. On-site or local geologic or geomorphologic features; and

   iii. On-site or local human-made features or events (both surface and subsurface).

   As previously demonstrated, this facility is not located in an unstable area.

e. Landfill units shall not be located on a site that is archaeologically or historically sensitive as determined by the Alabama Historical Commission. Written certification must be provided from the State Historic Preservation Officer.

As previously demonstrated, there are no archaeological or historical sites within the landfill boundary.

2. Water Quality Standards

A facility shall be located so as to not adversely impact water quality by complying with the following:

a. A facility shall not cause a discharge of pollutants into waters of the State, including wetlands, that is in violation of the requirements of the National Pollution Discharge Elimination System (NPDES), Alabama Water Pollution Control Act, Code of Alabama 1975, §§22-22-1 to 22-22-14 and/or section 404 of the Clean Water Act, as amended.

The facility is covered under a basewide NPDES permit (Permit No. AL0000019).

b. A facility shall not cause non-point source pollution of waters of the State, including wetlands, that violates any requirements of an area wide and statewide water quality management plan that has been approved under the Alabama Water Pollution Control Act.

The facility will comply with this requirement.

c. Landfill units including buffer zones shall not be permissible in wetlands, beaches, or dunes.

The facility will comply with this requirement.

d. Landfill units shall not be permissible in any location where the disposal of solid waste would significantly degrade wetlands, beaches, or dunes.

The facility will comply with this requirement.

e. Landfill units shall be located outside the boundaries of the coastal area, unless no other reasonable alternative is available. If a site within the coastal area is proposed for development as a landfill unit, it shall be demonstrated to the satisfaction of the Department that siting, design, construction, and operation will ensure that present levels of coastal plants and animals will be maintained.

This facility is not located in **a coastal area.**

3. Other Requirements

Solid Waste Disposal Facilities must comply with any other applicable State or Federal rules, laws, regulations, or other requirements.

This facility will comply with applicable State and Federal rules, laws, regulations, and other requirements.

3.0 GENERAL DESIGN STANDARDS FOR DISPOSAL FACILITIES (ADEM Rule 335-13-4-.11)

1. General Standards

   335-13-4-.12 through 335-13-4-.20 provides standards for establishing a landfill unit providing that the siting standards of 335-13-4-.01 have been fully complied with to the satisfaction of the Department. Certain requirements contained in 335-13-4-.01 through 335-13-4-.20 may be enhanced or reduced by the Department as deemed necessary to comply with the Act and this Division.

2. Hydrogeology Standards

   a. For purposes of designing the bottom elevation of the proposed cell, the applicant shall measure the groundwater elevation at the location of the proposed cell or liner system. Such determinations shall be based on groundwater measurements taken in area of the proposed cell or liner system as approved by the Department. At each measuring location, the applicant shall obtain a minimum of two measurements taken during each of the three consecutive months of February, March, and April, or as otherwise approved by the Department, with no two measurements taken within any twelve-day period. Having obtained the measurements, the applicant shall design the facility so that the bottom elevation of the liner shall be a minimum of five feet above the highest measured groundwater level. The applicant shall submit to the Department all data known to exist concerning groundwater elevations at the landfill site and shall submit to the Department a location map showing all monitoring wells or piezometers and drilling logs for all monitoring wells or piezometers used to obtain any groundwater elevation data that is submitted. Nothing herein shall prevent the Department from requiring additional groundwater measurements or from requiring an additional buffer as it may deem appropriate with respect to a particular site.

      As previously demonstrated, significant long-term groundwater elevation measurement has been performed at this facility, and based on those measurements, a groundwater elevation map was developed. The five foot separation requirement is complied with.

   b. When the geologic and hydrological data so indicate, the Department may specify greater separation distances, a liner(s), or a leachate collection system, or combination of the above to protect the groundwater.

      Not applicable.

   c. When the geological and hydrological data so indicate, the Department may allow engineering controls to remove, divert, drain, or otherwise modify zones of saturation above the uppermost aquifer.

      Not applicable.

4.0 PLANS AND OPERATIONAL REPORTS (ADEM Rule 335-13-4-.12)

1. Compliance

   Plans and operational reports for construction, operation, maintenance, closure, and post-closure care of landfill units shall be prepared and kept on site and shall comply with 335-13-5-.02(1) and this chapter.

   These documents will be prepared and kept on site.

2. Plan Requirements

   These plans and reports shall include the following as determined necessary by the Department:

   a. Sufficient control points on-site to provide for accurate horizontal and vertical control for facility construction, operation, and closure and post-closure.

      See Design and Operation Plan, Sheets 3 - 5 of 13.

   b. Detail presentation of geological and hydrogeological units in the disposal site, with typical sections of disposal method and plan and profile sheets on all areas or trenches.

      See Design and Operation Plan, Sheets 10 and 11 of 13.

   c. Boundary plat and legal property description prepared, signed, and sealed by a land surveyor of the proposed boundary of the facility and disposal area of the facility.

      See Design and Operation Plan, Sheets2 of 13.

   d. Initial and final topographical maps at contour intervals of five feet or as otherwise specified by the Department.

      See Design and Operation Plan, Sheets 5 and 6 of 13.

   e. Existing and proposed surface drainage pattern to include control structures designed to handle run-on and run-off. Design calculations for sediment control basins, etc. should be provided.

See Design and Operation Plan, Sheets 7 of 13 and Design Calculations in Appendix E of this document.

   f. Buffer zones, screening, and other aesthetic control measures. Buffer zones around the perimeter of the landfill unit shall be a minimum of 100 feet in width measured in a horizontal plane. No disposal or storage practices for waste shall take place in the buffer zone. Roads, access control measures, earth storage, and buildings may be placed in the buffer zone.

A minimum 100' buffer is shown on the Design and Operation Plan, Sheet 3 of 13. It is noted that historical cells extended beyond the buffer as shown.

g. Details of plans for permanent all weather access roads.

See Design and Operation Plan, Sheet 12 of 13.

h. A summary of 335-13-4-.01 standards and conclusions of action to be taken and implemented into facility design.

The Design and Operation Plan complies with this requirement.

i. Location of any areas of the facility used for disposal of solid wastes.

These areas are located on the Design and Operation Plan.

j. Presentation of special engineering features or considerations which must be included or maintained in facility construction, operation, maintenance, and closure. Items required in 335-13-4-.12 through 335-13-4-.20 shall be included.

The Design and Operation Plan complies with this requirement.

k. Quality assurance/quality control (QA/QC) plans for all components of the liner, leachate collection, and cap systems.

A QA/QC plan for the cap system is included in the Closure Plan which is located in the Appendix C of this document.

l. Location of all explosive gas wells and/or monitoring points.

See Design and Operation Plan, Sheet 9 of 13. The explosive gas wells will remain in place but are no longer monitored in accordance with Section VIII of approved Permit 45-03.

5.0 SITE GEOLOGY AND HYDROGEOLOGY (ADEM Rule 335-13-4-.13)

1. Site Hydrogeology

   The site hydrogeology shall be established to the uppermost aquifer and subsequent interconnecting aquifers.

   This requirement was previously complied with for the existing permit and is on file at ADEM.

2. Hydrogeological Evaluation

   This requirement was previously complied with for the existing permit and is on file at ADEM.

6.0 GROUNDWATER RESOURCES (ADEM Rule 335-13-4-.14)

1. Groundwater

Groundwater resources in the vicinity of the landfill unit shall be determined as a basis for facility design, groundwater protection, and groundwater monitoring required under 335-13-4-.27

a. The depth to the groundwater and the direction of flow shall be established during the hydrogeological evaluation.

The groundwater surface elevation at each monitoring well and piezometer will be determined during sampling and at least semi-annually through the active life and post-closure care period. The groundwater flow rate and direction will also be determined during these events, in accordance with Permit 45-03.

b. The groundwater in the first saturated zone below the landfill unit shall be evaluated as follows:

1. A minimum of one hydraulically upgradient monitoring well for background data and two hydraulically downgradient monitoring wells shall be required.

   The wells to be used for groundwater monitoring include upgradient well RS083A and downgradient wells RS079, RS080, and RS229.

2. The location and design of the monitoring wells shall be approved by the Department prior to installation and the upgradient well shall be located so as not to be affected by the landfill unit.

   This requirement was previously complied with. Future monitoring well installations, as necessary, will also comply with this requirement.

3. The monitoring wells shall be installed well in advance of projected facility opening so as to provide an undisputed background water quality sample from each well. Background water quality shall be established using the sampling and analysis procedures described in 335-13-4-.27.

   This requirement was previously complied with.

4. Additional monitoring wells above the minimum may be required by the Department based on site hydrology, geology, topographical features and waste characteristics.

5. The groundwater sampling and analysis plan shall be prepared in accordance with 335-13-4-.27.

   A Sampling and Analysis Plan has been prepared. The latest SAP is in the operating record as required by the Solid Waste Disposal Facility Permit 45-03.

2. Soil Permeability

The permeability of on-site soils, specifically those underlying the disposal site, shall be determined by laboratory testing at a qualified soils laboratory and followed up by pump testing or slug testing of monitoring wells.

This requirement was previously complied with.

7.0 COVER REQUIREMENTS (ADEM Rule 335-13-4-.15)

Daily, weekly, or some other periodic cover shall be required at all landfill units, as determined by the Department.

1. The suitability and volume of any soils for daily, intermediate, and final cover requirements shall be determined by soil borings and analysis.

   Soil material for cover is available from various borrow sources on Redstone Arsenal.

2. Any proposal to use alternate cover systems shall be submitted to and approved by the Department prior to implementation.

   A submittal to use chipped wood, mulch, and compost has been submitted to and approved by ADEM (see letter in Appendix F of this document). A 50/50 mix of green waste to soil was approved according to Section VIII Variances and Special Conditions of Permit 45-03.

3. Alternative cover shall be approved by the Department in compliance with federal law and the USEPA rules for guidance to achieve a level of performance equal to or greater than earthen cover material.
   Alternative cover was approved according to Section VIII of Permit 45-03.

8.0 EXPLOSIVE GASES (ADEM Rule 335-13-4-.16)

The generation of explosive gases, especially methane (CH_4) at a landfill unit which accepts organic waste shall be considered in the design and operation of the facility. Special attention shall be given to control and monitoring of explosive gases as follows:

1. Control

   a. Explosive gases shall not exceed the lower explosive limit (LEL) at the facility boundary.

   b. Explosive gases shall not exceed 25 percent of the LEL in facility structures except for gas control or recovery system components.

   c. Facility structures shall be designed and constructed so as not to allow explosive gases to collect in, under or around structures in concentrations exceeding the requirements of this rule.

   The facility will comply with these requirements.

2. Monitoring

   a. Gas monitoring equipment as required by the Department shall be provided at the landfill unit by the operating agency.

      This requirement will be complied with, as necessary.

   b. The Department, upon review of waste type, facility structures, site geology and surrounding land use, may require installation of permanent gas monitoring structures, gas vents, gas control or recovery systems.

      Gas monitoring wells and gas vents are shown on the Design and Operation Plans. The gas monitoring wells are not currently monitored or surveyed as approved by ADEM.

   c. An explosive gas monitoring and reporting plan shall be prepared and filed at the facility for all landfill units receiving organic wastes. All sites required to monitor for explosive gases shall submit a plan which indicates permanent monitoring points. The plan shall also include what measures shall be taken by the permittee, landfill supervisor, and any operators present on-site to protect human health and property should explosive gases be detected which exceed the LEL. The plan must be prepared by a registered professional engineer and include seal or signature and registration number in accordance with rule 335-13-5-.02(l)(a)5.(i). of the ADEM Administrative Code.

A Methane Monitoring Plan (MMP) was included in prior versions of this document. The MMP has been removed as ADEM has granted a variance (See Section VIII of Permit 45-03) from Rule 335-13-4-.16 requiring explosive gas monitoring.

1. The type and frequency of monitoring must be determined based on the following factors:

   i. Soil conditions;
   ii. Hydrogeological conditions surrounding the landfill unit;
   iii. Hydraulic conditions surrounding the landfill unit;
   iv. Location of the facility structures and property boundaries;
   v. Location of structures adjacent to facility.

   This item is complied with.

2. The minimum frequency for monitoring shall be quarterly for MSWLF and yearly for C/DLF and ILF.

   i. All monitoring reports shall be submitted to the Department and placed in the operating record of the facility within 30 days of the monitoring event.

   ii. Levels of gas detected shall be expressed in percent LEL and percent volume.

   Methane monitoring is not currently required.

3. If explosive gas levels exceed the limits specified in this rule, the permittee shall:

   i. Immediately take all necessary steps to ensure protection of human health and property and notify the Department,

   ii. Within 7 days of detection, place in the operating record of the facility the explosive gas levels detected and the immediate steps taken to protect human health and property,

   iii. Within 20 days of detection, submit to the Department for approval a remedial plan for the explosive gas releases. This plan shall describe the nature and extent of the problem and the proposed remedy. The plan shall be implemented upon approval by the Department, but within 60 days of detection. Also, within 60 days of detection, a copy of this plan shall be placed in the operating record of the facility and the Department notified that the plan has been implemented.

Methane monitoring is not currently required.

4. Monitoring points shall be located every 300 feet along the landfill permit boundaries. In areas where a dwelling is within 1000 feet of the boundaries, the monitoring points shall be 100 feet apart or as otherwise directed by the Department.

    i. Monitoring shall be conducted in structures, culverts, under bridges, drop inlets, and any other place that is conducive to gas accumulation.

    ii. Permanent gas monitoring structures, or use of the bar hole punch method, are required by the Department.

    iii. A minimum depth of six feet must be obtained for permanent monitoring structures and four feet when using the bar hole punch method.

    Methane monitoring is not currently required.

9.0 DRAINAGE (ADEM Rule 335-13-4-.17)

Owners or operators of all facilities must design, construct, and maintain:

1. A run-on control system to prevent flow onto the active and/or closed portions of the landfill during the peak discharge from a 25-year storm;

   As previously demonstrated, the facility design complies with this requirement. See Design and Operation Plan, Sheet 7 of 13.

2. A run-off control system from the active and/or closed portions of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm;

   As previously demonstrated, the facility design complies with this requirement. See Design and Operation Plan, Sheet 7 of 13.

3. On-site drainage structures to carry incident precipitation from the disposal site so as to minimize the generation of leachate, erosion, and sedimentation. Run-off from the active and/or closed portions of the landfill unit must be handled in accordance with 335-13-4-.01(2)(a), and (b) and shall be routed to a settling basin or other sedimentation control structure to remove sediment prior to release onto adjacent properties or waters.

   As previously demonstrated, the facility design complies with this requirement. See Design and Operation Plan, Sheet 7 of 13.

10.0 LINERS AND LEACHATE COLLECTION (ADEM Rule 335-13-4-.18)

No liners or leachate collection systems are required for this construction/demolition landfill.

11.0 ACCESS (ADEM Rule 335-13-4-.19)

The owner or operator of the facility must control public access and prevent unauthorized vehicular traffic and illegal dumping of wastes by using artificial barriers, natural barriers, or both, as appropriate to protect human health and the environment.

Access is controlled on all sides of this facility by either natural or artificial barriers. Ingress and egress are controlled at the facility entrance gate, which is open during the facility's normal operating hours of Monday through Friday, from 0700 to 1530.

12.0 CLOSURE AND POST-CLOSURE (ADEM Rule 335-13-4-.20)

1. Submittal

   The owner or operator must submit a closure / post-closure plan to the Department and place in the operating record, no later than the effective date of these regulations or by the initial receipt of waste, whichever is later.

   The Closure Plan is included in the Appendix C to this document.

2. Closure

   The requirements for closure of existing and proposed landfill units shall include the following unless otherwise noted.

   a. The owner or operator must prepare a written closure plan that describes the steps necessary to close all existing and proposed landfill units at any point during their active life in accordance with the cover design requirements in 335-13-4-.20(2)(b). The owner or operator must submit the closure plan as part of the permit application to the Department. The closure plan, at a minimum, must include the following information:

      1. A description of the final cover, designed in accordance with 335-13-4-.20(2)(b) and the methods and procedures to be used to install the cover;

         This item is discussed in the Closure Plan included in Appendix C of this document.

      2. An estimate of the largest area of the landfill unit ever requiring a final cover as required under 335-13-4-.20(2)(b) at any time during the active life;

         This item is discussed in the Closure Plan included in Appendix C of this document.

      3. An estimate of the maximum inventory of wastes ever on-site over the active life of the facility; and

         This item is discussed in the Closure Plan included in Appendix C of this document.

      4. A schedule for completing all activities necessary to satisfy the closure criteria in this rule.

         This item is discussed in the Closure Plan included in Appendix C of this document.

   b. A final cover system must be installed which is designed to minimize infiltration and erosion. The final cover system must be comprised of an erosion layer(s) underlain by an infiltration layer(s) as follows:

1. The infiltration layer for MSWLF and ILF must be comprised of a minimum of 18 inches of earthen material and/or a synthetic layer that has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less. The infiltration layer for C/DLF must be comprised of a minimum of 18 inches of compacted earthen material excluding sands, and

   The Closure Cap proposed in the Closure Plan (Appendix C) includes an eighteen (18) inch thick infiltration layer with a permeability no greater than 1 x 10^{-5} cm/sec. Should an area be left exposed without final cover installation for over 90 days, it shall have at least 12" of intermediate cover and this cover shall be vegetated.

2. The erosion layer must consist of a minimum 6 inches of earthen material that is capable of sustaining native plant growth, as specified in 335-13-4-.20(2)(d).

   An erosion layer at least six (6) inches thick is in the Closure Plan.

3. The Department may approve an alternative final cover design that includes:

   i. An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in 335-13-4-.20(2)(b)l., and

   ii. An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in 335-13-4-.20(2)(b)2.

   Not applicable.

c. Final soil cover shall be graded so that:

1. Surface water does not pond over the landfill unit.

   The facility design complies with this requirement.

2. The maximum final grade of the final cover system shall-not exceed 25 percent or as specified by the Department to minimize erosion.

   The facility design complies with this requirement.

3. Slopes longer than 25 feet shall require horizontal terraces, of sufficient width for equipment operation, for every 20 feet rise in elevation or utilize other erosion control measures approved by the Department.

   The facility design complies with this requirement.

4. The minimum final grade of the final cover system shall not be less than 5 percent or as specified by the Department to minimize ponding.

The facility design complies with this requirement.

5. For a permitted facility utilizing the area fill method or the trench method, final grading of the infiltration layer shall be completed within 90 days after the unit has received the last known receipt of waste.

   The Closure Plan complies with this requirement (see Appendix C of this document).

d. A vegetative or some other appropriate cover must be established to minimize erosion and, when applicable, maximize evapotranspiration. Within 90 days after completion of final grading requirements on each phase or each trench as specified in 335-13-4-.20(2)(a), the permittee or owner of a permitted landfill unit shall prepare the final cover for the establishment of a vegetative cover or alternative cover. Deep rooted vegetation (roots that may grow below the 6 inch erosion layer) shall be prohibited as vegetative cover. Preparation of a vegetative cover shall include, but not be limited to, the following:

   1. Placement of appropriate species of grass seed, fertilizer, and mulch; and

   2. Watering and maintenance necessary such that germination of grass will occur:

e. Prior to beginning closure of each landfill unit as specified in this rule, an owner or operator must submit to the Department and place in the operating record a notice of the intent to close the unit.

   The Closure Plan complies with this requirement (see Appendix C of this document).

f. The owner or operator must begin closure activities of each LF unit no later than 30 days after the date of which the LF unit receives the known final receipt of wastes. If the LF unit has remaining capacity and there is reasonable likelihood that the LF unit will receive additional wastes, closure activities of each LF unit must begin no later than one year after the date of known final receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Department if the owner or operator demonstrates that the LF unit has the capacity to receive additional wastes and the owner and operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed LF unit.

   The Closure Plan complies with this requirement (see Appendix C of this document).

g. The owner or operator of all LF units must complete closure activities of each LF unit in accordance with the closure plan within 180 days following the last known receipt of waste. Extensions of the closure period may be granted by the Department if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed LF unit. Extensions granted for closure of each LF unit shall not exceed a total of 180 days.

The Closure Plan complies with this requirement (see Appendix C of this document).

h. Following closure of each LF unit, the owner or operator must submit to the Department a certification, signed by an independent registered professional engineer verifying that closure has been completed in accordance with the closure plan, and a copy placed in the operating record. C/DLF and/or ILF owner or operator may submit certification signed by a registered professional engineer in lieu of an independent registered professional engineer.

The Closure Plan complies with this requirement (see Appendix C of this document).

i. Within 90 days after permit expiration, revocation or when final closure requirements in 335-13-4-.20 are achieved as determined by the Department, the permittee or owner of a facility must provide documentation of compliance with the requirements of the Uniform Environmental Covenants Program in ADEM Admin. Code Division 335-5 and shall record a notation onto the land deed containing the property utilized for disposal, and/or some other legal instrument that is normally examined during a title search, that will in perpetuity, notify any potential purchaser of the property that:

1. The land has been used as a solid waste disposal facility landfill unit;

2. Its use is restricted by the items contained in 335-13-4-.20(3)(c) and 335-13-4-.20(3)(d);

3. The locations and dimensions of the landfill unit with respect to permanently surveyed benchmarks and section corners shall be on a plat prepared and sealed by a land surveyor;

4. Contain a note, prominently displayed, which states the name of the permittee or operating agency, the type of landfill unit and the beginning and closure dates of the disposal activity.

5. Certification by an engineer or land surveyor that all closure requirements have been completed as determined necessary by the Department.

The Closure Plan complies with this requirement (see Appendix C of this document).

j. For a permitted facility, the permittee or land owner shall submit a certified copy of the recording instrument to the Department and place a copy in the operating record within 120 days after permit expiration, revocation or as otherwise directed by the Department.

The Closure Plan complies with this requirement (see Appendix C of this document).

k. Detail design for the closure of existing and proposed LF units shall be shown on a final contour and drainage plan. Items required in 335-13-4-.20(2)(b) through (d), (i), (j), and (3)(a), (d), and (f) shall be included.

These items are shown on the Design and Operation Plans which accompany this document (see Sheets 6 and 7 of 13).

3. Post-Closure

The requirements for post-closure of existing and proposed landfill units shall include the following unless otherwise noted.

a. Following closure of each LF unit, the owner or operator must conduct post-closure care. Post-closure care must be conducted for a minimum of 30 years; or a minimum of 5 years if closed prior to October 9, 1993, or the effective date of § 258.1 of 40 CFR 258, Solid Waste Disposal Criteria, whichever is later; except as provided under 335-13-4-.20(3)(b), and consist of at least the following:

    1. Eroded areas shall be filled with suitable soil cover, compacted, graded, and appropriate cover established as described in 335-13-4-.20(2)(d).

    2. Areas which provide for ponding of surface water shall be filled, graded, and an appropriate cover established as described in 335-13-4-.20(2)(d).

    3. Landfilled areas with extensive surface cracks in soil cover shall be corrected as necessary, or as determined by the Department, to prevent infiltration of surface water.

    4. An appropriate cover shall be maintained on the facility at all times as described in 335-13-4-.20(2)(d).

    5. Access control structures shall be maintained or erected and signs shall be posted stating that the facility is closed and giving the location of the nearest permitted landfill unit.

    6. Any waste dumped at the landfill unit following closure shall be removed to an approved landfill unit by the permittee, operating agency, or owner.

    7. Monitoring devices and pollution control equipment such as groundwater monitoring wells, explosive gas monitoring systems, erosion, and surface water control structures, and leachate facilities shall be maintained. Monitoring requirements shall continue in effect throughout the active life and post-closure care period as determined by the Department unless all solid waste is removed and no unpermitted discharge to waters has occurred.

    8. Other deficiencies such as vector control which may be observed by the Department shall be corrected.

The Post-Closure Care Plan in Appendix D of this document complies with this requirement.

b. The length of the post-closure care period may be:

1. Decreased by the Department if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Department; or

2. Increased by the Department if the Department determines that the lengthened period is necessary to protect human health and the environment.

c. The owner or operator of all LF units must submit to the Department and receive approval as part of the permit application, a written post-closure plan. A copy must also be placed in the operating record. The post-closure plan must include, at a minimum, the following information:

1. A description of the monitoring and maintenance activities required in 335-13-4-.20(3)(a) for each LF unit, and the frequency at which these activities will be performed;

2. Name, address, and telephone number of the person or office to contact about the facility during the post-closure period; and

3. A description of the planned uses of the property during the post-closure period.

A Post-Closure Care Plan in Appendix D of this document complies with these requirements.

d. Post-closure use of the property used for the disposal operation must never be allowed to disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems necessary to comply with the requirements of these rules. The Department may approve any other disturbance if the owner or operator demonstrates that the disturbance, including any removal of waste, complies with the following:

1. The activities will not increase the potential threat to human health or the environment; or

2. The activities are necessary to reduce a threat to human health or the environment.

A Post-Closure Care Plan in Appendix D of this document complies with these requirements.

e. Following completion of the post-closure care period for each LF unit, the owner or operator must submit to the Department a certification, signed by an independent registered professional engineer verifying that post-closure care has been completed in accordance with the post-closure plan, and a copy placed in the operating record. A C/DLF Owner or Operator may submit certification signed by a registered professional engineer in lieu of an independent registered professional engineer.

   A Post-Closure Care Plan in Appendix D of this document complies with these requirements.

f. If the Permittee or owner, or any subsequent owner of the land upon which a landfill unit is located wishes to remove waste, waste residues, the liner, if any, or any contaminated soils, the owner must request approval from the Department. The owner may also ask permission to remove the notation from the recording instrument if all waste and contaminated soils are removed from the property and no unpermitted discharges to waters have occurred.

   A Post-Closure Care Plan in Appendix D of this document complies with these requirements.

13.0 GENERAL OPERATION STANDARDS FOR LANDFILL UNITS (ADEM Rule 335-13-4-.21)

Any person or agency operating or planning to operate a landfill unit shall operate and maintain the facility consistent with this Division. General requirements for operating and maintaining an acceptable landfill unit shall be:

1. General Operation

   a. The operation and use of the landfill unit shall be as stipulated in the permit.

      The permit conditions will be complied with.

   b. Waste accepted at the facility shall be strictly controlled so as to allow only waste stipulated on the permit or otherwise as may be approved by the Department. The permittee of any facility permitted under these rules must have in the operating record a plan describing procedures the permittee will implement for detecting and preventing the disposal of free liquids, regulated hazardous wastes, regulated medical wastes, and regulated PCB wastes at the facility.

      This plan must include at a minimum:

      1. Random inspections of incoming loads to ensure that incoming loads do not contain free liquids, regulated hazardous wastes, regulated medical wastes, or regulated PCB wastes.

      2. Inspection of suspicious loads.

      3. Records of all inspections to include origin of waste suspected to be regulated hazardous, regulated medical, or regulated PCB waste, if known; transporters, to include transfer stations and all handlers of the waste en route to the disposal site; and any certifications from generators provided to the permittee or facility personnel. These records must be maintained on file in the operating record of the facility.

      4. Training of facility personnel to recognize free liquids, regulated hazardous wastes, regulated medical wastes, and regulated PCB wastes.

      5. Procedures for notifying the proper authorities if free liquids, regulated hazardous wastes, regulated medical wastes, or regulated PCB wastes are discovered at the facility.

      6. Methods to identify all industrial users of the facility, producers of special wastes, and transporters of these wastes.

A Hazardous Material Screening Plan is included in Appendix A of this document and complies with these requirements.

c. Prior to disposal of industrial waste and/or medical waste, the permittee shall obtain from each generator a written certification that the material to be disposed does not contain free liquids, regulated hazardous wastes, regulated medical wastes, or regulated PCB wastes.

1. This certification may be based on laboratory analysis of the waste on a case-by-case basis, or documentation supporting the generator's knowledge of the wastestream(s), or as may be required by the Department.

2. Copies of the certification shall be submitted to the Department for disposal approval and for any specific requirements prior to disposal. After submittal of the required certification, the Department shall have five (5) working days to respond. If no response is given, the permittee may dispose of the material as proposed.

3. In the case of one-time emergency disposal requests, the permittee shall submit the required certification no later than five (5) days after the disposal of waste.

4. Certification shall be renewed or revised biennially (every two years) or at such time that operational changes at the point of generation could render the waste hazardous, whichever is more frequent and submitted to the Department for approval.

5. Copies of these certifications and approvals shall be maintained on file in the operating record of the facility and shall be made available for the Department upon request.

6. The above requirements notwithstanding and, as may otherwise be required, pursuant to Division 13 rules, generators will not be required to submit certification to the Department provided that:

   i. The waste will be disposed of at a non-commercial industrial waste landfill which has been permitted by the Department, and is owned either exclusively or mutually by the generator(s) of the waste, and which disposes of waste generated only by the owner(s);

   ii. The wastestream(s) to be disposed of are specifically described in the Solid Waste Landfill Permit issued by the Department or in the final application as referenced by the permit for the site designated to receive the waste;

   iii. The required certification, as described above, is maintained on-site by the owner(s) of the landfill; and

iv. The required certification, as described above, is made available for inspection by the Department upon request.

These conditions will be complied with.

d. The landfill unit shall be operated in such a manner that there will be no water pollution or unauthorized discharge.

1. Any discharge resulting from a landfill unit or practice may require:

   i. A National Pollutant Discharge Elimination System (NPDES) permit under the Alabama Water Pollution Control Act as issued by the Department;

   The landfill will not generate a wastewater, and all stormwater from the facility is regulated under the basewide NPDES Stormwater Permit.

   ii. A dredge or fill permit from the Army Corps of Engineers as required under Section 404 of the Clean Water Act, as amended; or

   None required.

   iii. That a non-point source of surface waters does not violate an area wide or statewide water quality management plan that has been approved under the Alabama Water Pollution Control Act.

   This item will be complied with.

2. The groundwater shall not be contaminated as specified by this Division.

   The groundwater at this facility is presently being monitored and the results reported in accordance with an approved Sampling and Analysis Plan. Groundwater monitoring remains under ongoing review by the Solid Waste program within ADEM as discussed in Section 18.0 of this operation plan.

e. The historic and certified disposal areas shall be identified with a sufficient number of permanent markers which are at least visible from one marker to the next.

Permanent survey control markers meeting this requirement will be maintained at all times.

f. Measuring or weighing devices shall be required for all municipal solid waste landfill units accepting solid waste. All solid waste shall be properly measured or weighed prior to disposal unless otherwise approved by the Department.

This item will be complied with. Waste is measured by weight (ton) on scales that are certified on a quarterly basis.

g. Deep rooted vegetation (with roots that may grow below the six inch erosion layer) shall be prohibited as vegetative cover.

This requirement will be complied with.

h. With the exception of very small quantity generator waste disposed of in municipal solid waste landfills, regulated hazardous waste, as defined by Division 14 of the ADEM Administrative Code, is prohibited from disposal in a non-hazardous landfill unit.

This requirement will be complied with.

2 Open Burning

a) Open burning of solid waste at any landfill unit is prohibited unless approved by the Department as follows:

1. Clearing debris at the landfill unit such as trees and stumps may be burned if prior approval is received from the Department and the Alabama Forestry Commission.

2. Emergency clean-up debris resulting from catastrophic incidents may be burned at a permitted landfill unit if consistent with the intent of this Division and air pollution control requirements. Prior approval must be received from this Department and other appropriate agencies.

3. If approved, the burning shall not occur over previously filled areas or within 200 feet of existing disposal operations unless otherwise specified by the Department and such burning shall not cause a public nuisance or pose a threat to public health.

b) The person or agency requesting permission to burn solid waste shall apply in writing to the Department, outlining why a burn request should be granted. This request should include, but not be limited to, specifically what areas will be utilized, types of waste to be burned, the projected starting and completion dates for the project, and the projected days and hours of operation.

Open burning will not be conducted at the Facility.

14.0 SPECIFIC REQUIREMENTS FOR MUNICIPAL SOLID WASTE LANDFILLS (ADEM Rule 335-13-4-.22)

These requirements are not applicable for this Construction/Demolition Landfill.

15.0 SPECIFIC REQUIREMENTS FOR INERT – CONSTRUCTION/DEMOLITION LANDFILLLS AND INDUSTRIAL LANDFILLS (ADEM Rule 335-13-4-.23)

The following requirements in conjunction with 335-13-4-.21 shall be for operating and maintaining an acceptable C/DLF or ILF:

1. Operation

   a. All waste shall be covered as follows:

      1. A minimum of six inches of compacted earth or other alternative cover material that is approved by the Department shall be added at the conclusion of each week's operation or as otherwise specified by the Department to control disease vectors, fires, odors, blown litter, and scavenging.

         Weekly cover shall be soil, ground wood, mulch, or compost, with soil being utilized at least once per month. Soil shall be used on the top surface of waste on all weeks.

      2. In the event that erosion develops on previously covered disposal areas, or when covered waste otherwise becomes exposed, cover must be re-applied to comply with the minimum cover requirements of subparagraph (1)(a)1. of this section.

         This item will be complied with.

      3. Final closure shall be carried out in accordance with 335-13-4-.20 of this Division.

         See Closure Plan in Appendix C of this document.

   b. All waste shall be thoroughly spread in layers two feet or less in thickness and thoroughly compacted weekly with adequate landfill equipment prior to placing additional layers of waste or placing the weekly cover as specified in 335-13-4-.23(1)(a)l., unless otherwise approved by the Department. Waste, such as construction/demolition waste and other types of waste, which cannot be managed by landfill equipment in this manner shall be managed in a manner approved by the Department.

      This requirement shall be complied with except thicker layers of waste may be placed and compacted if necessary based on waste piece size.

   c. All waste shall be confined to as small an area as possible within a single working face and placed onto an appropriate slope not to exceed 4 to 1 (25%) or as approved by the Department.

Slopes on this facility will vary depending on the material being handled and the equipment capability. The working area shall be confined to as small an area as possible.

d. The facility shall be operated in accordance with approved plans and permits.

This item will be complied with.

e. The site shall be adequately secured to prevent entry except by authorized person(s) unless an operator is on site.

The landfill is controlled by natural and artificial boundary barriers and a gated entrance. This item will be complied with.

f. If the site is available to the public or commercial haulers, a sign shall be posted at the landfill stating:

1. Name of permittee,
2. Owner and/or operator,
3. Name of landfill,
4. Days and hours of operation,
5. Waste types accepted, and
6. Disposal fees for use of the landfill

This facility is only open to limited approved haulers, and based on this, an appropriate sign including items No. 1- 5 above will be posted at the landfill.

g. Provisions shall be made for disposal activities in adverse weather conditions.

The landfill is designed to be operated in all weather conditions.

h. Adequate personnel shall be provided to ensure continued and smooth operation of the site.

Adequate site operations personnel will be assigned to insure continued and smooth operation of the site (see Appendix G. of Standard Operating Procedure).

i. Adequate equipment shall be provided to ensure continued operation in accordance with permit and regulations.

The following minimum equipment will be provided to insure continued operation in accordance with the permit and regulations:

1. **Dozer**
2. **Loader**
3. **Excavator**
4. **Wood Waste Grinder**

j. Bulk or non-containerized liquid waste, or containers capable of holding liquids, shall not be accepted at a C/DLF or ILF unless:

1. The liquid is leachate or gas condensate derived from the C/DLF or ILF unit, and

2. The C/DLF or ILF unit is designed with a minimum single liner and leachate collection system or approved equivalent liner and leachate collection system.

These items will be prohibited for disposal at this facility.

k. Empty containers larger than 10 gallons in size must be rendered unsuitable for holding liquids prior to disposal in the landfill unit unless otherwise approved by the Department.

This item will be complied with.

l. Unless otherwise provided by 335-13-4-.23(1)(j), free liquids are prohibited from disposal in the landfill unit.

This item will be complied with.

2. Routine Maintenance

a. Scavenging shall not be permitted, and salvaging operations shall be controlled.

This item will be complied with.

b. Litter shall be controlled within the permitted facility.

This item will be complied with.

c. Completed sites or portions of sites shall be properly closed as provided by this Division and approved facility plans.

This item will be complied with.

d. An all-weather access road shall be provided to the dumping face.

This item will be complied with.

e. Environmental monitoring and treatment structures shall be protected and maintained in good repair and easily accessible.

This item will be complied with.

f. The average daily volume of waste received at a C/DLF or ILF shall be calculated by dividing the total month's receipts by the total number of days in the reporting month. Records shall be maintained on the average daily volume of waste received at C/DLFs and ILFs. A quarterly report which summarizes the daily volumes, with volumes received reported in a format specified and approved by the Department, shall be submitted to the Department and maintained on file in the operating record of the facility by the permittee. If the average daily volume is exceeded for two or more consecutive quarters, by 20 percent or 100 tons/day, whichever is less, a modification would be required to adjust the permitted average daily volume.

This item will be complied with.

g. Measures shall be taken to prevent the breeding or accumulation of disease vectors. If determined necessary by the Department or the State Health Department, additional disease vector control measures shall be conducted.

This item will be complied with.

3. Additional Requirements

a. Notwithstanding this rule, certain requirements for operating and maintaining a C/DLF and ILF may be enhanced or reduced by the Department as deemed necessary to comply with the Act and this Division. Any action by the Department to enhance or reduce the requirement(s) must be done in writing from the Department.

Any requirement received from ADEM will be incorporated in this Operation Plan.

b. [Reserved]

c. Industrial landfills which accept coal combustion residuals must also adhere to the applicable requirements of ADEM Admin. Code 335-13-15.

This facility does not accept coal combustion residuals.

16.0 SEPTIC TANK PUMPINGS AND SEWAGE SLUDGE (ADEM Rule 335-13-4-.24)

The practice of accepting septic tank pumpings and sewage sludge shall not occur at landfill units unless specifically approved in writing by the Department.

No septic tank pumpings and sewage sludges will be accepted at this facility.

17.0 REQUIREMENTS FOR MANAGEMENT AND DISPOSAL OF SPECIAL WASTE (ADEM Rule 335-13-4-.26)

1. Exceptions

    a. Requirements for the management and disposal of special waste at a landfill unit permitted by the Department shall meet the requirements of this rule.

    b. Certain requirements may be modified by the Department as deemed necessary to comply with the Act and this Division.

        1. Waste types for which specific rules and regulations under this Division have not been developed shall be managed and disposed of in a manner as determined by the Department to be consistent with the intent of the Act and this Division.

        2. Generators of a special waste may be required by the Department to provide an analysis and certification that the waste is nonhazardous waste or treated medical waste.

2. Disposal requirements for friable asbestos

    Any person who generates, processes, treats, or disposes of friable asbestos shall comply with the following practices:

    a. Friable asbestos shall be disposed of in a facility permitted by the Department. The friable asbestos shall arrive at the landfill unit in properly labeled, leak-tight containers as determined by the Department's Air Division.

        This requirement will be complied with.

    b. Containers shall be placed intact in a specially prepared place and covered with a minimum of 12 inches of earth or other alternative cover material, as approved by the Department, at the end of each working day. Asbestos waste may be landfilled in an excavation at the bottom of the operating face if no liner is present or the design depth restriction is not exceeded. The waste may also be placed in a separately designated area. If a separate area is utilized, it shall be clearly marked to prevent future excavation into the waste.

        This facility will allow both handling at the bottom of the operating face and in specially designated asbestos pits. When placed in asbestos pits, it shall be clearly marked to prevent future excavation into the waste.

    c. Proper handling precautions shall be taken to ensure that containers are not ruptured prior to placing the required daily earth cover as noted in 335-13-4-.26(2)(b). No machinery shall be operated directly over uncovered containers.

        This item shall be complied with.

d. Final cover shall be as noted in 335-13-4-.20(2)(b).

This item shall be complied with.

3. Disposal requirements for foundry wastes

Foundry waste which exhibits less than 50 percent of each of the TC Levels for metals as defined by the USEPA's Toxicity Characteristic Leaching Procedure (TCLP) may be managed in the following manner:

a. Foundry waste may be managed in areas other than:

    1. Flood plains;

    2. Wetlands;

    3. Residential zones; or

    4. Areas less than 5 feet above the uppermost aquifer

b. Each foundry must maintain records at the manufacturing facility. These records must include:

    1. A description of the site to within the ¼, ¼ Section of a specific township and range.

    2. Volume of foundry waste disposed of at each location.

c. The waste must be certified by the generator on a quarterly basis or whenever the process changes which would significantly alter the test results, whichever is more frequent. Certification of the foundry waste shall be accomplished by submitting the following:

    1. A completed Solid/Hazardous Waste Determination Form

    2. A TCLP analysis for metals

d. Each foundry must contact the Water Division of ADEM with regards to General Stormwater and/or NPDES permits.

e. Foundry waste from two or more foundries may be managed at one location provided adequate documentation and record keeping is maintained for each foundry.

f. Foundry waste not meeting the requirements of paragraph (3) of this rule must be managed at an approved recycle/reuse facility or at a landfill unit approved for the disposal of foundry waste and permitted by the Department.

These requirements will be complied with.

4. Disposal requirements for petroleum contaminated waste

   Any person who disposes of petroleum contaminated waste shall comply with the following practices:

   a. Petroleum contaminated waste must be disposed of in a MSWLF and/or a synthetically lined facility having a solid waste disposal permit issued by the Department and having groundwater monitoring wells.

   b. Prior to disposing of a petroleum contaminated waste in accordance with subparagraph (a) of this paragraph, the generator of the waste must provide the Department with a written certification that the waste is non-hazardous.

      1. The generator of a petroleum contaminated waste may use knowledge of the processes producing the waste to certify that the waste is non-hazardous; however, the Department, on a case-by-case basis, may require additional information and/or laboratory analyses to support the generator's certification.

      2. The written certification that the waste is non-hazardous must include laboratory analysis for metals if the source of the petroleum contamination is leaded gasoline, used automotive crank case oil, or if the generator has reason to believe that the source contains TCLP metals.

   c. Small quantities of petroleum contaminated waste may be disposed in MSWLF's, C/DLFs, or ILFs, and shall not require approval and/or testing, provided that the waste:

      1. Contains less than twenty-five (25) gallons of petroleum; and

      2. Total material (i.e., soil, rags, sorbent, etc.) is less than five (5) cubic yards per occurrence.

   These requirements will be complied with.

5. Disposal requirements for municipals solid waste ash.

   Municipal solid waste ash shall be disposed of at a MSWLF meeting at a minimum the design criteria established under 335-13-4-.18. Alternative disposal methods or uses must be approved by the Department prior to implementation.

   No municipal solid waste ash will be disposed of at this landfill.

6. Disposal requirements for wood ash waste

Wood ash waste which exhibits less than 50 percent of each of the TC Levels for metals as defined by the USEPA's Toxicity Characteristic Leaching Procedure (TCLP) may be managed in the following manner:

a) Wood ash waste may be managed in areas other than

   1. Flood plains;

   2. Wetlands;

   3. Residential zones; or

   4. Areas less than 5 feet above the uppermost aquifer.

b) Facilities managing wood ash waste in an area that is not a permitted landfill unit, not within the property boundaries of the generator, and meets the requirements of 335-13-4-.26 (6)(a) must maintain records at the facility that include the following:

   1. A description of the site to within ¼, ¼ Section of a specific Township and Range.

   2. Volume of the wood ash waste disposed of at each location on a quarterly basis.

   3. Certification of the wood ash waste on a quarterly basis or whenever the waste generating process changes which would significantly alter the test results, whichever is more frequent. Certification of the wood ash waste must be accomplished by submitting the following:

      i. A completed Solid/Hazardous Waste Determination Form.

      ii. A TCLP analysis for metals.

c) Facilities managing wood ash waste in an area that is not a permitted landfill unit, within the property boundaries of the generator, and meets the requirements of 335-13-4-.26 (6)(a) must maintain records at the facility that include the following:

   1. Certification of the wood ash waste on a two (2) year basis or whenever the waste generating process changes which would significantly alter the test results, whichever is more frequent. Certification of the wood ash waste must be accomplished by submitting the following:

      (i) A completed Solid/Hazardous Waste Determination Form.

      (ii) A TCLP Analysis for metals.

d) Each facility managing wood ash waste in accordance with 335-13- 4-.26(6) shall submit an annual report on or before January 31st of each year utilizing a format approved by the Department which contains the following:

1. Summary of the components of 335-13-4-.26(6)(b) and/or (c).

2. Documentation of the non-coal permitted fuel burned on a quarterly basis to include the type, quantity (mass input basis), and the percentage of total fuel, of each type of fuel burned.

e) Facilities managing wood ash waste in an area that is not a permitted landfill unit and meets the requirements of 335-13-4-.26 (6)(a) must contact the Water Division of the ADEM with regards to NPDES requirements for waste management areas.

(f) Wood ash waste from two or more facilities may be managed at one location provided adequate documentation and record keeping is maintained for each generator.

(g) Wood ash waste not meeting the requirements of paragraph (6) of this rule must be managed at a landfill unit approved for the disposal of wood ash waste and permitted by the Department.

No municipal solid waste ash will be disposed of at this landfill.

18.0 GROUNDWATER MONITORING AND CORRECTIVE ACTION (ADEM Rule 335-13-4-.27)

The groundwater at this facility is currently under Detection Monitoring and the results are reported in accordance with the Landfill Permit and an approved Sampling and Analysis Plan. If Assessment Monitoring is triggered and an alternative source cannot be demonstrated, it will be performed in accordance with the Landfill Permit and ADEM rule 335-13-4-.27(4). Corrective Action will be performed, if required, in accordance with the Landfill Permit and ADEM rule 335-13-4-.27(5).

19.0 RECORDKEEPING REQUIREMENTS (ADEM Rule 335-13-4-.29)

Recordkeeping shall be maintained as follows:

1. Operating Record

   The owner or operator of a MSWLF, C/DLF, or ILF unit must record and retain in an operating record at the facility, or in an alternative location approved by the Department, the following information as it becomes available:

   a. Solid Waste Disposal Facility Permit as issued by the Department.

   b. Permit application, operational narrative, and engineering drawings. This may include, but is not limited to:

      1. Any location restriction demonstration required under 335-13-4-.01 of this Division;

      2. Any MSWLF unit design documentation for placement of leachate or gas condensate in a MSWLF unit as required under 335-13-4-.22(1)(k) of this Division;

      3. Closure and post-closure care plans as required by 335-13-4-.20 of this Division;

      4. Explosive gas monitoring plans as required by 335-13-4-.16 of this Division;

      5. Corrective action plan, if necessary, which includes detection in assessment monitoring;

      6. Any other documentation submitted to the Department during the permitting process.

   c. Reports or documentation generated during the normal operation of the facility may include, but are not limited to:

      1. Gas monitoring results from monitoring and any remediation plans required by 335-13-4-.16;

      2. Inspection records, training procedures, notification procedures, and other information required in 335-13-4-.21(1)(b);

      3. Any monitoring, testing, or analytical data as required by 335-13-4-.20 of this Division concerning closure;

      4. Any demonstration, certification, finding monitoring, testing, or analytical data required by 335-13-4-.27 concerning groundwater monitoring and corrective action;

      5. Quarterly volume reports as required in 335-13-4-.22(2)(g) or 335-13-4-.23(2)(f) of this Division;

6. Waste certifications as required by 335-13-4-.21(1)(c) of this Division;

7. Any other report or document generated in the normal operation of the facility which is submitted to the Department.

d. Any cost estimates and financial assurance documentation required by 335-13-4-.28.

All items noted above will be placed in the facility Operating Record.

2. Department Notification

The owner/operator must notify the Department when the documents from subparagraph (l)(b) of this rule have been placed or added to the operating record, and all information contained in the operating record must be furnished upon request to the Department or be made available at all reasonable times for inspection by the Department.

ADEM will be notified that the appropriate documents have been placed in the facility Operating Record at the appropriate time.

3. Alternative Schedules

The Department can set alternative schedules for recordkeeping and notification requirements as specified in paragraphs (1) and (2) of this rule, except for notification requirements in 335-13-4-.0l(l)(c) and 335-13-4-.27(4)(g)3.(iii).

Not applicable.

20.0 PROPOSED SITE DEVELOPMENT

20.1 DESIGN CRITERIA

The proposed Construction/Demolition Landfill modification has been designed in accordance with established regulatory guidelines of the Alabama Department of Environmental Management (ADEM) as set forth by the Division 13, Solid Waste Program as modified through August 2022.

20.2 PERTINENT DESIGN FEATURES

The proposed landfill modification is an above-grade Construction/Demolition Landfill. The features incorporated in this design are:

1. A 100 foot minimum buffer zone along entire boundary of the disposal facility.

2. 25% maximum slopes and 5% minimum slopes toward the base of landfill to prevent any surface water ponding.

3. Sideslope drainage berms to control and direct stormwater run-off on landfill sideslopes.

4. Drainage ditches to divert runoff to discharge points from the disposal facility.

5. Sediment control measures.

6. A closure cap.

7. On site survey control established by monuments set at points of intersections along disposal facility boundary as well as interior control points.

8. A minimum 5' vertical separation between the base of waste and the groundwater potentiometric surface.

The working face will be minimized by the construction of weekly work cells sized to handle each week's volume, and covered at the end of every week's fill. Details of the proposed final cap system are presented on the details in the Design & Operation Plan. Existing site topographic features and encountered subsurface geologic and hydrogeologic conditions of the project area are summarized in past investigations on record with ADEM. A brief description of the various design features and construction procedures are presented in this document.

20.3 CONSTRUCTION PROCEDURES

The construction items listed below are in the order in which they will be constructed. The figures referred to in the following paragraphs are included in the plans for this application.

20.3.1 Temporary Erosion Control

Due to the limitations imposed by the existing site configuration, permanent erosion and sedimentation control structures will be constructed in the early stages of the development. These include the sedimentation devices along drainage ditches which convey collected runoff from temporary channels, and being constructed as necessary, to prevent runoff from entering the work area. Culverts and final drainage ditches can be constructed as work progresses.

The sediment barriers will consist of sedimentation devices as shown on the Erosion control drawings and will be maintained until the permanent erosion control measures of the final slopes configuration are installed and operational.

20.3.2 Soil Storage

Soil storage locations shall be determined and identified throughout the life of the landfill. Since the area to be filled will have a life of many years, the storage areas will change from time to time to allow quick transport from storage site to the open face area. Weekly cover materials and interim cover materials will be hauled from borrow sources on the Arsenal. Vegetative growth zone soils will also be hauled from borrow areas on the Arsenal.

20.3.3 Permanent Erosion Control and Protection

Permanent erosion control and protection will be accomplished by providing a system of relatively short slopes intercepted by berms which are designed to slow the runoff velocity and thus reduce soil transport across the final fill configuration.

The ditches are directed to empty into the large drainage ditch at the border to the landfill. The layout and grading plan for long-term surface water management is presented on drawings with final drainage ditches provided around the area fill. Intermediate ditching to prevent surface erosion will be moved with the working face movement and positioned to intercept runoff from non-grassed open face areas as quickly as possible. Appropriate siltation devices will be installed and maintained until final cap is installed and vegetation is established. All final slope surfaces will be revegetated for long-term erosion protection.

A minimum thickness of six (6) inches of soil capable of supporting vegetation shall be spread over the areas to be revegetated.

Within thirty (30) days of the completion of final cap installation, the seed bed shall be prepared and permanent grasses planted according to the applicable rates determined from soil testing. This procedure will be repeated as necessary to achieve a complete vegetative cover. Inspections of the site shall be conducted quarterly to determine if full vegetative cover has been achieved and to identify points of erosion and sedimentation. Frequency of inspections may be reduced once the vegetative cover is established to the satisfaction of the regulatory agency.

Establishment of vegetation on the final cover shall begin following the final grading of the cap. The areas to be seeded shall be dressed to a reasonably smooth, firm surface. Fertilizer and dolomitic limestone shall be applied at the applicable rate. These rates are dependent on the results of soil tests to be performed immediately prior to seeding.

Seed mixes shall be determined by the operator prior to seeding to assure the optimum vegetative cover.

All seed shall be broadcast evenly over the area immediately following tilling. The legume seeds shall be applied separately from all other seeds, except when a hydroseeder is used. If a hydroseeder is used, the slurry pH shall not be allowed to drop below a pH of 5.0.

Mulch shall be supplied uniformly over all seeded areas at the rate of two (2) tons per acre. The mulch shall consist of wheat or rye straw and shall be free of any noxious weeds.

20.3.4 Proposed Landfill Method

Refuse disposal operations will be accomplished by above ground construction of a compacted embankment of refuse and weekly cover material, i.e., the Area Method.

Temporary all weather access roads will extend to the working face and will be maintained in order to prevent tire punctures and a wet unstable traffic surface. Sediment barriers will be installed and cleaned as necessary to prevent discharge of sediment from the site.

Roads to remain as permanent access roads are identified on Sheet 2 of 13 of the Design and Operation Plan.

20.3.5 Compaction Practice

The incoming daily waste will be compacted as discussed in Section 12.3.4 "Proposed Landfill Method". A maximum compaction lift of two (2) feet will be used on construction debris material small enough in size to allow this lift thickness. Other incoming waste will be spread and compacted in appropriate lift depths for compaction by landfill equipment. Compaction shall occur on alternating days (Monday, Wednesday, and Friday) after unloading at the top or toe of the working face. A 10:1 to 3:1 working face will be maintained. However, positive drainage should be provided and the area of the working face minimized (see ADEM approval letter in Appendix F of this document.)

21.0 GROUNDWATER MONITORING PROGRAM

All groundwater monitoring at this site is performed in accordance with an approved Sampling and Analysis Plan to comply with the Solid Waste Disposal Facility Permit 45-03 as discussed in Section 6.0 of this operation plan.

22.0 FIRE PROTECTION

All site construction vehicles and equipment should carry a portable fire extinguisher. Additional fire protection is available from Redstone Arsenal's fire stations which are located at various locations on base. Off-site protection can be available from the City of Huntsville if the emergency cannot be handled by the Redstone Arsenal's staff and equipment. Water is available at the scalehouse on site for fire fighting. Additionally, soils used for weekly cover may be utilized for fire fighting.

23.0 COMMUNICATIONS

Site communication is achieved through cellular phones, carried by each landfill employee.

24.0 DUST CONTROL

A base water truck will be available as necessary to control dust along the site access roads.

25.0 APPENDICES

A. Hazardous Materials Screening Plan
B. Methane Monitoring Plan
C. Closure Plan
D. Post-Closure Plan
E. Design Calculations
F. ADEM Approval Letters for Alternative Cover Systems and Other Operational Procedures
G. Daily Material Received Summary Log
H. Twice-Weekly Random Inspection Sheet

A. Hazardous Materials Screening Plan

HAZARDOUS MATERIALS SCREENING PLAN

SOLID WASTE MANAGEMENT FACILITY SUPPORT ACTIVITIES

REDSTONE ARSENAL
MADISON COUNTY, ALABAMA
RSA EPA ID NO. AL7210020742

APRIL, 1997

Prepared For:
US Army Garrison
Redstone, Directorate of Public Works
Environmental Division

Prepared By:
Hodges, Harbin, Newberry & Tribble, Inc.
Consulting Engineers
484 Mulberry Street, Suite 265
Macon, Ga. 31201
Updated by Aptim Environmental & Infrastructure
October 2024

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FOR
HAZARDOUS MATERIALS SCREENING PLAN

Contents

I. PURPOSE

To establish procedures for preventing the disposal of unauthorized hazardous waste at the Redstone Arsenal Landfill.

II. PROCEDURES

A. Definitions:

1. ADEM - Alabama Department of Environmental Management
2. BASEOPS - Base Operations Contractor
3. DEMP - Directorate of Environmental Management and Planning
4. DPW - Directorate of Public Works
5. DRMO - Defense Reutilization and Marketing Office
6. Hazardous Waste - A hazardous waste is defined under 40 CFR Part 261.3 as a solid waste which:

   (1) Is not excluded from regulation under 261.4 (b)

   (2) Exhibits characteristics of a hazardous waste which include:

      a. Toxicity
      b. Reactivity
      c. Corrosivity
      d. Ignitability

   (3) Is a listed hazardous waste.

7. MICOM - U.S. Army Missile Command
8. MSW – Municipal Solid Waste
9. SWDF - Solid Waste Disposal Facility

B. The Landfill Operator or his designee will:

1. Inspect all manifests before vehicle is allowed to dump load to assure described load is acceptable at landfill.

2. Make random inspections of vehicle loads to assure material on vehicle is as described on manifest and note these inspections on the SWDF's Random Inspection Sheet to be submitted to DEMP weekly.

3. Reject any loads found by either manifest review or inspection to contain unacceptable hazardous waste of prohibited materials.

4. The following criteria will be followed for rejecting or accepting loads:

    a. Loads containing free liquids will be rejected.

    b. Loads containing known hazardous materials will be rejected unless:

        (1) It is a special waste accompanied with approval from ADEM and DEMP to dispose of at landfill.

        (2) It is accompanied by an ADEM approval letter with a DEMP approval signature.

    c. Containers are to be empty, dry and crushed before they can be accepted at landfill.

    d. Uncontaminated soil will be accepted if dry enough to be bladeable.

    e. Loads containing MSW will be rejected.

    f. Loads containing electrical scrap, metal or other recyclable material will not be accepted unless rejected by DRMO and accompanied by appropriate documentation from DRMO.

    g. Brush and wood for chipper can not be over 10 feet long and must be free of rock and dirt.

    h. Treated lumber can be accepted, but all other scrap lumber and combustibles must go to City of Huntsville incinerator for disposal.

    i. Properly bagged and labeled friable asbestos, accompanied by appropriate documentation, will be accepted at the toe of the working face and immediately covered.

    j. Broken concrete will be accepted if:

        (1) Concrete is uncontaminated.

(2) Concrete does not have long pieces of metal sticking out.

(3) Concrete is less than three (3) feet in length, three (3) feet in width and depth.

(4) Arrangements have been made for placement of large pieces in landfill.

5. Concrete should be diverted to the concrete recycling stockpile if recycling concrete criteria (see below) is met to meet Construction and Demolition Diversion requirements for the installation.

   - Concrete is uncontaminated
   - Free of rebar
   - Any wire mesh should be less than 0.148" (#9 gauge) diameter

k. Dead animals will be rejected.

6. Consult with the BASEOPS Environmental Engineer if there is any question as to whether a material is acceptable or not. The BASEOPS Environmental Engineer will relay this information to the LPM.

7. Make random observations of loads as they are dumped to verify vehicle's contents and require removal of any material found to be unacceptable. Log event on Daily Materials Received Summary Log.

8. In the event the hauler of a rejected load refuses to follow the guidance of the responsible Construction/Demolition Landfill Operator, call the appropriate BASEOPS Supervisor(s) and/or Manager(s). If necessary, call Security at 911. Note user refusal in Daily Materials Received Summary Log.

C The BASEOPS Environmental Engineer will:

1. Make a determination as to acceptability of materials submitted for disposal upon request by the Construction/Demolition Landfill Operator

2. Upon request by a potential landfill user, make a determination in advance of hauling as to acceptability of a material they desire to dispose of at landfill. The BASEOPS Environmental Engineer may require laboratory analysis, such as TCLP, etc., before making his decision.

3. Consult with DEMP on any material that he is not sure can go into the landfill.

4. In conjunction with the BASEOPS Human Resources Office, ensure proper training for personnel assigned landfill operational duties. Forward copies of all landfill personnel training records to DEMP.

D. The BASEOPS Human Resources Office will:

1. Maintain training records for personnel assigned landfill operational duties.

2. Maintain list of landfill operational personnel, their training and training expiration dates and forward a copy to DEMP.

3. In conjunction with the BASEOPS Environmental Engineer, obtain required training for landfill operational personnel.

III. RESPONSIBILITIES

A. The BASEOPS Contractor Environmental Engineer is responsible for ensuring this procedure complies with Federal, State, and local regulations including the IMCOM Environmental Offices, regulations, policies, and procedures governing the Redstone Arsenal Landfill.

B. The BASEOPS Contractor is responsible for ensuring the SOM personnel comply with this procedure (plan).

B. Methane Monitoring Plan

Note: Methane Monitoring Plan has been removed per Variance VIII of Permit 45-03.

C. Closure Plan

CLOSURE PLAN

SOLID WASTE MANAGEMENT FACILITY
SUPPORT ACTMTIES

REDSTONE ARSENAL
MADISON COUNTY, ALABAMA
RSA EPA ID NO. AL7210020742

APRIL, 1997

Prepared For:
US Army Garrison
Redstone, Directorate of Public Works
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484 Mulberry Street. Suite 265
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October 2024

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1.0 Introduction

The Closure Plan sets forth the methods and techniques to be utilized for closure of the C&D Landfill unit. It includes regulatory references and schedules for this closure. In summary, the Closure Plan is the step-by-step plan for closure of the landfill.

2.0 FINAL COVER (Rule 335-l3-4-.20(2)(b))

The final cover system of the landfill will meet the requirements of Rule 335-13-4-.20(2)(b). That cover system will include:

1. An 18" thick low permeability cover system installed over the waste. This soil will have a tested permeability no greater than l x 10^{-5} cm/sec.

2. A minimum 6" thick vegetative growth zone composed of topsoil or other soil which is capable of sustaining plant growth.

3. Permanent vegetation.

The landfill is designed to be closed with minimum slopes of 5% to assure ponding of surface water does not occur over the waste unit. Sideslopes on the landfill will not exceed 25 percent. On the sideslopes designed at 25 percent grade, stormwater diversion berms will be constructed at a 20 vertical spacing. These diversion berms will direct stormwater to permanent downdrain structures. The entire sideslope / downdrain system has been designed to minimize erosion. The 18" thick low permeability soil cover system shall be installed and tested according to the CQA program discussed below.

2.1 Compacted Soil Cover

A. General

1. The compacted soil cap shall be set-up and certified by the Owner in accordance with the approved plans, the rules, and this CQA document.

2. A registered professional engineer shall serve as the Construction Quality Assurance (CQA) Engineer for this work.

3. Construction Quality Assurance shall meet the minimum testing requirements as contained in Table 1.

B. Material

1. The compacted soil cover material shall consist of cohesive soils or synthetically improved soils meeting the permeability criteria of not more than 1 x 10^{-5} cm/sec.

TABLE 1 CLOSURE CONSTRUCTION QUALITY ASSURANCE REQUIREMENTS		
ITEM	TESTING	**FREQUENCY**
Borrow Source Grain Size	(ASTM D422)	5,000 yd^3
	Moisture Content (ASTM D2216)	5,000 yd^3
	Atterberg Limits (ASTM D4318)	5,000 yd^3
	Moisture-Density Curve (ASTM D698 or D1557)	5,000 yd^3
	Permeability (remold) (EM 110-2-1906, Appendix 7, Section 1 or ASTM D5084	10,000 yd^3 $\leq 1.0 \times 10^{-5}$ cm/sec
Clay Cover – During Const. Cone	Density – Nuclear or Sand (ASTM D2922 or D1556)	2 test / acre / lift
	Moisture Content (ASTM D2216)	2 test / acre / lift
Clay Liner – Lab Testing	*Permeability (ASTM D5084)	1 test / acre / lift $\leq 1.0 \times 10^{-5}$ cm/sec
	*Dry Density (ASTM D2922)	1 test / acre / lift
	*Moisture Content Undisturbed (ASTM D2216)	1 test / acre / lift
	*Atterberg Limits ASTM D4318	1 test / acre / lift
Testing to be performed on undisturbed samples.		

C. Stockpiling and Material Approval

1. All material to be used as the compacted soil cap shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA testing outlined herein. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

2. The procedure for testing during excavation and stockpiling is outlined below:

    a. Loads of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be routed to separate stockpiles consistent with its end use.
    b. During stockpiling operations, one (1) bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted clay liner material:

        1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil -Aggregate Mixtures, ASTM D2216.
        2. Method for Particle -- Size Analysis of Soils, ASTM D422.
        3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

    c. One (1) sample for every 5,000 cubic yards of material stockpiled will be selected for permeability testing (ASTM D5084-90) measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter and for determining the moisture-density relationship (ASTM D698).

3. Reports for the soil cover will be prepared by the CQA Engineer and shall include:
    a. Summary of laboratory test data.
    b. A summary of construction, sampling and testing method, and recommendation.

D. Test Fill for Cover

1. A test fill may be constructed using the same construction methods, equipment, and material to be used for the compacted soil cover. The test pad construction may be constructed prior to, or coincide with, the beginning of construction of the soil cover. This test fill may be used to establish means, materials, and methods for installation of the final cover system.

2. Construction equipment and methods shall be reviewed by the CQA Engineer prior to test pad placement.

3. Construction methods, sampling and testing, including permeability testing, shall be specified by the CQA Engineer.

E. Construction

1. Compacted Soil Cover shall be placed to conform to the $\leq 1 \times 10^{-5}$ cm/sec permeability criteria.

2. Only soil previously approved by the CQA Engineer shall be used in construction of the compacted soil cover.. Material deemed unsuitable by the CQA Engineer shall be removed as soon as possible.

3. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g., wetting, drying, scarification. etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

4. Moisture content will be monitored by the CQA Engineer or his representative prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly. The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is complete. Loose lift thickness should not exceed 10" for a final ± 6" compacted lift thickness.

   Each lift shall be checked visually for excessive rocks, debris, plant materials and other foreign material. The excessive soil cover shall be reasonably free of material which will not pass through a l" screen. This may require mechanical pulverizing of these soils or the use of a rock hound.

F. Sampling and Testing

1. The CQA Engineer or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below:

   a. Field density tests shall be performed at the rate of one per 10,000 square feet of covered area for the compacted soil cover. For any confirmed failing test, an area 100' x 100' shall be reworked and the area shall be retested.

   b. The field density tests shall be performed using a nuclear density gauge. The location of each test will be randomly determined by the CQA Engineer or his representative. All holes shall be patched with sodium bentonite pellets compacted and hydrated in the holes.

   c. Two (2) bulk samples of the soil cap for each lift will be collected during placement or compaction. The following tests will be performed:

      1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures ASTM D2216.

      2. Method for Particle -- Size Analysis of Soils ASTM D422.

      3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

   d. One (1) sample for every 43,560 square feet of cover area will be selected by the CQA Engineer for permeability testing (ASTM D5084-90) and for determining the moisture-density relationship (AS1M D698). For any confirmed failing test, an area 100' x 100' shall be reworked and the area shall be retested.

   e. Results of testing shall be certified to ADEM within 30 days of soil cap placement.

All grassing systems utilized on the final cap shall be determined at time of closure utilizing soil tests and agricultural expertise.

3.0 LARGEST AREA OF THE LANDFILL UNIT REQUIRING FINAL COVER (Rule 335-13-4-.20(2)(a)(2))

Based on designed development of the facility, the largest area of the landfill unit ever requiring a final cover as required under Rule 335-13-4-.20(2)(b) at any time during the active life will be 43.55 acres.

4.0 MAXIMUM INVENTORY OF WASTE

The estimated inventory of wastes ever on-site over the active life of the facility is 4,000,000 cubic yards. This estimate includes all waste types disposed on this site.

5.0 SCHEDULE FOR COMPLETING ALL ACTIVITIES NECESSARY TO SATISFY THE CLOSURE CRITERIA IN THE RULE

The proposed schedule for completing all activities necessary to satisfy the closure criteria in the rule is:

5.1 Prior to beginning closure of the unit, the owner or operator must submit to ADEM a notice of intent to close the unit. A copy of that notice shall be placed in the facility operating record.

5.2 The operator will begin closure activities on the unit no later than 30 days after the date which the unit receives the known final receipt of waste. Final cover may be installed at earlier dates as part of the facility operation. This shall include:

5.2.1 Installation of low permeability soil cover system.

5.2.2 Installation of permanent sides lope drainage berms and downdrains.

5.2.3 Installation of vegetative growth zone soil.

5.2.4 Installation and development of vegetative cover.

The final closure of the unit will be completed within 180 days of last known receipt of waste.

5.3 Following closure, the landfill owner or operator will submit to ADEM a certification, signed by an independent registered professional engineer, verifying that closure has been completed in accordance with the closure plan. If final cover installation is completed prior to the final closure time frame, it shall be certified at the time of final closure. A copy of this certification shall be placed in the facility operating record.

5.4 Within 90 days of final closure, the owner shall record a notation on the land deed containing the property utilized for disposal, that:

5.4.1 The land has been used as a solid waste disposal facility landfill unit.

5.4.2 Its use is restricted by items contained in Rules 335-13-4-.20(3)(c) and 335-13-4-20(3)(d).

5.4.3 The locations and dimensions of the landfill unit with respect to permanently surveyed benchmark and section corners shall be on a plat prepared and sealed by a land surveyor.

5.4.4 The plat shall contain a note, prominently displayed, which states the name of the owner, the type of the landfill unit, and the beginning and closure dates of the disposal activity.

5.4.5 Certification by an Engineer or Land Surveyor that all closure requirements have been completed as determined necessary by ADEM.

5.5 Within 120 days, the owner shall submit a certified copy of the aforementioned recording instrument to ADEM, with a duplicate copy placed in the facility operating record.

D. Post-Closure Plan

POST-CLOSURE PLAN

SOLID WASTE MANAGEMENT FACILITY
SUPPORT ACTMTIES

REDSTONE ARSENAL
MADISON COUNTY, ALABAMA
RSA EPA ID NO. AL7210020742

APRIL, 1997

Prepared For:
US Army Garrison
Redstone, Directorate of Public Works
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October 2024

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1.0 INTRODUCTION

Following closure of the landfill unit, the owner must conduct post-closure care for 30 years.

Following completion of the post-closure care period, the owner will submit to ADEM a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan. A duplicate copy of the certification will be placed in the facility operating record.

If the Permittee or owner, or any subsequent owner of the land upon which a landfill unit is located wishes to remove waste, waste residues, the liner, if any, or any contaminated soils, the owner must request approval from the Department. The owner may also ask permission to remove the notation from the recording instrument if all waste and contaminated soils are removed from the property and no unpermitted discharges to waters have been occurred.

2.0 POST-CLOSURE CARE REQUIREMENTS

The requirements for post-closure of the Redstone Arsenal Landfill include:

2.1 Eroded areas shall be filled with suitable soil cover, compacted, graded, and then covered with an appropriate vegetative cover.

2.2 Areas which provide for ponding of surface water shall be filled, graded, and an appropriate vegetative cover established.

2.3 Landfilled areas with extensive surface cracks in soil cover shall be corrected as necessary to prevent infiltration of surface water.

2.4 An appropriate vegetative cover shall be maintained on the facility at all times.

2.5 Access control structures shall be maintained at the site and signs shall be posted near the entrance stating that the facility is closed, and giving the location of the nearest permitted landfill unit.

2.6 Any waste dumped at the landfill unit following closure shall be removed to an approved landfill unit by the owner.

2.7 Monitoring devices for explosive gas monitoring systems (as necessary), erosion, and surface water control structures shall be maintained. Monitoring requirements shall continue in effect throughout the active life and post-closure care period as determined by ADEM unless all solid waste is removed and no unpermitted discharge to waters has occurred.

3.0 DESCRIPTION OF THE MONITORING AND MAINTENANCE ACTIVITIES REQUIRED IN RULE (Rule 335-13-4-.20(3)(a))

3.1 Monitoring

3.1.1 The methane gas monitoring system shall be maintained; however, as in the approved Permit 45-13 monitoring these methane monitoring is no longer required.

3.2 Maintenance

3.2.1 Erosion will be corrected with backfill of soil and the establishment of an adequate vegetative cover.

3.2.2 Areas where ponding (birdbaths) occur on the unit will be corrected by filling with soil to assure positive drainage. Ponding water over a waste unit is unacceptable.

3.2.3 Any surface cracks or rills detected in the final cover should be fully repaired to assure competence of the cover, then these repairs will be vegetated.

3.2.4 The vegetative cover shall be maintained with mowing, fertilization, mulching, and reseeding as necessary to prevent erosion of final cover soils.

3.2.5 All fences and gates shall be maintained.

3.2.6 All on-site ditches, culverts, berms, and other drainage structures will be maintained at all times during post-closure.

4.0 NAME, ADDRESS, AND PHONE NUMBER OF RESPONSIBLE PARTY

Listed below is information on the facility owner, who is the responsible party for postclosure of the C&D Landfill Unit:

Commander
US Army Garrison-Redstone
Attn: AMIM-REG-ZA (Garrison Commander)
4488 Martin Road
Redstone Arsenal, AL 35898
(256)876-8861

5.0 DESCRIPTION OF PLANNED USES OF PROPERTY DURING THE POSTCLOSURE PERIOD

Following closure, the landfill unit will be maintained as a restricted use greenway. Should any other uses be considered, those will be communicated to ADEM prior to inception of those uses.

E. Design Calculations

Note: Design Calculations are as presented in 1997.

DESIGN CALCULATIONS

SOLID WASTE MANAGEMENT FACILITY
SUPPORT ACTIVITIES

REDSTONE ARSENAL, ALABAMA
CONTRACT DACA21-96-D-0010
DELIVERY ORDER 0005
RSA EPA ID NO. AL7210020742
CORPS OF ENGINEERS, SAVANNAH DISTRICT

APRIL, 1997

Prepared For:

Redstone Arsenal (RSA)
Department of Environmental Management and Planning (DEMP)

Prepared By:

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1.0 LANDFILL VOLUME

TABLE 1

LANDFILL VOLUME

VOLUME (IN CUBIC YARDS)			
WASTE	WEEKLY COVER	FINAL COVER	TOTAL
2,960,000	**300,000**	**140,000**	**3,400,000**

DAILY COVER = 6"
FINAL COVER = 24"   ≥6   6" + 8"

LANDFILL LIFE

$$\frac{2{,}960{,}000 \text{ cy}}{300 \text{ cy / day x 5 days / wk x 52 weeks}} = 38 \text{ years}$$

2.0 STORM DRAINAGE CALCULATIONS

2.1 Assumptions

The following assumptions are used to size all downdrains, side slope berms, drainage ditches, and storm piping.

- Downdrains are designed to flow less than 2/3 full.
- Downdrains shall be corrugated plastic. PVC ?
- Manning's "n" = 0.023 for corrugated metal pipe
- Storm drainage flows shall be calculated using the Rational Method. Q = ciA
- c = 0.50
- Estimated velocities of storm water:

5% slope on top of landfill	= 1.3 fps
along side slope berms	= 2.0 fps
in downdrain pipes	= 12 fps
down 4:1 side slopes	= 3.5 fps

- All storm drainage calculations shall be based on the intensity/duration/frequency (IDF) curves for the community nearest the site with IDF curves and the 25 year storm. (Birmingham, Alabama)
- Side slope drainage berms shall be 24" high and designed at a minimum of 1% slope.
- Perimeter drainage ditches shall be designed with a 2' minimum bottom and 3:1 side slopes.
- Manning's "n" for corrugated plastic downdrain pipe shall be:

12" 0.018	21" 0.020
15" 0.018	24" 0.020
18" 0.020	

PVC = .009

HDPE = .012

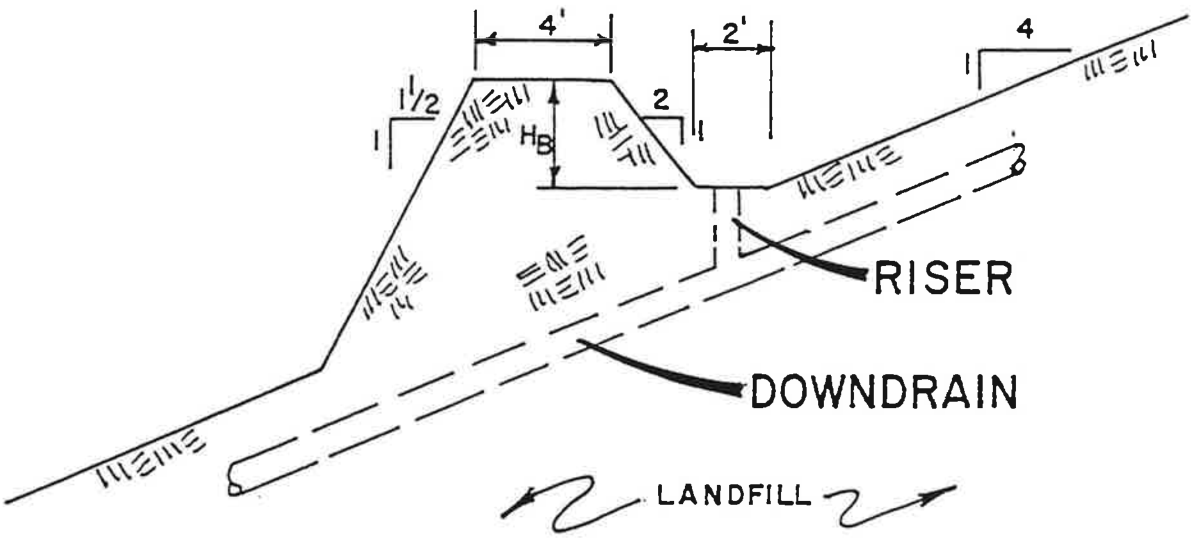
- Manning's "n" for concrete pipe shall be 0.013.
- See "Initial Grading Plan" for drainage structure locations.
- See "Erosion Control Plan" for location of erosion control devices.

2.2 Landfill Side Slope Drainage Berm and Riser Design

The following sketch shows a selected cross section for the side slope drainage berm. Using Manning's Equation with the "Flowmaster", it is determined that the berm will carry 71.82 cfs at a depth of 2 feet. The maximum flow carried in any one berm is only 9.39 cfs. Therefore the berm design is sufficient.

The riser is designed as an orifice based on handling the maximum flow for this specific site (11.82 cfs). At this flow rate, the head over a 18" risen prize is 1.39' which is below the maximum allowable height of 2.0 feet. Therefore 12", 15" and 18" riser will be used on site.

SIDE SLOPE DRAINAGE BERM



DRAINAGE BERM DESIGN

(1) Q max for drainage berm @ 1% slope = 71.82 cfs.

(2) Q actual = ciA = .50 (7.6)(2.47) = 9.39 cfs.

Max. Depth = 0.80 _.

Use 2 ' HIGH BERM (H)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: SIDESLOPE DRAINAGE BERM

Solve For Discharge

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0100 ft/ft
Depth............	2.00 ft

Computed Results:

Discharge........	71.82 cfs
Velocity.........	4.49 fps
Flow Area........	16.00 sf
Flow Top Width...	14.00 ft
Wetted Perimeter.	14.72 ft
Critical Depth...	1.74 ft
Critical Slope...	0.0190 ft/ft
Froude Number....	0.74 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: SIDESLOPE DRAINAGE BERM

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0100 ft/ft
Discharge........	9.39 cfs

Computed Results:

Depth............	0.80 ft
Velocity.........	2.66 fps
Flow Area........	3.52 sf
Flow Top Width...	6.80 ft
Wetted Perimeter.	7.09 ft
Critical Depth...	0.64 ft
Critical Slope...	0.0249 ft/ft
Froude Number....	0.65 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

TABLE 2 - RISER CALCULATIONS

RISER DESIGN

Orifice Flow = $Q = 3.782(D)^2(H)^{1/2}$

Riser Diameter	Max. Allowable Head on Riser	Max. Flow
12"	2.00'	5.35 cfs
15"	2.00'	8.36 cfs
18"	2.00'	12.03 cfs

New Riser No.	Flow in Berm (cfs)	New Riser Dia. (in.)	Head on New Riser (ft.)
1	3.78	12	1.00
2	6.03	15	1.04
3	3.78	12	1.00
4	4.89	15	0.68
5	5.23	15	0.78
6	5.78	15	0.96
7	7.91	18	0.86
8	4.08	12	1.04
9	4.38	12	1.34
10	4.85	15	0.67
11	5.36	15	0.82
12	4.68	15	0.63
13	4.42	12	1.37
14	5.40	15	0.84
15	6.59	15	1.24
16	7.64	18	0.81
17	9.39	18	1.22
18	3.78	12	1.00
19	6.93	15	1.38
20	6.63	15	1.26
21	5.14	15	0.76
22	5.74	15	0.94
23	6.21	15	1.10
24	6.77	15	1.31
25	8.74	18	1.05
26	3.70	12	0.96
27	5.14	15	0.76
28	6.36	15	1.16
29	4.01	12	1.12

2.3 Downdrain Design

The following table summarize the sizing of each downdrain that appears on the Final Drainage Plans and lists the area contributing to each downdrain, the intensity based on a 24 hour - 25 year storm event, the total discharge to be handled by each downdrain and the size of the downdrain and riser.

TABLE 3 - DOWNDRAIN CALCULATIONS									
Down Drain No.	Area (acres)	Contrib Area (acres)	Total Area (acres)	Intens. I (in/hr)	C Factor	Discharge Q=CIA (cfs)	Size of Downdrain (in)	% Full	Size of Riser (in)
1	0.89	0.00	0.89	8.5	0.50	3.78	12	37	12
2	1.47	0.89	2.36	8.2	0.50	9.68	15	45	15
3	0.89	2.36	3.25	8.2	0.50	13.33	15	54	12
4	1.15	3.25	4.40	8.2	0.50	18.04	18	52	15
5	1.23	4.40	5.63	8.1	0.50	22.80	18	60	15
6	1.36	5.63	6.99	8.1	0.50	28.31	21	53	15
7	1.93	6.99	8.92	8.1	0.50	36.13	21	52	18
8	0.96	0.00	0.96	8.5	0.50	4.08	12	39	12
9	1.03	1.79	2.82	8.5	0.50	11.99	15	51	12
10	1.14	2.82	3.96	8.5	0.50	16.83	15	63	15
11	1.26	3.96	5.22	8.5	0.50	22.19	18	59	15
12	1.10	5.22	6.32	8.5	0.50	26.86	21	51	15
13	1.04	0.00	1.04	8.5	0.50	4.42	12	40	12
14	1.27	1.04	2.31	8.5	0.50	9.82	15	45	15
15	1.55	2.31	3.86	8.5	0.50	16.41	15	62	15
16	1.84	3.86	5.70	8.3	0.50	23.66	18	61	18
17	2.47	5.70	8.17	7.6	0.50	31.05	21	56	18
18	0.89	0.00	0.89	8.5	0.50	3.78	12	37	12
19	1.67	0.89	2.56	8.3	0.50	10.62	15	47	15
20	1.56	2.56	4.12	8.3	0.50	17.10	18	50	15
21	1.21	4.12	5.33	8.3	0.50	22.12	18	59	15
22	1.35	5.33	6.68	8.2	0.50	27.39	21	52	15
23	1.46	6.68	8.14	8.2	0.50	33.37	21	59	15
24	1.65	8.14	9.79	8.2	0.50	40.14	24	53	15
25	2.27	9.79	12.06	7.7	0.50	46.43	24	58	18
26	0.87	0.00	0.87	8.5	0.50	3.70	12	37	12
27	1.21	0.87	2.08	8.5	0.50	8.84	12	61	15
28	1.57	2.08	3.65	8.1	0.50	14.78	15	58	15
29	0.99	3.65	4.64	8.1	0.50	18.79	18	53	12

2.4 Drainage Ditch Design

Table 3 summarizes each design parameter of each drainage ditch as shown on the Erosion Control Plan shown in the Design and Operation Plan.

The objective of this section is the proper size, the shape of each ditch based on the calculated discharge to be handled and to determine if temporary ditch protection is required if velocities are too high for initial groundcover conditions.

In Table 3, the selected bottom width and side slopes are listed as well as an "n" value equal to bare ground. Based on the contributing area, 24-hour - 25 year storm event, time of concentration and run-off factor, a discharge is calculated. The selected shape, Manning's "n" slope, and the calculated flow is entered into a computer program called "Flowmaster" which calculates the depth of flow and velocity based on Manning's Open Channel Equation. If the velocity is less than 2.0 fps, then we assume that no temporary ditch protection is required. If the velocity is greater than 2.0 fps, then temporary ditch protection is required. Temporary ditch protection materials including their Manning's "n" values and the maximum allowable shear stresses are listed in the Appendix.

The new Manning's "n" is required into the computer program which calculates a new depth of flow and velocity. This new depth is then used to calculate shear stress for the temporary ditch protection material selected. If the calculated shear stress exceeds the allowable shear stress, then a different protection material is selected. This process continues until the calculated shear stress is less than the allowable for the selected ditch protection material.

For example, in Table 3, under Ditch No. 2, the depth flow is 0.22 feet and the velocity is 4.93 fps based on a flow of 2.08 cfs an "n" value of 0.020 (bare ground) and a slope of 5.60%. Since this velocity exceeds 2.0 fps, a ditch protection material is selected. In this case Excelsior Matting is selected which has an "n" value of 0.066 at depths of flow between 0.0 - 0.5 feet (see Appendix). With this material, the new depth of flow and velocity are calculated. The new depth is 0.39 feet and the new velocity is 2.05 fps. The shear stress is calculated as 1.36. Since this is below the allowable shear stress of 1.55 for Excelsior Matting, then the selected ditch protection works. The selected material is also shown on the Erosion Control Plan of the Construction Plan Documents.

TABLE NO. 4 - DRAINAGE DITCH CALCULATIONS

DESIGN DATA	DITCH NO. 1	2	3	4
Bottom Width	1′	1′	1′	1′
Left Side Slope	4:1	4:1	5:1	5:1
Right Side Slope	4:1	4:1	5:1	5:1
Manning′s "n"	0.020	0.020	0.020	0.020
Starting Elevation	610	632	630	620
Ending Elevation	602	618	620	618
Length	150	250	350	333
Slope	0.0533	0.0560	0.0286	0.0060
c Factor	0.5	0.5	0.5	0.5
Area	0.47	0.49	0.89	0.63
Contributing Area	4.65	0.00	0.00	0.89
Total Area	5.12	0.49	0.89	1.52
Time of Concentration	7.2	1.8	2.3	4.2
Intensity	8.1	8.5	8.5	8.5
Discharge	20.74	2.08	3.78	6.46
Depth	0.65	0.22	0.33	0.59
Velocity	8.82	4.93	4.31	2.76
Velocity < 2.00?	NO	NO	NO	NO
Manning′s "n"	0.062	0.066	0.066	0.035
Depth	1.05	0.39	0.56	0.75
Velocity	3.79	2.05	1.77	1.82
Shear Stress	3.49	1.36	1.00	0.28
Type of Protection	9"RIP-RAP	EXCELSIOR	EXCELSIOR	EXCELSIOR

DESIGN DATA	DITCH NO. 5	6	7	8
Bottom Width	1′	2′	2′	2′
Left Side Slope	5:1	3:1	3:1	3:1
Right Side Slope	5:1	3:1	3:1	3:1
Manning′s "n"	0.020	0.020	0.020	0.020
Starting Elevation	618	612	621	621
Ending Elevation	606	606	612	600
Length	300	600	400	700
Slope	0.0400	0.0100	0.0225	0.0300
c Factor	0.5	0.5	0.5	0.5
Area	0.62	1.12	0.59	1.52
Contributing Area	1.52	0.00	0.00	0.00
Total Area	2.14	1.12	0.59	1.52
Time of Concentration	5.9	3.1	2.5	4.2
Intensity	8.3	8.5	8.5	8.5
Discharge	8.88	4.76	2.51	6.46
Depth	0.45	0.43	0.25	0.38
Velocity	6.08	3.34	3.69	5.40
Velocity < 2.00?	NO	NO	NO	NO
Manning′s "n"	0.035	0.035	0.066	0.035
Depth	0.57	0.57	0.47	0.51
Velocity	4.00	2.23	1.58	3.61
Shear Stress	1.42	0.36	0.66	0.95
Type of Protection	EXCELSIOR	EXCELSIOR	EXCELSIOR	EXCELSIOR

TABLE NO. 4 - DRAINAGE DITCH CALCULATIONS

DESIGN DATA	DITCH NO. 9	DITCH NO. 10	DITCH NO. 11	DITCH NO. 12
Bottom Width	2′	2′	2′	1′
Left Side Slope	3:1	3:1	3:1	4:1
Right Side Slope	3:1	3:1	3:1	4:1
Manning's "n"	0.020	0.020	0.020	0.020
Starting Elevation	611	611	608	601
Ending Elevation	600	608	601	588
Length	200	200	450	800
Slope	0.0550	0.0150	0.0156	0.0163
c Factor	0.5	0.5	0.5	0.5
Area	0.29	0.41	0.90	1.45
Contributing Area	0.00	0.00	8.58	9.48
Total Area	0.29	0.41	9.48	10.93
Time of Concentration	1.4	2.0	10.8	15.2
Intensity	8.5	8.5	6.9	6.0
Discharge	1.23	1.74	32.71	32.79
Depth	0.13	0.23	1.00	1.02
Velocity	3.99	2.87	6.59	6.36
Velocity < 2.00?	NO	NO	NO	NO
Manning's "n"	0.066	0.066	0.035	0.035
Depth	0.25	0.43	1.28	1.28
Velocity	1.77	1.23	4.35	4.18
Shear Stress	0.86	0.40	1.24	1.30
Type of Protection	EXCELSIOR	EXCELSIOR	EXCELSIOR	EXCELSIOR

DESIGN DATA	DITCH NO. 13
Bottom Width	1′
Left Side Slope	4:1
Right Side Slope	4:1
Manning's "n"	0.020
Starting Elevation	588
Ending Elevation	583
Length	500
Slope	0.0100
c Factor	0.4
Area	5.28
Contributing Area	28.11
Total Area	33.39
Time of Concentration	17.6
Intensity	5.7
Discharge	76.13
Depth	1.58
Velocity	6.55
Velocity < 2.00?	NO
Manning's "n"	0.035
Depth	1.98
Velocity	4.30
Shear Stress	1.24
Type of Protection	EXCELSIOR

2.5 Drainage Structures

Below are sketches detailing the design of each storm drainage pipe. Location of all of these structures can be found on the Initial Grading Plan of the Design and Operation Plan.

Each sketch lists the discharge needed to be carried by the pipe and checks to see if the inlet or outlet controls the pipe sizing.

TABLE 5 NEW DRAINAGE STRUCTURES				
PIPE NO.	SIZE	LENGTH	SLOPE	MATERIAL
100	36"	54'	1.00%	RCP
101	18"	54'	3.70%	RCP
102	24"	60'	3.33%	RCP
103	48"	100'	1.00%	RCP

RCP = reinforced concrete pipe

PIPE NO. 100

Q = 50 cfs
Allowable headwater = 5'

Inlet Control:
Assume 36 " dia. RCP at 50 cfs
HW = 3.0 x 1.35 = 4.05'

INLET CONTROL

Outlet Control:
Find critical depth (dc) = 2.3

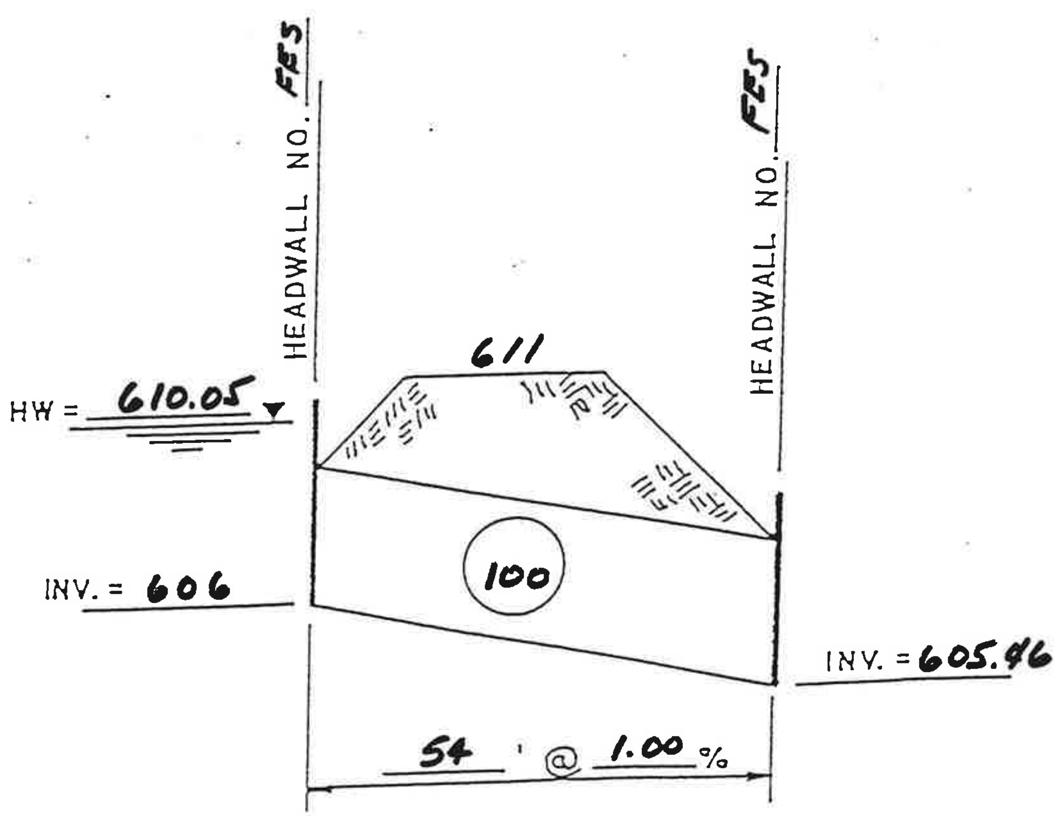
$h_o = \frac{d_c + D}{2} = \frac{2.3+3.0}{2} = 2.65$

H = head = 1.45
L = length = 54
S_o = slope = 1.00%

$HW = H + h_o - LS_o = 1.45 + 2.65 - 54(.01) = 3.56$

Final Pipe Selection:
36 " dia RCP at 50 cfs

Length = 54'
Slope = 1.00%



PIPE NO. 101

Q = 8 cfs

Allowable headwater = 4.5

Inlet Control:

Assume 18 " dia. RCP at 8 cfs

HW = 1.5 x 1.25 = 1.88

INLET CONTROL

Outlet Control:

Find critical depth (dc) = 1.2

$h_o = \frac{d_c + D}{2} = \frac{1.2 + 1.5}{2} = 1.35$

H = head = 0.8

L = length = 54'

S_o = slope = 3.70%

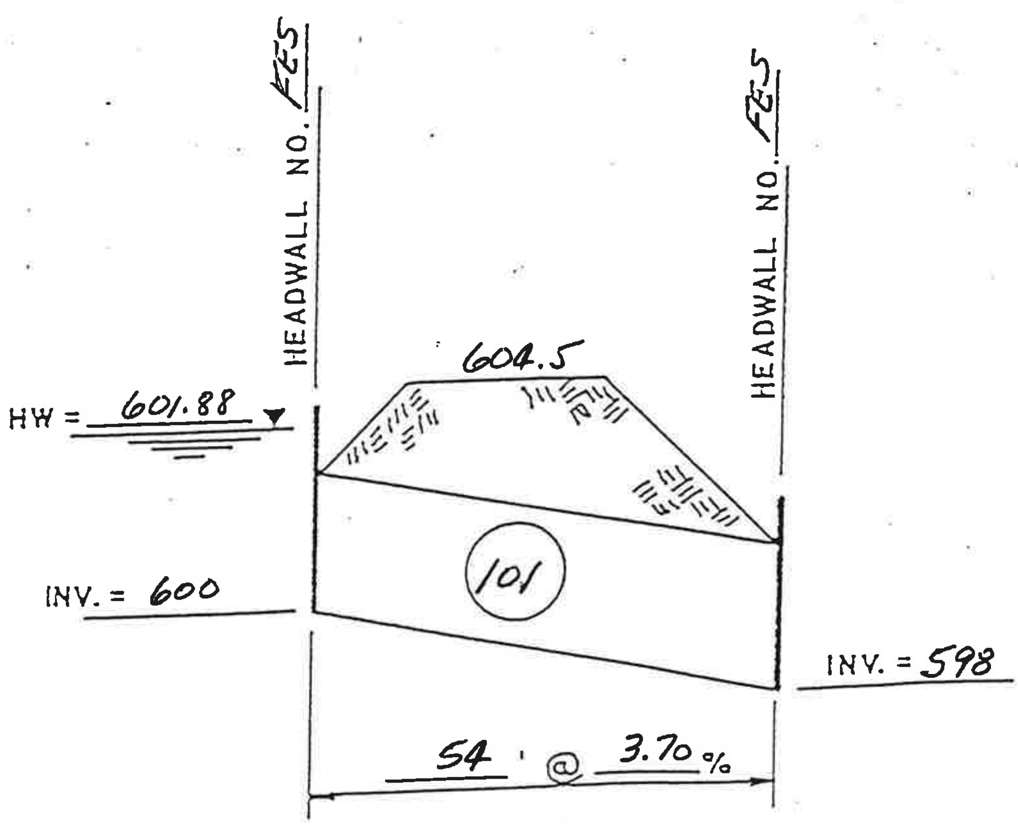
$HW = H + h_o - LS_o = 0.8 + 1.35 - 54(.037) = 0.15$

Final Pipe Selection:

_____ " dia RCP at 8 cfs

Length = 54'

Slope = 3.70%



PIPE NO. 102

Q = 26 cfs
Allowable headwater = 4

Inlet Control:

Assume 24 " dia. RCP at 26 cfs

HW = 2.0 x 2.0 = 4.0

INLET CONTROL

Outlet Control:

Find critical depth (dc) = 1.8

$h_o = \frac{d_c + D}{2} = \frac{1.8 + 2.0}{2} = 1.9$

H = head = 2.4

L = length = 60'

S_o = slope = 3.33%

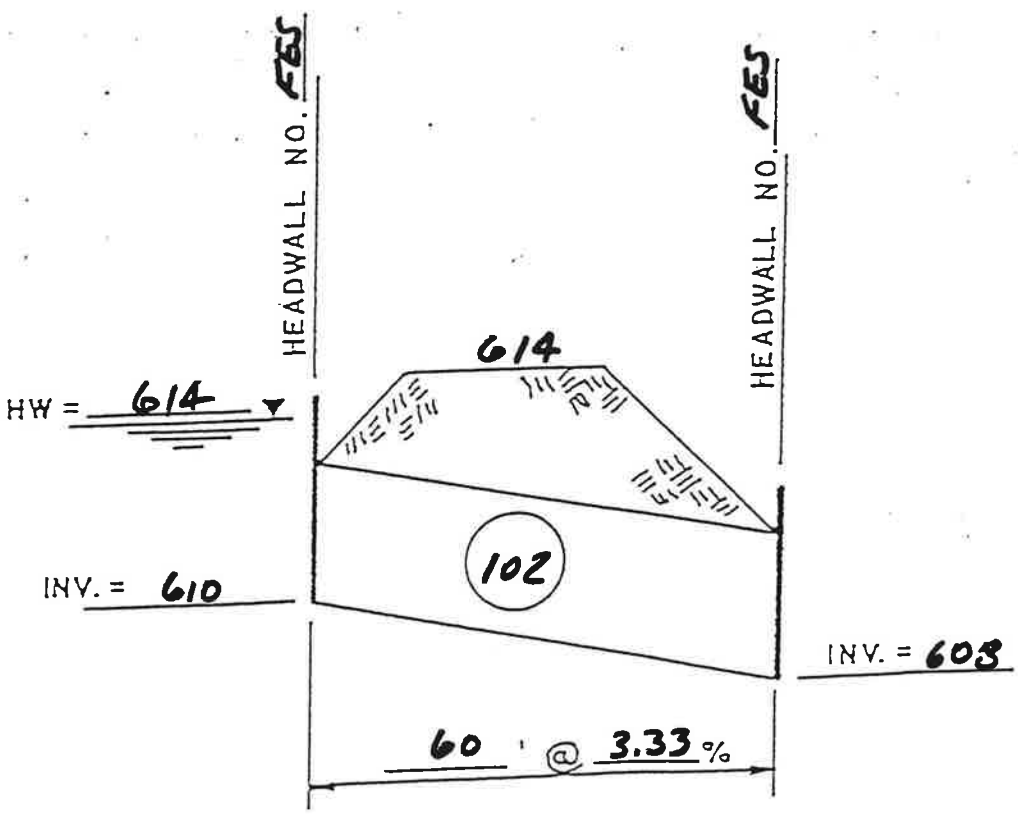
$HW = H + h_o - LS_o = 2.4 + 1.9 - 60(.0333) = 2.3$

Final Pipe Selection:

24 " dia RCP at 26 cfs

Length = 60'

Slope = 3.33%



PIPE NO. 103

Q = 102 cfs (TOTAL)
Allowable headwater = 6

Inlet Control:
Assume 48 " dia. RCP at 102 cfs
HW = 4.0 x 1.35 = 5.40

INLET CONTROL

Outlet Control:
Find critical depth (dc) = 3.0

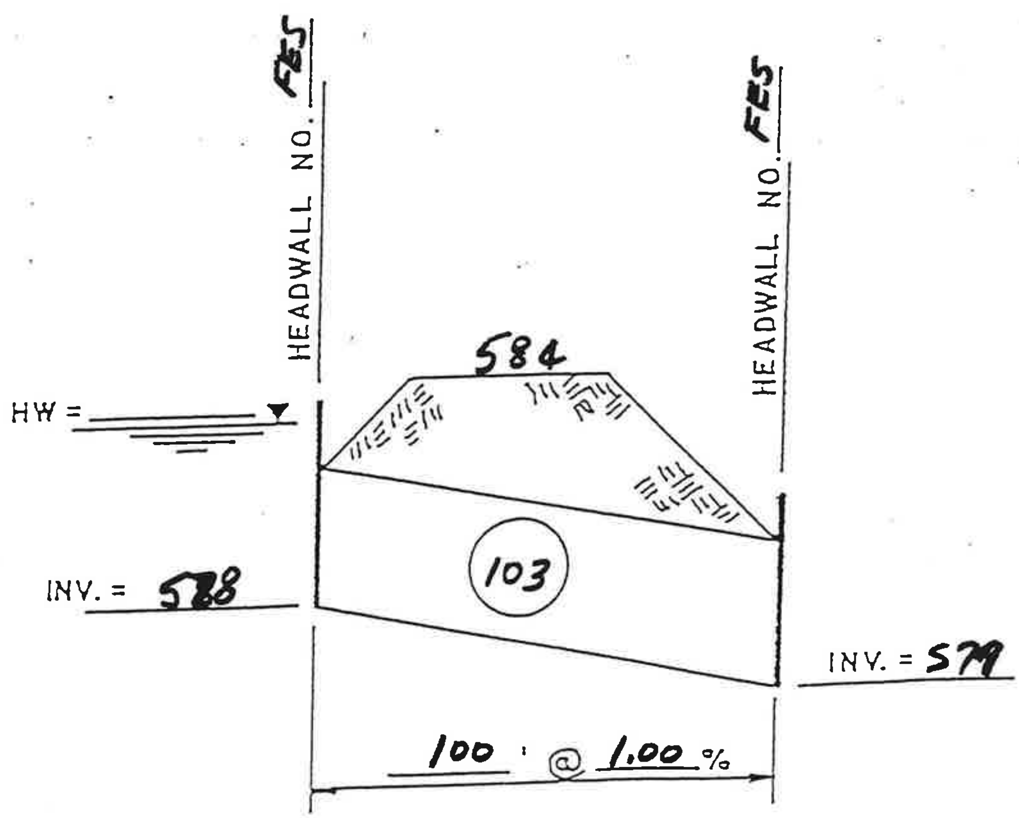
$h_o = \frac{d_c + D}{2} = \frac{3.0+4.0}{2} = 3.5$

H = head = 1.9
L = length = 100'
S_o = slope = 1.00%

$HW = H + h_o - LS_o = 1.9 + 3.5 - 100(.01) = 4.4$

Final Pipe Selection:
______" dia RCP at 102 cfs

Length = 100'
Slope = 1.00%



2.6 Outlet Protection Calculations

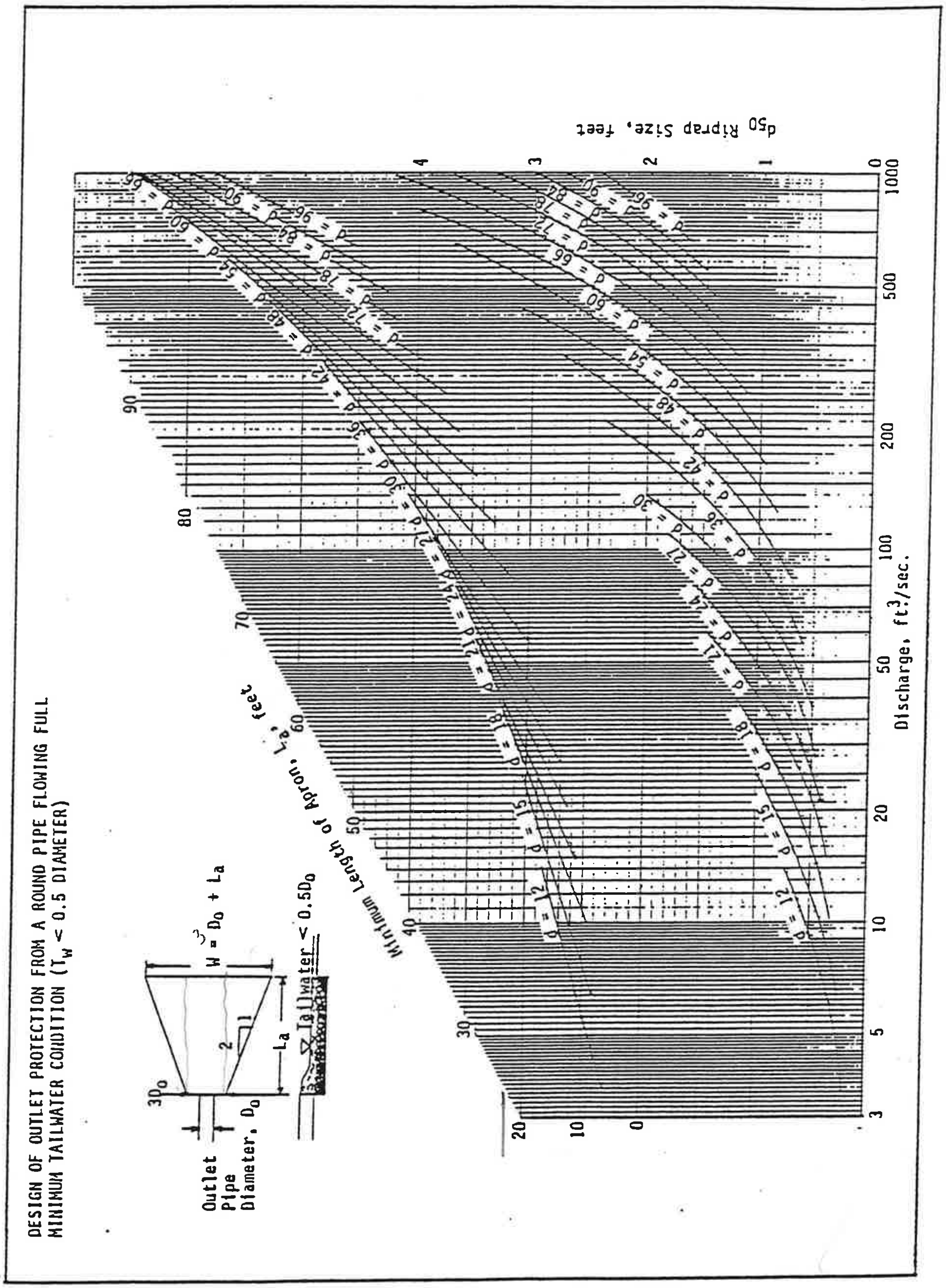


Figure 6-18.3

Source: USDA-SCS

PIPE NO. 7

GIVEN

Q_{25} = 36 cfs

D_o = 21 in.

La = 26 ft.

d^{50} = 12 in.

(2) A2T

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ x La/9

= 53 S.Y. 12 " Rip Rap

$3 D_o = 63''$ OR $5.25'$

PIPE NO. 12

Q_{25} = 27 cfs

D_o = 21" in.

La = 18 ft.

d^{50} = 9 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 29 S.Y. 9 " Rip Rap

PIPE NO. 17

Q_{25} = 32 cfs

D_o = 21 in.

La = 22 ft.

d^{50} = 9 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 40 S.Y. 9 " Rip Rap

PIPE NO. 25

Q_{25} = 46 cfs

D_o = 24 in.

La = 26 ft.

d^{50} = 12 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 55 S.Y. 12 " Rip Rap

PIPE NO. 29

Q_{25} = 19 cfs

La = 16 ft.

D_o = 18 in.

d^{50} = 9 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 22 S.Y. 9 " Rip Rap

PIPE NO. 100

Q_{25} = 50 cfs

La = 20 ft.

D_o = 36 in.

d^{50} = 12 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 42 S.Y. 12 " Rip Rap

PIPE NO. 101

Q_{25} = 38 cfs

La = 17 ft.

D_o = 30 in.

d^{50} = 6 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 30 S.Y. 6 " Rip Rap

PIPE NO. 102

Q_{25} = 26 cfs

La = 16 ft.

D_o = 24 in.

d^{50} = 6 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 25 S.Y. 6 " Rip Rap

PIPE NO. 103

Q_{25} = 103 cfs

La = 26 ft.

D_o = 48 in.

d^{50} = 12 in.

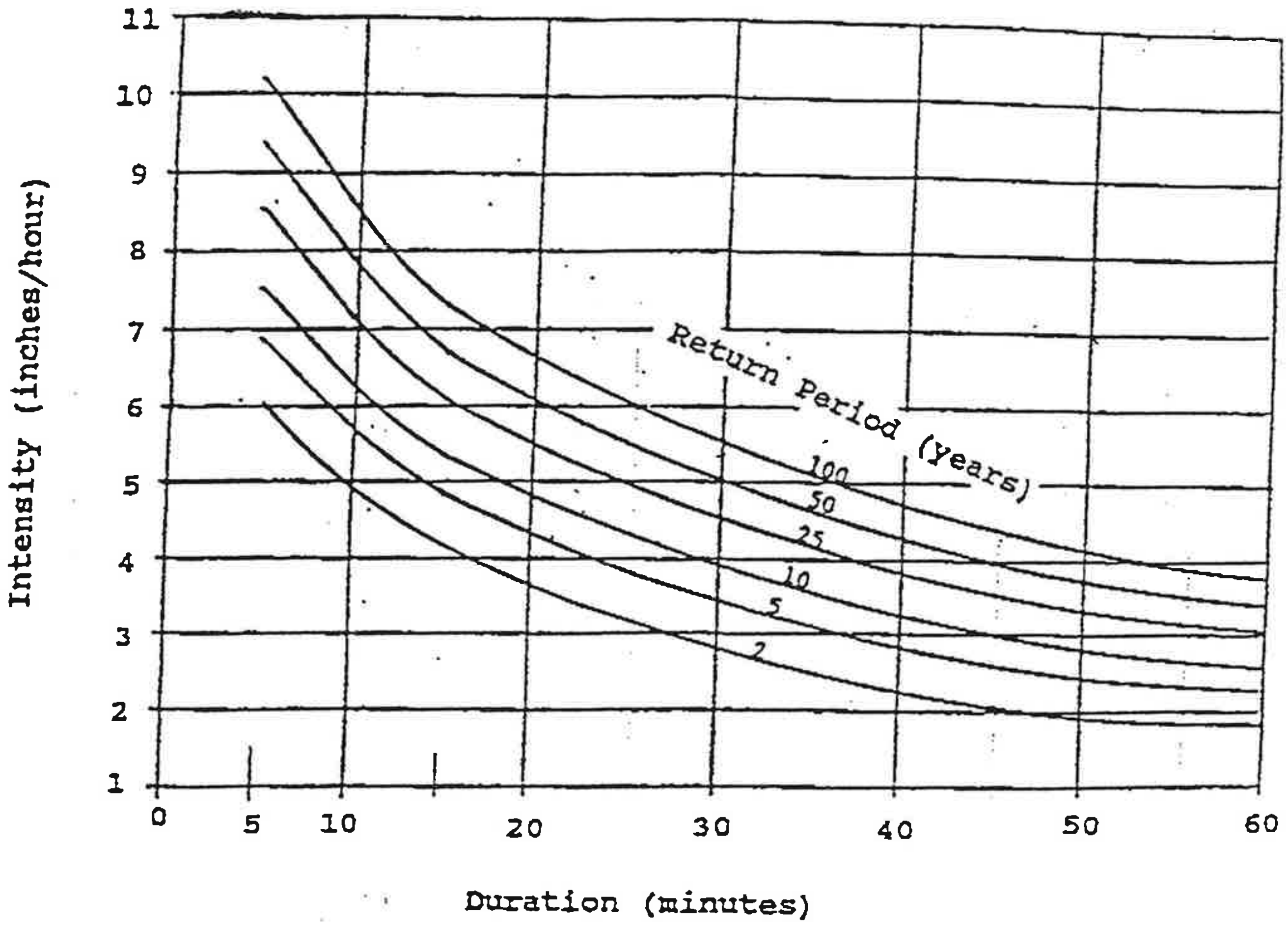
Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 72 S.Y. 12 " Rip Rap

3.0 APPENDIX

- **IDF CURVES - BIRMINGHAM, ALABAMA**

Intensity, Duration, and Frequency
Relationships for Birmingham Rains



Source: National Weather Service Birmingham Office

- **COMPUTER PRINTOUTS OF DOWNDRAIN CALCULATIONS**

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 1

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	3.78 cfs

Computed Results:

Depth.............	0.37 ft
Velocity..........	14.24 fps
Flow Area.........	0.27 sf
Critical Depth....	0.83 ft
Critical Slope....	0.0212 ft/ft
Percent Full......	37.14 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.79 (flow is Supercritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 2

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	9.68 cfs

Computed Results:

Depth.............	0.56 ft
Velocity..........	18.12 fps
Flow Area.........	0.53 sf
Critical Depth....	1.18 ft
Critical Slope....	0.0372 ft/ft
Percent Full......	44.90 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.87 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 3

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	13.33 cfs

Computed Results:

Depth.............	0.68 ft
Velocity..........	19.64 fps
Flow Area.........	0.68 sf
Critical Depth....	1.23 ft
Critical Slope....	0.0735 ft/ft
Percent Full......	54.17 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.69 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 4

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	18.04 cfs

Computed Results:

Depth.............	0.78 ft
Velocity..........	19.59 fps
Flow Area.........	0.92 sf
Critical Depth....	1.45 ft
Critical Slope....	0.0613 ft/ft
Percent Full......	51.67 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.40 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 5

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	22.80 cfs

Computed Results:

Depth.............	0.90 ft
Velocity..........	20.69 fps
Flow Area.........	1.10 sf
Critical Depth....	1.48 ft
Critical Slope....	0.1017 ft/ft
Percent Full......	59.77 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.21 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 6

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	28.31 cfs

Computed Results:

Depth.............	0.93 ft
Velocity..........	21.92 fps
Flow Area.........	1.29 sf
Critical Depth....	1.71 ft
Critical Slope....	0.0670 ft/ft
Percent Full......	52.91 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.49 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 7

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	36.13 cfs

Computed Results:

Depth.............	1.08 ft
Velocity..........	23.18 fps
Flow Area.........	1.56 sf
Critical Depth....	1.73 ft
Critical Slope....	0.1135 ft/ft
Percent Full......	61.74 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.27 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 8

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	4.08 cfs

Computed Results:

Depth.............	0.39 ft
Velocity..........	14.54 fps
Flow Area.........	0.28 sf
Critical Depth....	0.85 ft
Critical Slope....	0.0235 ft/ft
Percent Full......	38.70 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.77 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 9

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	11.99 cfs

Computed Results:

Depth.............	0.64 ft
Velocity..........	19.14 fps
Flow Area.........	0.63 sf
Critical Depth....	1.22 ft
Critical Slope....	0.0584 ft/ft
Percent Full......	50.82 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.76 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 10

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	16.83 cfs

Computed Results:

Depth.............	0.79 ft
Velocity..........	20.70 fps
Flow Area.........	0.81 sf
Critical Depth....	1.24 ft
Critical Slope....	0.1213 ft/ft
Percent Full......	62.92 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.44 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 11

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	22.19 cfs

Computed Results:

Depth.............	0.88 ft
Velocity..........	20.57 fps
Flow Area.........	1.08 sf
Critical Depth....	1.48 ft
Critical Slope....	0.0959 ft/ft
Percent Full......	58.73 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.24 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 12

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	26.86 cfs

Computed Results:

Depth.............	0.90 ft
Velocity..........	21.64 fps
Flow Area.........	1.24 sf
Critical Depth....	1.70 ft
Critical Slope....	0.0598 ft/ft
Percent Full......	51.27 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.53 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 13

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	4.42 cfs

Computed Results:

Depth.............	0.40 ft
Velocity..........	14.86 fps
Flow Area.........	0.30 sf
Critical Depth....	0.88 ft
Critical Slope....	0.0265 ft/ft
Percent Full......	40.42 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.75 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 14

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	9.82 cfs

Computed Results:

Depth.............	0.57 ft
Velocity..........	18.19 fps
Flow Area.........	0.54 sf
Critical Depth....	1.18 ft
Critical Slope....	0.0383 ft/ft
Percent Full......	45.27 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.87 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 15

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	16.41 cfs

Computed Results:

Depth.............	0.77 ft
Velocity..........	20.59 fps
Flow Area.........	0.80 sf
Critical Depth....	1.24 ft
Critical Slope....	0.1150 ft/ft
Percent Full......	61.85 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.48 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 16

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	23.66 cfs

Computed Results:

Depth.............	0.92 ft
Velocity..........	20.86 fps
Flow Area.........	1.13 sf
Critical Depth....	1.48 ft
Critical Slope....	0.1101 ft/ft
Percent Full......	61.24 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.17 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 17

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	31.05 cfs

Computed Results:

Depth.............	0.98 ft
Velocity..........	22.40 fps
Flow Area.........	1.39 sf
Critical Depth....	1.72 ft
Critical Slope....	0.0819 ft/ft
Percent Full......	56.00 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.42 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 18

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	3.78 cfs

Computed Results:

Depth.............	0.37 ft
Velocity..........	14.24 fps
Flow Area.........	0.27 sf
Critical Depth....	0.83 ft
Critical Slope....	0.0212 ft/ft
Percent Full......	37.14 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.79 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 19

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	10.62 cfs

Computed Results:

Depth.............	0.59 ft
Velocity..........	18.56 fps
Flow Area.........	0.57 sf
Critical Depth....	1.20 ft
Critical Slope....	0.0451 ft/ft
Percent Full......	47.34 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.83 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 20

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	17.10 cfs

Computed Results:

Depth.............	0.75 ft
Velocity..........	19.33 fps
Flow Area.........	0.88 sf
Critical Depth....	1.44 ft
Critical Slope....	0.0547 ft/ft
Percent Full......	50.05 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.43 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 21

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	22.12 cfs

Computed Results:

Depth.............	0.88 ft
Velocity..........	20.55 fps
Flow Area.........	1.08 sf
Critical Depth....	1.48 ft
Critical Slope....	0.0953 ft/ft
Percent Full......	58.61 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.24 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 22

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	27.39 cfs

Computed Results:

Depth.............	0.91 ft
Velocity..........	21.74 fps
Flow Area.........	1.26 sf
Critical Depth....	1.70 ft
Critical Slope....	0.0624 ft/ft
Percent Full......	51.87 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.51 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 23

Solve For Actual Depth

Given Input Data:

Diameter..........	1.75 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	33.37 cfs

Computed Results:

Depth.............	1.03 ft
Velocity..........	22.78 fps
Flow Area.........	1.47 sf
Critical Depth....	1.73 ft
Critical Slope....	0.0957 ft/ft
Percent Full......	58.61 %
Full Capacity.....	51.50 cfs
QMAX @.94D........	55.39 cfs
Froude Number.....	4.35 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 24

Solve For Actual Depth

Given Input Data:

Diameter..........	2.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	40.14 cfs

Computed Results:

Depth.............	1.05 ft
Velocity..........	23.92 fps
Flow Area.........	1.68 sf
Critical Depth....	1.95 ft
Critical Slope....	0.0663 ft/ft
Percent Full......	52.69 %
Full Capacity.....	73.52 cfs
QMAX @.94D........	79.09 cfs
Froude Number.....	4.60 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 25

Solve For Actual Depth

Given Input Data:

Diameter...........	2.00 ft
Slope..............	0.2500 ft/ft
Manning's n........	0.020
Discharge..........	46.43 cfs

Computed Results:

Depth..............	1.15 ft
Velocity...........	24.75 fps
Flow Area..........	1.88 sf
Critical Depth.....	1.97 ft
Critical Slope.....	0.0908 ft/ft
Percent Full.......	57.65 %
Full Capacity......	73.52 cfs
QMAX @.94D.........	79.09 cfs
Froude Number......	4.48 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 26

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	3.70 cfs

Computed Results:

Depth.............	0.37 ft
Velocity..........	14.15 fps
Flow Area.........	0.26 sf
Critical Depth....	0.82 ft
Critical Slope....	0.0207 ft/ft
Percent Full......	36.71 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.79 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 27

Solve For Actual Depth

Given Input Data:

Diameter..........	1.00 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	8.84 cfs

Computed Results:

Depth.............	0.61 ft
Velocity..........	17.65 fps
Flow Area.........	0.50 sf
Critical Depth....	0.99 ft
Critical Slope....	0.1087 ft/ft
Percent Full......	60.89 %
Full Capacity.....	12.87 cfs
QMAX @.94D........	13.84 cfs
Froude Number.....	4.34 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 28

Solve For Actual Depth

Given Input Data:

Diameter..........	1.25 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.018
Discharge.........	14.78 cfs

Computed Results:

Depth.............	0.72 ft
Velocity..........	20.12 fps
Flow Area.........	0.73 sf
Critical Depth....	1.24 ft
Critical Slope....	0.0919 ft/ft
Percent Full......	57.78 %
Full Capacity.....	23.33 cfs
QMAX @.94D........	25.09 cfs
Froude Number.....	4.60 (flow is Supercritical)

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DOWNDRAIN NO. 29

Solve For Actual Depth

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	18.79 cfs

Computed Results:

Depth.............	0.79 ft
Velocity..........	19.78 fps
Flow Area.........	0.95 sf
Critical Depth....	1.46 ft
Critical Slope....	0.0669 ft/ft
Percent Full......	52.95 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	4.38 (flow is Supercritical)

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- **COMPUTER PRINTOUTS OF DRAINAGE DITCH CALCULATIONS**

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 1

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0533 ft/ft
Discharge........	20.74 cfs

Computed Results:

Depth............	0.65 ft
Velocity.........	8.82 fps
Flow Area........	2.35 sf
Flow Top Width...	6.21 ft
Wetted Perimeter.	6.37 ft
Critical Depth...	0.99 ft
Critical Slope...	0.0074 ft/ft
Froude Number....	2.53 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 1

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.062
Channel Slope....	0.0533 ft/ft
Discharge........	20.74 cfs

Computed Results:

Depth............	1.05 ft
Velocity.........	3.79 fps
Flow Area........	5.48 sf
Flow Top Width...	9.41 ft
Wetted Perimeter.	9.67 ft
Critical Depth...	0.99 ft
Critical Slope...	0.0709 ft/ft
Froude Number....	0.87 (flow is Subcritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 2

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0560 ft/ft
Discharge........	2.08 cfs

Computed Results:

Depth............	0.22 ft
Velocity.........	4.93 fps
Flow Area........	0.42 sf
Flow Top Width...	2.78 ft
Wetted Perimeter.	2.84 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0100 ft/ft
Froude Number....	2.23 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 2

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.066
Channel Slope....	0.0560 ft/ft
Discharge........	2.08 cfs

Computed Results:

Depth............	0.39 ft
Velocity.........	2.05 fps
Flow Area........	1.01 sf
Flow Top Width...	4.15 ft
Wetted Perimeter.	4.25 ft
Critical Depth...	0.34 ft
Critical Slope...	0.1094 ft/ft
Froude Number....	0.73 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 3

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0286 ft/ft
Discharge........	3.78 cfs

Computed Results:

Depth............	0.33 ft
Velocity.........	4.31 fps
Flow Area........	0.88 sf
Flow Top Width...	4.31 ft
Wetted Perimeter.	4.37 ft
Critical Depth...	0.42 ft
Critical Slope...	0.0094 ft/ft
Froude Number....	1.68 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 3

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.066
Channel Slope....	0.0286 ft/ft
Discharge........	3.78 cfs

Computed Results:

Depth............	0.56 ft
Velocity.........	1.77 fps
Flow Area........	2.13 sf
Flow Top Width...	6.61 ft
Wetted Perimeter.	6.72 ft
Critical Depth...	0.42 ft
Critical Slope...	0.1026 ft/ft
Froude Number....	0.55 (flow is Subcritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 4

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0060 ft/ft
Discharge........	6.46 cfs

Computed Results:

Depth............	0.59 ft
Velocity.........	2.76 fps
Flow Area........	2.34 sf
Flow Top Width...	6.91 ft
Wetted Perimeter.	7.03 ft
Critical Depth...	0.54 ft
Critical Slope...	0.0088 ft/ft
Froude Number....	0.84 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 4

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0060 ft/ft
Discharge........	6.46 cfs

Computed Results:

Depth............	0.75 ft
Velocity.........	1.82 fps
Flow Area........	3.55 sf
Flow Top Width...	8.49 ft
Wetted Perimeter.	8.64 ft
Critical Depth...	0.54 ft
Critical Slope...	0.0268 ft/ft
Froude Number....	0.50 (flow is Subcritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 5

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0400 ft/ft
Discharge........	8.88 cfs

Computed Results:

Depth............	0.45 ft
Velocity.........	6.08 fps
Flow Area........	1.46 sf
Flow Top Width...	5.50 ft
Wetted Perimeter.	5.59 ft
Critical Depth...	0.63 ft
Critical Slope...	0.0084 ft/ft
Froude Number....	2.08 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 5

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0400 ft/ft
Discharge........	8.88 cfs

Computed Results:

Depth............	0.57 ft
Velocity.........	4.00 fps
Flow Area........	2.22 sf
Flow Top Width...	6.73 ft
Wetted Perimeter.	6.85 ft
Critical Depth...	0.63 ft
Critical Slope...	0.0257 ft/ft
Froude Number....	1.23 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 6

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0100 ft/ft
Discharge........	4.76 cfs

Computed Results:

Depth............	0.43 ft
Velocity.........	3.34 fps
Flow Area........	1.43 sf
Flow Top Width...	4.59 ft
Wetted Perimeter.	4.74 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0089 ft/ft
Froude Number....	1.06 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 6

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0100 ft/ft
Discharge........	4.76 cfs

Computed Results:

Depth............	0.57 ft
Velocity.........	2.23 fps
Flow Area........	2.14 sf
Flow Top Width...	5.45 ft
Wetted Perimeter.	5.63 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0273 ft/ft
Froude Number....	0.63 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 7

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0225 ft/ft
Discharge........	2.51 cfs

Computed Results:

Depth............	0.25 ft
Velocity.........	3.69 fps
Flow Area........	0.68 sf
Flow Top Width...	3.49 ft
Wetted Perimeter.	3.57 ft
Critical Depth...	0.31 ft
Critical Slope...	0.0098 ft/ft
Froude Number....	1.47 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 7

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.066
Channel Slope....	0.0225 ft/ft
Discharge........	2.51 cfs

Computed Results:

Depth............	0.47 ft
Velocity.........	1.58 fps
Flow Area........	1.59 sf
Flow Top Width...	4.80 ft
Wetted Perimeter.	4.95 ft
Critical Depth...	0.31 ft
Critical Slope...	0.1064 ft/ft
Froude Number....	0.48 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 8

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0300 ft/ft
Discharge........	6.46 cfs

Computed Results:

Depth............	0.38 ft
Velocity.........	5.40 fps
Flow Area........	1.20 sf
Flow Top Width...	4.29 ft
Wetted Perimeter.	4.41 ft
Critical Depth...	0.53 ft
Critical Slope...	0.0085 ft/ft
Froude Number....	1.80 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 8

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0300 ft/ft
Discharge........	6.46 cfs

Computed Results:

Depth............	0.51 ft
Velocity.........	3.61 fps
Flow Area........	1.79 sf
Flow Top Width...	5.05 ft
Wetted Perimeter.	5.21 ft
Critical Depth...	0.53 ft
Critical Slope...	0.0261 ft/ft
Froude Number....	1.07 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 9

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0550 ft/ft
Discharge........	1.23 cfs

Computed Results:

Depth............	0.13 ft
Velocity.........	3.99 fps
Flow Area........	0.31 sf
Flow Top Width...	2.78 ft
Wetted Perimeter.	2.82 ft
Critical Depth...	0.20 ft
Critical Slope...	0.0109 ft/ft
Froude Number....	2.11 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 9

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.066
Channel Slope....	0.0550 ft/ft
Discharge........	1.23 cfs

Computed Results:

Depth............	0.25 ft
Velocity.........	1.77 fps
Flow Area........	0.70 sf
Flow Top Width...	3.51 ft
Wetted Perimeter.	3.60 ft
Critical Depth...	0.20 ft
Critical Slope...	0.1189 ft/ft
Froude Number....	0.70 (flow is Subcritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 10

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0150 ft/ft
Discharge........	1.74 cfs

Computed Results:

Depth............	0.23 ft
Velocity.........	2.87 fps
Flow Area........	0.61 sf
Flow Top Width...	3.36 ft
Wetted Perimeter.	3.43 ft
Critical Depth...	0.25 ft
Critical Slope...	0.0103 ft/ft
Froude Number....	1.19 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 10

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.066
Channel Slope....	0.0150 ft/ft
Discharge........	1.74 cfs

Computed Results:

Depth............	0.43 ft
Velocity.........	1.23 fps
Flow Area........	1.41 sf
Flow Top Width...	4.57 ft
Wetted Perimeter.	4.71 ft
Critical Depth...	0.25 ft
Critical Slope...	0.1126 ft/ft
Froude Number....	0.39 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 11

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0156 ft/ft
Discharge........	32.71 cfs

Computed Results:

Depth............	1.00 ft
Velocity.........	6.59 fps
Flow Area........	4.96 sf
Flow Top Width...	7.97 ft
Wetted Perimeter.	8.30 ft
Critical Depth...	1.20 ft
Critical Slope...	0.0068 ft/ft
Froude Number....	1.47 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 11

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0156 ft/ft
Discharge........	32.71 cfs

Computed Results:

Depth............	1.28 ft
Velocity.........	4.35 fps
Flow Area........	7.52 sf
Flow Top Width...	9.71 ft
Wetted Perimeter.	10.13 ft
Critical Depth...	1.20 ft
Critical Slope...	0.0210 ft/ft
Froude Number....	0.87 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 12

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0163 ft/ft
Discharge........	32.79 cfs

Computed Results:

Depth............	1.02 ft
Velocity.........	6.36 fps
Flow Area........	5.15 sf
Flow Top Width...	9.14 ft
Wetted Perimeter.	9.39 ft
Critical Depth...	1.21 ft
Critical Slope...	0.0069 ft/ft
Froude Number....	1.49 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 12

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0163 ft/ft
Discharge........	32.79 cfs

Computed Results:

Depth............	1.28 ft
Velocity.........	4.18 fps
Flow Area........	7.84 sf
Flow Top Width...	11.24 ft
Wetted Perimeter.	11.56 ft
Critical Depth...	1.21 ft
Critical Slope...	0.0213 ft/ft
Froude Number....	0.88 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 13

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.020
Channel Slope....	0.0100 ft/ft
Discharge........	76.13 cfs

Computed Results:

Depth............	1.58 ft
Velocity.........	6.55 fps
Flow Area........	11.63 sf
Flow Top Width...	13.68 ft
Wetted Perimeter.	14.07 ft
Critical Depth...	1.74 ft
Critical Slope...	0.0062 ft/ft
Froude Number....	1.25 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: REDSTONE ARSENAL LF

Comment: DRAINAGE DITCH NO. 13

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0100 ft/ft
Discharge........	76.13 cfs

Computed Results:

Depth............	1.98 ft
Velocity.........	4.30 fps
Flow Area........	17.69 sf
Flow Top Width...	16.86 ft
Wetted Perimeter.	17.34 ft
Critical Depth...	1.74 ft
Critical Slope...	0.0190 ft/ft
Froude Number....	0.74 (flow is Subcritical)

- **TEMPORARY DITCH LINER CALCULATION PROCEDURES**

Tractive Force Procedure

The design of riprap-lined channels and temporary channel linings is based on analysis of tractive force.

NOTE: This procedure is for uniform flow in channels and is *not* to be used for design of deenergizing devices.

To calculate the required size of an open channel, assume the design flow is uniform and does not vary with time. Since actual flow conditions change through the length of a channel, subdivide the channel into design reaches as appropriate.

PERMISSIBLE SHEAR STRESS
The permissible shear stress, T_d, is the force required to initiate movement of the lining material. Permissible shear stress for the liner is not related to the erodibility of the underlying soil. However, if the lining is eroded or broken, the bed material will be exposed to the erosive force of the flow.

COMPUTING NORMAL DEPTH
The first step in selecting an appropriate lining is to compute the design flow depth (the normal depth) and determine the shear stress.

Normal depths can be calculated by Manning's equation as shown for trapezoidal channels in Figure 8.05d. Values of the Manning's roughness coefficient for different ranges of depth are provided in Table 8.05e for temporary linings and Table 8.05f for riprap. The coefficient of roughness generally decreases with increasing flow depth.

Table 8.05e
Manning's Roughness Coefficients for Temporary Lining Materials

	n value for Depth Ranges		
Lining Type	0-0.5 ft	0.5-2.0 ft	>2.0 ft
Woven Paper Net	0.016	0.015	0.015
Jute Net	0.028	0.022	0.019
Fiberglass Roving	0.028	0.021	0.019
Straw with Net	0.065	0.033	0.025
Curled Wood Mat	0.066	0.035	0.028
Synthetic Mat	0.036	0.025	0.021

Table 8.05f
Manning's Roughness Coefficient for Riprap and Gravel

Material	d_{50} (inches)	*n* value for Depth Ranges 0-0.5 ft	0.5-1.0 ft	1.0-2.0 ft	> 2.0 ft
Gravel	1	0.033	0.028	0.026	0.025
	2	0.045	0.034	0.034	0.031
Riprap	6	0.106	0.054	0.044	0.041
	9	0.215	0.068	0.062	0.047
	12	0.797	0.084	0.060	0.053
	15	—	0.104	0.068	0.059
	18	—	0.127	0.076	0.064
	21	—	0.158	0.085	0.070
	24	—	0.199	0.095	0.076

DETERMINING SHEAR STRESS

Shear stress, T, at normal depth is computed for the lining by the following equation:

$$T = yds$$

where:

T = shear stress in lb/ft^2
y = unit weight of water, 62.4 lb/ft^3
d = flow depth in ft
s = channel gradient in ft/ft.

If the permissible shear stress, T_d, given in Table 8.05g is greater than the computed shear stress, the riprap or temporary lining is considered acceptable. If a lining is unacceptable, select a lining with a higher permissible shear stress and repeat the calculations for normal depth and shear stress. In some cases it may be necessary to alter channel dimensions to reduce the shear stress.

Computing tractive force around a channel bend requires special considerations because the change in flow direction imposes higher shear stress on the channel bottom and banks. The maximum shear stress in a bend, T_b, is given by the following equation:

$$T_b = K_b T$$

where:

T_b = bend shear stress in lb/ft^2
K_b = bend factor
T = computed stress for straight channel in lb/ft^2

The value of K_b is related to the radius of curvature of the channel at its center line, R_c, and the bottom width of the channel, B, Figure 8.05e. The length of channel requiring protection downstream from a bend, L_p, is a function of the roughness of the lining material and the hydraulic radius as shown in Figure 8.05f.

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Lining Type	Permissible Unit Shear Stress, T_d (lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} Stone Size (inches)	
Gravel Riprap	1	0.40
	2	0.80
Rock Riprap	6	2.50
	9	3.80
	12	5.00
	15	6.30
	18	7.50
	21	8.80
	24	10.00

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d.

Step 3. Calculate shear stress at normal depth.

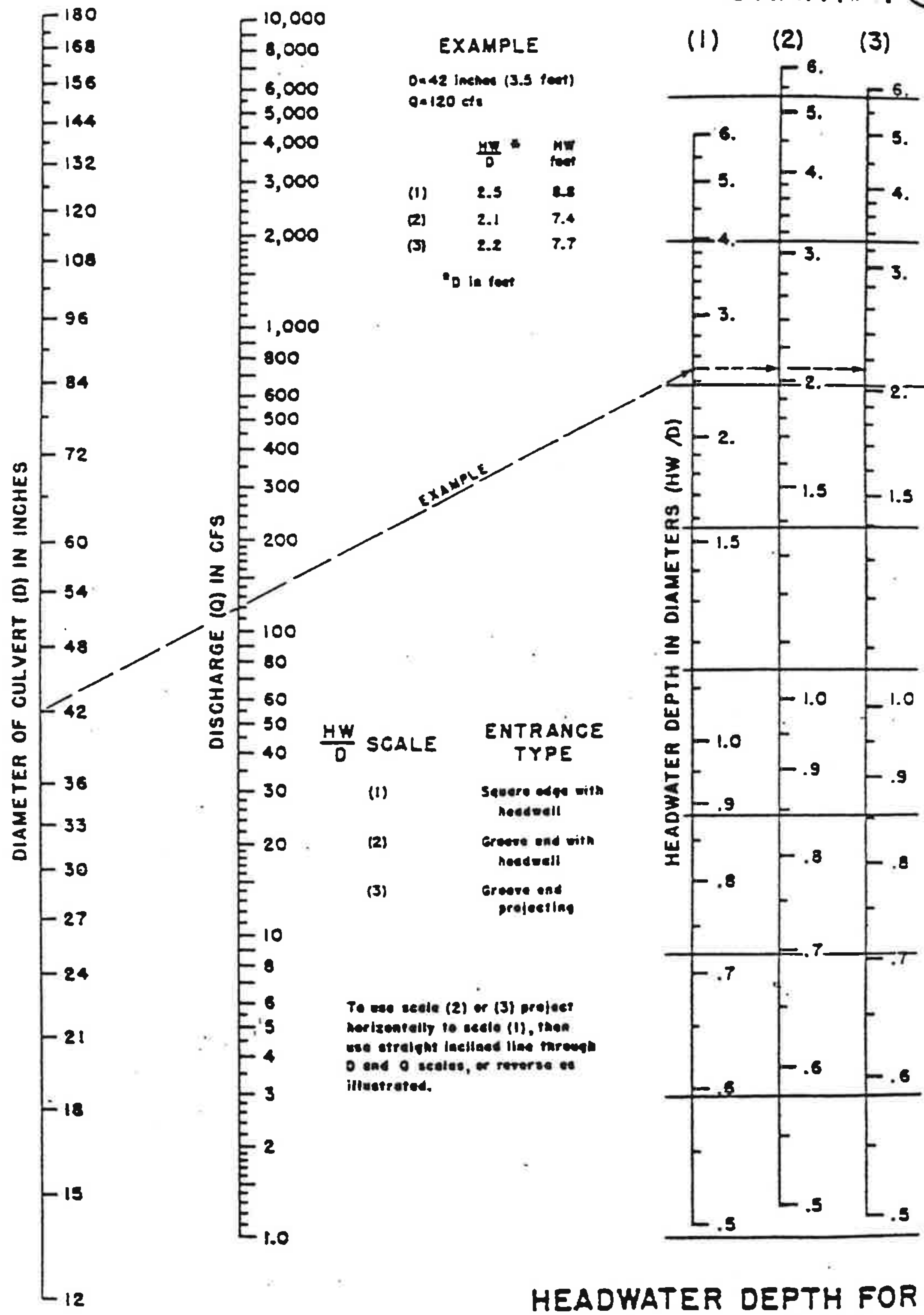
Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b.

- **HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL**

CHART 1



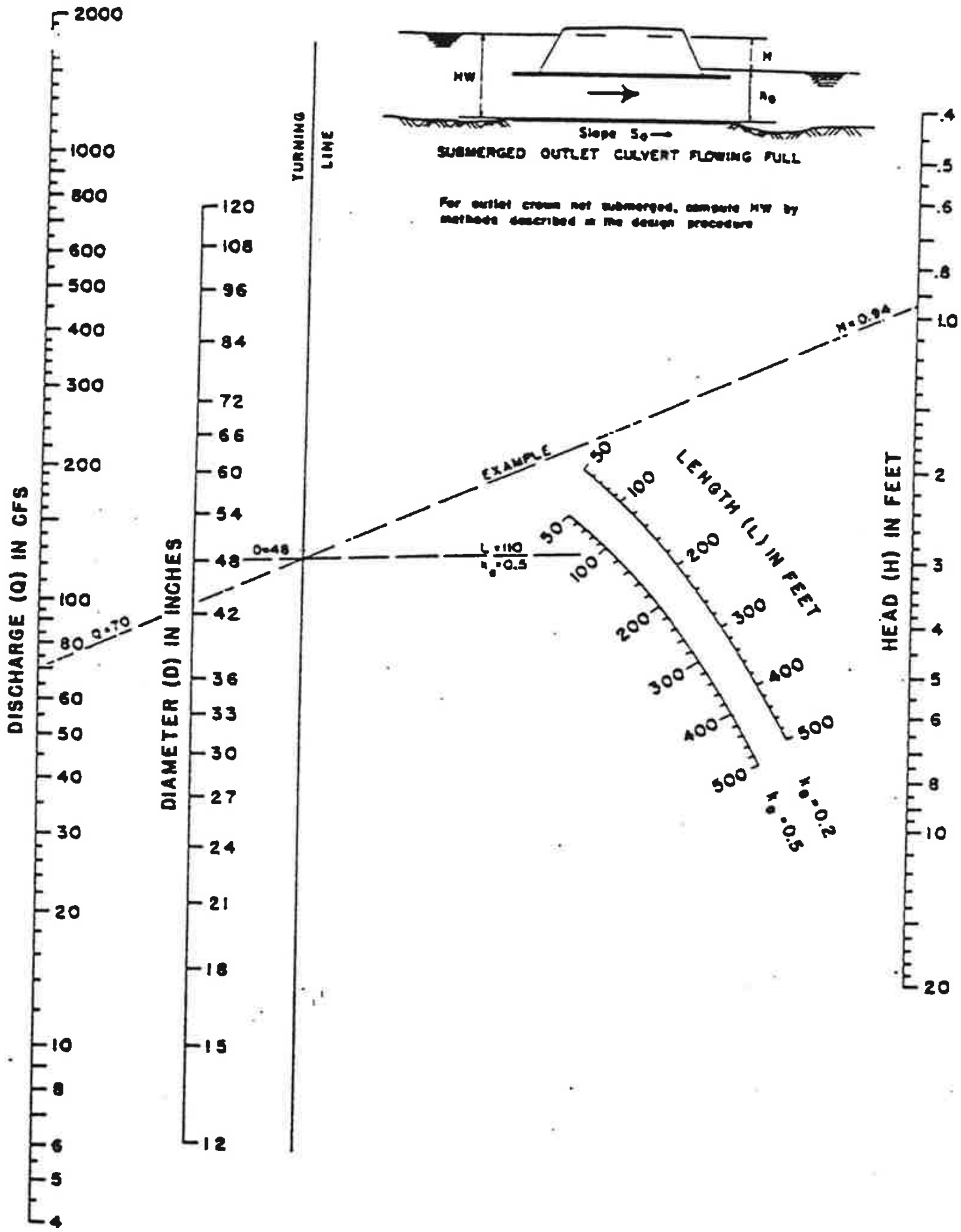
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

- **HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL**

CHART 5



HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL
$n = 0.012$

BUREAU OF PUBLIC ROADS JAN. 1963

F. ADEM Approval Letters for Alternative Cover Systems and Other Operation Procedures

Note: Also refer to Section VIII Variance of Permit 45-03

ADEM

ALABAMA
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

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February 5, 1997

Mr. Jerry M. Hubbard, Director
Directorate of Environmental Management and Planning
United States Army Missile Command
Redstone Arsenal, Alabama 35898

Re: Changes in Plans
Redstone Arsenal Landfill/45-03

Dear Mr. Hubbard:

On January 21, 1997, the Department received your request for several changes to the operations of the Redstone Arsenal Landfill. The following are summarized statements of the requested changes and our respective responses:

1. The request was that the operator be permitted to fill the working face from both the toe and top. This is approved. The operator should, however, insure that the waste is confined to as small an area as possible, as stipulated in Section III.G. of the permit.

2. It was requested that the operator be allowed to utilize slopes between 10:1 and 3:1 for the working face. The shallow working face is approved, but positive drainage should be provided and, as mentioned above, the area of the working face should be minimized.

3. It was requested that the operator be allowed to use wood chips or ground wood products as weekly cover, with soil used once per month. The use of the chips or wood products is approved, but the area of wood cover should be kept at a minimum, extra precautions should be taken to prevent fires, and additional procedures and/or provisions should be put into place to extinguish a fire, particularly when dry and windy conditions might occur.

4. It was requested that the compaction of waste be on alternate days rather than daily, and that the operator be allowed to use different methods or equipment for the compaction. These are approved, but it should be noted that insufficient compaction of the waste could result in reduced capacity and the increased likelihood of depressions forming in the final cover.

5. The request was that the use of plastic netting and the rates of distribution of the seed, fertilizer, etc. for the cover be optional. These changes are approved, provided that erosion be minimized during and after the establishment of the cover.

6. It was requested that gas monitoring not be required for points GM-3, GM-4, GM-5, GM-6, GM-7, and GM-8. Our files have only August 14, 1996 as the date that gas monitoring/measurement was conducted at these points. At that time, the gas concentration was recorded as exceeding 100% LEL at points GM-7 and GM-8, and zero at the other points. The monitoring of all points should be continued for the time being, and a plan should be submitted by April 30, 1997 to describe what precautions or measures have been or would be implemented in the vicinity of these points in order to provide a safe area for anyone or any equipment which might go into or operate in or very near the area.

If you have any questions about the approvals or statements above, please contact Bill Wood at 334-271-7767.

Sincerely,

Russell A. Kelly, Chief
Solid Waste Branch
Land Division

RAK/BW:word/bw\swtech\mad\RALF3.doc

File: Madison Co/Redstone Arsenal LF/45-03

ADEM

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

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April 7, 1997

Mr. Jerry M. Hubbard, Director
Directorate of Environmental Management and Planning
United States Army Missile Command
Redstone Arsenal, Alabama 35898

Re: Deletion of Gas Monitoring Points and
Implementation of Safety Measures
Redstone Arsenal Landfill/45-03

Dear Mr. Hubbard:

In your letter of March 17, 1997, you provided the justification for the abandonment of gas monitoring points GM-3, GM-4, GM-5, GM-6, GM-7, and GM-8 and an explanation of the additional safety measures that would be put into place at the Redstone Arsenal Landfill. Based on this information, the proposed changes to the gas monitoring plan are approved.

If you have any questions about this letter or other matters regarding the gas monitoring plan, please contact Bill Wood at 334-271-7767.

Sincerely,

Russell A. Kelly

Russell A. Kelly, Chief
Solid Waste Branch
Land Division

RAK/BW:word/bw\swtech\mad\RALF4

c: Mr. David Koonce
Solid Waste Branch
Land Division

File: Madison Co/Redstone Arsenal Landfill/45-03

G. Daily Materials Received Summary Log

REDSTONE ARSENAL SOLID WASTE FACILITY
DAILY MATERIALS RECEIVED SUMMARY LOG

SOM on Duty:

		__/__/__ M D Y Monday			__/__/__ M D Y Tuesday			__/__/__ M D Y Wednesday			__/__/__ M D Y Thursday			__/__/__ M D Y Friday				Remarks
	ARMY / NASA	Rubble, CY	Asbestos, CY	Other, CY	Rubble, CY	Asbestos, CY	Other, CY	Rubble, CY	Asbestos, CY	Other, CY	Rubble, CY	Asbestos, CY	Other, CY	Rubble, CY	Asbestos, CY	Other, CY	Total by Company	
Daily Total by Waste																		
Grand Total																		

AMSMI-RA-EMP Form 101

Page ______ of ______

H. Twice-Weekly Random Inspection Sheet

Redstone Arsenal Solid Waste Disposal Facility
Twice-Weekly Random Inspection Sheet

Time: ______________

Truck Driver's Name: ______________________________ Date: ______________

Truck No.: ______________________________ Tag No.: ______________

Contractor: ______________________________ Contract No: ______________

Point of Origin: ____

Type of Waste: ☐ Rubble ☐ Special Waste

Items Found in Load as Follows: ____

____

Acceptable ☐ Not Acceptable ☐

Inspected by: ____
Printed Name

____
Signature

Title: ____

Comments: ____

____

Time: ______________

Truck Driver's Name: ______________________________ Date: ______________

Truck No.: ______________________________ Tag No.: ______________

Contractor: ______________________________ Contract No: ______________

Point of Origin: ____

Type of Waste: ☐ Rubble ☐ Special Waste

Items Found in Load as Follows: ____

____

Acceptable ☐ Not Acceptable ☐

Inspected by: ____
Printed Name

____
Signature

Title: ____

Comments: ____

____

AMSMI-RA-EMP Form 100

Sampling and Analysis Plan for Semiannual Groundwater Monitoring
Construction and Demolition Landfill
RSA Landfill Permit No. 45-03

Redstone Arsenal
Madison County, Alabama
U.S. EPA ID No. AL7 210 020 742

Prepared for:

U.S. Army Corps of Engineers, Mobile District
Post Office Box 2288
Mobile, Alabama 36628-0001

Prepared by:

Aptim Federal Services, LLC
11400 Parkside Drive, Suite 400
Knoxville, Tennessee 37934

Contract No. W91278-20-D-0021
Task Order W9127821F0219
Project No. 501722

October 2024

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List of Acronyms

ADEM	Alabama Department of Environmental Management
APTIM	Aptim Federal Services, LLC
ASD	Alternate Source Demonstration
bgs	below ground surface
C&D	Construction and Demolition
CB&I	CB&I Federal Services LLC
DoD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
HGL	HydroGeoLogic, Inc.
IDW	investigation-derived waste
IW	Installation-Wide
MSFC	George C. Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
QA	quality assurance
QAPP	Quality Assurance Program Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSA	Redstone Arsenal
SAP	sampling and analysis plan
SOP	Standard Operating Procedure
SSI	statistically significant increase
UTL	upper tolerance limit
VOC	volatile organic compound

1.0 Introduction

This work plan describes the groundwater sampling and analyses to be performed at the Construction and Demolition (C&D) Landfill located at Redstone Arsenal (RSA) in Madison County, Alabama. This program meets the requirements specified in the current Alabama Department of Environmental Management (ADEM) Solid Waste Disposal Facility Permit No. 45-03 for the C&D Landfill (hereinafter referred to as the “Permit [ADEM, 2018]).

This sampling and analysis plan (SAP) is for Detection Monitoring only and should be used in conjunction with the field sampling methodologies provided in the approved Installation-Wide (IW) Quality Assurance Program Plan (QAPP) (HydroGeoLogic [HGL], 2019). Per the Permit, groundwater samples are to be collected semiannually (March and September of each year) from three downgradient wells and one upgradient well. Pursuant to ADEM Administrative Code 335-13-4-.27(3), the samples are to be analyzed for the parameters listed in ADEM Administrative Code 335-13-4-Appendix I for Detection Monitoring: 16 inorganic constituents (hereafter referred to as “metals”) and 47 organic constituents (all of which are volatile organic compounds [VOCs]), using U.S. Environmental Protection Agency (EPA) SW-846 analytical methods (Appendix A). Field parameters—including pH and specific conductance (conductivity), as per ADEM Administrative Code 335-13-4-Appendix I—are also to be collected for each sample. Standard Operating Procedures (SOPs) for the field-work tasks are provided in Appendix B.

Following receipt of analytical data from the laboratory, the downgradient-well data will be statistically compared to the upgradient-well data, in accordance with ADEM Administrative Code 335-13-4-.27 and EPA guidance for groundwater monitoring at Resource Conservation and Recovery Act (RCRA) facilities (EPA, 1989; 1992; 2009). A report will be prepared that presents the analytical data and the results of the statistical evaluation; per the Permit, it will be submitted to ADEM within 90 days of each sampling event.

1.1 Redstone Arsenal Site Description

RSA is bounded by the city of Huntsville to the north and east and the Tennessee River to the south (Figure 1-1). The towns of Madison and Triana are located to the northwest and southwest of the facility, respectively. RSA encompasses approximately 38,100 acres, and the Department of the Army controls 36,459 acres of that total. Of the 36,456 acres controlled by the Department of Army, approximately 15,500 acres are woodlands, approximately 1,000 acres are leased for agricultural use, and approximately 12,000 acres are used for test ranges. The National Aeronautics and Space Administration (NASA) was granted 1,841 acres in the central part of RSA for the George C. Marshall Space Flight Center (MSFC). Prior to this land grant in 1960, the area occupied by MSFC was used by the Army. A portion of the southeastern part of RSA was previously used as a government-owned, contractor-operated facility to develop solid rocket propellants. This area is now referred to as the "Redstone Arsenal Rocket Engine" facility. International Specialty Products produces iron carbonyl on approximately 10 acres of leased land in the central portion of the facility. Approximately 1,260 acres owned by the Tennessee Valley Authority and 5,617 acres of the Wheeler National Wildlife Refuge are within the boundaries of RSA.

1.2 C&D Landfill Site Description

The C&D Landfill occupies 43.11 acres in the central portion of RSA (Figure 1-1). The C&D Landfill has operated since 1993 under ADEM Permit No. 45-03 (ADEM, 2018). The site was previously operated as a sanitary/industrial Municipal Solid Waste Landfill (RSA-010) from 1973 to 1992 (Figure 1-2). The configuration of the current C&D Landfill is shown on Figure 1-3. Historical disposal operations at RSA-010 included the disposal of waste oil in pits and the operation of a sanitary landfill that received a wide range of wastes, including hospital infectious waste, roofing, rubble, and brush and rocks. Adjacent to RSA-010 is the Closed DDT Landfill (RSA-107), operated in the early 1980s during DDT cleanup programs. The C&D Landfill is bounded by RSA-183 to the north; MSFC to the west; RSA-053 to the east; and, to the southeast, the Wheeler National Wildlife Refuge and Huntsville Spring Branch (including RSA-101, DDT Contaminated Area DD, also referred to as the "Olin Consent Decree area"). The C&D Landfill lies above RSA-010.

In July 2016, RSA submitted an Alternate Source Demonstration (ASD) to ADEM to address chemical constituents that exhibit statistically significant increases over background at the C&D Landfill (CB&I Federal Services LLC [CB&I], 2016). The ASD concluded that other sites adjacent to, beneath, and upgradient of the C&D Landfill are the sources of the groundwater contamination observed at the C&D Landfill. ADEM approved the ASD in a letter dated September 20, 2016. Lastly, it should be noted that Solid Waste Management Unit RSA-010 is located directly beneath the C&D Landfill. ADEM approved the Revision 2 RCRA Facility Investigation (RFI) Report for RSA-010 in a letter dated October 26, 2023. In this report, Army concluded that multiple chemicals of concern in groundwater require an action for this site. RSA-010 was considered to be the primary or contributory source for these chemicals of concern in groundwater in the RFI Report for RSA-010. Per ADEM's concurrence letter, RSA-010 has been listed in RSA's Alabama Hazardous Waste Management and Minimization Act Permit as a site requiring a corrective measures work plan.

1.3 Site Geology

The C&D Landfill is underlain by Mississippian-age carbonates (Tuscumbia Limestone and Fort Payne Formation), which are in turn underlain by the Mississippian/Devonian-age Chattanooga Shale, a regional stratigraphic and structural marker. Bedrock is not exposed at the C&D Landfill. The bedrock is mantled with unconsolidated overburden consisting of silty, sandy clay; silty clay; and clay with chert formed from in situ weathering of the underlying carbonate bedrock. The chert content and occurrence are directly related to relict cherty beds within the parent bedrock (Aptim Federal Services, LLC [APTIM], 2023).

Depth to bedrock ranges from approximately 40 feet below grade in the northwestern portion of the site near well F10-RS2354 to 110 feet below ground surface (bgs) in the south-central portion of the site. However, this latter depth of 110 feet bgs is affected by an accumulation of waste within the landfill. Locally, the top of rock varies as much as 55 feet over lateral distances of less than 200 feet. Hereafter in the text of this SAP, the prefixes “F10-” or “F53-” are omitted from the well identification numbers for convenience and readability.

At RSA-010 and the C&D Landfill area, the overburden residuum has been reworked as part of the landfilling process. Landfill waste is present at the ground surface to depths of 50 to 80 feet in some areas.

Native soil in the near surface consists of fine- to medium-grained sands, clayey sands, and sandy clays with discontinuous clay and silt layers of variable thicknesses. At the C&D Landfill, the thickness of the upper residuum sands, clayey sands, and sandy clays ranges from a few feet in areas of landfill trenches to approximately 60 feet in the northwestern portion of the landfill near well RS082A. These sands, clayey sands, and sandy clays are interpreted to contain discontinuous perched groundwater zones (further discussed in Section 1.4). Below this material is the residuum, which consists of gravelly chert and weathered Tuscumbia Limestone with a rubble zone commonly present at the soil-bedrock interface. The thickness of the gravelly chert residuum ranges from approximately 10 feet at well RS554 to over 60 feet near boring SB021 in the central portion of the C&D Landfill (CB&I, 2016). Bedrock underlying RSA-010 includes the Tuscumbia Limestone. This rock layer is characterized by thinly bedded, highly cherty limestone and dolomite with a highly irregular bedrock surface. The Tuscumbia Limestone is present across the entire site. Bedrock elevation ranges from 500 to 575 feet above mean sea level in the general vicinity of the C&D Landfill.

1.4 Site Hydrogeology

Groundwater occurs in unconfined and confined water table aquifers within the localized perched zones, shallow to middle overburden, and deep overburden. The deep overburden includes weathered limestone and cherty rubble zones near the soil/bedrock interface. Groundwater also occurs within shallow to deep, karst limestone bedrock. The overburden and shallow bedrock are hydraulically interconnected. Groundwater in bedrock flows along thin, laterally discontinuous solution features formed along bedding-plane partings and stylolites within the upper, shallow portion of the Tuscumbia Limestone and is either confined or semiconfined (APTIM, 2023).

1.5 Groundwater Flow Direction

As noted in previous reports and observed during the RFI at RSA-010, the water levels within the residuum demonstrate typical behavior of low-permeability clayey units; the potential for vertical flow is much greater than that for horizontal flow. Thus, monitoring wells show different water levels in the various zones in which the wells are screened. Interpretation of groundwater flow in this area has been completed under various investigations, with the general consensus that two basic groundwater zones have been identified in the overburden: a perched zone and an interface zone, which includes the deeper overburden and bedrock. These units were mapped as part of the RSA-010 RFI, and additional hydrogeological information on them is contained in the RSA-010 RFI report (APTIM, 2023). Figure 1-4 provides a typical potentiometric surface map for the upper and middle residuum, using groundwater level measurements obtained during the March 2024 sampling event at the C&D Landfill (APTIM, 2024).

1.6 C&D Landfill Monitoring Wells

The Permit-required monitoring network consists of four wells, all of which were installed prior to the beginning of operation of the C&D Landfill in 1993:

- RS079 – installed in 1981 and located along the southern landfill boundary; designated as a downgradient well in the Permit
- RS080 – installed in 1981 and located in the southeast corner of the landfill boundary; designated as a downgradient well in the Permit
- RS083A – installed in 1984 and located along the northwestern landfill boundary; designated as the upgradient well in the Permit
- RS229 – installed in 1990 and located along the southeastern landfill boundary; designated as a downgradient well in the Permit.

In addition to the above wells for groundwater sampling, the following additional wells are included in the water-level monitoring program based on recommendations in the previous SAP (CB&I, 2015):

- RS015
- RS077
- RS078
- RS082A
- RS084
- RS085
- RS087
- RS088
- RS091
- RS176
- RS232
- RS391
- RS398
- RS139
- RS346
- RS554.

2.0 Field Procedures

Section IV of the Permit specifies the groundwater monitoring requirements for the C&D Landfill (ADEM, 2018). Table 1 of the Permit identifies the wells to be included in the monitoring program: upgradient well RS083A and downgradient wells RS079, RS080, and RS229. Monitoring well construction details are provided in Table 2-1 and the SOPs cited below are provided in Appendix B.

2.1 Groundwater Level Measurements

Water levels, mean sea level elevation monitoring point, and depths to water will be recorded for the 20 wells located within and around the C&D Landfill (Section 1.5). The measurements will be performed in accordance with the RSA-specific SOP No. 16.0, *Groundwater Level Measurements* (HGL, 2019; Appendix B of this SAP). The data will be used to construct potentiometric surface maps and evaluate groundwater flow in the upper and middle residuum. The groundwater flow rate will be determined pursuant to Section IV.B.2 of the Permit.

2.2 Monitoring Well Purging

Prior to sampling, the monitoring wells will be purged with a submersible pump, in accordance with SOP No. 7.0, *Groundwater Sampling* (HGL, 2019; Appendix B of this SAP).

2.3 Groundwater Sampling

Groundwater samples will be collected from Permit-designated wells RS079, RS080, RS083A, and RS229. Per ADEM Code of Regulations 335-13-4, groundwater samples shall not be field-filtered prior to laboratory analysis. Groundwater sampling will be performed using a submersible pump for low-flow sampling techniques, in accordance with SOP No. 7.0, *Groundwater Sampling* (HGL, 2019; Appendix B of this SAP). Field readings will also be obtained for each sample, after ensuring that the equipment is calibrated in accordance with SOP No. 24.0, *Field Equipment Calibration* (HGL, 2019; Appendix B of this SAP). The analytical program is discussed further in Section 3.0.

2.4 Equipment Decontamination

Decontamination will be performed on sampling and non-sampling equipment to prevent cross contamination between sampling locations. Equipment decontamination will be performed in accordance with SOP No. 3.0, *Field Equipment Decontamination* (HGL, 2019; Appendix B of this SAP).

2.5 Well Inspection and Maintenance

During every sampling event, well inspections will be performed and documented on well-inspection checklists (Section 2.6). The groundwater monitoring wells will be maintained in accordance with Sections IV.A.1 and IV.A.2 of the Permit.

2.6 Investigation-Derived Waste Management

Investigation-derived waste (IDW) water samples will be collected and analyzed for VOCs by EPA SW-846 Method 8260C, semivolatile organic compounds by EPA SW-846 Method 8270D, and metals by EPA SW-846 Methods 6010C/7470A. All IDW water will be containerized, analyzed, and disposed in accordance with SOP No. 4.0, *Investigation-Derived Waste* (HGL, 2019; Appendix B of this SAP).

2.7 Field Documentation

Groundwater purge forms, sample collection logs, and well-inspection checklists will be filled out during each sampling event, in accordance with SOP No. 1.0, *Field Documentation* (HGL, 2019; Appendix B of this SAP). The completed forms will be included in the corresponding semiannual monitoring report.

3.0 Analytical Program

Groundwater sampling for Detection Monitoring will be conducted at the C&D Landfill during March and September of each year, per Section IV, B.4 of the Permit. To ensure quality and consistency of the data, analytical services will be provided by a full-service laboratory that has current certification in accordance with the *Quality Systems Manual for Environmental Laboratories*, Version 5.4 (U.S. Department of Defense [DoD], 2021) or latest version. Standard EPA SW-846 analytical methods will be performed at the off-site laboratory to provide certified and validatable data. The detection limit will usually be at or below the corresponding EPA Regional Screening Level, for most constituents. Each regular sample and quality assurance (QA)/quality control (QC) sample will be assigned a unique sample identification number, as displayed in Table 3-1.

3.1 Sample Handling Procedures

Sample container requirements (including sample volumes), preservation requirements, turn-around times, and laboratory holding times for the C&D Landfill monitoring program are listed in Table 3-2. The field sampling team will maintain physical custody of the samples at all times prior to shipment to the analytical laboratory. Sample handling, packaging, and shipping will be performed in accordance with SOP No. 15.0, *Non-Hazardous Sample Handling, Packaging and Shipping* (HGL, 2019; Appendix B of this SAP).

3.2 Quality Assurance/Quality Control Sampling

The QA/QC samples will be collected in accordance with the requirements and procedures in the IW QAPP (HGL, 2019; Appendix B of this SAP). These samples include equipment rinsates, trip blanks, field duplicates, and matrix spike/matrix spike duplicates (Table 3-1). Collection and analysis of these samples will be used to monitor decontamination procedures, sample handling procedures, laboratory precision and accuracy, and sample matrix effects.

3.3 Analytical Parameters

Each groundwater sample will be analyzed for the 16 metals and 47 VOCs listed in Appendix I of ADEM Administrative Code 335-13-4. This analyte list is reproduced within this SAP as Appendix A. Samples shall not be field-filtered or filtered by the laboratory prior to metals analyses.

Pursuant to the Permit, field measurements of pH and specific conductance will be obtained at the time of sampling at each well. Additional field tests will include dissolved oxygen, oxidation-reduction potential, temperature, and turbidity.

3.4 Data Management and Data Validation

All analytical data generated for the semiannual monitoring events will be managed in accordance with the procedures specified in the IW QAPP (HGL, 2019; Appendix B of this SAP). Samples will be analyzed using approved EPA SW-846 Update III Methods in accordance with the *Quality Systems Manual for Environmental Laboratories*, Version 5.4 (DoD, 2021 [or latest version]) and laboratory SOPs (HGL, 2019).

Complete raw data packages received by the Groundwater Monitoring Contractor will contain all the necessary information for the generation of definitive data. Sample data will be validated by the Groundwater Monitoring Contractor's validation team primarily using the *Quality Systems Manual for Environmental Laboratories*, Version 5.4 (DoD, 2021 [or latest version]) as guidance and the EPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and *Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Data Review* (EPA, 2010) for secondary guidance. EPA Region 3 *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993) are applied during the blank evaluation portion of the validation activities. Specific QC criteria identified in the IW QAPP (HGL, 2019), analytical methods, and laboratory SOPs will be applied to all sample results. For any analytical methods not addressed by the validation guidelines, the evaluation will be based on the published method requirements, laboratory-specific SOPs, and technical judgment following the logic of the Contract Laboratory Program validation guidelines for data qualification.

Electronic data will comply with all Redstone Central Data Repository reporting requirements.

4.0 Statistical Evaluation and Reporting

Following receipt of analytical data from the laboratory, the downgradient well data will be statistically compared to the upgradient well data. This evaluation will be used to identify statistically significant increases (SSIs) over background, which will be documented in the semiannual monitoring report. Statistical analysis and reporting are discussed further, below.

4.1 Statistical Evaluation

Statistical analysis will follow the guidance presented in ADEM Administrative Code 335-13-4-.27 and EPA guidance for groundwater monitoring at RCRA facilities (EPA, 1989; 1992; 2009). Site-specific background values will be obtained that represent 95th upper tolerance limits (UTLs) calculated using data from the Permit-designated upgradient well (RS083A). These background values will be calculated for analytes that are detected in the downgradient well samples. A concentration in a downgradient well sample that exceeds the corresponding 95th UTL represents an SSI over background.

Other statistical evaluations mentioned in ADEM Administrative Code 335-13-4-.27 and that could be performed include parametric or nonparametric analysis of variance procedures, prediction interval procedures, and control charts; or another statistical test that meets the performance standards of 335-13-4-.27(2)(m) and that is submitted for and receives ADEM approval. EPA guidance specifically notes that the same test or procedure might not be appropriate for all constituents, depending on the statistical characteristics (e.g., variance, distribution type, and nondetect percentage) of each chemical's concentration data (EPA, 2009). Tailoring statistical analyses to the data minimizes error rates. Future semiannual monitoring reports might therefore provide statistical approaches other than UTL comparisons; however, all statistical evaluations will conform to ADEM Administrative Code and EPA guidance.

The current Permit states "The Permittee has been approved for inter-well statistical analysis" (*sic*) (Section IV, B.6; ADEM, 2018). "Interwell" specifically refers to the comparison of one well's data set versus another well's data set (such as a downgradient well versus an upgradient well) and is distinct from intrawell tests, which compare one well's data to itself. Interwell statistical analyses include a variety of procedures, as described in EPA (2009). An industry-standard, EPA-recommended interwell test is the nonparametric Wilcoxon rank sum test, which compares the central tendencies of two distributions (e.g., downgradient versus upgradient), and which has previously been approved for use at the C&D Landfill.

4.2 Reporting

Per the Permit, a report will be submitted to ADEM within 90 days of each semiannual groundwater monitoring event. All reports will be included in the Operating Record, as required by Sections I.I.1 and IV.D.2 of the Permit. The C&D Landfill reports will include the following:

- Facility/site location and feature map
- Groundwater potentiometric surface map
- Groundwater flow rate
- Tabulated summary of groundwater elevation data
- Tabulated summary of analytical results and field readings
- Statistical evaluation and list of SSI constituents
- Summary of event findings and any deviations
- Full analytical laboratory report
- Data validation summary
- Chain-of-custody forms, sample collection logs, purging and sampling forms, and other pertinent field forms.

5.0 References

Alabama Department of Environmental Management (ADEM), 2018, ***Solid Waste Disposal Facility Permit, U.S. Army Garrison/Redstone Arsenal, Redstone Arsenal Landfill, Southeast ¼ of Section 5, Township 5 South, Range 1 West in Madison County, Alabama, Permit Number 45-03***, issuance date December 13, 2018; effective date February 6, 2019.

Aptim Federal Services, LLC (APTIM), 2024, ***Construction and Demolition Landfill Semiannual Monitoring Report, March 2024, RSA Landfill Permit No. 45-03, Redstone Arsenal, Madison County, Alabama***, June.

Aptim Federal Services, LLC (APTIM), 2023, ***Revision 2 Resource Conservation and Recovery Act Facility Investigation Report for RSA-010, Closed Sanitary Landfill, Operable Unit 06, U.S. Army Garrison-Redstone, Madison County, Alabama,*** May.

CB&I Federal Services LLC (CB&I), 2016, ***Alternate Source Demonstration, Construction and Demolition Landfill, RSA Landfill Permit No. 45-03, Redstone Arsenal, Madison County, Alabama***, July.

CB&I Federal Services LLC (CB&I), 2015, ***Sampling and Analysis Plan for Semiannual Groundwater Monitoring at the Construction and Demolition Landfill, Redstone Arsenal, Madison County, Alabama***, January.

HydroGeoLogic, Inc. (HGL), 2019, ***Final Revision 4 Installation-Wide Quality Assurance Program Plan, U.S. Army Garrison – Redstone, Madison County, Alabama, Volumes I and II, prepared for U.S. Army Corps of Engineers, Huntsville District, U.S. Army Engineering and Support Center, Huntsville***, December.

U.S. Department of Defense (DoD), 2021, ***Quality Systems Manual for Environmental Laboratories***, Version 5.4.

U.S. Environmental Protection Agency (EPA), 2010, ***Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Data Review***, EPA/540/R-94/013, January.

U.S. Environmental Protection Agency (EPA), 2009, ***Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance***, EPA/530/R-09/007, Office of Resource Conservation and Recovery Program Implementation and Information Division, March.

U.S. Environmental Protection Agency (EPA), 2008, ***Contract Laboratory Program National Functional Guidelines for Organic Data Review***, EPA-540-R-08, June.

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U.S. Environmental Protection Agency (EPA), 1992, ***Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance***, Environmental Statistics and Information Division, Office of Policy, Planning, and Evaluation, EPA/530/R-93/003, July.

U.S. Environmental Protection Agency (EPA), 1989, ***Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance***, Office of Solid Waste, Waste Management Division, EPA/530/SW-89/026, July.

TABLES

Table 2-1

Well Construction Details
Construction and Demolition Landfill
Redstone Arsenal, Madison County, Alabama

Well Number	Well Type	Purpose	Date Installed	Northing	Easting	Top of Casing Elevation (ft. amsl)	Ground Surface Elevation (ft. amsl)	Total Depth (ft. bgs)	Screened Interval (ft. bgs)		Screened Interval Elevation (ft. amsl)		Well Diameter (inches)
									Top	Bottom	Top	Bottom	
F10-RS015	Overburden	Water Level	15-Nov-78	1504350.73	409618.94	609.53	606.86	66.4	51.0	61.0	555.86	545.86	2
F10-RS077	Overburden	Water Level	6-Aug-81	1503866.30	410453.66	602.80	600.70	41.0	23.9	38.9	576.80	561.80	4
F10-RS078	Overburden	Water Level	7-Aug-81	1502487.33	409706.12	597.59	595.21	36.0	20.6	35.6	574.61	559.61	4
F10-RS079	Overburden	Downgradient	7-Aug-81	1502387.84	410358.98	607.94	605.86	55.0	39.8	54.8	566.11	551.11	4
F10-RS080	Overburden	Downgradient	7-Aug-81	1502409.39	411125.73	571.18	568.01	31.0	13.7	28.7	554.29	539.29	4
F10-RS082A	Overburden	Water Level	6-Jan-84	1504024.83	409283.49	636.03	633.49	68.2	48.0	68.0	585.49	565.49	4
F10-RS083A	Overburden	Upgradient	16-Jan-84	1504035.77	409487.76	626.49	623.90	66.3	51.1	66.1	572.80	557.80	4
F10-RS084	Overburden	Water Level	9-Jan-84	1504114.32	409536.88	622.62	619.91	39.0	23.8	38.8	596.11	581.11	4
F10-RS085	Overburden	Water Level	17-May-84	1504099.38	409818.97	611.48	608.11	45.5	20.6	40.6	587.51	567.51	4
F10-RS087	Overburden	Water Level	12-Aug-87	1503348.35	410757.33	605.67	603.03	65.0	51.0	61.0	552.03	542.03	2
F10-RS088	Overburden	Water Level	10-Aug-87	1502112.05	410902.27	561.72	559.36	25.0	7.5	17.5	551.86	541.86	3
F10-RS091	Overburden	Water Level	4-Aug-87	1503412.22	409208.54	623.83	621.30	73.5	60.0	70.0	561.30	551.30	3
F10-RS176	Overburden	Water Level	25-May-88	1504380.72	409968.21	591.36	589.13	52.2	39.0	49.0	550.13	540.13	3
F10-RS229	Overburden	Downgradient	17-Sep-90	1502804.31	410982.47	587.95	585.61	37.7	20.2	34.2	565.41	551.41	2
F10-RS232	Overburden	Water Level	4-Sep-90	1501982.39	410000.57	571.41	569.02	23.0	9.8	18.8	559.22	550.22	2
F10-RS391	Overburden	Water Level	25-Jul-96	1503896.90	408903.07	624.56	622.41	45.0	34.5	44.5	587.91	577.91	2
F10-RS398	Overburden	Water Level	9-Jul-96	1503851.03	410442.19	606.29	603.68	80.4	70.0	80.0	533.68	523.68	2
F53-RS139	Overburden	Water Level	11-Aug-87	1502748.57	411569.71	583.38	580.90	40.0	30.0	40.0	550.90	540.90	2
F53-RS346	Overburden	Water Level	30-Jun-92	1504539.64	410664.54	592.87	590.08	26.5	16.5	26.5	573.58	563.58	2
F53-RS554	Overburden	Water Level	24-Oct-96	1503788.40	410583.14	600.20	597.69	50.0	37.0	47.0	560.69	550.69	2

Permit-listed well.
amsl - Above mean sea level.
bgs - Below ground surface.
ft. - Feet.

Table 3-1

Sample Designations and Analytical Parameters
Construction and Demolition Landfill
Redstone Arsenal, Madison County, Alabama

Sample Location	Sample Designation	Sample Depth (feet)	QA/QC Sample Designation		Analytical Parameters
			FD [1]	MS/MSD [1]	
C&D Landfill Round 1 (March Event) [2]					
F10-RS080	F10-RS077 -GW- BKXXXX -REG	TBD			Appendix I VOCs, Appendix I Metals
F10-RS079	F10-RS079 -GW- BKXXXX -REG	TBD	F10-RS079-GW-BKXXXX-FD		Appendix I VOCs, Appendix I Metals
F10-RS083A	F10-RS083A -GW- BKXXXX -REG	TBD			Appendix I VOCs, Appendix I Metals
F10-RS229	F10-RS229 -GW- BKXXXX -REG	TBD		F10-RS229-GW-BKXXXX-MS/MSD	Appendix I VOCs, Appendix I Metals
C&D Landfill Round 2 (September Event) [2]					
F10-RS080	F10-RS080 -GW- BKXXXX -REG	TBD			Appendix I VOCs, Appendix I Metals
F10-RS079	F10-RS079 -GW- BKXXXX -REG	TBD	F10-RS079-GW-BKXXXX-FD		Appendix I VOCs, Appendix I Metals
F10-RS083A	F10-RS083A -GW- BKXXXX -REG	TBD			Appendix I VOCs, Appendix I Metals
F10-RS229	F10-RS229 -GW- BKXXXX -REG	TBD		F10-RS229-GW-BKXXXX-MS/MSD	Appendix I VOCs, Appendix I Metals
RSA-010 IDW					
010-SITE	010-SITE -WA- BKXXXX -REG	NA			TCL VOCs, TCL SVOCs, TAL Metals
010-SITE	010-SITE -WA- BKXXXX -REG	NA			TCL VOCs, TCL SVOCs, TAL Metals

[1] The MS/MSD/FD locations are subject to change due to field conditions. Project chemist will be notified and database updated accordingly.

[2] Actual sample designations will contain unique numeric identifiers in place of "XXXX."

FD - Field duplicate.
IDW - Investigation-derived waste.
MS - Matrix spike.
MSD - Matrix spike duplicate.
NA - Not applicable.
QA - Quality assurance.
QC - Quality control.
REG - Regular sample.
SVOC - Semivolatile organic compound.
TAL - Target Analyte List.
TBD - To be determined.
TCL - Target Compound List.
VOC - Volatile organic compound.

Table 3-2

Analytical Program Summary
Construction and Demolition Landfill
Redstone Arsenal, Madison County, Alabama

Parameters	Analytical Method	Matrix	Total Number of Samples	FD	MS	MSD	Equipment Rinsate (1/event)	Trip Blank (1/cooler)	TAT Needed [1]	Sample Container/Preservation Requirements [2]	Holding Time	Total Number of Containers
Groundwater Samples (per event)												
Appendix I VOCs	SW5030B / SW8260C	Water	4	1	1	1	1	2	Normal	3 x 40-mL vials w/septa; HCl to pH<2	14 days	30
Appendix I Metals (unfiltered)	SW3005A / SW6010B/ SW7470A	Water	4	1	1	1	1	0	Normal	1 x 250-mL HPDE HNO_3 to pH<2	6 months; Mercury - 28 days	8
IDW Water (per event)												
TCL VOCs	SW5030B / SW8260C	Water	2	0	0	0	0	0	Normal	3 x 40-mL vials w/septa; HCl to pH<2	14 days	6
TCL SVOCs	SW3540C / SW8270D	Water	2	0	0	0	0	0	Normal	2 x 1 Liter	7 days prep; 40 days analysis	6
TAL Metals	SW3005A / SW6010C/ SW7470A	Water	2	0	0	0	0	0	Normal	1 x 250-mL HPDE HNO_3 to pH<2	6 months; Mercury - 28 days	2

[1] Sample deliverables should include a Level IV, Contract Laboratory Program-like data package and EDD for all samples with the exception of IDW samples, which require certificates of analysis and EDD only.

[2] All samples will be cooled to 4 degrees Celsius in conjunction with preservation requirements noted prior to shipment to the laboratory.

EDD - Electronic data deliverable.
FD - Field duplicate.
HCl - Hydrochloric acid.
HDPE - High-density polyethylene.
HNO_3 - Nitric acid.
IDW - Investigation-derived waste.
mL - Milliliter.
MS/MSD - Matrix spike/matrix spike duplicate.
SW - U.S. Environmental Protection Agency's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846).
SVOC - Semivolatile organic compound.
TAL - Target Analyte List.
TAT - Turn-around time.
TCL - Target Compound List.
VOC - Volatile organic compound.

FIGURES

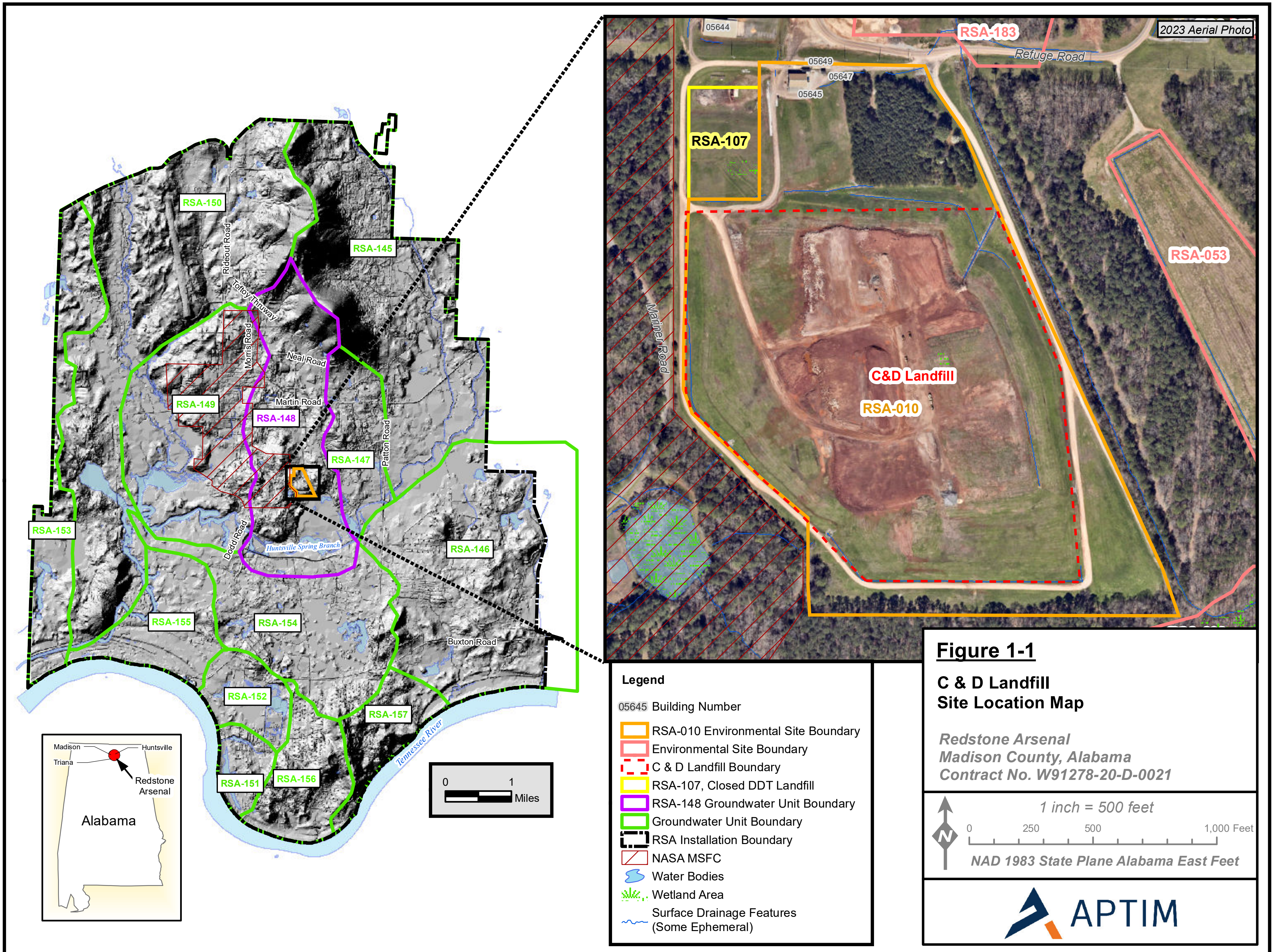

Figure 1-1

C & D Landfill Site Location Map

Redstone Arsenal
Madison County, Alabama
Contract No. W91278-20-D-0021

F:\Projects\Redstone_ERMA_Small_Business\GIS_Documents\Project_Maps\RSA_010\LF_Spring2024\RSA_010_Site_Location_Map.mxd

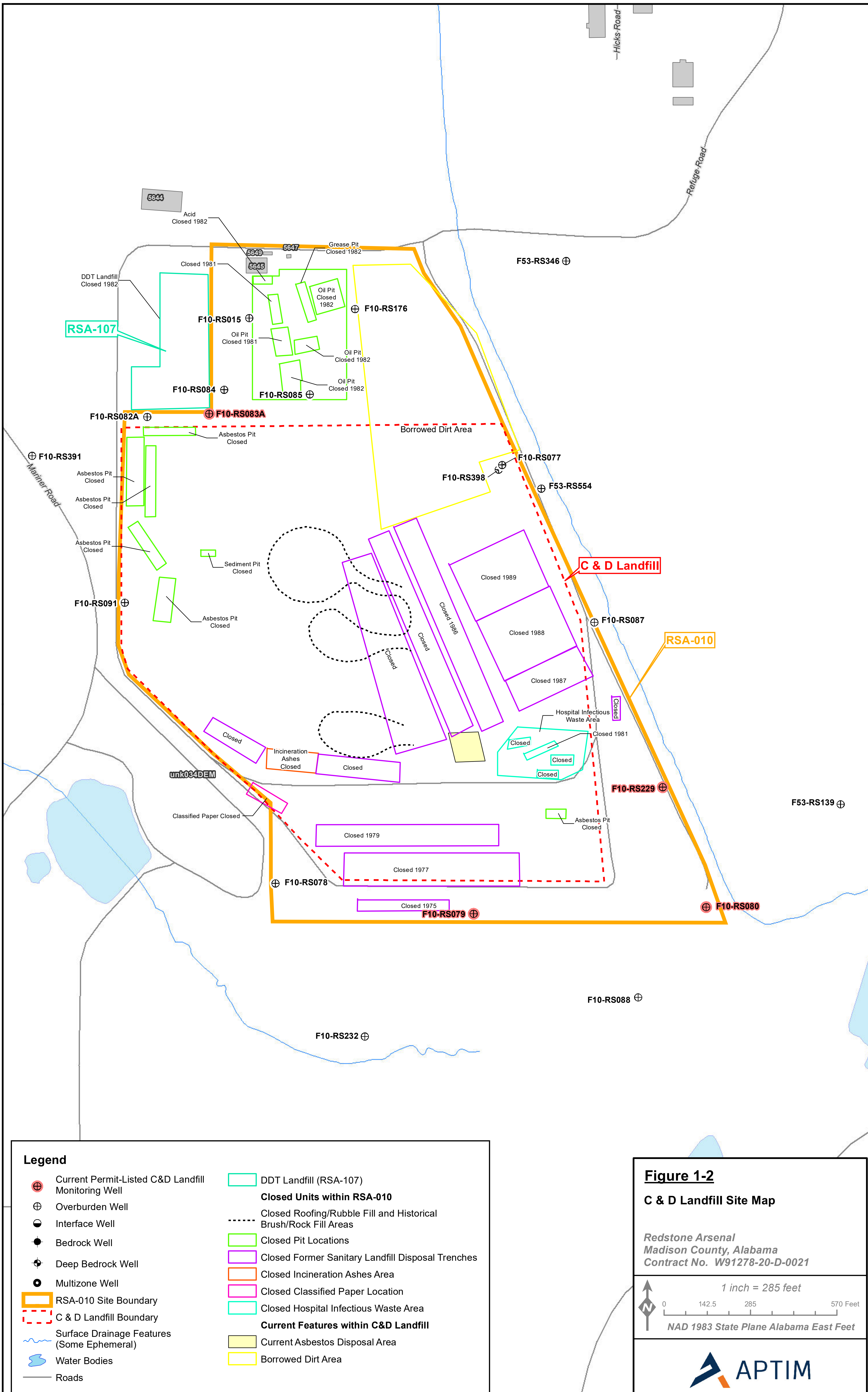

Figure 1-2

C & D Landfill Site Map

Redstone Arsenal
Madison County, Alabama
Contract No. W91278-20-D-0021

Document Path: F:\Projects\Redstone_ERMA_Small_Business\GIS_Documents\Project_Maps\RSA_010\LF_Spring2024\RSA_010_CD_Landfill_Site_Map.mxd

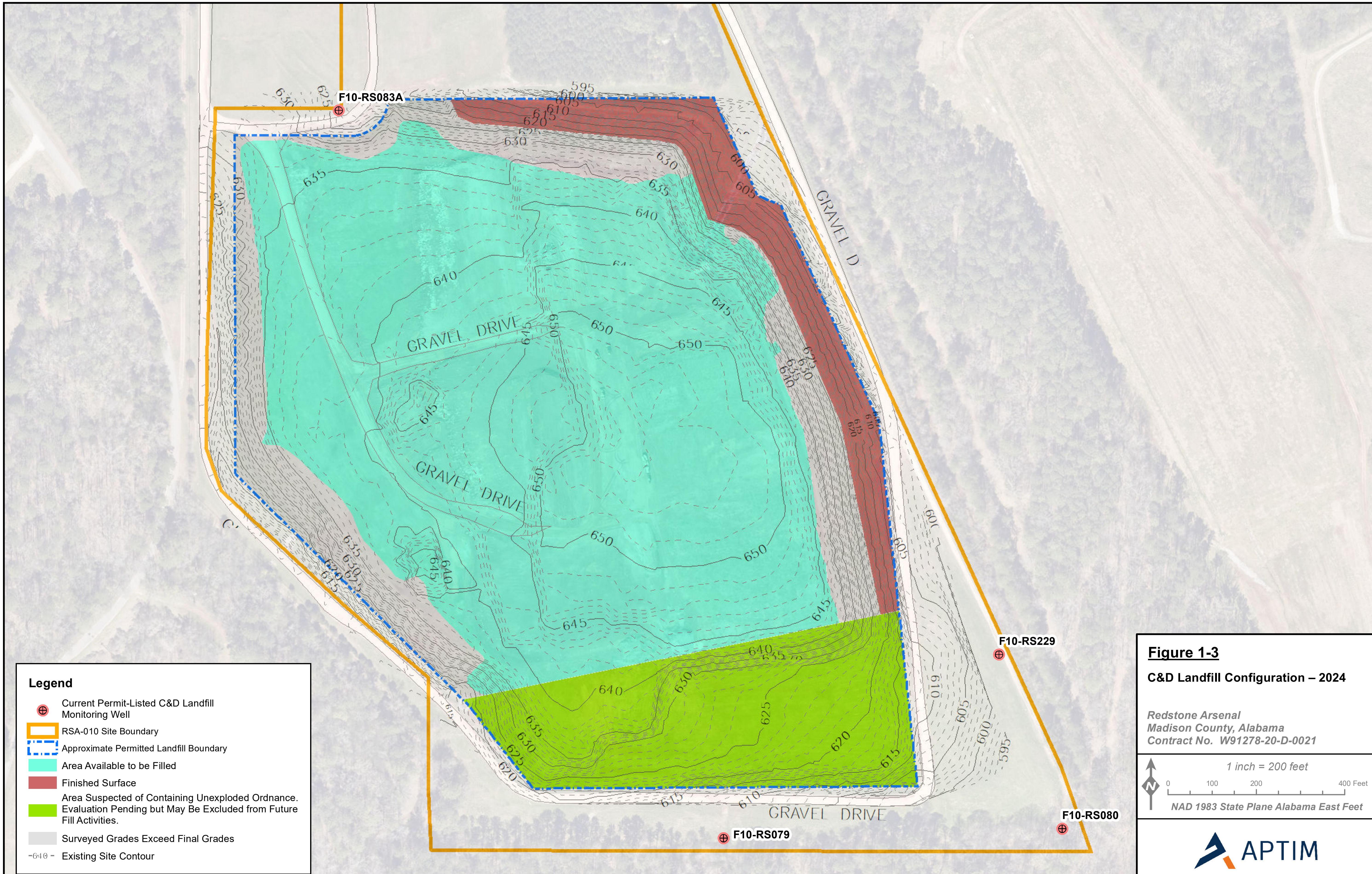

Figure 1-3

C&D Landfill Configuration – 2024

Redstone Arsenal
Madison County, Alabama
Contract No. W91278-20-D-0021

APTIM

Document Path: F:\Projects\Redstone_ERMA_Small_Business\GIS_Documents\Project_Maps\RSA_010\Monitoring_Report_Sept2023\RSA_010_Landfill_Detail_Map.mxd

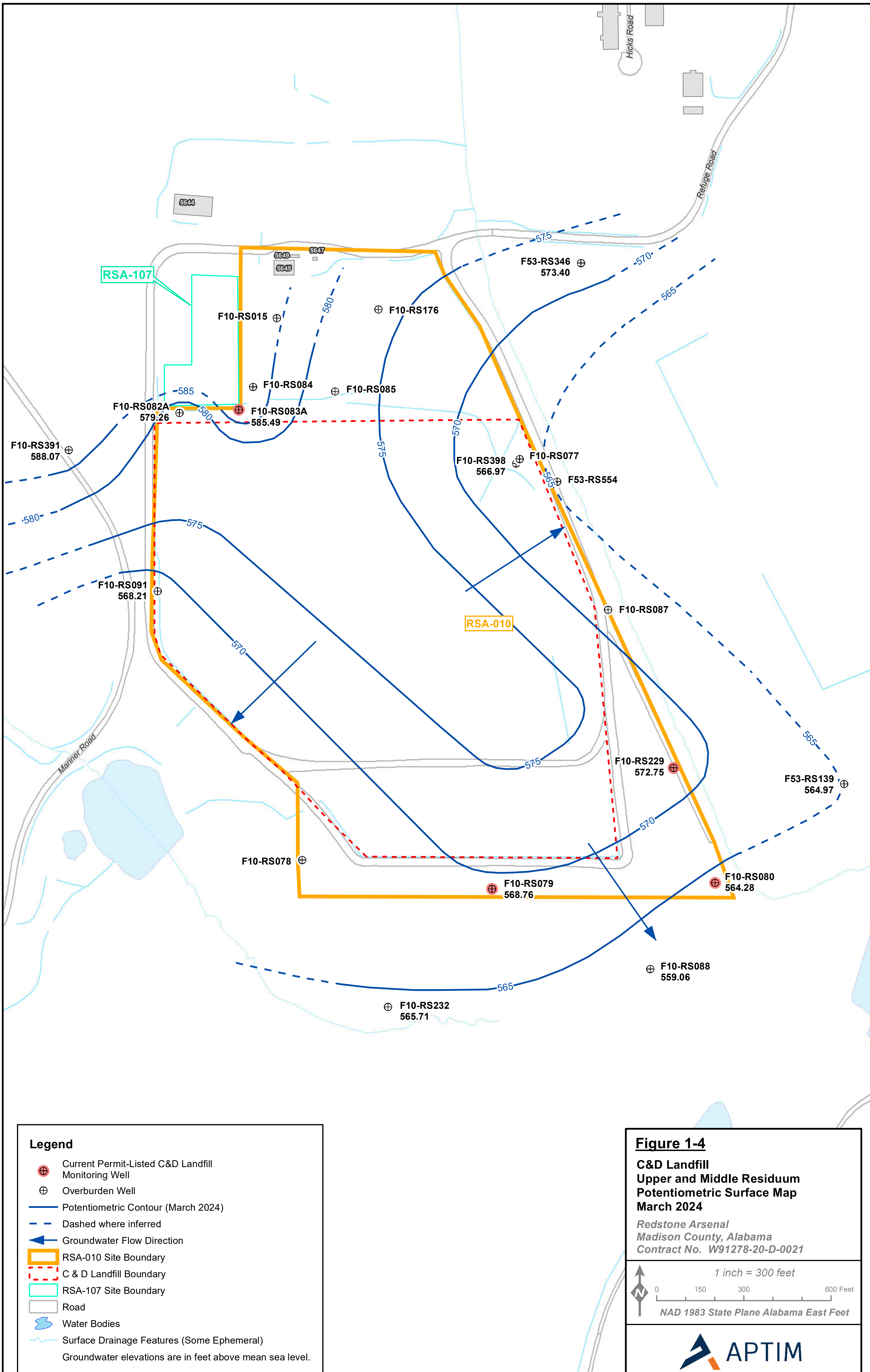

Figure 1-4

C&D Landfill
Upper and Middle Residuum
Potentiometric Surface Map
March 2024

Redstone Arsenal
Madison County, Alabama
Contract No. W91278-20-D-0021

Document Path: F:\Projects\Redstone_ERMA_Small_Business\GIS_Documents\Project_Maps\RSA_010\LF_Spring2024\RSA_010_OVB_Pot_Mar24.mxd

APPENDIX A

ANALYTICAL PARAMETERS FOR DETECTION MONITORING

335-13-4-APPENDIX I CONSTITUENTS FOR DETECTION MONITORING[1]

	Common Name[2]	CAS Number[3]
	pH[4]	N/A
	Specific Conductance[4]	N/A
	Inorganic Constituents	
1.	Antimony	Total
2.	Arsenic	Total
3.	Barium	Total
4.	Beryllium	Total
5.	Cadmium	Total
6.	Chromium	Total
7.	Cobalt	Total
8.	Copper	Total
9.	Lead	Total
10.	Mercury	Total
11.	Nickel	Total
12.	Selenium	Total
13.	Silver	Total
14.	Thallium	Total
15.	Vanadium	Total
16.	Zinc	Total
	Organic Constituents	
17.	Acetone	67-64-1
18.	Acrylonitrile	107-13-1
19.	Benzene	71-43-2
20.	Bromochloromethane	74-97-5
21.	Bromodichloromethane	75-27-4
22.	Bromoform; Tribromomethane	75-25-2
23.	Carbon disulfide	75-15-0
24.	Carbon tetrachloride	56-23-5
25.	Chlorobenzene	108-90-7
26.	Chloroethane; Ethyl chloride	75-00-3
27.	Chloroform; Trichloromethane	67-66-3
28.	Dibromochloromethane; Chlorodibromomethane	124-48-1
29.	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8
30.	1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4
31.	o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
32.	p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
33.	trans-1,4-Dichloro-2-butene	110-57-6
34.	1,1-Dichloroethane; Ethylidene chloride	75-34-3
35.	1,2-Dichloroethane; Ethylene dichloride	107-06-2
36.	1,1-Dichloroethylene; 1,1-dichloroethene; Vinylidene chloride	75-35-4
37.	cis-1,2-Dichloroethylene; cis-1,2Dichloroethene	156-59-2

38.	trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5
39.	1,2-Dichloropropane; Propylene dichloride	78-87-5
40.	cis-1,3-Dichloropropene	10061-01-5
41.	trans-1,3-Dichloropropene	10061-02-6
42.	Ethylbenzene	100-41-4
43.	2-Hexanone; Methyl butyl ketone	591-78-6
44.	Methyl bromide; Bromomethane	74-83-9
45.	Methyl chloride; Chloromethane	74-87-3
46.	Methylene bromide; Dibromomethane	74-95-3
47.	Methylene chloride; Dichloromethane	75-09-2
48.	Methyl ethyl ketone; MEK; 2-Butanone	78-93-3
49.	Methyl iodide; Iodomethane	74-88-4
50.	4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1
51.	Styrene	100-42-5
52.	1,1,1,2-Tetrachloroethane	630-20-6
53.	1,1,2,2-Tetrachloroethane	79-34-5
54.	Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4
55.	Toluene	108-88-3
56.	l,l,l-Trichloroethane; Methylchloroform	71-55-6
57.	1,1,2-Trichloroethane	79-00-5
58.	Trichloroethylene; Trichloroethene	79-01-6
59.	Trichlorofluoromethane; CFC-11	75-69-4
60.	1,2,3-Trichloropropane	96-18-4
61.	Vinyl acetate	108-05-4
62.	Vinyl chloride	75-01-4
63.	Xylenes	1330-20-7

Notes

[1] This list contains 47 volatile organics for which possible analytical procedure provided in EPA Report SW-846, "Test Methods for Evaluating Solid Waste," Third Edition, November 1986, as revised December 1987, includes Method 8260; and 15 metals for which SW-846 provides either Method 6010 or a method from the 7000 series of methods.

[2] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

[3] Chemical Abstracts Service registry number. Where "Total" is entered, all species in the groundwater that contain this element are included.

[4] State specific requirements.

Author: Russell A. Kelly; Heather Jones.
Statutory Authority: Code of Alabama 1975, §§ 22-27-4, 22-27-7.
History: Effective: November 2, 1993. **Amended**: Effective: July 26, 1996.
Amended: Filed: April 24, 2018; Effective: June 8, 2018.

APPENDIX B

STANDARD OPERATING PROCEDURES

SOP No. 1.0, *Field Documentation*
SOP No. 3.0, *Field Equipment Decontamination*
SOP No. 4.0, *Investigation-Derived Waste*
SOP No. 7.0, *Groundwater Sampling*
SOP No. 12.0, *Field-Measurable Physical Characteristics*
SOP No. 15.0, *Non-Hazardous Sample Handling, Packaging and Shipping*
SOP No. 16.0, *Groundwater Level Measurements*
SOP No. 24.0, *Field Equipment Calibration*

Subject: FIELD DOCUMENTATION

1.0 PURPOSE AND SUMMARY

The objective of this standard operating procedure (SOP) is to establish the minimum documentation requirements for personnel performing field activities at Redstone Arsenal (RSA), Madison County, Alabama. This procedure meets the requirements of U.S. Army Corps of Engineers (USACE) (1990), U.S. Environmental Protection Agency (EPA) (1986), and EPA (1980). Any exceptions to these requirements are noted in Section 6.0. Documents other than those required by contract and used in the preparation of this SOP are listed in Section 7.0.

Field Activity Daily Logs and field forms are the permanent, handwritten and electronic records of the field activities performed at RSA. Field Activity Daily Logs are documents wherein real-time, detailed accounts of daily activities are recorded. In addition to recording all of the day's events, Field Activity Daily Logs are used to create a history of the activities of the site, which can be used to reconstruct daily events. In addition, Field Activity Daily Logs are reviewable documents for quality assurance (QA)/quality control (QC) audit purposes. Field forms are used to record data from specific activities at RSA. These forms are used in conjunction with the Field Activity Daily Logs as an effective way of recording field data and avoiding omissions in a systematic format.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring that field activities are completed to meet the project objectives, conducted in accordance with the project plans and requirements, and performed according to the respective procedures. The QCSM is also responsible for ensuring all site personnel are trained in and follow the proper procedures and that they document all activities. The QCSM or his designee should review the daily documentation to ensure entries are correct and complete.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure. In addition, all team members must ensure that work is performed in complete accordance with this SOP.

3.3 Quality Assurance/Quality Control Manager

The QA/QC Manager is responsible for ensuring that this SOP is correctly implemented and that Field Activity Daily Logs and all other field forms meet the requirements of this SOP.

4.0 DEFINITIONS

None.

5.0 TEXT

5.1 Required Equipment

The following is a list of the supplies and equipment needed to implement this SOP in the field.

1. Permanent, indelible, ink pens with black or blue ink
2. Sharpie® or other indelible markers
3. Field notebooks and Field forms.

5.2 General Requirements

Documentation of field activities will satisfy the following certain basic requirements:

Appropriate header information, such as project name, project number, descriptive title, inclusive pagination, and identification of an originator.

- Legible entry of data. Whenever corrections are to be made, a single line is to be placed through the incorrect entry, the correction is to be written near the original entry or a reference made to the location of the correction. Such corrections are to be initialed and dated.

- Completing field records with enough detail that field activity may be reconstructed by someone other than the originator. If equipment is used, include the serial number where available.
- Supplying specific data requested on field forms. Information that is not applicable should be noted as such using the symbol "N/A" or lined out and initialed. Information that is to be completed at an unspecified later date (e.g., survey data) should be noted as such by using the symbol "TBD."

5.3 Specific Requirements for Field Activity Daily Logs

Field Activity Daily Logs are used to document the daily field activities and provide a history of site work. Both site-specific and task-specific information are recorded on the Field Activity Daily Logs. Field Activity Daily Log. Field Activity Daily Logs provide an established format for the entry of selected information (e.g., weather, site visitors, telephone conversations, etc.). The bottom of each handwritten Field Activity Daily Log page should be signed and dated. When a Field Activity Daily Log is completed on hard copy, a diagonal line shall be drawn across the unused space and signed by the person completing the Field Activity Daily Log.

All of the general documentation requirements specified in Section 5.2 shall be followed. It may not be necessary for all field personnel to compete a Field Activity Daily Log, as long as they are included in the list of personnel on the Field Activity Daily Log for the day. If it is necessary for all field personnel on a task to complete a Field Activity Daily Log, an abbreviated Field Activity Daily Log may be completed by most of the personnel on a task, so long as one main Field Activity Daily Log for the task is completed and is referenced on the abbreviated Field Activity Daily Logs.

No blank spaces should be left after completing a page in the Field Activity Daily Log. If a blank space is necessary, it should be filled, either horizontally or diagonally, with a single line and initialed by the person completing the Field Activity Daily Log.

Spaces are provided for some of the required information on the Field Activity Daily Log. These include:

1. <u>Activities</u> – A summary of anticipated activities for the day
2. <u>Weather</u> – The conditions at the beginning of the day and the anticipated forecast
3. <u>Personnel</u> – Names, titles, and companies of personnel performing the task at hand
4. Day and date (on each page)
5. Site visitors (and affiliation)
6. Important telephone calls
7. Project name
8. Project number
9. Changes from plans or specifications or other important decisions

10. Signature (on the first page).

In addition to these entries, the beginning of each day should include an entry for:

1. Instrumentation – Field instruments used, serial or identification numbers, and reference to the daily calibration logs
2. Site Sketch – On the first day at a site and a reference to the Field Activity Daily Log containing the sketch on subsequent days at the site.

The daily entries should include:

- Chronological records, in military time format, of the day's activities. The activities shall be recorded as they occur.
- Visitors on the site, including name, affiliation, and time of arrival and departure.
- Description of any field tests conducted and citations of the guidance or SOP used for the test (e.g., testing conducted according to instruction in the Omni Immunoassay Kit for DDT).
- Samples collected, including splits, blanks, duplicates, matrix spikes, and regular environmental samples. This information should include all sample identifiers, container types, preservatives, and analyses requested. When sample custody is transferred, the name of the person receiving custody, as well as the time and date, should be recorded. The appropriate SOP number should also be cited.
- Records of the equipment used on site, including type of equipment and identification number.
- Documentation of decontamination method and equipment used. The decontamination SOP reference should also be cited.
- Calculations performed (e.g., calculated sand pack volumes and comparison to actual values or calculated values for grout required to complete wells).
- Field forms being used to record site data (such as soil boring logs, monitoring well purge logs, and sample collection logs [SCL]) should be referenced (e.g., "See boring log for this well dated 02/19/2000"). In addition, it is desirable to record the most important information both on the field form and in the Field Activity Daily Log. For example, the last three readings for groundwater sampling parameters should also be included in the Field Activity Daily Log.
- Records of equipment problems, including breakdowns and repairs.
- Summary included at the end of the day.
- End notations. The end of each day's entries should be noted as "end of day's notes." A diagonal line is drawn across the unused portion of the page, and this diagonal line should be signed and dated.

The bottom of each page should include the date and the signature of the person completing the field log entries.

Attachment 1 includes a blank Field Activity Daily Log and continuation sheet.

5.4 Field Forms

A variety of field forms are used to document specific tasks at RSA, including health and safety activities and activities related to environmental operations. Not all of the forms will be discussed here, but blank forms are included as a resource. The appropriate SOP or installation-wide document is referenced for these blank forms. The field forms that are commonly used are discussed in the text, and examples of blank forms, are included in Attachment 1. The discussion of field forms will be split into three divisions: health and safety forms; drilling, sampling, and hydrogeologic forms; and other forms.

5.4.1 Health and Safety Forms

A wide variety of forms used for specific safety- and health-related activities at RSA are included in the latest version of the Installation-Wide Accident Prevention Plan. These forms are also included in this SOP; however, only the most commonly used forms are described and provided with completed examples. The remainder of the safety and health forms are included but are not presented in detail. Accompanying health and safety information, as it relates to the additional forms included in this document, are presented in the Installation-Wide Accident Prevention Plan. The following list represents commonly used health and safety forms. Examples of these forms are included in Attachment 1.

1. Tailgate Safety Meeting including sign in/sign out form
2. Field Activity Daily Log
3. Exclusion Zone Entry Log
4. Daily Heat Stress Monitoring Form
5. Mechanized and Marine Equipment Inspection Form
6. Job Safety Analysis.

The specific details for these forms and the associated activities can be found in the Installation-Wide Accident Prevention Plan.

1. Air Monitoring Data Sheets
2. Chain of Custody Record, Seals, and Sample Labels
3. Daily Excavation Inspection Form
4. Daily Vehicle Inspection
5. Employee Notification of Industrial Hygiene Results Form
6. Excavation Permit
7. Exclusion Zone Entry Log

8. Extraction Well Construction Form
9. Field Activity Daily Log
10. Field Work Variance
11. Groundwater Purge Form
12. Hot Work Permit Form
13. Hazardous, Toxic, or Radioactive Waste (HTRW) Drilling Log
14. Investigation-Derived Waste (IDW) Information Log
15. Job Safety Analysis
16. Lock Out Log
17. Lockout/Tagout Periodic Inspection
18. Monitoring Well Construction Form
19. Nonconformance Report
20. Pre-Operation Checklist for Pressure Water Jet Cleaning Cutting Equipment
21. Project Heat Stress Monitoring Form
22. Rescue Service Evaluation Form
23. Redstone Arsenal Sign In/Sign Out Sheet
24. Tailgate Safety Meeting
25. Temporary Piezometer Construction Form
26. USACE Safety Inspection Checklist, Drilling Equipment
27. Utility Mark-Out Documentation
28. Well Construction Forms (Monitoring Well Construction Form [Bedrock], Extraction Well Construction Form [Bedrock], Water FLUTe, Well Construction Form [Bedrock])
29. Well Abandonment Form
30. Well Development Log

Tailgate Safety Meeting

A tailgate safety meeting is to be conducted at the beginning of each day of field activities and when new personnel arrive on the site. The meeting is to include field personnel, subcontractors, teaming partners, and visitors on the site (anyone who is planning to be involved in site-related activities). As a minimum, safety topics discussed in the tailgate safety meeting form are to be documented and presented. The requirements for tailgate safety meetings are fully discussed in the Installation-Wide Accident Prevention Plan.

Documentation is to be completed using a Tailgate Safety Meeting form. Attachment 1 includes a blank version of the form. In general, the form is used to record the project-specific details, safety topics presented, and a printed list of attendees with signatures. Continuation sheets are available to allow for the listing of numerous attendees.

Exclusion Zone Sign-In/Sign-Out Log

Personnel entering and exiting exclusion zones are required to complete the exclusion zone sign-in/sign-out log. The appropriate log will be maintained by site health and safety personnel or the site geologist or engineer. The log will be completed per day for each exclusion zone. Personnel entering the exclusion zone will sign the signature line and record the time of entry and exit, in military time format, for each ingress and egress of the exclusion zone. An example of the general exclusion zone sign-in/sign-out form is found in Attachment 1.

Employee Physiological Monitoring Record for Heat Stress Forms

An Employee Physiological Monitoring Record for Heat Stress Form will be completed during work conditions that require heat stress monitoring. One of these forms is completed for each worker per site per day and shall be completed by the on-site health and safety observer. A blank version is included in Attachment 1. The requirements for heat stress monitoring are fully discussed in the Installation-Wide Accident Prevention Plan.

Safety Audits

Safety audits are periodically performed during field operations at RSA. Documentation of the safety audits should ensure that the basic documentation requirements found in Section 5.2 are met; completion dates or projected completion dates and all responsible parties are listed; and deficiencies are addressed, corrected, and verified. USACE has several safety checklists for various types of heavy equipment. These forms will be used where appropriate. A blank version of a checklist for drilling equipment is included in Attachment 1.

Field Calibration Logs

Field Calibration Logs will be kept for all instruments that are used during the fieldwork. Field testing and monitoring equipment will be inspected and calibrated before each use. Calibrated equipment will be uniquely identified using the manufacturer serial number or other unique identification. The date, time, and results will be noted in the Field Calibration Logs. Attachment 1 contains blank versions of these logs.

5.4.2 Drilling Forms, Sampling Forms, and Hydrogeologic Forms

Drilling forms, sampling forms, and hydrogeologic forms are used to record data generated during common field activities. These forms provide a structured format to ensure that all pertinent data are recorded and should be used in conjunction with the Field Activity Daily Logs. These forms will be discussed further in the following order:

Drilling Forms

1. HTRW Drilling Log
2. Monitoring Well Construction Logs
   - Temporary Piezometer Construction Form
   - Monitoring Well Construction Form
   - Monitoring Well Construction Form (Bedrock)
   - Extraction Well Construction Form (Bedrock)
   - Water FLUTe Well Construction Form (Bedrock)
   - Daily Drilling Services Summary Sheet
   - Well Development Log
   - Well Abandonment Form.

Sampling Forms

1. Groundwater Purge Form
2. Sample Collection Log
3. Sample Label
4. Analysis Request and Chain-of-Custody Record.

Hydrogeologic Forms

1. Groundwater Level Measurements
2. Continuous Water Level Measurement Form
3. Borehole Flowmeter Survey Data Form.

HTRW Drilling Log

Forms are commonly used to record data collected during drilling operations and monitoring well installation. The purpose of the HTRW Drilling Log is to completely and accurately record the events and findings associated with the drilling process. Entries should be neat, objective, and concise. Details of the soil and rock description can be found in SOP No. 22.0, *Description of Geologic Materials*. Data from soil and bedrock borings are to be recorded on the HTRW Drilling Log, the RSA version of which is shown in Attachment 1. The field engineer or geologist completing the log is to supply the following information as necessary in indelible, legible writing:

1. The boring/well number listed at two locations on every page. The boring/well number will include its full designation (e.g., Soil boring number 13 at RSA-013 will be listed as 013-SB013).
2. A sketched location that will include enough local features and approximate distances to structures in order for someone else to be able to arrive at that boring/well some months later. The boring/well location will include the RSA site number, applicable nearby building numbers, nearby surface features (i.e., streams and fences), and/or named roads.

3. Samples for chemical analysis, listing out the sample numbers, collection intervals, and date and time of collection.
4. Descriptions of the soil and rock, including information listed on the RSA field guide found in SOP No. 22.0.
5. The description of the soil and rock to determine the Unified Soil Classification System (USCS) classification used on the HTRW Drilling Log. The vertical scale on the drilling log will be approximately 1 inch to 1 foot.
6. Noteworthy changes in soils conditions designated with either a dashed or solid line at the depth the change was observed in the Description of Materials and USCS\Lithology columns. Corresponding with the line will be, in parentheses, the recorded depth of the change.
7. Sample number and time shown graphically at collection depth. Beginning and ending sample depth will be recorded with a solid line and numeric depth at the specified depth in the analytical sample number or geotechnical sample or core box number column.
8. Rock quality designation calculated for each core run and recorded in the remarks column on the HTRW Drilling Log (for rock coring only).
9. Remarks denoting the appearance of water, fractures, and other structural features (in the Remarks column).
10. The volume of fluids that are introduced into the boring documented on the HTRW Drilling Log.

SOP Nos. 9.0, *Drilling Bedrock*, and 20.0, *Drilling Unconsolidated Material*, provide additional information on the data that is recorded on the HTRW Drilling Log.

Monitoring Well Construction Form

The installation of monitoring wells is a common activity at RSA. Monitoring well construction forms are used to record the details and measurements associated with any type of well installed at RSA. All fields on the Monitoring Well Construction Forms should be completed, and any field not used should be filled with a N/A for “not applicable” or TBD for “to be determined.” Measurements on the Monitoring Well Construction Forms should be expressed to the nearest tenth of a foot (e.g., bottom of screen 29.5 ft.). Well construction forms are typically tailored to the specific type of well being built. Blank versions of four well construction forms commonly used at RSA are included in Attachment 1. If a type of well to be installed is not covered by one of the existing Monitoring Well Construction Forms, a new form will be created based on and tailored to the specific well attributes. The volume of fluids that are introduced into the borehole as a result of drilling or bentonite and grout hydration will be documented on the Monitoring Well Construction Form. SOP No. 17.0, *Monitoring Well Installation,* provides additional information on the data that is recorded on the Monitoring Well Construction Form.

Daily Drilling Services Summary Sheet

When subcontracted drilling services are used, a Daily Drilling Services Summary Sheet will be completed and signed by the on-site geologist or engineer, the drilling subcontractor representative, and the contractor's QCSM. One of these forms shall be completed each day for each location where drilling services are employed. Lines not used on the form shall be completed with N/A to indicate that the field was not applicable.

Well Development Log

After each well has been constructed (no sooner than 48 hours or later than 7 days after the grouting), each well will be developed. Attachment 1 includes a blank Well Development Log. The Well Development Logs must fulfill the basic documentation requirements found in Section 5.2 and include initial water quality parameters, details on surging and pumping, periodic water quality readings, and final water quality readings. Details on well development, including required data, are included in SOP No. 8.0, *Standards for Conducting Well Development*.

Well Abandonment Form

The abandonment of boreholes and wells at RSA will be documented using a Well Abandonment Form. This form is used to record the pre-abandonment condition of the borehole or well (e.g., borehole diameter, total depth, screened interval, depth to filter pack, depth to seal, etc.) and site conditions after abandonment. The Well Abandonment Form is a two-page form and may be reproduced so that the pages are in a two-sided format. A blank copy of the form is found in Attachment 1.

Groundwater Purge Form

A Groundwater Purge Form will be completed for groundwater samples collected at RSA. This form will accompany an SCL and is used to record groundwater parameters and verify that the groundwater sampled is representative of groundwater in the screened formation. Data recorded on this form must fulfill the basic documentation requirements found in Section 5.0 above and include details specified in SOP No. 7.0, *Groundwater Sampling*. A blank copy of the Groundwater Purge form is provided in Attachment 1.

Sample Collection Log

An SCL will be generated for every sample location and interval or matrix collected. If the samples are preplanned from a geographic information system (GIS) database, then the sample coordinator will provide preprinted logs to the field crew. In the event that preplanning of samples is not possible, a blank SCL will be provided. On the blank SCL, the sample coordinator will complete the shaded areas, and personnel collecting the samples will complete the reminder of the log. If water quality parameters are measured during sample collection (surface water and groundwater samples), the instrument make and model (e.g., Horiba U-10) should be noted in the comments section on the SCL. A blank copy of the Sample Collection Log is provided in Attachment 1.

Sample Label

A sample label will be completed for each container filled with a sample. Labels are usually preprinted from a GIS system for preplanned samples; however, if sample preplanning is not possible, the sampler will complete blank labels. Blank labels require that the sampler obtain the sample number, laboratory analysis required, preservation, and filtration information from the sample coordinator. The date and time of sample collection can then be completed by the sampler at the time of sample collection. All sample times are to be recorded in military time format. A blank copy of sample labels is presented in Attachment 1.

Analysis Request and Chain-of-Custody Record

The Analysis Request and Chain-of-Custody Record is used to specify to the laboratory the required analyses and is also used to document the transfer of custody from the field personnel to the laboratory. The sampling team, Sample Coordinator, and QCSM will maintain the overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the on-site screening facility and/or fixed-based laboratory. The Analysis Request and Chain-of-Custody Record will accompany the samples in shipment. For reference, a copy will be maintained at the site, while the original document will be sent to the Knoxville, Tennessee, office for filing. Attachment 2 includes a copy of a blank form.

Groundwater Level Measurement Form

Groundwater level measurements will be recorded on either the Field Activity Daily Log or a preprinted groundwater level measurement form. If a preprinted form is used, then the form must be referenced in the Field Activity Daily Log. A completed groundwater level measurement form will fulfill the basic documentation requirements found in Section 5.2. In the event that multiple groups are utilizing the sample preprinted form, the monitoring wells not measured by any specific sampling group will be lined out and initialed. One diagonal line will suffice for regional locations. Details on completion of groundwater measurements can be found in SOP No. 16.0, *Groundwater Level Measurements*.

Continuous Water Level Measurement Forms

Data from continuous water level measurements are recorded in a field form designed for this specific task. Specific details on continuous water level measurements can be found in SOP No. 14.0, *Continuous Water Level Monitoring*.

5.4.3 Other Forms

A variety of other forms are used to document day-to-day site activities. A list of the forms discussed in this section is presented below.

1. Variance Report
2. Nonconformance Report

3. Photographic Documentation Log
4. Vehicle Inspection Form
5. Vehicle Usage Log
6. Container Log for IDW
7. Daily Site Log.

Variance Report

Changes (variances) to any approved work plan may be initiated whether in the field or in the office. The QCSM or designee will initiate field variances. The Task Manager or Technical Lead will initiate variances to the project plans that are from the office. All field variances will be noted on the Field Activity Daily Log at the time the situation is found and will be recorded on a Variance Report. Attachment 1 includes a blank Variance Report. Variances will be approved by the contractor's Project Manager, the contractor's QA/QC Manager, and the USACE Contracting Officer Representative prior to implementation of the change. Variances that affect the project scope, cost, or the schedule must be approved by the USACE before being implemented. Tables included in plans that may be affected by site conditions should also include asterisks (*) language that would indicate possible field changes.

Nonconformance Report

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency or deviation that renders the quality of an item or activity unacceptable or indeterminate. The originator of a Nonconformance Report will describe the finding on the form provided for this purpose and will notify the contractor's Project Manager and QA/QC Manager. Each nonconformance will be reviewed and a disposition given for the time, activity, or condition. The disposition of a nonconformance will be documented and approved by the organization responsible for the issuance of the nonconformance. A blank Nonconformance Report is included in Attachment 1.

Photographic Documentation Log

There are two types of photographic documentation media at RSA—digital and print. Digital photographs of development water and site activity photos are to be recorded on a photographic documentation log. A copy of this log will be included with the media storing the photographs. Conventional print photographs are to be logged on a photographic documentation log. This log will include a description of the photographs taken, date, time, and other pertinent information.

Vehicle Inspection Form

A Daily Vehicle Inspection form is to be completed. This form documents that the vehicles used by the project are in good condition and it is also used to identify problems for repair. A blank version of this form is in Attachment 1.

Vehicle Usage Log

The vehicle usage log is completed daily for all rental vehicles used during field operations at RSA. This log documents the vehicles used for each individual project so that the charges for these vehicles can be accurately applied to the projects.

Container Log for IDW

All solid and liquid IDW generated at RSA must be tracked for proper final disposition. The Container Log for IDW documents the IDW type, date generated, generation site, date sampled, IDW container type, unique IDW container number (assigned by the CB&I QCSM), and initial characterization (hazardous or nonhazardous) based on generator/site knowledge. One of these logs is to be completed for each workday when IDW is generated. A blank form is included in Attachment 1.

Daily Site Log

A sign in/sign out sheet is used to document the presence of all personnel on site. Daily sign in and sign out is mandatory and includes recording of the printed name, signature, affiliation, and time of arrival and departure. One of these logs is to be completed for each workday. Examples of blank logs are included in Attachment 1.

Other Field Paperwork

Through the course of the project, it may be necessary to generate additional field forms and other paperwork. These forms will follow the basic requirements in Section 5.2.

5.5 General Records Requirements

Records generated as a result of this SOP will be controlled and maintained in the project record files.

All deletions should be marked through with a single line and initialed. Correction fluid or other methods of obliterating an entry on a form or Field Activity Daily Log are not acceptable.

It is to be noted that the philosophy of documentation is that if an activity or process is not documented, it never occurred.

6.0 EXCEPTION PROVISIONS

Field Activity Daily Logs will be used instead of field notebooks as specified in EPA (1986) and EPA (1980). The Field Activity Daily Log will be used to record the same information that would be recorded in a field notebook.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

Hazardous Waste Remedial Action Program, 1996, *Standard Operating Procedures for Site Characterization,* DOE/HWP-1OO/R1, September.

U.S. Army Corps of Engineers (USACE), 1998, Monitoring Well Design, Installation, and Documentation, at Hazardous, Toxic, and Radioactive Waste Sites, EM 1110-1-4000, November.

U.S. Environmental Protection Agency (EPA), 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01, August.

U.S. Environmental Protection Agency (EPA), 1987, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

U.S. Environmental Protection Agency (EPA), 1986, Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document, EPA/PB87-107751.

U.S. Environmental Protection Agency (EPA), 1980, Procedure Manual for Ground Water Monitoring at Solid Waste Disposal Facilities, SW-611, December.

U.S. Environmental Protection Agency (EPA) Field Branches Quality System and Technical Procedures, available at the following URL: http://www.epa.gov/region4/sesd/fbqstp/index.html.

8.0 TABLES

None.

9.0 ATTACHMENT

- Attachment 1, Examples of Blank Field Forms Referenced in this SOP.

ATTACHMENT 1

EXAMPLES OF BLANK FIELD FORMS REFERENCED IN THIS SOP

This page was intentionally left blank.

FIELD ACTIVITY DAILY LOG

PROJECT NAME:

Project Name:		**Project Number:**			
Contract No.:		**Project Location:**	Redstone Arsenal, Madison County, AL		
Delivery Order:		**Daily Report Date:**		**No.:**	

KEY PROJECT PERSONNEL - *update as applicable to the delivery order*	
Project Management Personnel	
CEHNC COR/PM	
CEHNC PM Specialist	
CEHNC Geophysicist	
RCMD PM	
RSA Site Manager	
USAEC Environmental Restoration Manager	
CASO, AMSCM, WASAS	
CARA PM/Site Supervisor	
Contractor Program Manager	
Contractor Corporate Quality Management	
Contractor Project Manager	
Contractor Technical Manager	
Contractor Geophysicist	
Subcontractor PM	
Field Personnel	
CEHNC Ordnance & Explosives Safety Specialist (OESS)	
Contractor Senior UXO Supervisor (SUXOS)	
Contractor UXO Safety Officer (UXOSO)	
Contractor UXO Quality Control Specialist (UXOQCS)	

1.0 General Information						
1.1 Weather						
Temperature:						
Clear □	Fog □	Cloudy □	Rain □	Snow □	Windy □	______ mph

1.2 Summary of Activities	
Time	**Description of Activities**

1.3	**Daily Health and Safety Briefing Conducted? (file in site office)**	**Yes** ☐	**No (supply reason in notes)**
1.4	**Any safety incidents or near misses?**	**Yes (explain in notes)**	**No** ☐
Notes:			
1.5	**Work Planned for Next Work Day**		

2.0 Personnel Record

2.1 Field Personnel (*excluding Site Visitors*)

Name	Organization	Position	Comments	On-site (Y/N)	Hours

2.0 Personnel Record					
2.1 Field Personnel (*excluding Site Visitors*)					
Name	**Organization**	**Position**	**Comments**	**On-site (Y/N)**	**Hours**

2.2 Site Visitors			
Name	**Organization**	**Purpose of Visit**	**Safety Brief (Y/N)**

3.0 Equipment Onsite					
3.1	**Vehicles**				
Vehicle	**Source**	**VIN**	**Assigned to:**	**On Site:**	**Off Site:**

3.2	**Contractor Rental Equipment On Site**			
Equipment Type	**SS#**	**Vendor**	**On Site:**	**Off Site:**

3.3	**Subcontractor Equipment On Site**			
Equipment Type	**SS#**	**Vendor**	**On Site:**	**Off Site:**

3.0 Equipment Onsite

4.0 List of MEC Recovered to date

Date	Type (mod/mark required)	QTY	Location	Date of Demo

5.0 Demolition Materials Accounting

Delivered Item	QTY	QTY Used	QTY Stored

6.0 Completion Status of Site Activities

Activity	Estimated/Total	Completed Today	Cumulative	Percent Complete	Comments

7.0 Exposure Data				
Company	**Daily Total for Week Ending – X/X/20XX**		**Cumulative**	
	Hours	**Miles**	**Hours (total)**	**Miles (total)**

8.0 Instructions from Government Personnel
None

9.0 Signatures		
Signed by:		
	________________________(SUXOS, Contractor)	**Date**
	_______________(Project Manager, Contractor)	**Date**

Safety Meeting/Training Attendance Log

Date:		**Time:**		**Conducted by:**	
Site Name/Location:					
Contract Number:		**Delivery/Task Order Number:**			
Project Manager:		**Site Manager** (when applicable)**:**			
(Senior) UXO Supervisor:		**Site Safety Officer/Unexploded Ordnance Safety Health Officer:**			

Training Provided:
☐ Initial Site Hazard ☐ Daily Safety Meeting ☐ Other:
☐ Weekly Safety Training ☐ Task/Hazard Specific

Weather Conditions: ☐ Fair ☐ Poor
Temperature (Low/High): to °F
Wind speed: mph
Direction:
Precipitation: %
Humidity: %

I. TRAINING TOPICS COVERED

☐ Planned Site Activities	☐ Heat or Cold Stress	☐ Respirator Use
☐ Demolition Operations	☐ Biological Hazards	☐ Decontamination Procedures
☐ Site Controls	☐ Chemical Hazards	☐ Emergency Procedures/Route
☐ Exclusion Zone/Personnel Limits	☐ Routes of Chemical Exposure	☐ First Aid Procedures
☐ Site Communications	☐ Chemical Exposure Symptoms	☐ Buddy Team Procedures
☐ Physical Hazards	☐ Level/Type of PPE	☐ Other (describe topic(s) below)

Explain: ____
____.

Hospital/Clinic:	**Address:**	**Phone:**

II. SITE PERSONNEL / TRAINING ATTENDEES (Continued on 2nd page)

	Name	Signature	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

III. SAFETYBRIEF / TRAINING VERIFICATION

I certify that the personnel listed on this roster have received the safety and health training described above.

______________________________ ______________________________

Site Manager or Senior UXO Supervisor   Site Safety and Health Officer or UXO Safety Officer

II. SITE PERSONNEL / TRAINING ATTENDEES (continued from 1st page)			
	Name	**Signature**	**Company**
11.			
12.			
13.			
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TAILGATE SAFETY MEETING LOG

DATE		TIME		TEAM NO.	
SITE NAME/LOCATION				GRID NO.	

1. Safety Topics Discussed:

☐	Site Description	☐	Environmental Concerns/Hazards
☐	Site Controls	☐	Emergency Procedures/Route
☐	Personal Protective Equipment	☐	First Aid Procedures
☐	Emergency Procedures/Equipment	☐	Injury Reporting
☐	Site Evacuation	☐	Safe Work Practices
☐	Physical/Biological Hazards	☐	Other:
☐	Heat or Cold Stress	☐	Other:
☐	Communication/Radio Procedure	☐	Other:

2. Task Operation and Remarks:

____

____

3. Attendees:

	Print Name	Signature	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Meeting Conducted by:	Signature:

EXCLUSION ZONE ENTRY LOG

Date: Client:

Location: Job No.:

Name	Time In	Time Out	Time In	Time Out	Time In	Time Out	Level of Protection

HEAT STRESS MONITORING LOG

NAME	DATE		Time	Time	Time	Time	Time
		Pulse					
		Temp					
		Pulse					
		Temp					
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DAILY PROJECT SAFETY INSPECTION REPORT

Project:____Date:____________________

Inspector Name: ____

Work Area Description: ____

____

Site Activities at Time of Inspection ____

____

____

	YES	NO	NA
FIRST AID			
1. Are first aid kit locations identified and accessible?	☐	☐	☐
2. Are emergency eye wash/safety showers available and inspected monthly?	☐	☐	☐
3. Are first aid kits inspected weekly?	☐	☐	☐
4. Is a qualified first aid/CPR provider on site?	☐	☐	☐
PERSONAL PROTECTIVE EQUIPMENT			
1. Have levels of personnel protection been established?	☐	☐	☐
2. Are respirators decontaminated, inspected, changed and stored according to standard procedures?	☐	☐	☐
3. Have employees been fit-tested?	☐	☐	☐
4. Is defective personal protective equipment tagged and taken out of service?	☐	☐	☐
5. Does compressed breathing air meet CGA Grade "D" minimum?	☐	☐	☐
6. Are there sufficient sizes and quantities of protective equipment? Coveralls, gloves, reflective vests?	☐	☐	☐
7. At a minimum, are employees utilizing safety glasses, hearing protection, hard hats, and safety toe boots, chemical protective gloves (if applicable) and following SSHP requirements?	☐	☐	☐
8. Is there protection against insects, sunburn, heat stress, cold stress, vibration and other environmental hazards? Shade, warming shelters, drinking water, work-rest regimen enforced?	☐	☐	☐
FIRE PREVENTION			
1. Are employees smoking only in designated outdoor areas?	☐	☐	☐
2. Are fire lanes established and maintained?	☐	☐	☐
3. Are flammable liquid dispensing systems bonded?	☐	☐	☐
4. Are approved safety cans available for storage of flammable liquids?	☐	☐	☐
5. Has the local fire department been contacted?	☐	☐	☐
6. Are flammables and combustibles properly stored?	☐	☐	☐
7. Are flammable storage cabinets available and used when needed?	☐	☐	☐
AIR MONITORING			
1. Is required air monitoring being conducted?	☐	☐	☐
2. Are air monitoring instruments calibrated daily?	☐	☐	☐
3. Are air monitoring logs up to date?	☐	☐	☐
4. Are instrument user manuals available?	☐	☐	☐
5. Are instruments being maintained?	☐	☐	☐
6. Are employees notified of personal sampling results within 5 days of receipt?	☐	☐	☐
7. Is dust being controlled?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ______________

	YES	NO	NA
WELDING AND CUTTING			
1. Are fire extinguishers present at welding and cutting operations? Is a fire watch assigned?	☐	☐	☐
2. Are confined spaces evaluated prior to and during cutting and welding operations?	☐	☐	☐
3. Have Hot Work Permits been completed?	☐	☐	☐
4. Are proper helmets, goggles, aprons, and gloves available for welding and cutting operations?	☐	☐	☐
5. Are welding machines properly grounded?	☐	☐	☐
6. Are oxygen and fuel gas cylinders stored a minimum of 20 feet apart?	☐	☐	☐
7. Are only trained personnel permitted to operate welding and cutting equipment?	☐	☐	☐
8. Are gas cylinders transported in a secured vertical position with caps in place?	☐	☐	☐
9. Is there adequate ventilation to prevent inhalation of metal fume (manganese)?	☐	☐	☐
HAND AND POWER TOOLS			
1. Are defective hand and power tools tagged and taken out of service?	☐	☐	☐
2. Is eye protection available and used when operating power tools?	☐	☐	☐
3. Are guards and safety devices in place on power tools?	☐	☐	☐
4. Are power tools inspected before each use?	☐	☐	☐
5. Are non-sparking tools available when necessary?	☐	☐	☐
6. Is the correct tool being used for the job?	☐	☐	☐
MOTOR VEHICLES			
1. Are vehicles clean and regularly inspected?	☐	☐	☐
2. Are personnel licensed for the vehicles they operate?	☐	☐	☐
3. Are unsafe vehicles tagged and reported to supervision?	☐	☐	☐
4. Is vehicles safety equipment operating properly?	☐	☐	☐
5. Are loads secure?	☐	☐	☐
6. Are vehicle occupants using safety belts?	☐	☐	☐
7. Are current insurance cards and blank accident report forms located in vehicles?	☐	☐	☐
EMERGENCY PLANS			
1. Are emergency numbers posted?	☐	☐	☐
2. Have emergency escape routes been designated?	☐	☐	☐
3. Are employees familiar with the emergency signal?	☐	☐	☐
4. Has the emergency route to the hospital been established and posted?	☐	☐	☐
5. Is a vehicle on site that can transport injured employees to the hospital?	☐	☐	☐
6. Is there emergency support documentation (written agreements, telephone conversation log)	☐	☐	☐
MATERIALS HANDLING/ MANLIFTS/OPERATOR EQUIPMENT QUALIFICATIONS			
1. Are materials stacked and stored to prevent sliding or collapsing?	☐	☐	☐
2. Are tripping hazards identified?	☐	☐	☐
3. Are semi-trailers chocked?	☐	☐	☐
4. Are fixed jacks used under semi-trailers?	☐	☐	☐
5. Are riders prohibited on materials handling equipment?	☐	☐	☐
6. Are approved manlifts provided for the lifting of personnel?	☐	☐	☐
7. Are personnel in manlifts wearing approved fall protection devices?	☐	☐	☐
8. Are only qualified operators utilized i.e., forklift trained, heavy equipment, crane operator? Documentation of qualification?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ________________

	YES	NO	NA
FIRE PROTECTION			
1. Has a fire alarm system been established?	☐	☐	☐
2. Do employees know the location and use of all fire extinguishers?	☐	☐	☐
3. Are fire extinguisher locations posted?	☐	☐	☐
4. Are combustible materials segregated from open flames?	☐	☐	☐
5. Have fire extinguishers been professionally inspected during the last year?	☐	☐	☐
6. Are fire extinguishers visually inspected monthly?	☐	☐	☐
7. Has a fire drill occurred within the last 12 months?	☐	☐	☐
ELECTRICAL/CONTROL OF HAZARDOUS ENERGY			
1. Is electrical equipment and wiring properly guarded and maintained in good condition?	☐	☐	☐
2. Are extension cords kept out of wet areas?	☐	☐	☐
3. Is damaged electrical equipment tagged and taken out of service?	☐	☐	☐
4. Have underground electrical lines been identified by proper authorities?	☐	☐	☐
5. Has a lockout/tagout system been established?	☐	☐	☐
6. Are GFCIs being used on all temporary electrical systems and as needed?	☐	☐	☐
7. Are extension cords being inspected daily?	☐	☐	☐
8. Are warning signs exhibited on high voltage equipment (250V or greater)?	☐	☐	☐
9. Is adequate distance maintained from overhead electrical lines?	☐	☐	☐
10. Are switches, circuit breakers, and switchboards installed in wet locations enclosed in weatherproof enclosures?	☐	☐	☐
11. Are restricted or limited approach boundaries identified on electrical panels?	☐	☐	☐
12. Are authorized electricians trained in NFPA 70?	☐	☐	☐
13. Are only electrically rated tools being used for electrical work?	☐	☐	☐
CRANES/RIGGING/CRITICAL LIFTS			
1. Are cranes inspected daily prior to use?	☐	☐	☐
2. Are crane swing areas barricaded or demarked?	☐	☐	☐
3. Is all rigging equipment tagged with an identification number and rated capacity?	☐	☐	☐
4. Is rigging equipment inspection documented?	☐	☐	☐
5. Are slings, chains, and rigging inspected before each use?	☐	☐	☐
6. Are damaged slings, chains, and rigging tagged and taken out of service?	☐	☐	☐
7. Are slings padded or protected from sharp corners?	☐	☐	☐
8. Do employees keep clear of suspended loads?	☐	☐	☐
9. Are rated load capacities and special hazard warnings posted on crane?	☐	☐	☐
10. Are the records of annual crane inspection available?	☐	☐	☐
11. Has accessible areas within the swing radius of the rear of the crane been barricaded?	☐	☐	☐
12. Do crane operators have required training/certification?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ______________

	YES	NO	NA
COMPRESSED GAS CYLINDERS/PRESSURIZED SYSTEMS			
1. Are breathing air cylinders charged only to prescribed pressures?	☐	☐	☐
2. Are like cylinders segregated and stored in well ventilated areas?	☐	☐	☐
3. Is smoking prohibited in cylinder storage areas?	☐	☐	☐
4. Are cylinders stored secure and upright?	☐	☐	☐
5. Are cylinders protected from snow, rain, etc.?	☐	☐	☐
6. Are cylinder caps in place before cylinders are moved?	☐	☐	☐
7. Are fuel gas and oxygen cylinders stored a minimum of 20 feet apart?	☐	☐	☐
8. Are propane cylinders stored and used only outside of buildings?	☐	☐	☐
SCAFFOLDING/ AERIAL WORK PLATFORMS			
1. Is scaffolding placed on a flat, firm surface?	☐	☐	☐
2. Are scaffold planks free of mud, ice, grease, etc.?	☐	☐	☐
3. Is scaffolding inspected before each use?	☐	☐	☐
4. Are defective scaffold parts taken out of service?	☐	☐	☐
5. Have employees completed scaffold user training?	☐	☐	☐
6. On scaffolds where platforms are overlapped, is planking overlapped a minimum of 12 inches?	☐	☐	☐
7. Does scaffold planking extend over end supports between 6 to 18 inches (dependent upon platform length)?	☐	☐	☐
8. Are employees restricted from working on scaffolds during storms and high winds?	☐	☐	☐
9. Are all pins in place and wheels locked?	☐	☐	☐
10. Is required perimeter guarding (top rail, mid rail, and toe board) present?	☐	☐	☐
11. Has a competent person been designated to oversee scaffold construction?	☐	☐	☐
12. Are employees prohibited from moving mobile scaffold horizontally while employees are on them?	☐	☐	☐
13. Are all scaffold components manufactured by the same company?	☐	☐	☐
WALKING AND WORKING SURFACES AND GENERAL SITEHOUSEKEEPING			
1. Are ladders regularly inspected?	☐	☐	☐
2. Are access ways, stairways, ramps, and ladders clean of ice, mud, snow, or debris?	☐	☐	☐
3. Are ladders being used in a safe manner?	☐	☐	☐
4. Are ladders kept out of passageways, doors, or driveways?	☐	☐	☐
5. Are broken or damaged ladders tagged and taken out of service?	☐	☐	☐
6. Are metal ladders prohibited in electrical service?	☐	☐	☐
7. Are stairways and floor openings guarded?	☐	☐	☐
8. Are safety feet installed on straight and extension ladders?	☐	☐	☐
9. Is general housekeeping being maintained?	☐	☐	☐
10. Are ladders tied off?	☐	☐	☐
11. Are handrails and side rails installed along the unprotected sides of stairways having 4 or more risers or rising more than 30 inches?	☐	☐	☐
SITE SAFETY PLAN			
1. Is a site safety plan available on site or accessible to all employees?	☐	☐	☐
2. Does the safety plan accurately reflect site conditions and tasks?	☐	☐	☐
3. Have potential hazards been described to employees on site?	☐	☐	☐
4. Is there a designated safety official on site?	☐	☐	☐
5. Have all employees signed the safety plan acknowledgment form?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ______________

SITE POSTERS

	YES	NO	NA
1. Are the following posters displayed in a prominent and accessible area?			
A. Minimum Wage	☐	☐	
B. OSHA Job Protection	☐	☐	
2. Are all required state-specific posters displayed?	☐	☐	☐

SITE CONTROL

	YES	NO	NA
1. Are work zones clearly marked?	☐	☐	☐
2. Are support trailers located to minimize exposure from a potential release?	☐	☐	☐
3. Are support trailers accessible for approach by emergency vehicles?	☐	☐	☐
4. Is the site properly secured during and after work hours?	☐	☐	☐
5. Is an exclusion zone sign-in/sign-out log maintained?	☐	☐	☐
6. Are only personnel with current training and physicals permitted in exclusion or contamination reduction zone?	☐	☐	☐

HEAVY EQUIPMENT

	YES	NO	NA
1. Is heavy equipment inspected as prescribed by the manufacturer? Records available?	☐	☐	☐
2. Is defective heavy equipment tagged and taken out of service?	☐	☐	☐
3. Are project roads and structures inspected for load capacities and proper clearances?	☐	☐	☐
4. Is heavy equipment shut down for fueling and maintenance?	☐	☐	☐
5. Are backup alarms installed and working on mobile equipment?	☐	☐	☐
6. Have qualified equipment operators been designated? Licenses and training verified?	☐	☐	☐
7. Are riders prohibited on heavy equipment?	☐	☐	☐
8. Are guards and safety appliances in place and used?	☐	☐	☐
9. Are operators using the "three point" system when mounting/dismounting equipment?	☐	☐	☐

EXCAVATION

	YES	NO	NA
1. Has a "competent person" been designated to oversee excavation activities?	☐	☐	☐
2. Prior to opening excavations, are utilities located and marked?	☐	☐	☐
3. Has a professional engineer evaluated all excavations greater than 20 feet deep?	☐	☐	☐
4. Is there rescue equipment on site and accessible to the excavation area?	☐	☐	☐
5. Is excavated material placed a minimum of 24 inches from the excavation?	☐	☐	☐
6. Are the sides of excavations sloped or shored to prevent cave ins?	☐	☐	☐
7. Have excavations greater than 4 ft deep been monitored for hazardous atmospheres (i.e., LEL/O_2 deficiency, toxics)?	☐	☐	☐
8. Are ladders or ramps used in excavations over 4 feet deep?	☐	☐	☐
9. Are means of egress available so as to require no more than 25 feet of lateral travel?	☐	☐	☐
10. Are barriers, i.e., guardrails or fences, placed around excavations near pedestrian or vehicle thoroughfares?	☐	☐	☐
11. Is excavation inspected daily by competent persons and documented?	☐	☐	☐

CONFINED SPACES

	YES	NO	NA
1. Have employees been trained in the hazards of confined spaces?	☐	☐	☐
2. Are all confined spaces identified and labeled to prevent entry?	☐	☐	☐
3. Is a copy of the confined space entry procedure available?	☐	☐	☐
4. Has a rescue plan been established?	☐	☐	☐
5. Is an entry supervisor present at each permit-required entry?	☐	☐	☐
6. Are required extraction/fall protection devices being used?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ______________

	YES	NO	NA
DECONTAMINATION			
1. Are decontamination stations set up on site?	☐	☐	☐
2. Is decontamination water properly contained and disposed of?	☐	☐	☐
3. Are all pieces of equipment inspected for proper decontamination before leaving the site?	☐	☐	☐
4. Are shin/metatarsal guards being used during power washing activities?	☐	☐	☐
HAZARD COMMUNICATION			
1. Is there a copy of the HAZCOM procedure on site?	☐	☐	☐
2. Are there SDSs for required materials/chemicals present on site?	☐	☐	☐
3. Are all containers properly labeled, as to content, hazard?	☐	☐	☐
4. Have employees been trained in accordance with the HAZCOM procedure?	☐	☐	☐
5. Do employees (including subcontractors) know and understand the effects of exposure from the chemicals on site?	☐	☐	☐
6. Have all personnel signed the HAZCOM acknowledgment form?	☐	☐	☐
7. Is there an updated list of chemicals maintained on site?	☐	☐	☐
TRAINING			
1. Are tailgate safety meetings being conducted daily or before each shift?	☐	☐	☐
2. Are current training/medical records maintained on site?	☐	☐	☐
3. 40 hour and 8 hour refresher training certificates available, if applicable?	☐	☐	☐
4. 30 hour OSHA construction certificate available for SSHO?	☐	☐	☐
DOCUMENTATION			
1. Is an OSHA 300 Log maintained and the 300A posted during February 1 to April 30?	☐	☐	☐
2. Are accident report forms available?	☐	☐	☐
3. Is a copy of health and safety policy and procedures available on site?	☐	☐	☐
RADIOACTIVE MATERIALS/X-RAY GENERATING EQUIPMENT			
1. Is there a license or registration? (examples: Troxler gauge or XRF device)	☐	☐	☐
2. Is radioactive material stored on site?	☐	☐	☐
3. Is the radioactive material storage area posted with a sign stating “Caution Radioactive Materials”?	☐	☐	☐

DAILY PROJECT SAFETY INSPECTION REPORT
(continued)

Project: ______________________________ Date: ______________

All Negative Responses	Corrective Action	Assigned To	Date Assigned	Date Completed	Verified By

DESCRIBE POSITVE SAFETY OBSERVATIONS

Hot Work Permit

This Hot Work Permit is required for any operation involving open flames are producing heat and/or sparks and must be completed by the **Permit Authorizing Individual (PAI)** and posted at the site. Hot Work includes, but is not limited to: brazing, torch cutting, grinding, soldering, and welding. **If any of the following applicable precautions cannot be met, Hot Work is not permitted.**

HOT WORK DONE BY CONTRACTOR		
DATE:	CONTRACT	
LOCATION OF PROPOSED WORK:		
NATURE OF THE WORK		
NAME OF THE HOT WORK OPERATOR		
I verify the above locations been examined, the precautions checked on the required Precautions Checklist have been taken to prevent fire, and permission is authorized for the work.		
NAME OF THE PAI CONTACT#		
PERMIT REQUEST	DATE	TIME
PERMIT EXPIRES	DATE	TIME
SIGNATURE OF PAI		
CORPORATE HEALTH AND SAFETY APPROVAL		

REQUIRED PRECAUTIONS CHECKLIST

Approved
Expiration Date
Notes:

- ☐ Available sprinklers, hose streams, and extinguishers are in service/operable.
- ☐ Hot work equipment in good repair.
- ☐ Area supervisor notified

Requirements within 35 feet of work

- ☐ Flammable liquids, dust, lint and oil deposits removed.
- ☐ Explosive atmosphere in area eliminated
- ☐ Floors swept clean of combustibles
- ☐ Combustible floors wet down
- ☐ Remove other combustibles where possible. Otherwise protect with fire-resistant tarpaulins, screens or shields.
- ☐ All wall and floor openings covered
- ☐ Fire-resistant tarpaulins suspended beneath elevated hot work

Work on walls or ceiling/enclosed equipment

- ☐ Construction is non-combustible and without combustible covering or insulation
- ☐ Combustibles on the other side of walls moved away
- ☐ No danger exists by conduction of heat into another room or area
- ☐ Enclosed equipment is cleaned of all combustibles
- ☐ Containers purged of flammable liquids and vapors

Fire watch/hot work area monitoring

- ☐ Fire watch will be provided during and continuously for 30 minutes after work, including any work breaks
- ☐ Fire watch is supplied with suitable extinguishers
- ☐ Fire watch is trained in the use of this equipment and in sounding alarm
- ☐ Fire watch is required for joining areas, above and below
- ☐ Hot work area inspected 30 minutes at the job is completed

Other precautions taken

- ☐ Confined space entry permit required
- ☐ Area is protected with smoke or heat detection
- ☐ Ample ventilation to remove smoke/vapor from work area provided
- ☐ Lockout/ tag out provided

PERMIT-REQUIRED CONFINED SPACE ENTRY

CONFINED SPACE PRE-ENTRY INSPECTION CHECKLIST

DATE: ____________________ **CLIENT:** ____

SPACE LOCATION AND DESCRIPTION: ____

____

____ **SPACE NUMBER** ______________________
(IF APPLICABLE)

PURPOSE OF ENTRY: ____

JOB NUMBER: ____

CLIENT CLASSIFICATION: ☐ NON-PERMIT ☐ PERMIT REQUIRED ☐ UNKNOWN*
☐ NON-PERMIT DUE TO VENTILATION/MONITORING (Permit Space; Hazard Eliminated)

If permit required, reasons for classification**

ATMOSPHERIC

- ☐ Oxygen Deficient
- ☐ Oxygen Enriched
- ☐ LEL
- ☐ Flammable Dusts
- ☐ Toxics
- ☐ IDLH

ENGULFMENT HAZARDS

- ☐ Water/Liquids
- ☐ Solid Materials

INTERNAL CONFIGURATION

- ☐ Converging Walls
- ☐ Maze Construction
- ☐ Obstacle(s) in Space

OTHER RECOGIZED HAZARDS

- ☐ Energy/Mechanical
- ☐ Hot Work
- ☐ Use of Chemicals/Compressed Gases in Space
- ☐ Other Serious Hazard(s)**

List ____

____

Technical Notes:

____
____
____
____
____
____
____
____
____
____
____
____
____
____

*Space must be classified prior to entry

**If available, reference and/or attach Confined space Classification Form

PERMIT-REQUIRED CONFINED SPACE ENTRY

AIR MONITORING MEASUREMENTS

TESTS MADE	PERMISSIBLE ENTRY LEVEL	DEPTH	DISTANCE	BEFORE VENTILATION	AFTER VENTILATION
Oxygen	19.5% to 23.5%				
Lower Flammable Limit	<10%				
Carbon Monoxide	<25 ppm				
Hydrogen Sulfide	<11 ppm				
Hydrocarbons	<1ppm				

INSTRUMENTS

MAKE	MODEL	SERIAL NO.	CALIBRATION DATE

EQUIPMENT NECESSARY FOR ENTRY - CHECKLIST

EQUIPMENT	YES	NO
Confined Space Entry Permit Needed (Corporate Health & Safety Notified)	☐	☐
Authorized Entrants, Authorized Attendants, Entry Supervisor*	☐	☐
Lockout/Tagout Materials	☐	☐
Ventilation Fan, Hoses and Saddle Vent	☐	☐
Barriers, Danger Signs, Flags, Traffic Cones (devices)	☐	☐
Direct Reading Gas Monitor(s) with Current Bench Calibration	☐	☐
Safety Harness and Lifelines for Entrant and Standby Persons	☐	☐
Hoisting Equipment ☐ with Fall Protection	☐	☐
Fire Extinguisher (ABC)	☐	☐
First Aid and Infection Control Kit	☐	☐
Powered Communications ☐ Intrinsically Safe	☐	☐
Electric Equipment and Lighting ☐ Explosion Proof	☐	☐
Hardhat, Goggles, Boots, Gloves, Disposable Outerwear	☐	☐
Chemical Protective Clothing	☐	☐
Escape Bottles - 5 Minute/10 Minute (ESCBA)	☐	☐
Air Purifying Respirators with ESCBA	☐	☐
Supplied Air Respirators (Level B) ☐ Airline with ESCBA ☐ SCBA	☐	☐

***Please indicate dates of CSE training for authorized personnel**

PERMIT-REQUIRED CONFINED SPACE ENTRY

CONFINED SPACE RESCUE TEAM ☐ ONSITE ☐ OFFSITE

Name: ______________________ Phone Number: ______________________

Contact Person: ______________________ Estimated Response Time: ______________________

☐ Rescue Team notified and available to respond to entry site when:
- Entrants are not wearing supplied air respirators: AND
- Entrants are not exposed to obvious IDLH or potential IDLH conditions; AND
- Entrants can be expected to "self-rescue" under normal circumstances; AND
- No other need for a standby rescue team.

☐ Rescue team notified and staged at entry site when:
- Entrants are wearing supplied air respirators; OR/AND
- Entrants are exposed to obvious IDLH or potential IDLH conditions; OR/AND
- Entrants would be expected to have difficulty in "self-rescue."

Sketch Confined Space - Ventilation Points - Monitoring Points

A copy of this document shall be reviewed by the Confined Space Entry Team Prior to Entry.

Inspector Signature: ______________________ Date: ______________________

Project Manager: ______________________ Date: ______________________

TEST DATA

OXYGEN, FLAMMABILITY, AND TOXIC CONTAMINANT(S)

Time	Percent Oxygen	Percent LEL	______ (Other)	______ (Other)	______ (Other)	______ (Other)	Tester's Initials	Comments

TESTER'S SIGNATURE:

AUTHORIZED ENTRANTS

_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________
_____________________________ _____________________________

AUTHORIZED ATTENDANT(S)

____
____
____

RESCUE PERSONNEL

____
____
____

Diagram the confined space indicate location of manways and ventilators. Indicate location(s) where tests conducted.

) (Man-way
∞ Ventilator
X Test Location

ACCEPTABLE CONDITIONS

1. Entry Permit completely filled out 2. Oxygen between 19.5 and 23.5 3. Combustible gases below 10% LEL
4. Permissible Levels of toxic gases (list): 5. Other:

_____________________________ _____________________________ _____________________________
_____________________________ _____________________________ _____________________________
_____________________________ _____________________________ _____________________________
_____________________________ _____________________________ _____________________________

PRCS SAFE FOR ENTRY
Date/Time: ___________________________
Name of Entry Supervisor ______________________ Signature ______________________________
Current Entry Supervisor (if different) ____________________________
Entry Permit Expires (if longer that 1 shift): Date/Time ______________________________

ENTRY PERMIT CANCELED
Date/Time _________________ Signature _________________________________
Reason (X) ___Work Complete ___Authorized Conditions Not Met ___Incident

PROBLEMS DURING ENTRY AND RESOLUTION Please describe: ______________________________
____

RECLASSIFICATION TO NON-PERMIT-REQUIRED CONFINED SPACE
Describe hazard removal methods, without use of ventilation _______________________________________
____
TESTING VERIFICATION SHOWN AT TIME _____________ ON TESTED DATA CHART ABOVE
DATE/TIME ____________________ ENTRY SUPERVISOR SIGNATURE__________________________

REVIEWED BY:
Health and Safety Representative Signature ___________________________________ Date _________________

DAILY INSPECTION FOR FORKLIFTS AND TOW MOTORS

Forklift Identification:__________________Week of:__________________ Hours/Mileage:____________Inspector: __________

ITEM INSPECTED	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY		SATURDAY		SUNDAY	
	OK	*NR	OK	*NR	OK	*NR	OK	*NR	OK	*NR	OK	*NR	OK	*NR
Engine Oil Level/Fluids														
Hydraulic System (Level/Leaks)														
Fuel Connection														
Neutral Safety Switch														
Foot Brake (Pedal Holds)														
Parking Brake														
Steering														
Horn/Backup Alarm														
Lights														
Data Plate w/Lifting Capacity														
Clear of Extraneous Materials														
Fire Extinguisher														
Wheels & Tires														
Mast														
Carriage														
Chains (Condition/Proper Tension)														
Fork Adjusting Slides														
Inspectors Name and Employee No.														

ANY DISCREPANCIES MUST BE REPORTED TO MAINTENANCE!! KEEP ALL BODY PARTS INSIDE THE CAGE -- DRIVE CAREFULLY!!

*NR - Needs Repaired

Project: **Contract No.:** **Project No.:**
Location: **Client:**

DAILY EQUIPMENT INSPECTION REPORT

Type of Equipment:

Unit #: **SN:**

DATE:________________ **Hour Meter:_______________**

ITEM	PASS	FAIL	NOT APPLICABLE	REMARKS
Anti-Slip Steps				
Axles/Seals				
Backup Alarm				
Belts and Hoses				
Body				
Boom/Stick				
Bucket/Blade/Thumb				
Controls				
Cutting Edge				
Defroster/Heater				
Engine				
Filters/Separators				
Fire Extinguisher				
Fluid Levels				
FOPS/ROPS				
Fuel Level/Tank				
Handholds				
Horn				
Lights				
Mirrors				
Muffler				
Radiator				
Safety Signs				
Seat Belts				
Steering				
Tires/Tracks				
Windows				
Windshield Wipers				

ADDITIONAL INFO: ____

CONDITION OF THE ABOVE VEHICLE IS SATISFACTORY FOR USE: Y N (Circle)

Competent Operator Signature: ________________________ ______________________________

Print Signature

UTILITY MARK-OUT DOCUMENTATION

Project Name:______________________________ Location: ____
FTL Name:_________________________________ Date: ____
Utility Called:______________________________ Confirmation #: ____
Subcontractor:______________________________ Task/Activity: ____
County of work:_____________________________ Municipality of work: ____________________________________

Before work is done on any site, contact the appropriate local utility locating service (One Call, Miss Dig, Uloco, etc.) or a local utility contractor to have sub grade utilities marked. NOTE: Boring locations to be placed not in the public right of way are typically not marked out by the public utility mark out, and a private utility locate service must be engaged. Indicate to the utility locator the nearest intersecting street for the site: ____

____Confirmation No:______________________________.

List utility firms (public and private) and the utility they will mark.

Utility Marker Emergency Telephone Numbers Major Utilities Marked by Color Code			
Name of Utility Company	Utility	Color Code	Emergency Telephone Number
	Water	Blue	
	Gas	Yellow	
	Electric	Red	
	Telephone/Cable/ Communication	Orange	
	Sewer	Green	
"ALL UNDERGROUND UTILITIES MAY NOT BE LOCATED BY THE LOCAL UTILITY SERVICE." Accordingly, you must list other known utilities in the area that the "One Call" service will not contact:			

Attach photos of the area prior to placing boreholes.
Take photos of the area indicating minimum 5 feet hand dig, post hole dig, probe, GPR, or other.
NOTE: For any borehole, should 5 feet minimum clearance not be obtained, you must contact Business Line VP or equivalent (Operations Director or other on the Federal Business Line) and obtain a variance.

Completed by:

______________________	______________________	______________________
Name	Signature	Date

EMPLOYEE NOTIFICATION OF INDUSTRIAL HYGIENE MONITORING RESULTS

Employee Name ______________________________

Project Name ________________________________ Project No. ____________________

Project Manager ______________________________

Substance Monitored ____________ Date Monitored __________ Sample Number _______

Results ___________________ mg/m^3 ______________ppm Other _______________

Exposure Standard __________ mg/m^3 ______________ppm Other _______________

Protective Equipment Used ____

____

____

For instance where exposures were found to be in excess of an exposure limit, the following corrective action steps (engineer administrative, job techniques, etc.) are being taken to reduce potential future exposures:

____

____

____

____

____

____

____

H&S Representative: _________________ ___________________________ __________

Name Printed Signature Date

Employee Monitored: _________________ ___________________________ __________

Name Printed Signature Date

LOCKOUT/TAGOUT PROCEDURE

Equipment________________________________ Location________________________________

Date________________________________ Written by ________________________________

Make Notifications

Notify affected employee(s) that a lockout is required, the reason for the lockout, and the expected duration.

Take all necessary equipment, tools, and personal protective equipment to the job site.

Consider hazards associated with the work you will be doing and gather the tools and equipment needed to do the job safely.

Machine or Equipment Shutdown

Determine all sources of energy feeding into the machine or equipment. Describe the steps needed to shut down the equipment.

Isolation and Lockout/Tagout

Describe steps needed to isolate equipment from all energy sources, including the location(s) to apply lockout/tagout devices. If a lockout device cannot be applied, list the location of the tagout device and any additional precautions taken to ensure the level of safety is equal to that of a lockout device.

Release Stored Energy

List any devices that may contain stored energy and the process to safely release or contain this energy. Examples include, but are not limited to, capacitors, springs, hydraulic/pneumatic cylinders, and pressurized piping.

Verification of Isolation

To ensure that all energy sources have been isolated; 1) Ensure that no personnel can be exposed to operating machinery or equipment, 2) Operate all controls to ensure that the equipment will not operate. List all controls that need to be tested and all indicators that should be observed to ensure the equipment has been isolated from all energy sources. <u>CAUTION</u>: Ensure all controls have been returned to the <u>off</u> or <u>neutral</u> position upon completion of the test.

Jogging or Cycling (If applicable)

If, during repair or maintenance activities, the machine or equipment is required to be jogged or cycled, <u>list the location of lockout/tagout device(s) that can be removed</u> to accomplish this. Only the lockout/tagout devices absolutely necessary to allow the equipment or machine to be jogged or cycled should be removed. After the equipment or machine has been cycled or jogged, the lockout/tagout devices shall be reapplied and above steps shall be repeated prior to commencing work.

Release from Lockout/Tagout and Restoring to Service

- Make sure all tools and other materials have been removed.
- Make sure machines are fully reassembled and guards and other safety devices have been reinstalled.
- Check the work area to ensure that all employees are clear of the equipment or machine.
- Verify that all controls are in their neutral or off position.
- Each lockout/tagout device shall be removed from each energy isolation device by the employee who applied the device.
- Indicate here any steps needed to safely re-energize the machine or equipment.

- Notify all affected employees that the lockout/tagout devices have been removed and the machine or equipment is safe for use.

LOCKOUT/TAGOUT FOR ELECTRICAL EQUIPMENT

Project Name: ______________________ Project Number: ____________________

Job: ____

Device: ____

Location: ____

Authorized Person: ____

Site Supervisors: ____

PREPARATIONFORSHUTDOWN

1. Determine power type and shutoff location.
2. Determine if there is more than one energy source.
3. Determine magnitude of power (voltage).
4. Notify affected employees in the area that equipment wi1 1 be locked out for maintenance.
5. Shutoff power sources to machine.

LOCKOUT TAGOUT

6. Lock and tag main switches in the OFF position, remove fuses·.
7. Verify that no power is available to the equipment using a voltmeter, if necessary.
8. Drain devices such as capacitor banks.
9. Verify that these devices have no stored energy by use of the voltmeter.
10. Repair equipment.

RETURN TO SERVICE

11. Be sure all connections are made and any unused tools and equipment are removed.
12. Remove lock if necessary to verify machine is repaired. The maintenance employee, while verifying the machine is repaired cannot leave the immediate area.
13. Remove tag from machine.
14. Notify employees in the area that the equipment is available.

Signature: ____

Authorized Person: ____

Site Supervisor: ____

LOCKOU TAGOUT FOR STEAM, WATER, AND FLUID LINES

Project Name: ______________________ Project Number: ________________

Job: ____

Device: ____

Location: ____

Authorized Person: ____

Site Supervisors: ____

PREPARATION FOR SHUTDOWN

1. Determine types and shutoff location.
2. Determine if there is more than one energy source.
3. Determine magnitude of compressed air or gas.
4. Notify affected employees in the area that equipment will be locked out for maintenance.
5. Disconnect/shutoff main steam, water, or fluid lines to equipment.

LOCKOUT/TAGOUT

6. Lock and tag main supply (i.e. chaining through valve handle with lock) in the OFF position with a bleeder open on the load side.
7. Drain fluids from shutoff valves to equipment.
8. Repair equipment.

RETURN TO SERVICE

9. Be sure all connections are made and any unused tools and equipment are removed.
10. Remove lock if necessary to verify machine is repaired. The maintenance employee, while verifying the machine is repaired cannot leave the immediate area.
11. Remove tag from machine.
12. Notify employees in the area that the equipment is available.

Signature: ____

Authorized Person: ____

Site Supervisor: ____

LOCKOU TAGOUT PROCEDURE FOR SPECIFIC EQUIPMENT

Project Name: ________________________ Project Number: _________________

Equipment: ____

Cat. No. and Location: ____

Serial Number (if available): ____

Electrical: ______________________ Voltage: _____________ Location: ___________________

Describe: ____

Air (Type): ______________________________________ Location: ___________________

Describe: ____

Gases (Type): ____________________________________ Location: ___________________

Describe: ____

Steam (Type): ____________________________________ Location: ___________________

Describe: ____

Water: ____ Location: ___________________

Describe: ____

Fluids: ____ Location: ___________________

Describe: ____

Hydraulic: _______________________________________ Location: ___________________

Describe: ____

Stored Energy – Capacitors, Springs, Etc.: ____

Describe: ____

LOG DATA AND RETURN TO SITE SUPERVISOR

Excavation Inspection

THIS INSPECTION IS TO BE COMPLETED BY THE COMPETENT PERSON

EACH DAY THAT EMPLOYEES WILL BE ENTERING AN EXCAVATION.

Project Name:________________________________Project Number: ______________________________

Date:________________Time:___________________Competent Person: ___________________________

Soil Classification (see Soil Classification Worksheet): ___________________________________

Excavation Depth: ______________________________ Excavation Width: ______________________________

Type of Protective System Used: ____

		YES	NO	N/A
1.	**GENERAL:**			
	Surface encumbrances removed or supported			
	Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
	Hard hats, steel-toed boots, and safety glasses worn by all employees.			
	Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation.			
	Walkways over excavations 6 feet or more above lower levels are equipped with standard guardrails.			
	Warning vest or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic.			
	Employees required to stand away from vehicles being loaded or unloaded.			
	Warning system established and utilized when mobile equipment is operating near excavation edge.			
	Employees prohibited from going under suspended loads.			
2.	**UTILITIES:**			
	Utility companies contacted and/or utility locations delineated.			
	Underground installations protected, supported, or removed while excavation is open.			
3.	**MEANS OF ACCESS AND EGRESS:**			
	Lateral travel to means of egress no greater than 25 feet in trench excavations 4 feet or more in depth.			
	Ladders used in excavations secured and extended 3 feet above the edge of the trench.			
	Structural ramps used by employees designed by a competent person.			
	Structural ramps used for equipment designed by a registered professional engineer.			

4.	**WET CONDITIONS:**			
	Precautions taken to protect from the accumulation of water.			
	Water removal equipment monitored by a competent person.			
	Surface water or runoff diverted or controlled to prevent accumulation in the excavation.			
	Inspections made after every rainstorm or other hazard-increasing occurrence.			
5.	**HAZARDOUS ATMOSPHERE:**			
	Atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficient, combustible, or otherwise hazardous atmosphere.			
	Adequate precautions taken to protect employee from exposure to a hazardous atmosphere.			
	Testing conducted to ensure that the atmosphere remains safe.			
	Emergency equipment, such as breathing apparatus, safety harness and line, and basket stretcher readily available where hazardous atmosphere does exist.			
6.	**SUPPORT SYSTEMS:**			
	Materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads.			
	Materials and equipment used for protective systems inspected and in good condition.			
	Damaged materials and equipment used for protective systems inspected by a Registered Professional Engineer after repairs and before being placed back into service.			
	Protective systems installed without exposing employees to the hazards of cave-ins, collapses, or from being struck by materials or equipment.			
	Members of support systems securely fastened to prevent failure.			
	Support systems provided to insure stability of adjacent structures, buildings, roadways, sidewalks, walls, *etc.*			
	Excavations below the level of the base or footings approved by a registered professional engineer.			
	Removal of support systems progresses from the bottom, and members are released slowly as to note any indication of possible failure.			
	Excavation of material to a level of greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.			
	Shield system placed to prevent lateral movement.			
	Employees are prohibited from remaining in shield system during vertical movement.			
7.	**REMARKS:**			

RESERVICE & OPERATIONAL CHECKLIST FOR PRESSURE WATER JET CLEANING AND CUTTING EQUIPMENT

The following information shall be verified before starting work:

ITEM	DESCRIPTION	
1.	Date (Print):	
2.	Location:	
3.	Equipment being cleaned (Print):	
4.	Is the area, including the other end of unit being cleaned, properly	
5.	Have precautions been taken to protect all electrical equipment?	
6.	Is there any hazard to personnel resulting from damage to the equipment such as release of corrosive chemicals, flammable liquids, gases, or the like?	
7.	Are all fittings of the correct pressure rating?	
8.	Are all hoses of the correct pressure rating?	
9.	Are all fittings in good operating condition?	
10.	Are all hoses in good operating condition?	
11.	Are all nozzles free from plugging and in good operating condition?	
12.	Have precautions been taken to prevent line-mole reversal?	
13.	Is the filter on the pump suction clean and in good operating	
14.	Is there an adequate water supply?	
15.	Have precautions been taken against freezing?	
16.	Do all personnel have proper personal protective equipment for this job?	
17.	Do all personnel have proper training for this job?	
18.	Are all personnel qualified to perform this work?"	
19.	Has the complete hook-up been flushed and air removed from the system prior to installing the nozzle?	
20.	Has hook-up, including pipes, hoses, and connections, been pressure tested with water at the maximum operating pressure?	
21.	Is the dump system operating properly (will it dump when released)?	
22.	Are all control systems operational?	
23.	Is the location of emergency medical aid known?	

RESCUE SERVICE EVALUATION

Project / Location: ___________________________________ Project No.:_________
Identity of PRCS ____
Name of Rescue Service ____
Address ____
Contact Person/Phone Number ____
Required Response Time _____________ Estimated Response Time ____________
Availability of Rescue Service ____

PERFORMANCE EVALUATION (Observe Test Rescue and Answer Following Questions)

	YES	NO
Have all members of the service been trained in the potential hazards of the permit space(s), or of a representative permit space(s) from which rescue may be needed?		
Can team members recognize the signs, symptoms, and consequences of exposure to hazardous atmospheres that may be present in the permit space(s)?		
Is every team member provided with, and properly trained in, the use and need for PPE which may be required to perform permit space rescue?		
Are team members trained in the first aid and medical skills needed to treat victims overcome or injured by the types of hazards that may be encountered I the permit space(s)?		
Do all team members perform their functions safely and efficiently?		
Do rescue service personnel focus on their own safely before considering the safety of the victim?		
Can the rescue service properly test the atmosphere of the identified PRCS?		
Can the rescue personnel identify information pertinent to the rescue from entry permits, hot work permits, and MSDS?		
Has the rescue service been informed of any hazards to personnel that may arise from outside the space, such as those that may be caused by future work near the space?		
Can the rescue service safely perform rescue(s) from the identified PRCS?		
Does the rescue service have a plan for rescue from the identified PRCS?		
Is the plan adequate for all types of rescue operations that may be needed?		

I certify that the evaluated rescue service is equipped and capable of providing rescue services during entry activities for the identified PRCS.

Evaluator:

_____________________ _____________________________ ________________
Name Signature Date

REAL TIME AIR MONITORING RESULTS LOG

Location:____________________ **Project No.:**____________________ **Date:** ____________________

Instrument: Mfg/Model/Serial No.:____________________________________ **Calibrated by:** ____________________________________

REAL TIME AIR MONITORING RESULTS

Date	Instrument Operator	Time	Monitoring Results		Action Level Exceeded (Y or N)	Location/Activity	Corrective Actions
			Compound	Concentration			

Comments: ____

Calibration Q.C.: Calibrations are to be within □5% for validity.
Abbreviations: CO = carbon monoxide, %LEL = percent of the lower explosive limit, O_2 = oxygen

HTRW DRILLING LOG

DISTRICT						HOLE NUMBER
1. COMPANY NAME			2. DRILLING CONTRACTOR			SHEET 1 OF SHEETS
3. PROJECT			4. LOCATION			
5. NAME OF DRILLER			6. MANUFACTURER'S DESIGNATION OF DRILL			
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT			8. HOLE LOCATION			
			9. SURFACE ELEVATION			
			10. DATE STARTED		11. DATE COMPLETED	
12. OVERBURDEN THICKNESS			15. DEPTH GROUNDWATER ENCOUNTERED			
13. DEPTH DRILLED INTO ROCK			16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED			
14. TOTAL DEPTH OF HOLE			17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)			
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT	INSPECTOR	HOLE NUMBER
		SHEET OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)

PROJECT	HOLE NO

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

Temporary Piezometer

Project:
Location:
Client:
Subcontractor:
Driller:

Piezometer Number:
Site Locaiton:
Installation Date:
Northing:
Easting:
Project Number:

Top of Casing Stickup (ft):
Land Surface Elevation (ft):

Approximate Diameter
of Borehole (in):

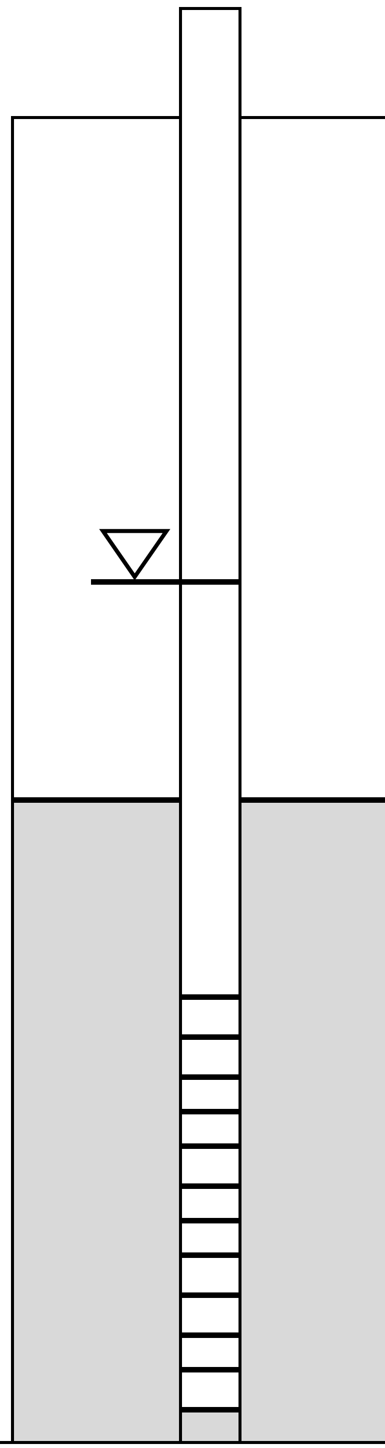
Well Casing Diameter (in):

Depth to Water (ft):
During Drilling:
Date:

Top of Bentonite (ft)
Top of Filler Pack (ft)

Top of Screen
Interval (ft)
Bottom of Screen
Interval (ft)

Bottom of Piezometer (ft)
Bottom of Filler Pack (ft):
Bottom of Borehole (ft):



Filler Pack Material:
Manufacturer:
Product Name:
Size:
Installation:
(Prepacked Screen/Filler
Sock/Gravity/Tremie)

Well Casing:
Manufacturer:
Type:
Diameter (in):

Well Screen Casing:
Manufacturer:
Type:
Slot Size (in):
Slot Type:
(Continuous/Factory Slot/Wrap)

Sump/End Cap:

Backfill Material:

Abandonment Date:

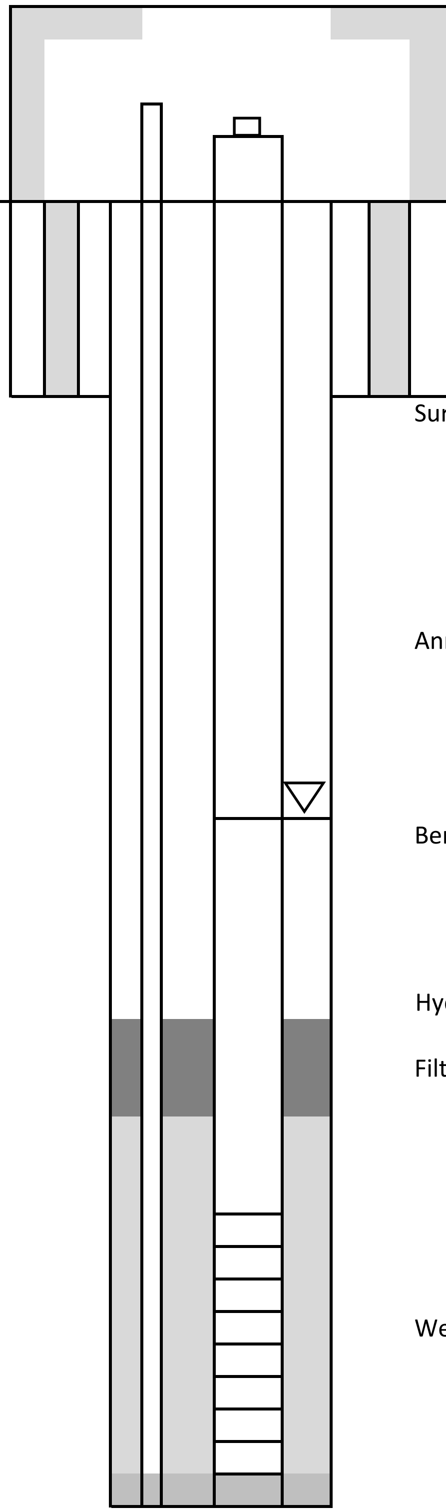
Procedure:
(Natual Fill/Grouted/Casing Removed)

Completed as Well:

Extraction Well Construction Form (Bedrock)

Project: ______________________
Location: ______________________
Client: ______________________
Subcontractor: ______________________
Driller: ______________________

Well Number: ______________________
Site Location: ______________________
Installation Date: ______________________
Northing: ______________________
Easting: ______________________
Project Number: ______________________



Top of Vault Elevation (ft): ________

Top of Measuring Tube Elev. (ft): ________

Approx. Diameter
of Section 1 Borehole (in): ________
Diameter of Surface Casing (in): ________
Depth to Bedrock (ft): ________
Bottom of Surface Casing (ft): ________

Well Casing:
Manufacturer: ________
Type: ________
Diameter (in): ________

Depth to Water (ft): ________
During Drilling: ________
Date: ________
Post Development: ________
Date: ________

Approx. Diameter of
Section 2 Borehole (in): ________

Well Cassing Diameter (ft): ________

Top of Bentonite Seal (ft): ________

Top of Filler Pack (ft): ________

Top of Screen Interval (ft): ________

Bottom of Screen Interval (ft): ________
Bottom of Well (ft): ________
Btoom of Filler Pack (ft): ________
Bottom of Borehole (ft): ________

Sump/End Cap: ________
Backfill Material: ________

Vault: ________
Dimensions: ________

Pump: ________
Manufacturer: ________
Type: ________
Size:
Shut off Sensor
Depth (ft): ________
Reset Sensor
Depth (ft): ________

Surface Casing:
Type: ________
Diameter (in): ________
Installation: ________
(Tremie/Haliburton/Cementing Plug/Other Plug)

Annular Space Seal:
Type: ________
Installation: ________
(6-in lift/One Section/Gravity/Tremie/Pumped)

Bentonite Seal:
Manufactturer: ________
Type: ________
(Pellets/ Slurry)
Installation: ________
Hydration time (hrs): ________

Filter Pack Material: ________
Manufacturer: ________
Product Name: ________
Size: ________
Volume added: ________
Installation: ________
(Gravity/Tremie)

Well Screen Casing:
Manufacturer: ________
Type:
Slot Size (in): ________
Slot Type: ________
(Continuous/Factory Slot/Wrap)

WELL CONSTRUCTION FORM
(STANDARD WELL)

FIELD REPRESENTATIVE: ______________________

DRILLING CONTRACTOR: ______________________

DRILLING TECHNIQUE: ______________________

AUGER SIZE AND TYPE: ______________________

BOREHOLE IDENTIFICATION: ______________________

BOREHOLE DIAMETER: ______________________

WELL IDENTIFICATION: ______________________

WELL CONSTRUCTION START DATE: ____________

WELL CONSTRUCTION COMPLETE DATE: ________

SCREEN MATERIAL: ______________________

SCREEN DIAMETER: ______________________

STRATUM-SCREENED INTERVAL (FT): ____________

CASING MATERIAL: ______________________

CASING DIAMETER: ______________________

TYPE OF FILTER PACK: ______________________

GRADIATION: ______________________

AMOUNT OF FILTER PACK USED: ________________

TYPE OF BENTONITE: ______________________

AMOUNT BENTONITE USED: ______________________

TYPE OF CEMENT: ______________________

AMOUNT CEMENT USED: ______________________

GROUT MATERIALS USED: ______________________

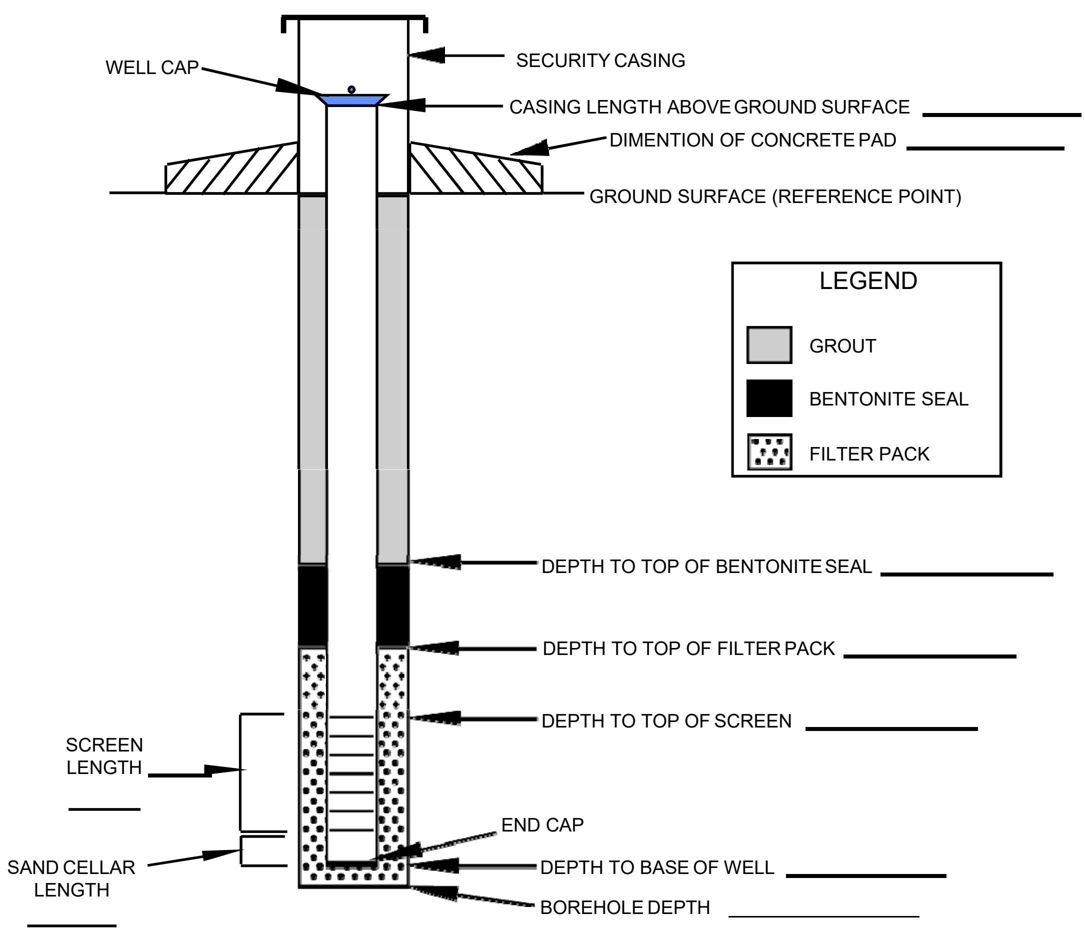
DIMENSIONS OF SECURITY CASING: ________________

TYPE OF WELL CAP: ______________________

TYPE OF END CAP: ______________________

COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: ______________________ INSTALLATION OBSERVED BY: ______________________

DISCREPANCIES: ____

WELL CONSTRUCTION FORM
(FLUSHMOUNT WELL)

FIELD REPRESENTATIVE: ______________________

DRILLING CONTRACTOR: ______________________

DRILLING TECHNIQUE: ______________________
AUGER SIZE AND TYPE: ______________________

BOREHOLE IDENTIFICATION: ______________________
BOREHOLE DIAMETER: ______________________
WELL IDENTIFICATION: ______________________

WELL CONSTRUCTION START DATE: __________
WELL CONSTRUCTION COMPLETE DATE: __________

SCREEN MATERIAL: ______________________
SCREEN DIAMETER: ______________________
STRATUM-SCREENED INTERVAL (FT): __________

CASING MATERIAL: ______________________
CASING DIAMETER: ______________________

TYPE OF FILTER PACK: ______________________
GRADIATION: ______________________
AMOUNT OF FILTER PACK USED: ______________________

TYPE OF BENTONITE: ______________________
AMOUNT BENTONITE USED: ______________________

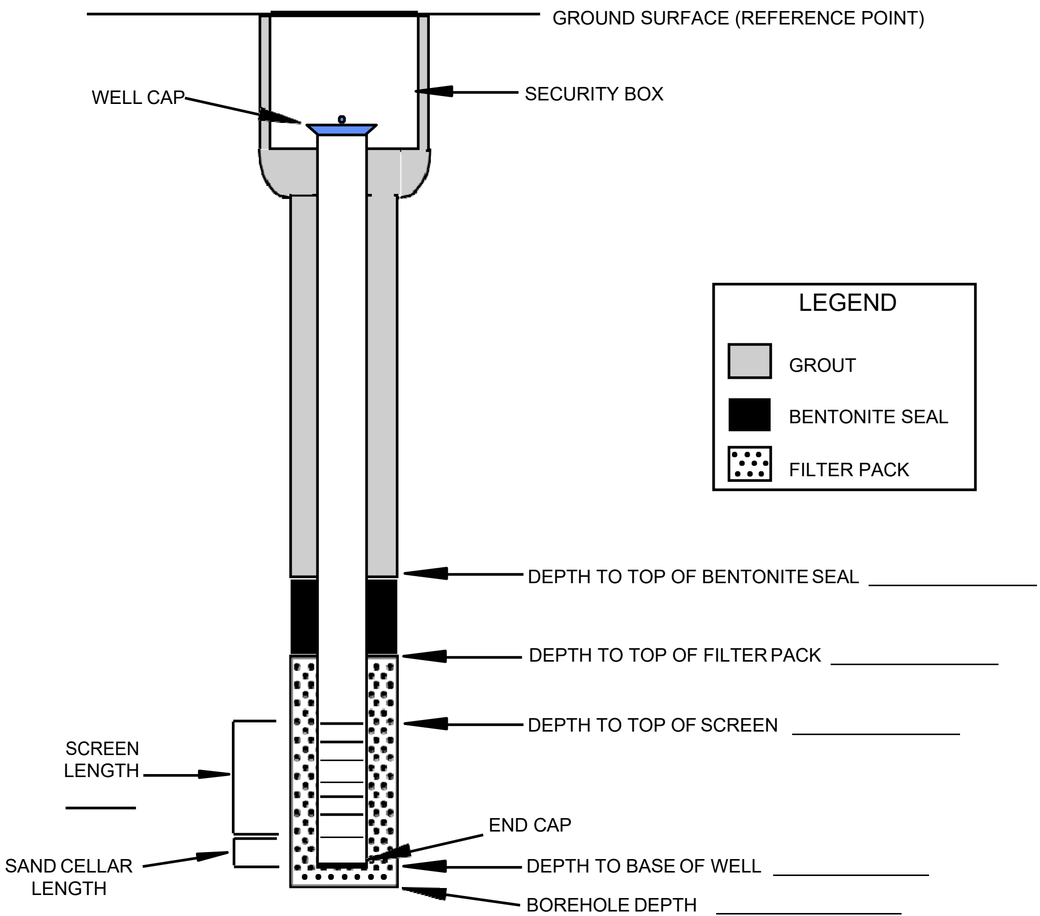
TYPE OF CEMENT: ______________________
AMOUNT CEMENT USED: ______________________
GROUT MATERIALS USED: ______________________

DIMENSIONS OF SECURITY BOX: ______________________

TYPE OF WELL CAP: ______________________
TYPE OF END CAP: ______________________

COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: ______________________ INSTALLATION OBSERVED BY: ______________________

DISCREPANCIES: ____

WELL DEVELOPMENT LOG

Site ID:	Well No.:	Page 1 of 2
Installation: Tooele Army Depot South		Location:
Project No.:	Client/Project:	
Development Subcontractor:		Drillers:
Start Date:	Completion Date:	Casing Dia.: 4 inch	Dev. Rig:
Developed by:	Log Book No.:	Pages:	Well Vol.:

Development method:

- Bailing
- Surging
- Bailing
- Pumping

Equipment:

- SMEAL development rig
- 10 foot long, 3.5 inch diameter stainless steel 3 gallon bailer
- Loose fitting surge block with a rubber disc
- 3 inch grundfose pump
- Solinist 500 foot water level meter / model 101 #

Date Stabilized Groundwater Depth Measured: ________/_______/_______. Pre-Dev. SWL______________ft.
Pre-Dev Total Depth____________ft. Post-Dev. SWL:_____________ft. Post-Dev. Total Well Depth:_____________ft.
Silt Removed:___________inches. Range and average discharge rate:_________________gpm.
Total quantity of water removed:___________gals. Maximum drawdown during pumping________ft. at_______gpm.
Disposition of discharged water:

Purge Data

Total depth__________- Depth to water________________= Column Height (ft.)______________x
Gal/ft *______= Well Volume___________+ Water Added_____________=_________x Number of
Volumes to be purged___________= Required purge Volume___________._Actual purge Volume _________

* PURGE CALCULATIONS: π(BOREHOLE RADIUS^2)- π(WELL RADIUS^2)

9-inch ID borehole with 4.5-inch ID well = 2.47 gallons / foot

Time	Volume Removed (gal.)	Water Level (ft TOC)	Turbidity (NTUs)	Clarity/ Color	DO mg/l	ORP mV	Temp. ºC	pH	Conductivity (mS/cm)	Remarks:

Calibration: Date / Time /

Water quality meter: YSI 556 / #16512

Ph: 7.00 / 4.00 / Conductivity: 1.413 mS/cm / ORP : 240 mV /

Turbidity meter: Hach 2100p 800 NTUs / 100 NTUs / 20 NTUs / <0.1 NTUS /

WELL DEVELOPMENT LOG (CONT.)

Site ID:	Well No.:	Page 2 of 2
Installation: Tooele Army Depot	Location: Sanitary Waste Landfill	

Time	Volume Removed (gal.)	Water Level (ft TOC)	Turbidity	Clarity/ Color	D.O. mg/l	ORP mV	Temp. ºC	pH (.)	Conductivity (mS/cm)	Remarks:

COMMENTS: ____

____

____

____

____

____

____

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID _ _______
PAGE_______of ________

PROJECT NAME:___________________PROJECT NO. : _______________________________ DATE: ________________________

LOCATION:________________________DATE INSTALLED: ____

TOTAL DEPTH (FTOC)______________CASING DIAMETER ____

MEASURING POINT HEIGHT ABOVE/BELOW GROUND LEVEL ____

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☐ Pumping ☐ Surge ☐ Describe____

Equipment decontaminated prior to development ☐ Yes ☐ No

Describe____

EQUIPMENT NUMBERS:

pH Meter _________________ EC Meter __________________ Thermometer ________________ Turbidity Meter _________________

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

Measured Well Depth Prior to Development (B)___________________________ft.

Measured Water Level Depth (C)_____________________ft.

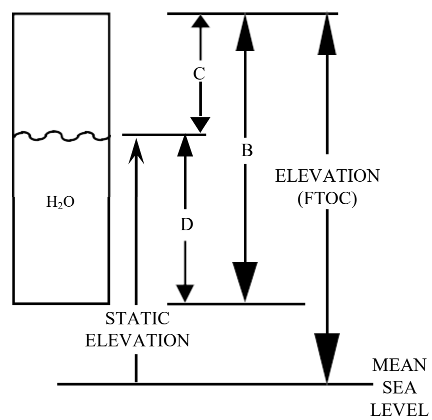
Length of Static Water Column (D)________-________=__________ft.
(B) (C)

Pumping

Casing Water Volume_________x_________=___________gal
(A) (D)

Total Purge Volume =__________(gal)

Measured Well Depth After Development (B)___________________________ft.



Time	DTW (feet btoc)	Flow Rate (gpm or lpm)	Gallons Removed	pH	Cond. (mS/cm)	Temp. (deg C)	Turbidity (NTU)	Notes

WELL ABANDONMENT FORM

Project:	Well No.:
Client:	Coordinates:
Project No.	N E

Date Begun:	Date Completed:	Prepared By:	Reference Point for Measurements:

Well Type: (circle one) Overburden Bedrock Extraction Temporary Other: ______________________	NOTES:

BEFORE ABANDONMENT

WELL CONSTRUCTION SUMMARY

Well No.:	Location:
TD:	Drilled By:
Date Completed:	Ground El.:
	TOC El:

AFTER ABANDONMENT

	NO	YES	N/A
Concrete Pad Removed			
Protective Posts Removed			
Surface Casing Removed			
Flush Mount Removed			

SITE SKETCH

LOW-FLOW GROUNDWATER PURGE AND SAMPLE LOG

Project No.:	Site ID:	
Installation:	Log Book No.	Pages:
Contractor:	Sampler(s)	
Purge Start Date: / / Time:	Purge End Date: / / Time:	
Weather: Wind mph Precipitation:	Air Temperature: °F	
Well Labeled: Y/N [ ] Well Secure: Y/N [ ]	Comments:	
PID SN:	Well Headspace (PID mu) Odor	
Water Level Instrument:	Serial No.:	
SWL beginning (BTOC):	WL After pump install (BTOC):	Max Drawdown (inches):
Well Casing 2" 4" 6" Other:	Borehole diameter:	Sandpack length (L): ft.
Screen Length:	Parameters Measured With:	
Water Column height (h): ft.	Total Purge Vol. Gallons	
Purge Method:	Max Purge Rate: L/min	Sampling Flow Rate: mL/min
Pump Type:	Pump Vol.:	Tubing Material:
		Vol./ft:
		Total ft.:
Flow-Through Cell Vol.:	Total Pump + Tubing + Cell Vol.:	
Casing radius:______(in)/12 =_______**r** (decimal ft)	Borehole radius:_____(in)/12 =______r (decimal ft)	

Well Casing Vol. = 3.14 x **r**(______)^2 x h(_______) x 7.48 (conversion from ft^3 to gal.) = gallons

Sandpack Vol. = 3.14 x r(_____)^2 x L(_____) x 7.48 – Well Casing Vol.(_____above) x 0.3 = gallons

Total Well Vol. = Well Casing Vol. (______above) + Sandpack Vol. (______above) = gallons

Depth of pump inlet (BTOC) and rational:

PURGE CYCLE

Actual Time	Elapsed Time	Volume Purged (gals)	Depth to Water (ft)	Depth of Pump Intake (ft)	Temp (°F)	pH	DO	ORP mV	Conductivity (µmhos/cm)	TDS ppm	Turbidity (NTU)	Comments

SAMPLE

Actual Time	Elapsed Time	Volume Purged (gals)	Depth to Water (ft)	Depth of Pump Intake (ft)	Temp (°F)	pH	DO	ORP mV	Conductivity (µmhos/cm)	TDS ppm	Turbidity (NTU)	VOC Collection Flow Rate

Sample Type:	Sample No.	
Sample Equipment	Sample Filtered: Yes [ ] No [ ]	Filter Type/Size:
Equipment Rinsate Sample No.:	Sample Equipment Decon: Date: by:	
Comments:		
Discharge Water Disposition:	Drum Number:	
Prepared by: Date: / /	Reviewed by: Date: / /	

PURGE CYCLE (CONTINUED)

Actual Time	Elapsed Time	Volume Purged (gals)	Depth to Water (ft)	Depth of Pump Intake (ft)	Temp (°F)	pH	DO	ORP mV	Conductivity (µmhos/cm)	TDS ppm	Turbidity (NTU)	Comments

Form FD 9000-24

GROUNDWATER SAMPLING LOG

SITE NAME:	SITE LOCATION:	
WELL NO:	SAMPLE ID:	DATE:

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet):	PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot X feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (gallons):

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (^{O}C)	COND. (circle units) µmhos/cm or µS/cm	DISSOLVED OXYGEN (circle units) mg/L or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT:	SAMPLING ENDED AT:
PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED: Y N Filtration Equipment Type:	FILTER SIZE:______µm
FIELD DECONTAMINATION: PUMP Y N	TUBING Y N (replaced)	DUPLICATE: Y N	

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

REFERNCE COC NO.:

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Project Name/No.:____________________ Sample Shipment Date:____________________ Bill To:_________________
Sample Team Member:________________ Laboratory Destination:____________________ _________________
Profit Center:_________________________ Laboratory Contact:_______________________ _________________
Project Manager:_____________________ Project Contact/Phone:_____________________ Report To:_______________
Purchase Order No.:__________________ Carrier Waybill No.:_______________________ _________________
Required Report Date:________________ __________________

Sample Number	Sample Time/Description	Date/Time Collected	Container Type	Preservative	Requested Testing Program	Condition of Receipt	RESULT > STEL ?

Special Instructions:

Possible Hazard Identification: Use caution when handling.

Non-haz:_____ Poison B: _____ Unknown: _____

Sample Disposal:

Return:____ Dispose at Lab:____ Archive:____

Turnaround Time:
Normal:_________ RUSH:___________

Level of QC Required:
I.______ II.______ III.______ Project Specific:______

1. Relinquished by: Date:_________________ Time:_________________

1. Received by: Date:_________________ Time:_________________

1. Relinquished by: Date:_________________ Time:_________________

1. Received by: Date:_________________ Time:_________________

Comments:

FIELD WORK VARIANCE

PROJECT NO.:	DATE:	VARIANCE NO.:
PROJECT NAME:	PAGE:	CONTRACT NO.:
DELIVERY ORDER NO.:		

PRESENT REQUIREMENTS: REQUESTED BY:

PROPOSED CHANGE:

TECHNICAL JUSTIFICATION:

COST/SCHEDULE IMPACT:

REASON FOR CHANGE:_______ADDITION _________DELETION

CHANGE ORDER
REQUIRED: _______NO _____YES CHANGE ORDER NO.
____

APPLICABLE DOCUMENT:

Cc: Distribution

APPROVED BY: DATE

APPROVED BY: DATE

APPROVED BY: DATE

FIELD WORK VARIANCE (FWV)
TRACKING LOG

FWV NO.	AFFECTED DOCUMENT	SUBJECT	DATE WRITTEN	DATE SUBMITTED	DATE APPROVED BY USACE	REMARKS

Nonconformance Report

No.:	**Nonconformance Report**
Division/Department:	Location:
Reported By: Date:	Date:
Part 1: Nonconformance	
Representative Notified:	Date Notified:
Date Corrective Action Plan Due:	
Nonconformance:	
Potential Harm:	
Part 2: Root Cause	
Part 3: Corrective Action Plan	
Corrective Actions:	
Actions to Prevent Recurrence:	
Estimated Completion Date:	
Responsible Manager Signature:	**Date:**
Quality Manager Signature:	**Date:**
Part 4: Corrective Action Closure	
Comments:	
Responsible Manager Signature:	**Date:**
Quality Manager Signature:	**Date:**

Photographic Log

Site Name	Picture	Specific Location	Activity Being Performed	Personnel in Picture	Date / Time

Unit #	______________	**Start Date**	______________
Mileage	______________	**Project #**	______________
Vehicle Type	______________	**License #**	______________
Inspected By	______________	**Fuel Front**	______________
Employee #	______________	**Fuel Rear**	______________

DAILY VEHICLE INSPECTION (Weekly Log)

N/A = Not Applicable C = Comments O = Okay N = Needs Attention	SAT	SUN	MON	TUE	WED	THU	FRI
Exterior/Interior Clean							
Lights: Head-Tail-Turn-Stop-Emergency-Back Up							
Operating Controls/ Gauges							
Battery/ Starter/ Horn							
Air Conditioner/ Heater/ Defroster							
Back-up Alarm (Trucks)							
Windshield, Other Glass, Wipers/Washer							
Mirrors: Inside-Outside (Convex-Trucks)							
Insurance Card & Accident Report Kit							
Emergency Phone Number List							
Map to Urgent Care Facility & Hospital							
Current Registration, Plates							
Service Brakes, Emergency/Parking Brake							
Trailer Aux. Brake Controller/Electrical Connection							
Coupling Devices/Safety Chain Anchor Point							
Wheel Chocks (When Equipped with Trailer)							
Engine Oil, Oil Pressure							
Transmission Oil & Drive Line							
Radiator/Cooling System							
Exhaust/ Muffler							
Front Axle/Steering/Suspension System							
First Aid Kit							
Fire Extinguisher (mounted/accessible/charged)							
Emergency Flares or Reflective Markers							
Tires/Wheels/Rims							
Spare Tire, Jack, Lug Wrench							
Frame/Bumpers							
Seat Belts (One for Each Passenger)							
Visible Damage to Body							
Driver Safety Notification Sticker							
Other, Please Enter Comments Below							

Was Unit Serviced? Yes/ No	Date Serviced	Miles

Comments: ______________________________

____

I have been authorized and I am licensed to operate this vehicle.

INSPECTORS SIGNATURE: ______________________ **DATE:** ______________

PLEASE REPORT ALL DEFICIENCIES TO YOUR SUPERVISOR

RETAIN THIS INSPECTION DOCUMENT IN PROJECT FILES

VEHICLE USAGE FORM	
EMPLOYEE NAME:	
VEHICLE NUMBER: ____	
USAGE	
DATE	
MILEAGE OUT	
MILEAGE IN	
TOTAL DAILY MILEAGE	
FUEL PURCHASED DOLLARS AND GALLONS	
DATE	
MILEAGE OUT	
MILEAGE IN	
TOTAL DAILY MILEAGE	
FUEL PURCHASED DOLLARS AND GALLONS	
DATE	
MILEAGE OUT	
MILEAGE IN	
TOTAL DAILY MILEAGE	
FUEL PURCHASED DOLLARS AND GALLONS	
DATE	
MILEAGE OUT	
MILEAGE IN	
TOTAL DAILY MILEAGE	
FUEL PURCHASED DOLLARS AND GALLONS	

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Subject: FIELD EQUIPMENT DECONTAMINATION

1.0 PURPOSE AND SUMMARY

The objective of this Standard Operating Project Procedure (SOP) is to describe the proper methods for decontaminating downhole and sampling equipment used to perform field investigations at Redstone Arsenal (RSA), Madison County, Alabama. Documents other than those required by the contract and consulted in the preparation of this SOP are listed in Section 7.0.

Decontamination of field equipment is necessary to ensure that chemical analyses reflect actual concentrations at sampling locations by maintaining the quality of samples and preventing cross-contamination. Furthermore, decontamination reduces the health hazards to field personnel and prevents the spread of contaminants off-site.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The QCSM is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure, as well as ensuring that all team members perform work in accordance with this procedure. The field team members are also responsible for communication of issues with the QCSM, Task Manager, and Technical Leads and for documenting change orders and directions.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance/Quality Control Manager is responsible for ensuring that this SOP is correctly implemented and that the quantity and quality of field equipment decontamination activities meet the requirements of the Site-Specific Field Sampling Plans.

4.0 DEFINITIONS

Decontamination – The process of removing or reducing undesirable physical and chemical constituents, from equipment or materials that come into direct contact with the sample media. Decontamination minimizes the potential for cross-contamination and ensures the representativeness of physical or chemical analyses proposed for a given sample.

Sampling Equipment – Sampling equipment includes split spoons, hand augers, bailers, submersible pumps, bowls, knives, scoops, water samplers, nondisposable filtration equipment, or any equipment that directly contacts samples.

Sample Contacting Equipment – Equipment that comes in direct contact with the sample or portion of the sample that will undergo chemical analyses or physical testing (for example, bailer, split-spoon sampler).

Potable Water – Tap water used for drinking purposes by the general population.

Deionized Water – Deionized, solvent-free water (ASTM International Type II or equivalent). Deionized water can be produced on site by using a mobile deionization/organic filtration system.

Detergent – Laboratory grade, phosphate-free detergent for washing equipment (Liquinox® is recommended, as the other commonly used detergent, Alconox®, is not phosphate-free).

5.0 TEXT

5.1 Required Forms and Documentation

- Field Activity Daily Log
- Material Safety Data Sheets.

5.2 Required Materials, Equipment, or Supplies

Decontamination procedures for small equipment, downhole and heavy equipment, pumps, and downhole probes are separately described below. Each section also includes the required materials, equipment, and supplies.

5.3 Specific Requirement for Small Sampling Equipment

Before samples are collected, small sample-contacting equipment will be decontaminated appropriately. Small sampling equipment includes trowels, split spoons, bailers, knives, mixing bowls, etc. Equipment necessary to complete decontamination procedures includes:

- Six 5-gallon or larger plastic buckets or troughs
- Laboratory-grade detergent (phosphate free, Liquinox recommended)
- Three stiff-bristle brushes capable of cleaning the inside and outside of equipment
- Teflon® sprayers or wash bottles or 2-gallon (to 5-gallon) manual pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Aluminum foil
- Potable water
- Deionized water
- Ten percent nitric acid solution made from reagent grade nitric acid and deionized water (use only on glass, Teflon, or stainless steel)
- Methanol (pesticide-grade) to be used only on glass, Teflon, and stainless steel (may degrade rubber, polyethylene, etc.)
- Hexane (pesticide-grade) to be used only on glass, Teflon, and stainless steel (may degrade rubber, polyethylene, etc.)
- Isopropanol (ASC reagent grade) to be used only on glass, Teflon, and stainless steel (may degrade rubber, polyethylene, etc.)
- Clorox™ bleach (to be used for removing dye)
- Gloves, goggles, and other personal protective equipment (PPE) as specified in the Site-Specific Health and Safety Plan.

The following decontamination procedures will be followed:

1. Set up a decontamination line on plastic sheeting covering the ground or on a table covered by plastic sheeting or aluminum foil (shiny side away from equipment). At minimum, use clean plastic sheeting to cover the ground beneath decontamination equipment and plastic sheeting or aluminum foil to cover tables or other surfaces where decontaminated equipment is to be placed. Locate the decontamination area away from potential contaminant sources (e.g., construction areas or the flight line) to reduce or eliminate potential cross-contamination during decontamination. The decontamination area should progress from “dirty” to “clean” and end with an area for drying equipment.
2. Set up a decontamination line consisting of the six buckets or troughs in one line. The first bucket will contain a detergent solution. The next two buckets will contain potable water for rinses. The next three buckets will be used to collect liquids from deionized water, nitric acid, and methanol rinses, respectively.
3. Dislodge as much loose dirt as possible from equipment before beginning the decontamination process. Wash the item thoroughly in the bucket or trough of detergent solution. Use a stiff-bristle brush to dislodge any clinging dirt. Before washing, disassemble any items that might trap contaminants internally.
4. Rinse in second bucket or trough containing potable water. Rinse water shall be replaced as necessary (generally when water is cloudy).
5. Repeat step 3 in the third bucket or trough for a second rinse.
6. Using a hand sprayer, rinse the item with deionized water over the fourth bucket.
7. Using a hand sprayer, rinse the item with a nitric acid solution in the fifth bucket. After the acid rinse, spray the item with deionized water over the same bucket.
8. Using a hand sprayer, rinse the item with methanol over the sixth bucket. An isopropanol rinse may be substituted for the methanol rinse to avoid the default generation of RCRA listed waste. A hexane rinse may be substituted for the methanol rinse or added as an additional rinse if gross contamination of the item by petroleum hydrocarbons is encountered. If hexane rinse is additional, collect the rinsate in a separate container. Do not rinse polyvinyl chloride (PVC), plastic or rubber items with methanol or hexane. Only glass, stainless steel, or Teflon items are to be rinsed with these solvents.
9. If the equipment will have time to air dry before its next use, allow it to fully air dry. If the equipment will not be allowed to fully air dry, rinse with deionized water over the last rinse bucket before reassembling or using any equipment.
10. If equipment will not be used immediately after drying, wrap in aluminum foil (shiny side out) for storage and transport.
11. Record decontamination protocol, equipment types, and date on the Field Activity Daily Log at each occurrence.

12. After the decontamination activities are complete, collect all contaminated waters, solvents, plastic sheeting, aluminum foil, disposable gloves, boots, and clothing. Place contaminated items in properly labeled containers for disposal. Liquids and solids must be drummed separately and handled in accordance with SOP No. 4.0, *Investigation-Derived Waste*.

5.4 Specific Requirement for Downhole and Heavy Equipment

Downhole equipment consists of nonsampling tools such as hollow-stem augers, drill pipe, bits, casing, and screen. Drill rigs, backhoes, and other heavy machinery are also included. Equipment necessary to complete decontamination procedures includes:

- Plastic sheeting or steel, prefabricated decontamination pad. (Decontamination pad construction requirements follow.)
- Metal, wooden, or plastic sawhorses or other stands
- Steam cleaner or high-pressure hot water washer capable of generating 2,500 pounds per square inch of pressure and producing steam or hot water (200 degrees Fahrenheit).
- Stiff-bristle brushes
- Potable water
- Gloves, goggles, boots, and other PPE as specified in the Site-Specific Health and Safety Plan.

Before drilling, sampling, excavating, leaving the site, and between locations, all drilling equipment used in field sampling activities must be decontaminated. All downhole augering, drilling, and sampling equipment shall be sandblasted (off-site) if it is new, painted, (such as split spoons or auger flights) or exhibits buildup of rust or caked material. Heavy equipment not directly used for sampling will be decontaminated at a designated area designed to contain decontamination wastes and waters. The following steps must be taken when decontaminating this equipment.

1. Set up a decontamination pad that is large enough (up to the size of the drill rig) to fully contain the equipment to be cleaned. If practical, a centralized decontamination area should be established. This area should be set up to contain contaminated rinse waters and may be constructed using one or more layers of heavy plastic sheeting, 6 mil or heavier, with bermed sides, a lined excavated pit, or a bermed concrete or asphalt pad. If possible, the area should be constructed to eliminate or minimize any overspray or wind-blown spray from decontamination activities (e.g., plastic sheeting secured to a wood frame surrounding the area). The decontamination area must be constructed so that fluids can be easily pumped from the area to holding containers.

2. Set up a "clean" area upwind of the decontamination pad to receive cleaned equipment for air drying. At minimum, clean plastic sheeting must be used to cover surfaces on which decontaminated equipment is to be placed.
3. Put on PPE as specified in the Site-Specific Health and Safety Plan before beginning cleaning activities.
4. For heavy equipment, areas exposed to contaminated soil should be sprayed using a steam spray unit. Be sure to spray down all surfaces, including the undercarriage. It is also good practice to clean the motor, hydraulic lift, oil fill, and fuel tank area to avoid introducing contamination at the work site.
5. For smaller equipment such as augers, place the objects to be cleaned on metal or plastic-covered metal sawhorses, supports, or decontamination trays. Using the steam-spray unit, spray the contaminated equipment. Be sure to spray inside corners and gaps especially well; use a brush, if necessary, to dislodge dirt.
6. For Steps 4 and 5, aim the sprayer downward as much as possible to avoid spraying outside the decontamination area.
7. If the condition of downhole or heavy equipment warrants using hot soapy water in the steam-spray unit, rinse the equipment with clean, clear potable water following the steam spray. If using steam spray without a detergent, the potable water rinse is not necessary.
8. Remove the equipment from the decontamination area to the "clean" area to dry.
9. Record decontamination protocol, equipment types, and date on the Field Activity Daily Log.
10. After decontamination procedures are complete, or any time the decontamination fluids fill the bermed or contained area, collect decontamination fluids and transfer them to appropriate containers. Place all plastic and PPE into appropriate containers. All containers must be labeled properly for disposal. Liquids and solids must be drummed separately and handled in accordance with SOP No. 4.0, *Investigation-Derived Waste*.

5.5 Specific Requirement for Pumps and Pump Assemblies

A pump will require decontamination if any potentially contaminated fluids come into contact with any part of the pump equipment. This requirement does not apply to peristaltic pumps because water does not contact any part of the pump. Only Teflon or Teflon-lined tubing should be reused for sampling after decontamination. If using PVC or polyethylene tubing, discard the tubing after each use unless the tubing is used for well development, where properly decontaminated tubing may be reused. Polyethylene or PVC tubing cannot be properly decontaminated, and potential for cross contamination during sampling remains high. This requirement also applies to the tygon tubing attached to the rollers of a peristaltic pump. The tygon tubing shall be discarded after use at a well.

The procedure provided below applies primarily to the decontamination of bladder pumps at the decontamination station established at the field office. A field setup may be implemented while decontaminating pumps other than bladder pumps or if frequent trips to the field office are not practical or cost effective. Equipment necessary to complete decontamination procedures include:

- Deionized water
- Plastic sheeting
- Source of electricity (generator or direct line)
- Compressor and controller for bladder pumps
- Three to five decontamination cells (4-inch-diameter PVC) for pumps and tubing
- Laboratory-grade detergent (phosphate free, Liquinox recommended)
- Clorox bleach (for pumps used in wells where dye has been introduced)
- Gloves, goggles, boots, and other PPE as specified in the Site-Specific Health and Safety Plan.

Following the use of a pump for development, purging, or sampling, the pump should be decontaminated by the following method.

1. Set up decontamination cells in a line on the plastic. Only three cells are required for normal decontamination; five cells are required for decontaminating pumps used in wells containing any kind of dye or that were used in sampling groundwater with volatile organic compound (VOC) concentrations greater than 0.5 percent the solubility limit for any individual VOC.
2. Add potable or deionized water with a small amount of detergent to the first container; add potable water or deionized water alone to the second container. Add deionized water to the third container. If decontaminating a pump used in a dye trace study well or that was used in sampling groundwater with VOC concentrations greater than 0.5 percent the solubility limit for any VOC, add Clorox bleach to a fourth cell and deionized water to a fifth cell. There should be sufficient water in each container to accomplish the decontamination procedure.
3. Decontamination cells may only be used to decontaminate one pump at a time. The cells must be cleaned, rinsed, and dried before and after each item is decontaminated.
4. For a field setup decontamination station, place one drum close enough to the decontamination area to collect the spent decontamination fluids.
5. Place the pump in the first container and pump enough water through it to equal at least three pump-and-tube volumes. Pump the water into the waste drum. Move the pump to the second container and repeat. Repeat again with deionized water in the third cell. However, one volume of deionized water is the minimum amount required for this rinse.

6. If necessary, place pump in the fourth cell containing Clorox bleach and pump at least three pump and pump-hose volumes. Repeat deionized water rinse in the fifth cell.
7. Record decontamination protocol, equipment types, and date on the Field Activity Daily Log.
8. After decontamination activities are complete, collect all contaminated water; solvents; plastic sheeting; aluminum foil; and disposable gloves, boots, and clothing. Place contaminated items in properly labeled drums for disposal. Liquids and solid wastes must be drummed separately and handled in accordance with the investigation-derived waste SOP No. 4.0.

5.6 Specific Requirement for Downhole Probes

Decontamination of downhole probes, such as water level indicators, pressure transducers, Trolls®, oil/water interface probes, etc., shall be based on the contamination expected in a well and on professional judgment.

5.6.1 Water Level Indicator

For decontaminating water level indicators during snapshot water level sweeps, follow the steps given below:

1. Carry a detergent solution and deionized water in two separate spray bottles.
2. Spray detergent solution in a piece of paper towel and deionized water in another piece of paper towel. This method involves wiping the water level indicator cable as it is pulled out of a well.
3. Grab the water level indicator cable with the two paper towels in your hands such that the detergent paper towel is below the deionized water paper towel.
4. Have a second person pull out the cable and roll it onto the carrying wheel.
5. Once the probe is out of the well, spray it first with the detergent solution and then with deionized water. Wipe with a clean paper towel and store in the carrying case.

5.6.2 Oil/Water Interface Probe

If an oil/water interface probe is used and oil was detected in the well, the probe and the cable should be decontaminated by immersing in the detergent and deionized water buckets. A methanol or hexane rinse may be added based on professional judgment.

5.6.3 Pressure Transducer/Troll

Decontamination procedures for pressure transducers and troll units will be based on site-specific conditions and will be similar to those described above for water level and oil/water interface indicator probes. If the contamination at a well is known or expected to be low or nonexistent, follow the procedures outlined for water level indicators. If, however, the contamination is expected to be high, a more thorough procedure, as described under the oil/water interface probe, shall be used.

5.7 Restrictions and Limitations

- Fluids from acid and solvent rinses must be stored separately until disposal options are determined.
- Purchased ionized water can be expensive. Deionized water can be produced on site with a mobile filtration system. All deionized water must have field-blank samples collected and analyzed at the proper frequency to ensure the purity of the water.

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0, Field Documentation

SOP No. 4.0, Investigation-Derived Waste

SOP No. 11.0, Field Generated Records Management

American Society for Testing of Materials (ASTM), 1990, Standard Practice for Decontamination of Field Equipment Used at Radioactive Waste Sites, D 5088-90, September.

U.S. Environmental Protection Agency (EPA), 1991, Handbook of Suggested Practices for the Design and Installation of Around-Water Monitoring Wells, EPA/600/4-89/034, PB 92-216886, March.

EPA Field Branches Quality System and Technical Procedures, available at the following URL: http://www.epa.gov/region4/sesd/fbqstp/index.html.

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Subject: INVESTIGATION-DERIVED WASTE

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) establishes specific management practices for the in-process handling and subsequent disposition of environmental media generated as a result of investigation and removal actions at Redstone Arsenal (RSA), Madison County, Alabama. Investigation-derived waste (IDW) will be handled in accordance with the most recent versions of Alabama Environmental Investigation and Remediation Guidance and Alabama Administrative Code (AAC) 335-14. This SOP serves as an update to IDW plans previously submitted to comply with Alabama Department of Environmental Management (ADEM) Consent Order No. 97-203-CHW for the management of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) IDW.

In support of RSA's Installation Restoration Program under the Federal Facilities Compliance Act of 1992 and CERCLA and to meet the requirements of RSA's Resource Conservation and Recovery Act (RCRA) permit, RSA is conducting investigation and removal activities which generate environmental media. The media typically consist of drill cuttings and fluids, monitoring well purge and development water, spent personal protective equipment (PPE), and other inert materials (i.e., plastic, rope, tape, paper, etc.) generated during operations, well installation and sampling activities, remedial actions, and associated site activities. When accumulated, the media must be managed appropriately to minimize the exposure to human health and the environment while adhering to applicable regulatory requirements.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITIES

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to their respective procedures. The QCSM is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members also perform work in accordance with this SOP.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance/Quality Control Manager is responsible for ensuring that this SOP is correctly implemented and that the quantity and quality of field- measurable physical characteristic samples collected meet the requirements of the Site-Specific Field Sampling Plans (SFSP).

4.0 DEFINITIONS

None.

5.0 TEXT

5.1 Required Records and Forms

For a description of required forms, refer to SOP No. 1.0, *Field Documentation*.

- Sample Collection Log (SCL)
- Field Activity Daily Log

- Sample tags/labels and the appropriate forms/documentation for sample shipment
- Material Safety Data Sheets (MSDS)
- SFSP.

5.2 Required Materials, Equipment, or Supplies

- Indelible black ink pens and markers
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Nitrile or latex gloves
- Decontamination equipment and supplies, including rinse bottles and deionized water
- Personal protective equipment (PPE)
- Socket wrench or bung wrench to access drums
- Appropriate equipment and meters for obtaining field measurements as specified in the SFSP (i.e., photoionization detector/flame ionization detector).

5.3 Procedures

5.3.1 Preparation

The following steps must be followed when preparing for management activities of IDW:

- Verify that all personnel have read and understand the approved Site-Specific Health and Safety Plan and have the proper training and certifications required under the Occupational Safety and Health Administration.
- Don the appropriate PPE as dictated by the Site-Specific Health and Safety Plan.
- Document the sampling events, recording the information on the SCL or equivalent form as specified. Document any and all deviations from standard operating procedures on the Field Activity Daily Log and include rationale for changes.

5.3.2 Specific Preparation

The following paragraphs detail the planned methodologies for dealing with environmental media generated during site activities. For the purpose of this document, a site, an area of contamination (AOC), and a solid waste management unit (SWMU) are all synonymous.

5.3.2.1 Initial Handling Requirements

All environmental media will be managed in an effort to minimize exposure to human health and the environment. Typically, the media will be generated as a result of these major activities: drilling soil borings; installation and development of monitoring wells; and groundwater sampling activities.

In instances where soil borings are advanced, either to retrieve soil samples or to allow for the retrieval of a groundwater sample via a hydropunch or similar sampling device (including obtaining a sample from an open borehole), the following handling protocols for IDW soil will be used:

- All soil cuttings will be placed adjacent to the borehole on plastic or other suitable material capable of preventing contact with the ground surface.
- All cuttings will be covered daily or during rainfall events to prevent contact with moisture.
- Upon completion of the downhole activity (i.e., drilling, groundwater sampling, etc.), the soil cuttings will be placed in open topped 55-gallon drums, labeled, sampled, and properly stored.

In cases where a soil test boring is advanced for the purposes of installing a monitoring well, all environmental media accumulated will be containerized to allow for characterization upon generation and situated at or near the point of generation. As solids are generated, they will first be placed into open-topped 55-gallon drums or other approved containers pending further characterization. Solids may be bulked into larger approved containers situated within the AOC. Liquids may be bulked upon generation unless directed otherwise. All solids and liquids will be separated prior to disposal.

Liquids may be held on site at the AOC or SWMU and are not required to be moved to a separate 90-day storage area. However, either the satellite accumulation restrictions regulating storage of less than 55 gallons or 90-day storage rules would apply to hazardous liquids that remain on the SWMU/AOC. Section 5.3.2.3 further discusses storage requirements. If hazardous liquids are stored on site, the satellite accumulation area or the temporary less-than-90-day storage area must meet ADEM requirements for secondary containment standards as noted in Section 5.3.2.3.

5.3.2.2 Labeling

After each container (i.e., drum, roll-off box, etc.) has been filled, the container and lid, if appropriate, will be labeled with a description of the media (i.e., soil, purge water, decon water, PPE), origin of media (i.e., Soil Boring A- 1, Monitor Well RS-0 1 2, etc.), date the media were placed in the container, site identification (i.e., SWMU or AOC number), date container was sealed and sampled, and a short statement stating that the contents are on hold waiting analytical test results. If the analytical results determine that the container contents are hazardous, a standard hazardous waste label will be placed on each container. The accumulation start date will be the same as the date recorded on the initial drum. A copy of correspondence (email) from ADEM clarifying their position on handling of potentially hazardous wastewater at RSA is provided as an attachment to this SOP. Nonhazardous waste containers may be labeled using a paint pen or other indelible marker that will not fade when exposed to weather. Hazardous waste containers will be marked with labels and information pursuant 40 Code of Federal Regulations (CFR) 262.34. A record of the number of containers, their contents, and the regulatory status of the waste will be completed at each generation site and will be included in the Field Activity Daily Log before leaving each site.

5.3.2.3 Storage

At the end of each day and/or field activity, all containers will be sealed or covered in such a way to prevent the introduction of rain water or surface runoff. Nonhazardous IDW will either be moved to a central IDW storage area, or, if feasible and in the best interest of operations, nonhazardous IDW will remain in the SWMU/AOC from where it was generated until final disposition is selected.

Within 72 hours of being generated, hazardous solid IDW will be moved to an RSA-approved Satellite Accumulation Area, a temporary 90-day storage area, or a fully permitted waste storage area. Wastewater IDW may be held at the AOC or SWMU in a temporary less-than-90-day storage area or it may be moved to a central 90-day storage area. Any temporary 90-day storage area established on an AOC or SWMU will meet ADEM’s secondary containment standards. Wastewater or solid hazardous IDW will be labeled during storage as discussed in Section 5.3.2.2.

Waste may be transported between storage areas when required or in preparation of disposal activities without specific regulatory concurrence (i.e., RSA is not required to obtain specific regulatory approval to transport wastes within the confines of RSA). Drums of hazardous wastewater will be removed from the AOC or SWMU in less than 90 days. All hazardous IDW will be shipped off site or properly treated and managed on site within 90 days of its accumulation start date.

5.4 Characterization of Media

The characterization of the media will be determined by a combination of generator knowledge and use of analytical data obtained during the activity from which the materials were generated. As stated, it is anticipated that specific generation activities will include soil borings, monitoring well installations, and monitoring well purge and development actions. Water obtained from specific monitoring well sampling points (i.e., purge and development water) will be characterized using groundwater sampling data taken from the specific well site from which the water was obtained. Analytical data obtained from a particular borehole reflecting soil contaminant levels will be used to characterize solids generated from that borehole. Other solids (such as rock) will be characterized for disposal based on the analytical results of the soil and water sampled at the specific location where the solids were generated. When appropriate, analytical data will be extrapolated to reflect toxicity characteristic leaching procedure (TCLP) values (i.e., 20x divisor rule for soils). Generator knowledge may be used to evaluate the media potential for toxicity, corrosivity, ignitability, reactivity, and listed waste scenarios.

In the event generator knowledge and data associated with previous site investigations are inadequate to accurately and thoroughly characterize the IDW, waste will be managed as hazardous waste. A representative sample will be retrieved from each waste stream warranting further characterization. In addition, representative samples will be collected from all IDW determined to be nonhazardous based on generator knowledge. These samples will be taken directly from containers after the waste has been generated. The suite of analyses to be run will be determined based on suspected contaminants and any information gleaned from previously available data. Hazardous versus nonhazardous determinations will be made utilizing those parameters outlined in AAC R. 335-14-2-.02, *Criteria for Identifying the Characteristics of Hazardous Wastes and for Listing Hazardous Waste*. More specifically, hazardous characteristics will be determined utilizing the requirements of AAC R. 335-14-2-.02 (1) and 335-14-2-.03. Where listed wastes are expected or where the potential exists, specific analytes (i.e., totals as opposed to TCLP) for the listed compounds will be tested in addition to determining any hazardous characteristics. All sampling and analytical testing protocols will be consistent with ADEM/U.S. Environmental Protection Agency (EPA) requirements and methodologies.

5.5 Management and Disposition

Once adequately characterized, the containers will be labeled as described. U.S. Department of Transportation-approved labels will be used if transportation outside of RSA boundaries is required or anticipated. The media may also be bulked on site (within the staging area) with like waste streams possessing compatible nonreacting characteristics.

5.6 Wastewater

In general, all wastewater generated during the described site activities will most likely be disposed either at an RSA-approved treatment facility or at the wastewater treatment facility currently operated at RSA.

5.6.1 Nonhazardous Wastewater

Upon proper characterization and approval from RSA representatives, wastewater determined to be nonhazardous (Section 40 CFR Part 261) but possessing some level of contaminants can be disposed directly into RSA's sanitary sewer system, where it will ultimately be treated at the RSA wastewater treatment plant (WWTP). The RSA representative will request waste characterization data, approximate volume, and the location of disposal in making the determination to accept sewer discharge. The nonhazardous water will typically be discharged at a manhole(s) located near the generation site.

All discharges will be in accordance with provisions outlined in Division 6, *Water Quality Program*, of the AAC. More specifically, the discharge will not be greater than 5 percent of the average dry weather capacity of the WWTP, greater than 5 percent of the design capacity of the WWTP, or subject to Section 403.6 of the Federal Water Pollution Control Act. No disposal permit is required as long as the wastewater is discharged in quantities of less than 25,000 gallons per day and the water is nonhazardous (40 CFR 261).

Wastewater generated during site activities and for which analytical tests showed no level of contamination present above approved detection limits will be considered nonregulated. The disposal means and methods of nonregulated waste water are at the discretion of RSA representatives (e.g., storm water system, open ditch, etc.) and do not require regulatory consultation or concurrence.

On a quarterly basis, RSA will submit documentation of all discharges (regulated and nonregulated) to ADEM. The documentation will contain pertinent information regarding the discharge, including, date, time, volumes, analytical data (if available), site, action, etc**.** All discharges to the sanitary sewer system will be coordinated in advance.

5.6.2 Hazardous Wastewater

Hazardous wastewater will be transported, when required, and treated at an off-site wastewater treatment facility when the following conditions are met:

1. The treatment facility meets the definition of a wastewater treatment unit as defined in AAC R. 335-14-1-.02.
2. The treatment facility is capable of (a) rendering characteristically hazardous wastes (AAC R. 335-14-2-.03) nonhazardous or (b) removing listed wastes (AAC R. 335-14-2-.04) from the contaminated media so that the media no longer contain the listed waste for which the media were originally considered hazardous. If after treatment, analytical tests show the listed waste is not present above laboratory detection limits, then the contaminated media will be considered to no longer contain the listed waste and will no longer be considered hazardous.
3. The wastewater treatment facility has been constructed at RSA in conjunction with a removal, interim remedial action, or remedial action at an AOC.

At no time will liquids that possess <u>hazardous</u> characteristics or meet the definition of a listed waste be disposed into the sanitary sewer system, unless the waste is specifically exempt under RCRA, CERCLA, or its applicable or relevant and appropriate requirement without applicable ADEM authorization.

Wastewater determined to be hazardous may be transported between AOCs and within RSA boundaries for treatment/disposition in accordance with the previously outlined provisions without specific regulatory concurrence.

On a quarterly basis, RSA will submit documentation of discharges to ADEM. The documentation will contain pertinent information regarding the discharge including date, time, volumes, analytical (if available), site, action, etc.

All discharges to the sanitary sewer system will be coordinated prior to any discharge.

In the event that RSA does not have a facility on line capable of treating the hazardous wastewater at or around the time of generation, and the water is expected to remain on site for a prolonged period of time (but not to exceed 90 days), the water will be stored in an area with an adequate secondary containment system until an approved treatment system is on line.

Unless specifically mandated by ADEM and EPA, the treatment and disposal of hazardous and nonhazardous wastewater will be performed as previously described. The wastes will be treated and disposed in a timely manner so as to expedite site activities and to ensure the protection of human health and the environment. Except where noted, specific written concurrence from ADEM and EPA prior to those actions previously described is not required.

5.7 Solids

Solids may include soil cuttings, rock, grout, spent PPE, plastic sheeting, rope, unused monitoring well construction materials, and other environmental media generated during field activities. All solids will be containerized at or near the point of generation and staged as described in Section 5.3.2.1. Other specific management practices are described in Sections 5.7.1 and 5.7.2.

5.7.1 Nonhazardous Solids

Soil cuttings and rock determined to be nonhazardous will be staged within the confines of the AOC from which they were generated or stored properly in an RSA-approved storage area. After characterizations (hazardous versus nonhazardous) are finalized and depending upon site conditions, nonhazardous cuttings will be removed from containers and replaced “at or near” the location from which they were derived. “At or near” infers media will be placed as near to their point of origin as is practical. Examples would be placing monitoring well cuttings around the monitoring well from which they originated as opposed to within it. However, when not practical, the media may be centrally located within the confines of the originating AOC in an area of minimal traffic and where the media could be managed in a manner protective of human health and the environment. At no time will contaminated media originating from one AOC be transported to another AOC for placement without prior written concurrence from ADEM and EPA.

In the event that site conditions are not conducive to the replacement of the materials (i.e., restricted space, confined area, etc.), soils and rock determined to be nonhazardous may be disposed into RSA's Solid Waste Disposal Facility-Construction/Demolition Landfill (ADEM Permit No. 45-03) or an approved off-site non-hazardous solid waste disposal facility as long as the following conditions are met:

1. Soils exhibiting contaminant levels below analytical detection limits are considered nonregulated and will be disposed at the discretion of RSA representatives.

2. The soil analytes do not exceed 50 percent of the TCLP analysis for any given compound. A disposal report is submitted within 45 days of disposal that includes a signed copy of ADEM's Solid/Hazardous Waste Determination form and any applicable analytical results.

Other nonhazardous solids such as spent PPE, plastic sheeting, rope, unused monitoring well construction materials, and other environmental media generated during field activities that have been determined to be nonhazardous will be emptied into dumpsters or roll-offs for disposal off site at a permitted solid waste disposal facility.

5.7.2 Hazardous Solids

Hazardous IDW solids can be segregated into two categories for purposes of waste management. The first is strictly IDW soils. Hazardous IDW soils will be immediately handled and stored as hazardous waste while on RSA. The waste soils will be analyzed, profiled, and managed off site at a permitted transportation, storage, and disposal facility for its characteristic and/or listed waste status. The second hazardous IDW solid category is essentially all non-soil-like media, generally anticipated to be in the form of debris and PPE. The soil versus nonsoil differentiation is necessary in order to select the correct treatment and disposal technology. Hazardous nonsoil and debris media can present different analytical and treatment strategies than contaminated soils.

6.0 EXCEPTION PROVISION

None.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0 – Field Documentation

SOP No. 11.0 – Field Generated Records Management

Alabama Department of Environmental Management (ADEM), 2009, Division 14 - Hazardous Waste Program, Revised Effective March.

Alabama Department of Environmental Management (ADEM), 2005, **Alabama Environmental Investigation and Remediation Guidance**, September.

McCoy and Associates, 1995, **RCRA Regulations and Keyword Index**, Elsevier, 1995.

U. S. Environmental Protection Agency (EPA), 1992a, **Guide to Management of Investigative-Derived Wastes**, Office of Solid Waste and Emergency Response, Publication 9345.3-03FS, April 1992.

U. S. Environmental Protection Agency (EPA), 1992b, **Management of Contaminated Media**, Region IV EPA, Guidance Number TSC-92-02, December 28, 1992.

U. S. Environmental Protection Agency (EPA), 1991, **Management of Investigative-Derived Wastes During Site Inspections**, Office of Research and Development, Publication, EPA/540/G-91/009, May 1991.

8.0 ATTACHMENTS

- Attachment 1, ADEM Email Addressing IDW.

ATTACHMENT 1

ADEM EMAIL ADDRESSING IDW

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Attachment I
ADEM Email Addressing IDW
RSA IWSAP SOPP 4.0

Kurth, Randy

Subject: FW: Response to ADEM original comments on the IDW discussion {Update}

Importance: High

From: Morrissette, Krishna M [mailto:KMorrissette@adem.state.al.us]
Sent: Wednesday, November 17, 2010 2:54 PM
To: Kurth, Randy
Cc: Davis, Emily; Burton, Don; Hodges, Barry A Mr CIV USA USACE; Shell, Ronald T; Wilson, J Jason; Reese, Dennis
Subject: RE: Response to ADEM original comments on the IDW discussion {Update}
Importance: High

Randy,

Sorry for the confusion on the 90-day storage issue. Here are some comments to further clarify ADEM position on the handling/ staging of potentially hazardous wastewater at RSA:

1. Wastewater can be held at the AOC or SWMU site and does not have to be immediately moved to another < 90 day storage area. The holding area must meet secondary containment standards.
2. It is OK to initially label the wastewater filled drums with the following information.
   - Description of the drum contents (e.g. wastewater from RSA-XXX)
   - Accumulation start date (the date the drum was filled)
   - A short statement that states that the contents are on hold awaiting analytical test results
3. If the analytical results come back noting the drum contents are hazardous, a standard hazardous waste label must be put on the drum noting all required information. The accumulation start date for the standard HW label should be the same date as recorded on the initial drum label.
4. Drums of hazardous wastewater must be removed from the AOC or SWMU in less than 90 days.

Remember that the generator must meet the < 90 day storage rules and regulations (e.g. weekly inspections, training, secondary containment, etc.) while holding the hazardous wastewater drums at the AOC or SWMU site.

As for your response to the example IDW information needed to support generator knowledge determination, it is adequate for our on-site visits. Since it is late in the afternoon for you (EST), I will try to call you to confirm the information presented in this email. Thanks again for your help in this matter, Randy!

Sincerely Yours,

Krishna "Kel" Morrissette
ADEM - Land Division: Facilities Engineering Section
Work: (334) 394-4335
Fax: (334) 279-3050
email: kmorrissette@adem.state.al.us

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Subject: GROUNDWATER SAMPLING

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel for the collection of groundwater samples from monitoring wells and temporary piezometers at Redstone Arsenal (RSA), Madison County, Alabama.

This SOP meets the requirements of the *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document* (U.S. Environmental Protection Agency [EPA], 1986), as stipulated in the contract. Any exceptions to the requirements are addressed in the section entitled "Exceptions." Documents other than those required by the contract and consulted in the preparation of this SOP are listed under "Cross References."

A consistently implemented groundwater sampling procedure will help ensure data comparability between different sampling events and between sites. One of the following methods shall be used to collect groundwater samples. The method to be used shall depend upon the site conditions or requirements of the Site-Specific Field Sampling Plans (SFSP). The low-flow method shall be used unless other methods are specified or approved for special circumstances.

(a) Low-flow purge and sample using a submersible bladder pump or submersible electric pump
This method involves purging the well at low-flow rates (< 1 liter per minute [L/min]) until water quality parameters stabilize (or are within acceptable ranges) and then collecting the sample at the same low-flow rates. This method should be used by default unless the site conditions or the SFSP require using a different method.

(b) Volume purge and sample using a submersible bladder pump or submersible electric pump
This method involves purging a fixed number of well volumes at high flow rates (>1 L/min). Purging is continued until the parameters stabilize or are within acceptable ranges. Desirable parameter values are normally achieved within a 3-5 well volume purge. The flow rate is lowered during sampling. This method is to be used where analytical results are desired not only from the well but also from an area of influence around the well. An example of a well to be sampled by this method is a perimeter well. This method shall be used only if specified in the SFSP or as approved by the contractor's Task Manager or Technical Lead.

(c) Volume purge and sample using a bailer
This method involves purging a fixed number of well volumes using a bailer. Purging is continued until at least 3 well volumes are purged and the parameters have stabilized. This method shall be used in lieu of the low-flow method, only if warranted by the site conditions (e.g. bent well casing). A bailer may also be used

only for collecting samples from a well that goes dry even at the slowest pumping rate during low-flow purging. In such a case, the well is pumped dry and the sample is collected with a bailer as soon as a sufficient quantity of water has accumulated in the well. This method shall be used only if specified in the SFSP or as approved by the contractor's Task Manager or Technical Lead.

(d) Hydropunch sampling
Screening quality groundwater samples shall be collected using hydropunch sampling methods. Purging of the hydropunch hole for parameter stabilization or to achieve volume-purge goals is not required. Samples are collected as soon as sufficient water is available.

(e) Passive or no-purge sampling
Passive or no-purge sampling may be used for low-yield wells or mitigating excessive sampling-induced turbidity, particularly where metals are analytes of interest.

The low-flow purge and sample method shall be used as a default method for collecting groundwater samples for chemical analysis. The use of methods (b) and (c) will be restricted only to special circumstances, either if specified in the SFSP or if warranted by site conditions. If site conditions warrant the use of method (b) or (c), prior approval from the principal investigator or the task manager is required, and the approving person must be identified in the Field Activity Daily Log. The hydropunch sampling techniques, method (d), are used to collect screening level characterization data, either to show presence or absence of contamination or to help in the placement of permanent monitoring wells.

Low-Flow Purge and Sample – Introduction: The low-flow (minimum drawdown, micropurging) sampling method is based on the premise that if a pump is located within the screened interval of a well and is pumping at a rate corresponding to the hydraulic conductivity of the formation, it will rapidly establish a horizontal laminar flow of groundwater and withdraw fresh formation water without significant mixing or dewatering of the stagnant casing water in the well (U.S. Army Corps of Engineers, 1995). The low-flow method aims to minimize well water turbidity, which may be caused by re-suspension of well sediments or additional developments of the formation during high-speed pumping.

Establishment of a low-flow regime will be ensured by carefully monitoring the drawdown; because excessive drawdown indicates that the pump is withdrawing stagnant casing water. The maximum drawdown allowed will be 0.3 feet (4 inches). During purging, the flow rate will typically be maintained within the range of 0.1 to 0.5 L/min. The flow rate will be decreased further if the drawdown exceeds 0.3 feet. Flow rates up to 1 L/min may be used in purging some high yielding residuum aquifers, if the drawdown remains within the allowable limit of 0.3 feet. Flow rates greater than 1 L/min may be allowed in bedrock wells where the well may be screened across a cavity, with the limitation of the maximum drawdown. However, the flow rate in all cases must be slowed down to 0.1 to 0.3 L/min during sampling to prevent turbulence and aeration of water.

If excessive drawdown is noted using the lowest possible pump rate, then the low-flow method is not applicable. In such a case, the well will be pumped dry once and the sample will be collected with a bailer as soon as an adequate quantity of water for samples is available.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The QCSM is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as for ensuring that all team members perform work in accordance with this SOP.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance/Quality Control Manager is responsible for ensuring that this SOP is correctly implemented and that the quantity and quality of surface water flow (discharge) data collected meet the requirements of the SFSPs.

4.0 DEFINITIONS

Bailer – An enclosed cylindrical tube containing a floating ball check-valve at the bottom. Lowering the bailer into water causes the ball to float, allowing water to enter the cylinder. Raising the bailer through the water causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.

Bladder Pump – An enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas displaces the well water through a one-way check-value at the top. The water is brought to the surface through a water discharge line; and the gas (air or nitrogen) is provided by compressors or compressed gas cylinders.

Hydropunch – A device used to collect groundwater samples using direct-push technology. Various forms of hydropunch techniques exist, differing in sampling tools and in the methods used to collect the samples. In general, the technique involves inserting a sampling tool into the soil, exposing a screen by retracting the outer part of the sampling tool, allowing time for water to enter the screened interval, and collecting samples using either a bailer or a peristaltic pump.

Peristaltic Pump – A self-priming, low-volume pump consisting of a rotor and ball bearing rollers. Tubing placed around the rotors is squeezed by the rotors as they revolve. The squeezing produces a wavelike contractual movement which causes water to be drawn through the tubing. The peristaltic pump is limited to sampling at depths of less than 25 feet.

Purging – The process of evacuation of the static water in the monitoring well to allow formation water to flow into the well. The aim of purging a well before sampling is to obtain a sample that is representative of the groundwater in the soil or rock formation. Purging can be accomplished either by utilizing low-flow or volume purge methods. In the low-flow purge method, water is pumped at a slow rate to establish a horizontal laminar flow and water is drawn from the formation without drawing in the stagnant casing water. Volume purge involves evacuating a minimum of 3 well volumes of water to ensure that all stagnant water has been removed from the well.

Electric Pump – A stainless steel 12 volt DC submersible impeller pump used with a variable-rate power controller to allow for pump discharge rate adjustments during low-flow sampling. Further refinement of low-flow pump discharge rates may be achieved using a stainless steel flow valve at the discharge end of the tubing at the ground surface. Water enters the pump at a bottom intake and is transported to the surface using a single Teflon or Teflon-lined discharge tubing. The stainless steel pump and flow valve are compatible with standard chemical decontamination procedures.

Water Quality Parameters – Chemical and physical properties of groundwater measured during purging and sampling to ensure that a representative groundwater sample has been collected and to document the ambient subsurface conditions at the time of sampling. The parameters normally measured include pH, oxidation-reduction potential (Eh), temperature, dissolved oxygen, conductivity, and turbidity. The measurements are made at specified intervals and documented in appropriate Sample Collection Logs completed in the field.

5.0 TEXT

5.1 Required Records and Forms

For a description of required forms, refer to SOP No. 1.0, *Field Documentation*.

1. Sample Collection Log
2 Groundwater Purge Form
3. Chain-of-Custody Form (Attachment 2)
4. SFSP
5. Material Safety Data Sheets
6. Field Activity Daily Log.

5.2 Required Materials, Equipment, or Supplies

The following supplies are required for the low-flow purge and sample method. Other supplies as needed, in addition to or in-lieu of those listed below, are specified in the respective sections.

1. Personal protective equipment (PPE), as required by the Site-Specific Health and Safety Plan
2. Calculator
3. Decontamination solutions; non-phosphate detergent, rinse water, isopropanol, 10% nitric acid solution, deionized water
4. Compressor, air
5. Controller Box

6. Insulated cooler with blue ice and packing materials
7. Cylinder, graduated, 2-liter
8. Drum, 55-gallon
9. Filters, high-capacity, in-line sample filter, 0.45 micron (perchlorate samples only)
10. Filtration units (disposable) 0.2 micron, and hand-operated vacuum pump (if needed in lieu of in-line filtration)
11. Flow-through cell or equivalent
12. Gasoline (for gas-powered compressor only)
13. Gloves, nitrile
14. Keys for unlocking well caps
15. Labels, sample bottles
16. Litmus paper or pH indicator strips
17. Paper towels
18. Pens, waterproof
19. Pipettes
20. Pump, bladder
21. Radio, two-way, hand-held or cellular phone
22. Safety glasses with side shields
23. Sample containers
24. Sheeting, polyethylene
25. Steel tape, weighted
26. Stop watch
27. Thermometer
28. Photoionization detector
29. Trash bags, large plastic
30. Trash can, 32-gallon plastic
31. Tubing, Teflon®-lined polyethylene discharge bundled with polyethylene air tube
32. Water level indicator.

5.3 General Requirements

The following procedures will apply to all groundwater sampling activities at RSA:

1. All sampling equipment (pump, bailer, water discharge tubing, support cables, water level indicator, flow-through cells, etc.) likely to come in contact with the sampled groundwater shall be decontaminated before and after each use or between sampling locations. The pump shall be initially dissembled and decontaminated. Refer to SOP No. 3.0, *Field Equipment Decontamination,* for complete procedures.
2. The water discharge tubing shall be attached and the pump used to circulate detergent solution, followed by potable water and deionized water rinses. Only Teflon® or Teflon®-lined tubing shall be reused after decontamination. Polyethylene or tygon tubing shall be discarded after each use and shall not be decontaminated for reuse.
3. Shade shall be provided for the spooled tube when a sampling event occurs during summer months in full sun. Otherwise, the tube may act as an effective heater, warming the groundwater sample and creating a potential for volatilization.
4. The portable generator/compressors shall be placed downwind from the sampling location.
5. Field parameter measurement "instruments" shall be stored in shade during transportation and at the sampling site. The instruments may give inaccurate readings if left under full sun.
6. To the extent possible, groundwater sampling shall be conducted so as to sample upgradient, presumably "clean" wells first.
7. All personnel involved in sampling shall wear appropriate PPE, including clean nitrile gloves, in accordance with the Site-Specific Health and Safety Plan.
8. In order to minimize turbidity in the well, it is recommended that pump and tubing assemblages be placed in the subject well at least 12 hours—and ideally 24 hours—prior to sample collection. All equipment should be lowered into the well as slowly as possible without tagging bottom to minimize turbidity.

5.4 Specific Requirements for Low-Flow Sampling

Pump Installation

The pump shall be installed 12 to 24 hours before purging and sampling.

1. For the sampling crew, follow the guidelines provided in the low-flow groundwater sampling decision memorandum. It will be the responsibility of the contractor's Task Manager, QCSM, or the sampling crew to review the construction and past history of the well. This review will help in understanding the monitoring well design and in establishing the purge rate and hydrogeological conditions that can be expected.
2. Measure the static water level and the total well depth with an electric water level indicator.
3. Determine the discharge tube diameter and other fittings from the decision chart (Figure 1).

4. Calculate the volume of the bladder pump and the discharge tube from the equations given below. The average volume of the bladder pump is assumed to be 500 milliliter (mL) for these calculations:

3/8-inch outside diameter (OD) (6 millimeter (mm) inside diameter [ID]) tube:	(500 + [8.6 x l]) mL
1/4-inch OD (4.3 mm ID) tube:	(500 + [4.4 x l]) mL

where:

Volume of bladder pump = 500 mL
l = length of tube in feet.

5. Based on the well design information, subsurface geology, and the measured water level, determine the location of the pump intake using the guidelines given below:

   a. If a zone with a relatively high hydraulic conductivity (K) is present in the screened interval, place the pump intake within this zone. A high K zone may be a sandy or gravel unit within an overall clayey unit or a fracture zone within the bedrock. If the high K zone is near the bottom of the screen, the pump intake should be as much above the well bottom as possible.

   b. If a high K zone is not present and the screen is completely submerged, place the pump intake near the middle or slightly above the middle of the screen.

   c. If a high K zone is not present and if the water level is below the top of the screen, place the pump near the middle of the water column. The pump intake should be as much above the well bottom as possible.

6. Connect the safety cable, discharge tube, and air tube (bladder pump only) to the pump. The discharge tube will be Teflon®-lined polyethylene, and its length will be appropriate for the well being sampled. For example, a 100-foot long tube may not be used in sampling a 30-foot deep well. Instead, a 50-foot length will be used.

   Using an appropriate length of tube will minimize the amount of decontamination fluids generated and lessen the opportunity for chemical and physical changes in the water due to contact with the spooled tube.

7. Gently lower the pump to the appropriate sampling depth so as to minimize the mixing of stagnant casing water with the screen water and the re-suspension of bottom sediments. Secure the pump at the desired depth by clamping the support cable to the 4-inch non-locking well cap.

8. Lower an electric water level indicator (with an audio and visual alarm) again into the well. Measure and record the water level. The water level may be temporarily elevated because of the insertion of the pump into the well. Wait for a few minutes until the water level returns to the static level.

9. Attach the air supply line to the pump controller (bladder pump only). Attach the discharge line to the purge water container. Check all tubing and compressor connections and verify the controller is functioning.

10. Turn on the power controller (electric pump only) or compressor/generator (bladder pump only). Using the power or pneumatic pump controller, begin to prime the pump and tubing by starting it at the lowest setting (balancing the interval times for discharge and filling). Once water begins to flow from the discharge line, record the water level in the well. Continuing to monitor the water level in the well, gradually increase the flow rate to the point at which the water level begins to decline in the well. Measure and record the flow rate using the stop watch and the 500 mL graduated cylinder. Note that this rate will serve to guide the initial purge rate during purging the subsequent day.
11. Measure and record the final water level and shut off the pump.
12. Disconnect the air supply line from the pump controller and disconnect lines from the controller to the compressor/generator in preparation for moving to the next sampling location.
13. Secure the well for a stabilization period of 12 to 24 hours before sampling.
14. Record pertinent data on the Groundwater Purge Form (Attachment 1).

5.5 Specific Requirements for Purging and Sample Collection

A 12- to 24-hour stabilization period shall be allowed after the installation of the pump. After this period, the well will be purged and sampled according to procedures given below:

1. Make proper connections for the pump. Connect the pump discharge tube bottom connection of the flow-through cell. Connect the tubing at the top of the flow-through cell to the purge water container.
2. Calibrate water quality meters and place probes into the flow cell.
3. Measure the water level in the well. Secure the water level probe 0.3 foot (4 inches) below the water level and keep the instrument on.
4. Start the pump at the lowest setting. Gradually increase the flow rate.
5. Constantly monitor the drawdown as the flow rate is increased. If the drawdown exceeds 0.3 foot, indicated by visual or audio alarms on the water level indicator, decrease the flow rate appropriately.
6. Monitor the pump flow rate in mL/min using a stop watch and a graduated measuring cylinder. The target flow rate is 100 to 500 mL/min (0.1 to 0.5 L/min), which may be increased in the case of a rapid recharging well to 1 L/min (residuum well) or greater (bedrock well), with the maximum drawdown limitation of 0.3 foot.
7. Measure water quality parameters every 5 to 105 minutes. The parameters and their tolerance limits are discussed in Section 5.10. The measurements shall be recorded on the Groundwater Purge Form (the initial and final water quality readings should also be recorded on page 2 of the Sample Collection Log). All measurements shall be

recorded in the units shown on the form. If measurements are made in different units, these units must be clearly shown on the form.

8. Once the water quality parameters stabilize and the calculated required minimum purge amount has been removed from the well, sample collection can begin. Collect samples at a 100 to 500 mL/min purging rate.

   A bailer should be used for sampling in the case where a well is extremely slow to recharge (i.e., the recovery rate is below the minimum possible pump rate) and has to be pumped dry. Follow the procedures given below under these circumstances.

9. If the recharge rate of a well fails to sustain the lowest possible flow rate of the pump, causing an excessive drawdown, purge the well dry once. Remove the pump from the well and allow the well to recover until adequate water for samples is available.

10. Use a bailer to collect samples as soon as adequate water is available in the well. Collect samples for different parameters as the water becomes available, in the order specified in Section 5.11. The recovery time may vary from a couple of hours to 12 hours. A minimum amount of time should be allowed between the drying of the well and sample collection. If a well is left unsampled for over 12 hours, the process should be repeated by purging the well dry again.

5.6 Specific Requirements for Volume Purge with a Pump

The procedures for pump installation and sample collection are the same as those for low-flow sampling. However, the procedure for purging is different from the low-flow method. Instead of purging at low-flow rates to maintain the drawdown within certain limits, the well should be purged at the maximum rate possible without dewatering the well. This would result in a significant drawdown in the well. The intent is to draw water in from a greater radius of influence around the well. However, the flow rate shall be adjusted so that the water level does not fall below the pump intake.

Purging shall continue until at least 3 well volumes have been evacuated and the parameters have stabilized. In some cases, it may be necessary to purge up to 5 well volumes before the parameters stabilize and turbidity is within the acceptable range of nephelometric turbidity units (NTU). Record all pertinent information on the Groundwater Purge Form and Sample Collection Log, identifying the sampling method used (i.e., volume purge with a pump) in the “Comments” field. Any fields in the form not applicable to the method used shall be clearly marked “N/A.”

5.7 Specific Requirements for Volume Purge and Sampling Using a Bailer

The following procedures shall be applicable while using a bailer for purging and sampling a well. A bailer may be used for purging only under special circumstances; for example; the well casing may be bent and may not allow insertion of a bladder pump beyond the bend. Prior approval from the principal investigator or the task manager shall be obtained and documented on the sample collection form before using this method.

1. Prepare and decontaminate equipment per SOP No. 3.0.
2. Measure the static water level and the total well depth with an electric water level indicator.
3. Use Teflon® bailers, if the bailers are to be decontaminated between wells and reused. Otherwise, use disposable bailers.
4. Use disposable twine or fishing line with the bailer. Do not decontaminate and reuse plastic twine. Only Teflon®-covered steel cable may be decontaminated and reused at another well.
5. To start purging, gently lower and raise the bailer in the water column.
6. Record water quality parameters at least twice for each well volume evacuated.
7. Purge until at least three well volumes have been evacuated and the water quality parameters have stabilized or the well is bailed dry. Proceed with sample collection once parameter stabilization and low turbidity values (Table 2) have been achieved. If the well is bailed dry, wait until adequate water is available in the well and proceed with sample collection.
8. Collect the samples in the analyte order provided in Section 5.11.
9. If collecting a filtered sample, use a disposable filtration unit with a hand-operated vacuum pump. Alternatively, send an unpreserved (no nitric acid added) sample to the laboratory. The sample will be filtered in the laboratory before analysis.
10. Record all pertinent information on the Groundwater Purge Form and Sample Collection Log, identifying the sampling method used (i.e., volume purge and sample with a bailer) in the "Comments" field. Any fields in the form not applicable to the method used shall be marked "N/A."

5.8 Specific Requirements for Hydropunch Sampling

Groundwater samples collected using hydropunch (Geoprobe®) methods are considered to be of screening quality because of the generally high turbidity of the samples. Samples with high turbidity contain excessive suspended solids and exhibit artificially high metal concentrations that are generally not representative of the groundwater. The decontamination and sampling protocols are, however, the same as in other methods that yield definitive data. If a peristaltic pump is used for sample collection, the tygon tubing attached to the pump shall not be decontaminated for reuse; instead it shall be discarded. The following equipment is required in addition or in lieu of equipment listed in Section 6.0:

1. Geoprobe® rig or equivalent
2. Peristaltic pump
3. Disposable in-line water filter, 0.45 micron pore size
4. Teflon®–lined tubing (length appropriate for sampling depth)
5. Tygon tubing (3 feet).

Specific procedures are as follows:

1. Prepare and decontaminate sampling equipment.
2. Push the groundwater sampling tool to the desired depth.
3. Attach the tygon tube to the peristaltic pump. A new tygon tube shall be used at each well and shall be discarded after sampling.
4. Attach a disposable in-line filter to the discharge end of the tygon tube (for perchlorate samples only).
5. Attach a short (1-foot) tube to the discharge end of the filter.
6. Attach the intake end of the tygon tube to the Teflon®-lined down-hole tube.
7. Start the pump, maintaining a steady bubble-free flow.
8. Measure water quality parameters before the start of sample. Parameter measurements are made during hydropunch sampling for documentation purposes and there are no requirements to purge the borehole for parameter stabilization or to achieve volume-purge goals.
9. Collect water in sample containers from the discharge end of the in-line filter. The order in which samples for various analytes must be collected is presented Section 5.11.
10. If the sampling hole is pumped dry during sampling, wait for enough water to accumulate and then collect samples.
11. Pull out the screen, drive rods, and other down-hole components. Abandon the borehole in accordance with SOP No. 21.0, *Monitoring Well and Borehole Abandonment*.
12. Record all pertinent information on the Sample Collection Log , identifying the sampling method used (i.e., hydropunch) in the “Comments” column. Any fields not applicable to the method used shall be clearly marked “N/A.”

5.9 Disposal of Purge Water

The water purged from the well is considered investigation-derived waste (IDW). All purge water shall be containerized and handled according to the SOP No. 4.0, *Investigation-Derived Waste*.

5.10 Specific Requirements – Water Quality Parameter Measurements

Water quality parameters to be monitored during the purge process shall include pH, temperature, conductivity, Eh, dissolved oxygen (DO), and turbidity. Measurements shall be made at intervals required by the specific method used. If using a pump, a flow-through cell will be used to measure field parameters at the discharge from the pump at a frequency specified in the sample collection log. If using a bailer for purging, field parameters shall be measured at least twice per well volume evacuated.

The goal of the purging process is to obtain a groundwater sample that is representative of the surrounding aquifer. Field parameters are the simplest indicators for determining when the formation water is being removed. The normal ranges of field parameters observed at RSA are indicated in Table 1. Stabilization of parameters is required before analytical samples may be collected, irrespective of the method used. Field parameter stabilization is defined as four consecutive readings within the criteria presented in Table 1.

Under low-flow sampling conditions, no minimum volume of water is required to be removed from a well prior to sampling. Under volume purge techniques (pump or bailer), at least 3 well volumes of water should be purged before sampling. Up to 5 well volumes may be purged if parameters do not stabilize after purging 3 volumes and there is an indication that the parameters may stabilize with further purging. However, if field measurements have not stabilized after 5 well volumes have been removed, then the contractor’s Task Manager, QCSM, or Technical Lead shall be contacted to determine whether collecting a sample is appropriate.

The Task Manager, QCSM, or Technical Lead shall use professional judgment in evaluating field measurements. For example, if DO readings are in the 5 to 7 milligrams per liter (mg/L) range, then 10 percent is a reasonable fluctuation. But if DO readings are in the 0.5 to 1 mg/L range, then fluctuations within 10 percent are perhaps overly stringent and 20 to 50 percent variations may be allowed. The same is true for conductivity and the 10-millivolt (mV) goal for redox. If after 5 well volumes have been purged, all parameters have stabilized except one or two that are relatively close to their respective target bounds, then this may be an adequate indication that formation water is being removed and sample may be collected. An exception to the 3 to 5 well volume criterion is the purging of deep wells, where each casing volume may be large and purging times excessively long. In such cases, professional judgment should be used to collect samples as soon as 3 well volumes are purged. Rationale for samples collected when field parameters are outside of the target fluctuations will be documented on the Field Activity Daily Log and Sample Collection Logs.

Turbidity measurements should be treated differently for different situations. When the analytical program specifies metals (total or unfiltered) for laboratory analysis, then the target turbidity shall be less than 10 NTUs, and consecutive turbidity readings less than 10 NTUs will be considered equivalent. When metals are not an analytical parameter, then turbidity is not as great a concern, and the target shall be less than 20 NTUs. However, in both cases, these goals may not be attainable due to silty or clayey sections of the aquifer matrix. If each parameter has stabilized, but turbidity is still above the target NTU value, then purging shall continue in an effort to attain the target NTU. Decisions to continue purging will be based on how far out of compliance the values are (e.g., 15 versus 100 NTUs), and whether NTU values are constant or are showing a decreasing trend.

During purging, the field parameter values shall be periodically compared to the normal parameter ranges observed at RSA (Table 1). Parameters outside the normal range may indicate a problem with instrument calibration or a faulty well construction. The accuracy of certain instruments tends to drift with time, and such instruments may require frequent calibration. An example of a faulty well construction is the presence of cement grout in the screen interval due to a poor bentonite seal. The cement grout causes the pH of the groundwater to be abnormally high (11 to 13 range). If the parameters are observed to be outside the normal range, the instruments shall be recalibrated and the measurement repeated. If the parameters are still outside the normal range for four consecutive readings during purging, the well construction may be faulty and the Task Manager, QCSM, or Technical Lead must be contacted for further direction. No samples shall be collected from a well with questionable construction until further direction.

5.11 Sample Collection

Regardless of the purging technique used, samples shall be collected at flow rates in the range 0.1-0.5 L/min or poured gently to avoid aeration, bubble formation, or turbulent filling of sample bottles (for volatile organic compounds, a flow rate of 0.1 L/min is preferred).

Samples shall be collected in the following order of target analytes, if adequate amount of water is available in the well:

- Volatile organic compounds
- Semivolatile organic compounds
- Perchlorate
- Turbidity
- Major water quality cations and anions
- Carbonate/bicarbonate
- Total suspended solids
- Total dissolved solids
- Kjeldahl nitrogen
- Total metals
- Dissolved metals
- Total petroleum hydrocarbons
- Cyanide
- Ammonia, nitrogen.

Samples for any target analytes not listed above shall be collected in the order of decreasing volatility within the framework of this list. If the amount of water available in the well is low, minimum volume requirements provided in Table 2 should be implemented, or certain target analytes may be omitted upon approval from the Task Manager and Project Chemist.

Filtered Samples. Filtered groundwater samples are normally not needed if a successful low-flow sampling program is implemented. However, if specified in the SFSP, filtered groundwater samples will be collected according to the following procedures:

1. If using a flow cell, connect an inline, disposable 0.45-micron filter to the discharge flow tube upstream from the flow cell. If a flow cell is not being used, connect the filter to the discharge tube of the pump. Collect the water discharging from the filter in the sample container.
2. If the flow rate is too slow to allow filtration through an in-line filter, or if samples are collected by a bailer, an alternative filtration method may be required. A disposable filtration unit and a hand-operated vacuum pump will be used to filter the sample in the field.
3. If filtration cannot be accomplished in the field, an unpreserved sample (no nitric acid added) cooled to 4 degrees Celsius (ºC) shall be shipped to the laboratory, along with the preserved sample for unfiltered analysis. The unpreserved sample shall be filtered upon receipt and the filtrate preserved with nitric acid. The data from the laboratory filtered sample will be reported as “dissolved metals.”

5.12 Records

For each monitoring well purged, the technician shall complete a Groundwater Purge Form and Sample Collection Log. These forms prompt the technician to identify and record information such as: site ID, well ID, sample number, depth of well, depth to water, and well diameter. The technician can then use the information on the forms to perform a well casing volume calculation. The forms also include spaces to record the field parameters that are measured during purging and any comments and observations. These forms also prompt the technician to record the sample number, collection date and time, sample containers, and associated QC sample information.

All well purging and sampling data and information shall be recorded in the Field Activity Daily Log for the site sampled. The Field Activity Daily Log entries shall be recorded chronologically and the time of the entry recorded first. All Field Activity Daily Log continuation pages shall be sequentially numbered and the last page recorded for the day shall be signed and dated by the recording technician.

6.0 EXCEPTION PROVISIONS

Exceptions to the requirements of the Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document (EPA, 1986) are as follows:

- Tygon tubing is normally used with peristaltic pumps. Tygon is not an inert material and is considered “unacceptable” by EPA (1986). To meet this requirement at RSA, new tygon tubing will be used at every new location. The tubing will not be decontaminated for reuse at other locations to prevent cross-contamination from any chemicals absorbed into the wall of the tubing. Further, only a short segment (2 to 3 feet) of tygon tubing is used at the rollers of the pump. The tygon tubing is then attached to a much longer Teflon® or Teflon®-lined downhole tube. Thus, the contact time is expected to be rather short.

- The EPA (1986) document requires that samples be collected at a rate of 100 mL/min or lower. This SOP requires sample collection at rates of 100-500 mL/min. More recent documents by EPA (e.g. EPA, 1995) consider these flow rates to be appropriate for sample collection.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0, *Field Documentation*

SOP No. 3.0, *Field Equipment Decontamination*

SOP No. 4.0, *Investigation-Derived Waste*

SOP No. 11.0, *Field-Generated Records Management*

SOP No. 13.0, *Field Measurable Chemical Characteristics*

SOP No. 15.0, *Non-Hazardous Sample Handling, Packaging, and Shipping*

SOP No. 16.0, *Groundwater Level Measurements*

U.S. Army Corps of Engineers (USACE), 1994, *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, September.

EPA Field Branches Quality System and Technical Procedures, available at the following URL: http://www.epa.gov/region4/sesd/fbqstp/index.html.

U.S. Environmental Protection Agency (EPA), 1995, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, Groundwater Issue*, EPA/540/S-95/504, December.

U.S. Environmental Protection Agency (EPA), 1986, *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document,* OSWER-9950.1, September.

8.0 TABLES

Table 1 Water Quality Indicator Parameters

Table 2 Water Sample Volume Requirements.

9.0 ATTACHMENTS

- Attachment 1, Groundwater Purge Form

Table 1
Water Quality Indicator Parameters
Redstone Arsenal, Madison County, Alabama

Measurement	Normal Range	Acceptable Variability[a]
pH	4.6 to 8.5	± 0.1
Temperature (°C)	10 to 18	± 10%
Specific Conductivity (μS/cm)	10 to 8,000	± 3%
Redox (mV)	+400 to -300	± 10
Dissolved oxygen (mg/L)	<10	± 10%
Turbidity (NTU)	variable	± 10%[b]

[a] Acceptable variability for four consecutive readings.
[b] Values of less than 10 NTU are considered to be equivalent.

°C - Degrees Celsius.
μS/cm - MicroSiemens per centimeter.
mV - Millivolt.
mg/L - Milligrams per liter.
NTU - Nephelometric turbidity unit.

Table 2
Water Sample Volume Requirements
Redstone Arsenal, Madison County, Alabama

Analysis	Standard Volume (mL)	Minimum Volume (mL)*	Minimum Volume Option*
Volatile organics	120	40	X
Semivolatile organics	1000	1000	
Pesticides/PCBs	1000	1000	
Herbicides	1000	1000	
Metals – Total	500	125	X
Metals – Dissolved	500	125	X
Mercury – Total Mercury – Dissolved	Included with metals (100)	Included with metals (100)	
Cyanide	500	125	X
Anions	250	100	X
Nitrate-nitrite	100	50	X
Total suspended solids and total dissolved solids (TSS and TDS)	500	200	X
Total organic carbon (TOC) RCRA 4/well	4 x 25	4 x 25	
Total organic halides (TOX) RCRA 4/well	4 x 100	4 x 100	
Total petroleum hydrocarbon (TPH)	1000	1000	X
Gasoline range organics (GRO)	80	40	X
Diesel range organics (DRO)	1000	1000	

*Quantitation limits (detection levels) may be affected when operating with minimum sample volumes. If volumes are lowered below the minimum sample volumes, quantitation limits will be raised.

ATTACHMENT 1

GROUNDWATER PURGE FORM

LOW-FLOW GROUNDWATER PURGE AND SAMPLE LOG

Project No.:	Site ID:
Installation:	Log Book No. / Pages:
Contractor:	Sampler(s)
Purge Start Date: / / Time:	Purge End Date: / / Time:
Weather: Wind mph Precipitation:	Air Temperature: °F
Well Labeled: Y/N [ ] Well Secure: Y/N [ ]	Comments:
PID SN:	Well Headspace (PID mu) Odor
Water Level Instrument:	Serial No.:
SWL beginning (BTOC): / WL After pump install (BTOC):	Max Drawdown (inches):
Well Casing 2” 4” 6” Other:	Borehole diameter: / Sandpack length (L): ft.
Screen Length:	Parameters Measured With:
Water Column height (h):	Total Purge Vol. Gallons
Purge Method: / Max Purge Rate: L/min	Sampling Flow Rate: mL/min
Pump Type: / Pump Vol.:	Tubing Material: / Vol./ft: / Total ft.:
Flow-Through Cell Vol.:	Total Pump + Tubing + Cell Vol.:
Casing radius:__________(in)/12 =__________**r** (decimal ft)	Borehole radius:__________(in)/12 =__________r (decimal ft)

Well Casing Vol. = 3.14 x **r**(______________)^2 x h(_________) x 7.48 (conversion from ft^3 to gal.) = gal.

Sandpack Vol. = 3.14 x r(____________)^2 x L(________) x 7.48 – Well Casing Vol.(_____________above) x 0.3 = gal.

Total Well Vol. = Well Casing Vol. (_________________above) + Sandpack Vol. (_____________above) = gal.

Depth of pump inlet (BTOC) and rational:

PURGE CYCLE

Actual Time	Elapsed Time	Volume Purged	Depth to Water	Depth of Pump Intake	Temp (°F)	pH	DO	ORP mV	Conductivity µmhos cm	TDS ppm	Turbidity (NTU)	Comments

SAMPLE

Actual Time	Elapsed Time	Volume Purged (gals)	Depth to Water (ft)	Depth of Pump Intake (ft)	Temp (°F)	pH	DO	ORP mV	Conductivity (µmhos/ cm)	TDS ppm	Turbidity (NTU)	VOC Collection Flow Rate

Sample Type:	Sample No.	
Sample Equipment	Sample Filtered: Yes [ ] No [ ]	Filter Type/Size:
Equipment Rinsate Sample No.:	Sample Equipment Decon: Date: by:	
Comments:		
Discharge Water Disposition:	Drum Number:	
Prepared by: Date: / /	Reviewed by: Date: / /	

Actual Time	Elapsed Time	Volume Purged (gals)	Depth to Water (ft)	Depth of Pump Intake (ft)	Temp (°F)	pH	ORP mV	Conduct ivity (μmhos/ cm)	TDS ppm	Turbidity (NTU)	Comments

Subject: FIELD MEASURABLE PHYSICAL CHARACTERISTICS

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) describes the methodology and procedures to be used to measure the physical characteristics of a groundwater sample that at the time of collection at Redstone Arsenal (RSA), Madison County Alabama, represents ambient conditions in the field; namely, temperature, specific conductance (conductivity), hydrogen-ion concentration (pH), turbidity, oxidation/reduction potential (ORP), and dissolved oxygen (DO). Procedures include selection of the appropriate meter/instrument(s) and the proper instrument calibration.

Numerous meters/instruments are commercially available. Some meters are capable of measuring multiple parameters that may include: pH, temperature, ORP, conductivity, DO, salinity, and turbidity. Therefore, individual meters discussed here are not necessarily the only instruments available. However, the setup and use of all instruments should follow a basic format to ensure consistency of use. Regardless of the brand of meter used, all meters should be properly maintained and operated in accordance with the manufacturer's instructions, and the calibration should be checked prior to use. Instrumentation operation and calibration instructions should be followed from the current instrument manual.

The details within this SOP should be used in conjunction with the Site-Specific Field Sampling Plans (SFSP), which will provide the following general information:

- Sample collection objectives
- Locations of samples to be collected for field measurable physical characteristics analysis
- Numbers and volumes of samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITIES

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The QCSM is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure, as well as ensuring all team members also perform work in accordance with this SOP.

The Project Quality Assurance Coordinator is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of samples collected for field measurable physical characteristics meet the requirements of the SFSPs.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance (QA)/Quality Control (QC) Manager is responsible for periodic review of field generated documentation associated with the SOP. If problems occur, the QA/QC Manager is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to the requirements, issuing nonconformances, etc.).

4.0 DEFINITIONS

Temperature – The measure of heat or cold on a defined scale.

Conductivity – The measure of the ability of an aqueous solution to carry an electric current.

ORP– The oxidation-reduction potential of an aqueous media. An ORP reaction is made up of two half-reactions, one involving oxidation (loss of electrons) and the other involving reduction (gain of electrons). Depending on the components available, voltage (or potential) is produced by the reaction (electron activity). The ORP of groundwater may be used to provide information on certain geochemical processes and biological processes that operate only within a certain range.

pH – The negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in grams equivalent per liter. It is used in expressing both acidity and alkalinity on a scale ranging from 0 (acidic) to 14 (alkaline), with 7 representing neutrality.

Turbidity – The reduction of transparency of a liquid due to the scattering of light by suspended particles.

5.0 TEXT

5.1 Required Records and Forms

The following forms are described in SOP No. 1.0, *Field Documentation*:

1. Sample Collection Log
2. Groundwater Purge Form
3. Field Activity Daily Log
4. Material Safety Data Sheets.

5.2 Required Materials, Equipment, or Supplies

1. YSI 6920 Multi-meter or equivalent
2. Decontamination materials
3. Gloves, nitrile or latex
4. Keys for unlocking well caps
5. Paper towels
6. Black ink pens, waterproof
7. Radio, two-way, hand held or cellular phone
8. Personal protective equipment
9. Sample containers
10. Stopwatch
11. Socket wrench set and screwdriver or pry bar for flush-mount well covers
12. Flow-through cell for monitoring during groundwater sampling (Refer to SOP No. 7.0, *Groundwater Sampling*, for required materials).
13. Sample cup/container to place instrument probe when water quality parameters of surface-water, development water, or hydropunch water samples are measured.
14. Spray bottle of deionized water to rinse instrument probes.

5.3 General Procedures

Knowledge of the site and careful planning are required before initiating the collection of samples for field measurable physical characteristics. Several standard steps should be taken before beginning any sampling activity.

1. Verify that all personnel have read and understood the approved, Site-Specific Health and Safety Plan and that they have the proper training and certifications required under the Occupational Safety and Health Administration.
2. Verify the site location by existing maps, well designations, and surface features.
3. Set up the appropriate decontamination line for equipment and personnel.
4. Check to see that all the necessary equipment (including personal protective equipment and samplers) is available at the site, is in good working condition, and has been properly decontaminated.
5. Check that all monitoring equipment is properly calibrated and operating following manufacturers specifications.
6. Set up the investigation-derived waste management system as outlined in the SFSP.

5.4 Specific Procedures

5.4.1 Calibration Procedures

The YSI 6920 Multiparameter Water Quality Sonde is needed for measuring pH, conductivity, turbidity, dissolved oxygen, ORP, and temperature. Physical measurements should be collected on the following water samples:

- During groundwater sampling, take readings from a flow-through cell. Some wells will not produce enough groundwater to make the cell operate; therefore, take one reading with a cup, since no water is constantly flowing through the cell.
- During development, put water in a cup and place the instrument in the cup to collect the reading.
- From hydropunch locations, place a water sample in a cup and place the instrument in the cup to collect the reading.
- During surface-water sampling, place the instrument directly into the water to be sampled (seep, spring, stream, etc.). If this is not applicable, place a water sample in a cup and place the instrument in the cup to collect the reading.

Prior to instrument calibration, verify that fresh and clean standards are being used. The single use of a standard is recommended; however, multiple uses are permissible at the project supervisor's discretion. Use extreme caution to avoid contamination or dilution of the standard. This requires thorough rinsing and drying of calibration/storage cup and probes between standards. If in doubt about standard use, reference the SFSP or contact the QCSM.

Before continuing with calibrations, ensure that the sonde is connected to the display unit via the communication cable and that the display is communicating with the sonde. This is done by selecting “Sonde run” and observing that the display unit is receiving real time readings from the sonde.

Pressing the “Esc” allows the calibration to back out of any menu and eventually return the main menu. This is helpful if the calibration event becomes confusing or is lost within the display sub-menus.

The following is a guide for field calibration. If more in-depth information is required regarding this YSI instrument, please reference the instruction manual.

Conductivity Calibration

1) Make certain that both the calibration cup and the probe are dry. Shake off any excess liquid and wipe down with a paper towel. Canned/pressurized air may also be used as a drying agent.
2) Fill the calibration cup with the conductivity standard and attach securely to the sonde. Verify that the circle on the side of the conductivity cell is submersed with the standard. Tap the calibration cup to dislodge any air bubbles from within the conductivity probe.
3) Select [SONDE MENU] from the main menu on the display.
4) Select [CALIBRATE] from the menu.
5) Select [CONDUCTIVITY] from the calibrate menu.
6) Select [SPCOND] from the menu (this is conductivity that is compensated for temperature).
7) Enter Conductivity standard value in mS (milli-siemens) and press [ENTER] . (10,000 micro-siemens [µS] = 10 milli-siemens [mS])
8) Ensure the reading is stable, then select [CALIBRATE].
9) If a [CONTINUE] message appears on the display, highlight it and press [ENTER]. This will return the display back to the conductivity calibration menu. Press [ESC] and this will return the display back to the main calibration menu. If an [ERROR] message has been received, verify that the conductivity probe is fully immersed (should be above the circle in the side of the probe) and that air bubbles are not lodged in the probe (tap vigorously on calibration cup). If the problem persists, contact field instrumentation support.

DO Calibration

1) Fill the bottom of the calibration cup with about 1/8-inch of water.
2) Secure the calibration cup to the sonde loosely (by about one twist) and stand upright. This is required because the probe and calibration cup interior must match ambient atmospheric pressure while creating an environment of air saturated with water (make certain that no water is touching the DO probe membrane).
3) Allow to sit for 10 minutes.
4) Select [SONDE MENU] from the main menu on the display.
5) Select [CALIBRATE] from the menu.
6) Select [DISSOLVED OXY] from the calibrate menu.
7) Select [DO%] from the DO calibration menu.
8) The unit will automatically put in the appropriate barometric pressure. Press [ENTER].
9) Highlight [CALIBRATE] and press [ENTER].
10) If you received a [CONTINUE] message, highlight it and press [ENTER]. This will return the display back to the DO calibration menu. Press [ESC] and this will return the display back to the main calibration menu. If [ERROR] message has been received, ensure that the appropriate time has elapsed, that no water is touching the DO membrane, and that there are no tears/holes/wrinkles in the DO membrane. Retry. If the problem persists, contact field instrumentation support.

pH Calibration

1) Fill the calibration cup with sufficient pH 7.0 buffer standard (yellow) to completely immerse the glass bulb on the pH probe.
2) Securely attach the calibration cup onto the sonde and stand upright.
3) Select [SONDE MENU] from the main menu on the display.
4) Select [CALIBRATE] from the menu.
5) Select [ISE1 PH] from the calibration menu.
6) Select [2 POINT].
7) Enter [7.0] and press [ENTER].
8) Allow sensor to stabilize and select [CALIBRATE].
9) Select [CONTINUE].
10) Pour out the 7 buffer, triple rinse the calibration cup and probe, thoroughly dry, and refill calibration cup with either 10 (blue) buffer or 4 (pink) buffer, based on calibration requirements.
11) Enter [10.0] or [4.0] and press [ENTER].

12) Allow sensor to stabilize and select [CALIBRATE].
13) If the display indicates a [CONTINUE] message, highlight it and press [ENTER] This will return the display back to the pH calibration menu. Press [ESC] and this will return the menu back to the main calibration menu. If an [ERROR] message has been received, ensure that the standards being used were the correct type and were fresh. If the problem persists, contact field instrumentation support.

ORP Calibration (typically does not require calibration).

CAUTION

MIXING ORP STANDARD WITH ANY ACIDS IS LETHAL! IT WILL CREATE HYDROGEN CYANIDE! ONLY MIX WITH DEIONIZED WATER AND DISPOSE OF WASTE PRODUCT PROPERLY.

1) Fill the calibration cup with enough ORP standard to completely immerse the glass bulb on the pH probe.
2) Securely attach the calibration cup onto the sonde and stand upright.
3) Select [SONDE MENU] from the main menu on the display.
4) Select [CALIBRATE] from the menu.
5) Select [ISE2 ORP] from the calibration menu.
6) Use the chart included with the standard to determine the appropriate value to input into the display in regard to temperature.
7) Enter that value and press [ENTER].
8) Allow sensor to stabilize and select [CALIBRATE].
9) Select [CONTINUE].
10) If the display indicates a [CONTINUE] message, highlight it and press [ENTER]. This will return the display back to the ORP calibration menu. Press [ESC] and this will return the display back to the main calibration menu. If an [ERROR] message has been received, ensure that the standards being used were the correct type and were fresh. If the problem persists, contact field instrumentation support

Turbidity Calibration *(for 6920 Sonde only)*

1) Fill the well within the bottom of the calibration cup with 0 nephelometric turbidity unit (NTU) standard.
2) Attach the calibration cup to the sonde and stand upright.
3) Select [SONDE MENU] from the main menu on the display.
4) Select [CALIBRATE] from the menu.
5) Select [OPTIC TURBIDITY] from the calibration menu.

6) Select [2 POINT].
7) Enter [0.0] and press [ENTER].
8) Highlight [CLEAN OPTICS] and press [ENTER].
9) Wait for the optical cleaning to complete, then highlight [CALIBRATE] and press [ENTER].
10) Select [CONTINUE].
11) Disconnect the calibration cup from the sonde, triple rinse, and thoroughly dry. Then, refill the well in bottom of the calibration cup with 100 NTU standard and secure the calibration cup to the sonde.
12) Enter [123] and press [ENTER].
13) Highlight [CLEAN OPTICS] and press [ENTER].
14) Wait for the optical cleaning to complete, then highlight [CALIBRATE] and press [ENTER]. If the display indicates a [CONTINUE] message, highlight it and press [ENTER]. This will return the display back to the calibration menu. Press [ESC] and this will return the display back to the main calibration menu.

5.4.2 Physical Measurements

Measurement of a water sample will be conducted primarily by using the flow cell. Water will be drawn from the source to the sonde, and information will automatically be displayed. It is important to remember that the temperature reading may be affected if the influent tubing is not protected from direct sunlight.

Field parameters also can be collected by placing the instrument directly into a cup containing fresh sample water in the following steps:

- Verify there is sufficient sample water for all instrument probes to be adequately submerged.
- Take the temperature reading immediately to avoid influence by the ambient air temperature.
- Allow the sensor to stabilize before logging the information on the appropriate field form(s).
- When readings have been completed, remove the instrument from the sample water, triple rinse the instrument and the cup with deionized water, and thoroughly dry before collecting the next sample.

At the conclusion of the day's sampling event, recalibrate and note any differentiation between the start-up calibration and the post-work calibration. Clean and store the instrument in accordance with the manufacturer's requirements.

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0 – *Field Documentation*

SOP No. 11.0 – *Field Generated Records Management.*

8.0 TABLES

None.

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Subject: NONHAZARDOUS SAMPLE HANDLING, PACKAGING AND SHIPPING

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use in packaging and shipping environmental samples for chemical and physical analysis at Redstone Arsenal, Madison County, Alabama.

This SOP applies only to the packaging and shipping of low concentration environmental samples. ***This procedure does not apply to those samples considered to be hazardous materials, hazardous waste, mixed waste, radioactive waste, or dangerous goods.*** 40 Code of Federal Regulations (CFR) 261.4(d) excludes samples of hazardous waste from complying with 40 CFR 261 to 268 provided the sample meets the requirements of §261.4(d). A hazardous waste manifest and land disposal restriction notification are not required for samples of hazardous waste that meet this exclusion. However, SOP No. 15 still does not apply to samples of hazardous waste that meet the definition of a hazardous material. Procedures for shipping hazardous/dangerous wastes are specified in the U.S. Department of Transportation (DOT) 49 CFR 171-178 and in the most current edition of the International Air Transport Association (IATA), Dangerous Goods Regulations. The details within this SOP are applicable only to the general requirements for sample packaging and shipping and should be used as a guide for developing more job-specific Site-Specific Field Sampling Plans (SFSP).

The details in this SOP should be used in conjunction with the SFSPs, which will generally provide the following information:

- Sample collection objectives
- Locations and depths of soil samples to be collected
- Numbers and volumes of soil samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control procedures and sampling required.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The Quality Control Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members perform work in accordance with this SOP.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance/Quality Control Manager is responsible for the periodic review of documentation generated during sample handling, packaging, and shipping and for the periodic review and audit of field personnel as they perform the work. If problems arise, the Quality Assurance/Quality Control Manager is also responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, and issuing variances and nonconformances).

4.0 DEFINITIONS

Environmental Sample – A low concentration sample that does not meet DOT or IATA definitions for a regulated shipment.

Hazardous Materials/Dangerous Goods Sample – A medium- or high-concentration sample regulated by either DOT or IATA.

Hazardous Waste – Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic, as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the U.S. Environmental Protection Agency.

Hazardous Material/Dangerous Good – A material in a quantity or form which may pose an unreasonable risk to health, safety, and/or property, as defined by DOT when transported in commerce. Hazardous materials are defined by DOT (49 CFR 171.8) and dangerous goods are defined by IATA (Section 3).

Sample – Physical evidence collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

DOT Regulations – Requirements for shipping hazardous materials by highway domestically is found at 49 CFR 171-178.

IATA Regulations (current edition) – Requirements for shipping dangerous goods by air, both domestically and internationally.

5.0 TEXT

5.1 Supplies and Equipment

The following is a list of the supplies and equipment needed to implement this SOP in the field.

5.1.1 Required Records and Forms

For a description of required forms, refer to SOP No. 1.0, *Field Documentation*.

1. Sample Collection Log
2. Field Activity Daily Log
3. Chain-of-custody (COC) (Attachment 2)
4. Sample tags/labels and the appropriate forms/documentation for sample shipment
5. Material Safety Data Sheets
6. SFSP
7. CFR 171-178 for ground shipping or the IATA regulations for air shipping.

5.1.2 Materials, Equipment, or Supplies

1. Indelible black-ink pens and markers
2. Plastic or metal coolers (typically provided by the laboratory)
3. Waterproof sealing tape
4. Ice (double bagged)
5. Fiberglass packing tape
6. Nitrile or Latex gloves
7. Plastic Zip-Loc® bags
8. Bubble wrap and/or Styrofoam packing material.

5.2 Procedures

The following steps must be followed when packaging and shipping ***non-regulated*** environmental samples:

1. Properly label (with indelible ink) sample container with the site, unique sample identifier, matrix type, time and date of collection, analytical method, preservatives, and sampling personnel at the time of sample collection. Clear tape should be placed over the label to minimize damage to sample label caused by moisture.
2. As soon as possible after sample collection, tightly seal the container and place a piece of custody tape over or around the cap. The custody tape should be placed over the cap so that any attempt to remove the cap will cause the tape to be broken. Do not place custody tape over a volatile organic analysis (VOA) vial septum.
3. Prepare COC and request-for-analyses forms, as required by the Quality Control Plan.
4. Place all containers in separate, appropriately sized, airtight, seam sealing polyethylene bags (e.g., Ziploc®). Seal the bag, removing any excess air and wrap with bubble wrap or similar material.
5. Place the bagged container inside an insulating shipping container, such as a common plastic picnic cooler (<u>not</u> Styrofoam).
6. Surround the bagged container with bubble wrap or Styrofoam.
7. Pack samples so they are surrounded and covered by a sufficient volume of ice to maintain a 4 ±2 degrees Celsius (°C) temperature immediately following collection of the samples in the field and during the entire shipping period. Ice used in the cooler must be contained in two sealed, leak-proof plastic bags to prevent contact of the sample containers with melted ice.
8. Compare sample labels to the COC forms to ensure proper documentation. Sample labels must be attached so they will not come loose from the sample containers during shipment or if they should become wet (prevented by proper use of clear tape wrapped around the label).
9. Place additional packing material (e.g. bubble wrap or Styrofoam) on top of the samples to eliminate the potential for samples to shift during shipment. Cushioning materials may be used to inhibit breakage of sample containers; however, cushioning material must not interfere with maintaining sample cooling.
10. Record the air bill number or other shipping information on the COC.
11. Place the original COC in a resealable bag and tape it inside the top/lid of the cooler. A copy of the COC must be retained for the field file.
12. Place custody seals on the shipping container. Use custody seals on individual bottles if coolers might be opened during transport (customs, etc.).

13. Seal cooler with strapping tape over the custody seals. Place address label on cooler. Mark the container "THIS END UP," or apply arrow labels that indicate the proper position to be maintained during shipping.
14. If samples are shipped via commercial overnight delivery service, retain a copy of the shipping bill in the appropriate files. Also, record all pertinent information on the Field Activity Daily Log. If sampling personnel are delivering samples to the laboratory, this should be noted on the COC. In this case, the cooler need not have custody seals during transport.
15. Contact the laboratory to confirm safe arrival of all samples. If delivery of samples will arrive at the laboratory on a weekend or holiday, notify the laboratory to have someone available to receive them. Any problems occurring after sample shipment should be recorded on the Field Activity Daily Log, along with the names of personnel at the laboratory who explained the problem.
16. See shipping details in Section 6.0, “Exceptions Provision,” for packages containing preserved samples or sample containers with preservative inside.

5.3 Records

All sample packaging and shipment data will be recorded on the Field Activity Daily Log for the samples shipped. The Field Activity Daily Log entries will be recorded chronologically, with the time of the entry recorded first. All Field Activity Daily Log continuation pages will be sequentially numbered, and the last page recorded for the day will be signed and dated by the recording technician.

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SOP No. 11.0, *Field Generated Records Management*.

6.0 EXCEPTION PROVISIONS

1. Blue ice or similar products are not allowed for shipping because they do not maintain the 4ºC standard required for sample shipping. Blue ice or equivalent should only be used while in the field collecting samples.
2. Samples must be packed so they are surrounded and covered by a sufficient volume of ice to maintain a 4 ± 2 ºC temperature immediately following collection of the samples in the field and during the entire shipping period. Ice used in the cooler must be contained in sealed, leak-proof plastic bags to prevent contact of the sample containers with melted ice.
3. When shipping, note that samples that are preserved with corrosives, such as hydrochloric acid, sulfuric acid, and sodium hydroxide, are not (*because of these preservatives)* subject to DOT’s definition of Class 8 – Corrosives, as long as these limitations are met:
   - Hydrochloric acid is in a water solution at a concentration of 0.04% or less by weight (pH $\geq$ 1.96),

- Nitric acid is in a water solution at a concentration of 0.15% or less by weight (pH $\geq$ 1.62),
- Sulfuric acid is in a water solution at a concentration of 0.35% or less by weight (pH $\geq$ 1.15), and
- Sodium hydroxide is in a water solution at a concentration of 0.08% or less weight (pH $\geq$ 12.30).

4. When shipping, note that samples that are preserved with methanol, are not (*because of this preservative)* subject to DOT's definition of Class 3 – Flammable Liquid*,* as long as each inner container (ie VOA vial) is limited to less than 30 milliliter (mL) of methanol and the outer packaging (ie cooler) is limited to a total of less than 500 mL of methanol.

   For shipment to the 50 U.S. states, no hazard (shipper's) declaration is required and you do not have to access or enter any data into the dangerous goods screens when using FedEx ShipManager. If you use a paper FedEx airbill you must check the box in Section 6 "Does this shipment contain dangerous goods?" to state "Yes, Shipper's Declaration Not Required" and add above the FedEx Tracking number the statement "***Dangerous Goods in Excepted Quantities***".

5. After it has been established that the samples do not meet DOT's definition of Class 8 – Corrosive *on the basis of the preservative*, it must still be determined whether the contaminant of concern itself meets the definition of a DOT hazard class. If it does, appropriate identification, classification, packaging, marking, labeling, and documentation must be performed accordingly.
6. When shipping bottles that contain preservatives *only*, the trained shipper will attempt to meet the small quantity/excepted quantity or limited quantity requirements detailed in the DOT or IATA regulations in order to reduce preparation time, materials costs, handling hazards, and shipping costs. Complete instructions can be found in the appropriate sections of the applicable regulations.
7. Per 49 CFR 172 Subpart H, any employee who performs hazardous materials (or dangerous goods) shipping is required to complete General Awareness and Function-Specific Training covering his or her particular shipping responsibilities, and to update this training at least every three years, for domestic shipping, or every two years for international shipping.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0 – *Field Documentation*

SOP No. 11.0 – Field *Generated Records Management*

Department of Transportation, *Hazardous Materials Regulations*, 49 CFR Parts 171-180.

U.S. Environmental Protection Agency (EPA) Field Branches Quality System and Technical Procedures, available at the following URL: http://www.epa.gov/region4/sesd/fbqstp/index.html.

HAZWRAP, 1996. *Document No. DOE/HWP-100, Standard Operating Procedure 5C, Packing and Shipping Environmental Samples*.

International Air Transport Association, *Dangerous Goods Regulations*, current edition.

EPA, 40 CFR 261.4(d).

8.0 TABLES

None.

9.0 ATTACHMENTS

None.

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Subject: GROUNDWATER LEVEL MEASUREMENTS

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in determining the groundwater level in monitoring wells at Redstone Arsenal, Madison County, Alabama.

Proper recording procedures are necessary to assure the quality and integrity of all groundwater level measurements. Prior to collecting groundwater levels, a strategy should be developed based on the objectives of the Site-Specific Field Sampling Plan (SFSP).

The measurement of the groundwater level in a well is frequently conducted in conjunction with groundwater sampling to determine the "free" water surface. This potentiometric surface measurement can be used to establish groundwater flow directions and gradients. Total well depth and groundwater level measurements are needed to determine the volume of water in the well casing prior to purging the well for sampling purposes.

All groundwater level and total depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. To be useful for establishing groundwater gradient, the reference point should be tied in with the National Geodetic Vertical Datum or a local datum.

When measuring wells for water table or potentiometric surface analysis, and when the contaminant history is known for each of the wells, it is advisable to collect water level measurements beginning with the least contaminated wells first and progressing to the most contaminated wells last, where practical.

The following documents were referenced during preparation of this SOP:

- ASTM D4750-1987
- U.S. Environmental Protection Agency (EPA), 1986
- EPA, 2007
- U.S. Army Corps of Engineers, 1998.

The details within this SOP should be used in conjunction with the SFSPs, which will generally provide the following information:

- Data collection objectives
- Locations for data collection
- Types of data to be collected
- Specific quality control procedures required.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager (QCSM) is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The QCSM is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure, as well as for ensuring all team members perform work in accordance with this SOP.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance/Quality Control Manager is responsible for ensuring that this SOP is correctly implemented and that data collected meet the requirements of the SFSPs.

4.0 DEFINITIONS

Electronic Water Level Indicator – An instrument that consists of a spool of dual wire, a probe attached to the end, and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or buzzer attached to the spool will signal the contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.

5.0 TEXT

5.1 Required Records and Forms

An example of each of the required forms listed below is contained in SOP No. 1.0, *Field Documentation*.

1. Field Activity Daily Log
2. Instrument operation manual.

5.2 Required Materials, Equipment, or Supplies

1. Indelible black-ink pens and markers
2. Personal protective equipment
3. Gloves, nitrile
4. Keys for unlocking well caps
5. Deionized water
6. Paper towels
7. Radio, two-way hand-held, or cellular phone
8. Appropriate equipment and meters for obtaining field measurements as specified in the SFSP (i.e., organic vapor analyzer)
9. Linear measuring device (e.g., tape measure)
10. Electronic water indicator (appropriate length)

The equipment must be capable of recording a measurement to the accuracy required by the SFSP. Project data quality objectives and site characteristics must be taken into account when determining the groundwater level measurement equipment to be used. The total number of wells to be measured, weather, river and stream levels, pumping, and construction can all affect water level measurements.

5.3 General Requirements

Operation manuals provide operation and calibration procedures to be followed. Several standard steps should be taken before any groundwater level measurement activity is performed.

1. Verify that all personnel have read and understood the approved Site-Specific Health and Safety Plan and that they have the proper training and certifications required under the Occupational Safety and Health Administration.

2. Verify the site location by existing maps and surface features.
3. Check to see that all the necessary equipment (including personal protective equipment) is available at the site, is in good working condition, and has been properly decontaminated.
4. Check that all monitoring equipment is properly calibrated and operational. At least every six months, check groundwater level measuring tapes against a surveyor's tape to determine if shrinking or stretching has occurred.
5. Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Note any damage or problems with the well head on the Field Activity Daily Log and notify the QCSM for repair or replacement of the equipment.
6. Uncap the well and, with an organic vapor analyzer, monitor the air space for organic vapors immediately above the open casing, if specified as required in the SFSP and Site-Specific Health and Safety Plan. Observe if any air is flowing into or out of the casing and if so, note observed conditions on the Field Activity Daily Log. If air is observed entering or flowing out of the casing, place the water level indicator inside the well until the air flow stops and the pressure equalizes.

5.4 Specific Requirements

The specific procedure for determining groundwater level using an electronic water level indicator is described below.

1. Lower the electronic water level indicator into the well until the water surface is encountered, as indicated by an audible (beep) or visual (light) signal.
2. When the water surface is reached, give the tape a short, sharp jerk to ensure that the probe is not responding to condensation along the well casing.
3. Measure the distance from the water surface to the permanent reference point. For aboveground "stickup" completions, the reference point is usually a mark or groove cut into the north side of the casing. If no permanent reference point is available for an aboveground completion, measure from another permanently fixed structure or from ground level. The point of measurement should then be noted on the Field Activity Daily Log and on the appropriate form on which the water level is recorded. For flush-mount completions, such as street boxes, the groundwater level measurement should be referenced to a steel grate placed across the rim of the street box and over the casing. Any aboveground completions without permanent reference points or marks should be brought to the attention of the QCSM.
4. Collect measurements until two consecutive measurements are identical or are within the specified tolerance of the SFSP (usually 0.01 foot). Record all appropriate information on the Field Activity Daily Log. At minimum, the following information must be recorded:
   - Project name and number
   - Unique well identification number

- Date and time of measurement collection
- Depth to water to the specified tolerance
- Weather conditions and any problems encountered.

5. Once the water level measurement is completed, where required by SFSP, turn the device to the [OFF] position and slowly lower the probe to the bottom of the well to sound the depth. Record the depth to the bottom of the well to the nearest 0.01 foot and document the bottom condition (i.e., soft, silty, hard).
6. Cap and relock the well.
7. Perform all equipment decontamination procedures as specified in SOP No. 3.0, *Field Equipment Decontamination*. **Measuring equipment must be decontaminated prior to utilizing for well measurements**.

5.5 Records

All information will be recorded on the Field Activity Daily Log for the subject site (SOP No. 1.0). The Field Activity Daily Log entries will be recorded chronologically, with the time of the entry recorded first. All Field Activity Daily Log continuation pages will be sequentially numbered, and the last page recorded for the day will be signed and dated by the recording technician. Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SOP No. 11.0, *Field Generated Records Management*.

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0 – *Field Documentation*

SOP No. 3.0 – *Field Equipment Decontamination*

SOP No. 11.0 – *Field Generated Records Management*

Annual Book of ASTM Standards, 1987 *Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)*, D4750.

EPA Field Branches Quality System and Technical Procedures, available at the following URL: https://www.epa.gov/quality/quality-system-and-technical-procedures-sesd-field-branches.

U.S. Environmental Protection Agency (EPA), 2007, *Groundwater Level and Well Depth Measurement*, Operating Procedure SESDPROC-105-R1, November.

U.S. Environmental Protection Agency (EPA), 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, U.S. Government Printing Office, Washington, D.C.

U.S. Army Corp of Engineers, 1998. *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites.* EM 1110-1-4000.

8.0 TABLES

None.

9.0 ATTACHMENTS

None.

Subject: FIELD EQUIPMENT CALIBRATION

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel at Redstone Arsenal (RSA), Madison County, Alabama, for the calibration of field equipment. The performance of proper calibration procedures will result in reliable field data. The general guidelines for calibration apply to all mechanical and/or electronic measurement equipment used in the field. There are a variety of field measuring instruments that are used at RSA. Each instrument has a unique calibration procedure. The manufacturer's calibration procedures for each instrument currently used or anticipated to be used at RSA are included with each instrument when received from the manufacturer.

2.0 TABLE OF CONTENTS

3.0 RESPONSIBILITY MATRIX

3.1 Quality Control Site Manager

The Quality Control Site Manager is responsible for ensuring calibration procedures are followed and appropriately documented in accordance with this SOP and the manufacturer's instructions for each field instrument. The Quality Control Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (sampler, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this SOP. It is the responsibility of all field personnel to identify, document, and submit recommendations to improve the quality, usability, and implementability of this SOP.

3.3 Quality Assurance/Quality Control Manager

The Quality Assurance (QA)/Quality Control (QC) Manager is responsible for ensuring that this SOP is correctly implemented. The QA/QC Manager is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to the abandonment requirements, issuing nonconformances, etc.) if problems occur.

4.0 DEFINITIONS

Calibration – As applied to field instruments, the process where the field instrument's response to a known standard is measured to verify the accuracy the instrument. The calibration process also includes the adjustment of the field instrument to read a standard within a manufacturer-determined tolerance.

PID – Photoionization Detector

FID – Flame Ionization Detector

5.0 TEXT

5.1 Required Records and Forms

1. Field Activity Daily Log
2. Calibration Logs (Attachment 1).

5.2 Required Equipment, Materials, and Supplies

Table 5-1 is an abbreviated list of field measurement instruments that are currently in use or could potentially be used at RSA in the future. Additional field measurement instruments may be required on a project-specific basis. The manufacturer's calibration guidelines should be consulted.

Table 5.1
Field Measurement Instruments

Instrument	Manufacturer	Use	Applications
TVA-1000-(FID/PID)	Foxboro	Air monitoring for organic vapors	Health and safety monitoring, field screening of air and soil samples
MiniRae 3000	Rae Systems	Air monitoring for organic vapors	Health and safety monitoring, field screening of air and soil samples
LEL/O2/H2S Monitor	Various	Air monitoring for explosive vapor concentration, oxygen levels, and hydrogen	Health and safety monitoring for toxic condition, particularly in confined spaces
Horiba U-10 Water Quality Checker	Horiba	Measurement of pH, specific conductivity, temperature, dissolved oxygen, salinity, and turbidity in water	Used in sampling of aqueous media and in well development
Turbidimeter MicroTPI	HF Scientific	Measurement of turbidity in water	Used in sampling of aqueous media and in well development
Redox meter	Orion	Measurement of oxygen reduction potential in groundwater or surface water	Used in sampling of aqueous materials and in well development

5.3 Procedures

In general, field measurement instruments are calibrated on a daily basis. The calibration information will be recorded on a Calibration Log (Attachment 1). Since the calibration procedures are instrument specific, the manufacturer instructions for calibration shall be followed for each piece of equipment. The manufacturer instructions for each type of field instrument used at RSA are included with each instrument.

5.4 Records

Information required to be recorded on the Calibration Log includes the following:

1. Date and time of calibration
2. Instrument type and serial number
3. Calibration solution (concentration, calibration solution lot number, and expiration date)
4. Measured results, including units, of instrument reading of calibration solution(s)
5. Adjustments made to instrument to achieve calibration
6. Measured results, including units, after adjustment
7. Acceptance criteria for calibration
8. Indication that instrument passed or failed calibration
9. Signature of individual that calibrated the instrument.

6.0 EXCEPTION PROVISION

None.

7.0 CROSS REFERENCES AND OTHER SOURCES OF INFORMATION

This SOP will be used in conjunction with the following cross references where applicable.

SOP No. 1.0 – Field Documentation

SOP No. 11.0 – Field Generated Records Management

Quality Control Requirements for Field Measurements Hazardous Waste Remedial Actions Program (HAZWRAP), DOE/HWP-69/R2, September 1996.

8.0 TABLES

Table 5.1 - Field Measurement Instruments.

9.0 ATTACHMENTS

- Attachment 1, Calibration Logs.

ATTACHMENT 1

CALIBRATION LOGS

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Equipment Calibration Log
Page __ of __

Project Name:
Project Number:

Equipment Number	Equipment Name	Date and Time	Standards Used	Equipment Reading	Comments	Performed By

Note: This list shall be completed for all calibration performed. Only equipment requiring periodic calibration will be included.

Calibration Record TVA 1000

Serial # ____________________________________

Date/Time	Cal. Gas Lot #		Post Calibrations Readings			Calibrated ( )	Initials
	PID	FID	Zero	PID	FID		

*Calibration gas PID – Isobutylene 100 ppm
Calibration gas FID – Methane 100 ppm

Explosimeter Calibration Log

Serial # ____

	Time/Date	Pentane Cal. Gas Concentration	Cal. Gas Lot #	Oxygen Reading	LEL Reading	Alarm Reading	Initials
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							
Before Calibration							
After Calibration							

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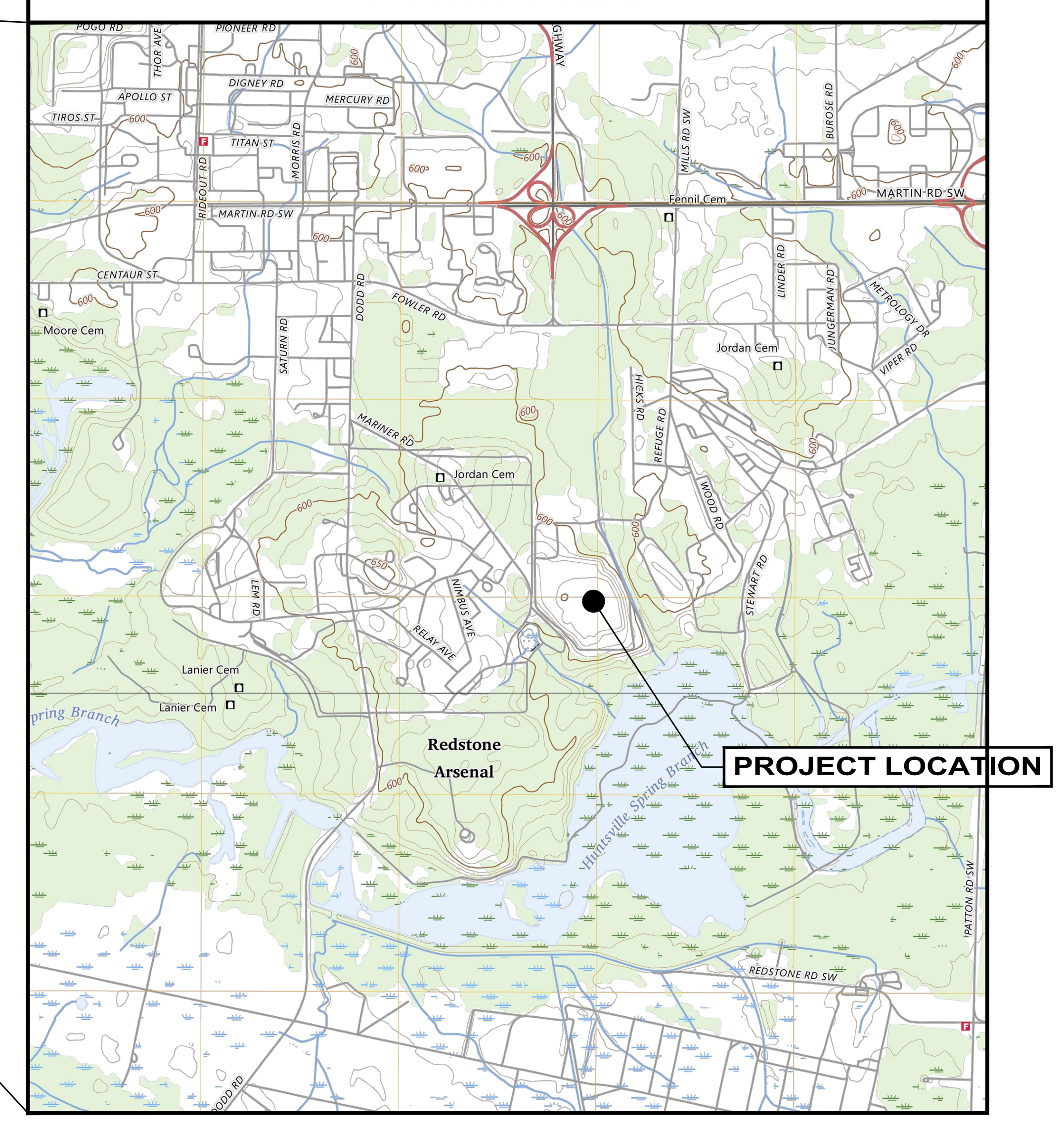
US ARMY

REDSTONE ARSENAL
HUNTSVILLE, ALABAMA
DESIGN AND OPERATION PLAN

VICINITY MAP



PROJECT LOCATION MAP

1" = 2500'

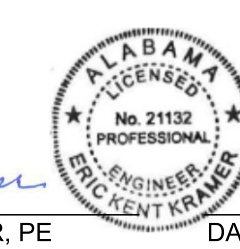
N

LOCUS MAP: USGS. MADISON QUADRANGLE. ALABAMA – MADISON COUNTY. 7.5 MINUTE SERIES. 2024. AND USGS. TRIANA QUADRANGLE. ALABAMA – MADISON COUNTY. 7.5 MINUTE SERIES. 2024.

DRAWING INDEX

GENERAL NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.



Eric K Kramer 07-Nov-2024

ERIC KENT KRAMER, PE DATE
LICENSE NUMBER PE21132

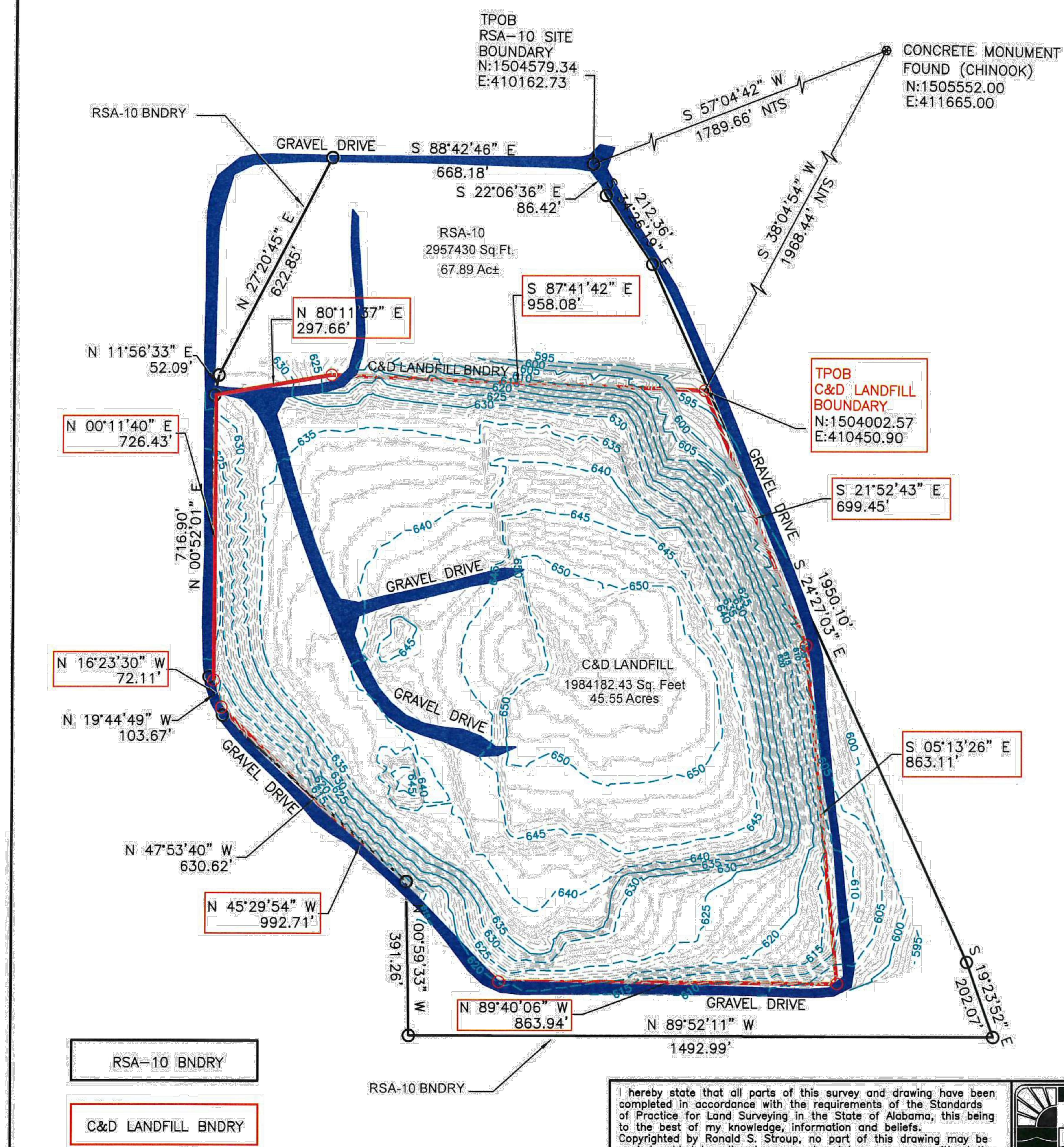
REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

VICINITY MAP AND INDEX TO DRAWINGS

PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	C01	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 1 OF 13	



STATE PLANE
ALABAMA EAST
ZONE NAD 83

STATE OF ALABAMA
COUNTY OF MADISON

I, Ronald S. Stroup, a Registered Engineer and Land Surveyor, State of Alabama, hereby report that to the best of my knowledge, information and beliefs, the following is a true and correct map or plat of the following described tract of land:

This tract of land containing 67.89 Acres, known as RSA-10, located by Coordinates provided by client lying in Section 5, Township 5 South, Range 1 West Madison County, Alabama being more

particularly described as follows:
Commence at a found concrete monument (known as Chinook Monument) with Alabama East State Plane Coordinate of N:1505552.00 E: 411665.00, thence run South 57 degrees 04 minutes 42 seconds West for a distance of 1789.66 feet to a point, said point being the TRUE POINT OF BEGINNING with Alabama East State Plane Coordinate of N:1504579.34 E: 410162.73;

thence run South 22 degrees 06 minutes 36" East for a distance of 86.42 feet to a point;
thence run South 34 degrees 26 minutes 19 seconds East for a distance of 212.36 feet to a point;
thence run South 24 degrees 27 minutes 03 seconds East for a distance of 1950.10 feet to a point;
thence run South 19 degrees 23 minutes 52 seconds East for a distance of 202.07 feet to a point;
thence run North 89 degrees 52 minutes 11 seconds West for a distance of 1492.99 feet to a point;
thence run North 00 degrees 59 minutes 33 seconds West for a distance of 391.26 feet to a point;
thence run North 47 degrees 53 minutes 40 seconds West for a distance of 630.62 feet to a point;
thence run North 19 degrees 44 minutes 49 seconds West for a distance of 103.67 feet to a point;
thence run North 00 degrees 52 minutes 01 seconds East for a distance of 716.90 feet to a point;
thence run North 11 degrees 56 minutes 33 seconds East for a distance of 52.09 feet to a point;
thence run North 27 degrees 20 minutes 45 seconds East for a distance of 622.85 feet to a point;
thence run South 88 degrees 42 minutes 46 seconds East for a distance of 668.18 feet back to the TRUE POINT OF BEGINNING.

This is a special purpose survey located by coordinates provided by client.

STATE OF ALABAMA
COUNTY OF MADISON

I, Ronald S. Stroup, a Registered Engineer and Land Surveyor, State of Alabama, hereby report that to the best of my knowledge, information and beliefs, the following is a true and correct map or plat of the following described tract of land:

This tract of land containing 45.55 Acres, known as C&D Landfill, located by Coordinates provided by client lying in Section 5, Township 5 South, Range 1 West Madison County, Alabama being more particularly described as follows:

Commence at a found concrete monument (known as Chinook Monument) with Alabama East State Plane Coordinate of N:1505552.00 E: 411665.00, thence run South 38 degrees 04 minutes 54 seconds West for a distance of 1968.44 feet to a point, said point being the TRUE POINT OF BEGINNING with Alabama East State Plane Coordinate of N:1504002.57 E: 410450.90;

thence South 38 degrees 04 minutes 54 seconds West for a distance of 1968.44 feet to a point;
thence run South 21 degrees 52 minutes 43 seconds East for a distance of 699.45 feet to a point;
thence run South 05 degrees 13 minutes 26 seconds East for a distance of 863.11 feet to a point;
thence run North 89 degrees 40 minutes 06 seconds West for a distance of 863.94 feet to a point;
thence run North 45 degrees 9 minutes 54 seconds West for a distance of 992.71 feet to a point;
thence run North 16 degrees 23 minutes 30 seconds West for a distance of 72.11 feet to a point;
thence run North 00 degrees 11 minutes 40 seconds East for a distance of 726.43 feet to a point;
thence run North 80 degrees 11 minutes 37 seconds East for a distance of 297.66 feet to a point;
cthence run South 87 degrees 41 minutes 42 seconds East for a distance of 958.08 feet back to the TRUE POINT OF BEGINNING.

This is a special purpose survey located by coordinated provided by client,

ALABAMA PROFESSIONAL ENGINEER AND LAND SURVEYOR
REGISTERED NO. 12707
RONALD S. STROUP

Ronald S. Stroup Reg. No. 12707

Revised Date: 18 OCT 2024

MID-SOUTH TESTING INC. 2220 BELTLINE ROAD SW, DECATUR ALABAMA, 35601

Sheet	Title: Aptim Federal Services	Scale: 1" = 300'	Project No: 22-01-0190
of	Project: RSA-10 Bndry/C&D Landfill	Date: 16 AUG 22	Cad name: RSA LANDFILL
		Drawn By: SMR	File: W-WORKING FILES

REV. NO.	DATE	DESCRIPTION

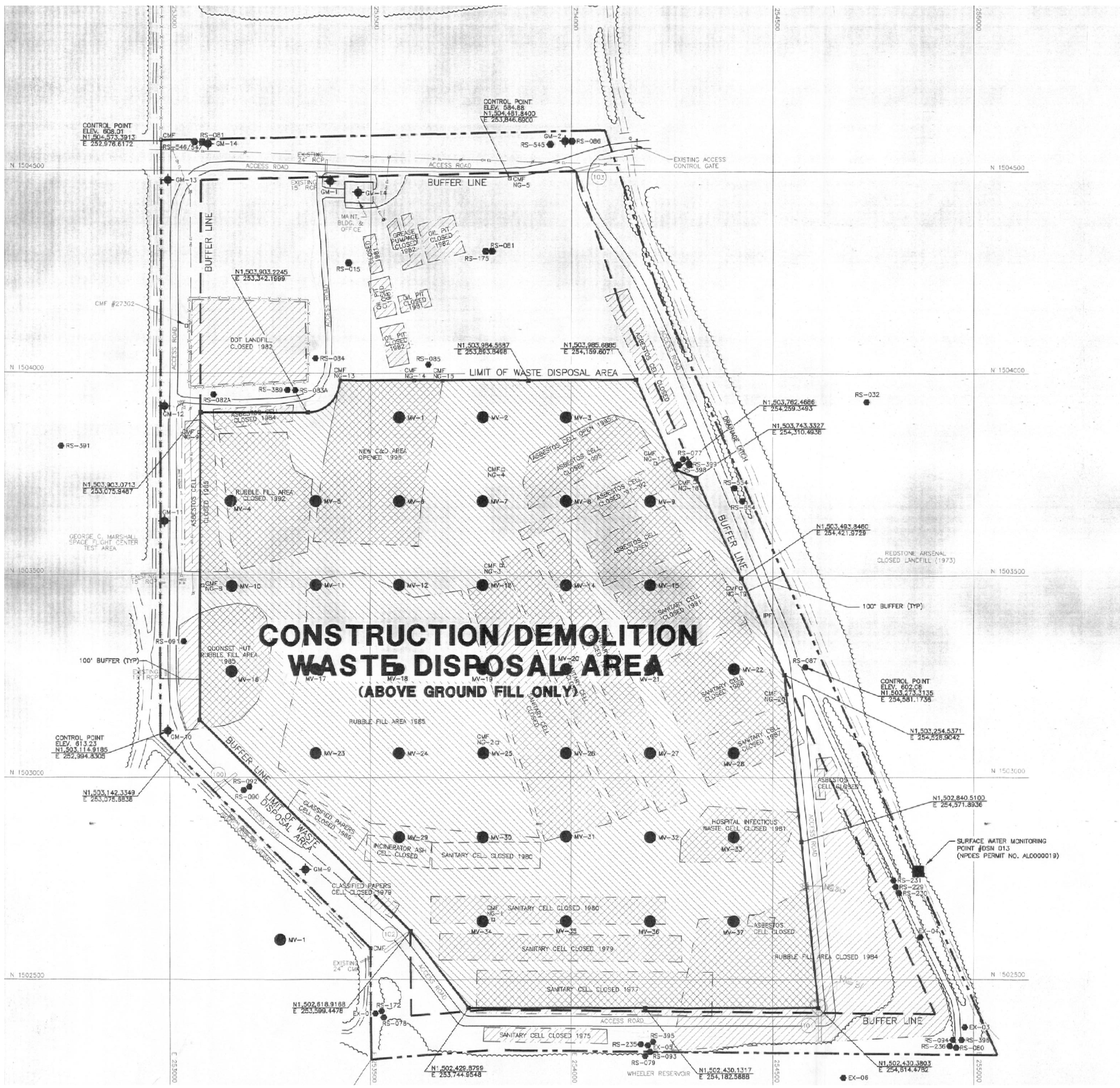
APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

BOUNDARY SURVEY (2022)
(REPROJECTED AT 1" = 150')

PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	**C02**	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 2 OF 13	

This map was produced by BEI Aerial Mapping, Manchester, Georgia
for Hodges, Harbin, Newberry & Tribble, Inc.
of Redstone Arsenal Landfill, Huntsville, Alabama
BEI PROJECT # 96-11121
DATE OF PHOTOGRAPHY: November 22, 1996
DATE OF SUBMITTAL: November 25, 1996



150' 0 150'

GRAPHIC SCALE

NOTES:

1. THIS MAP HAS BEEN REPROJECTED FROM 1" = 100' TO 1" = 150'.

REV. NO.	DATE	DESCRIPTION

APTIM

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

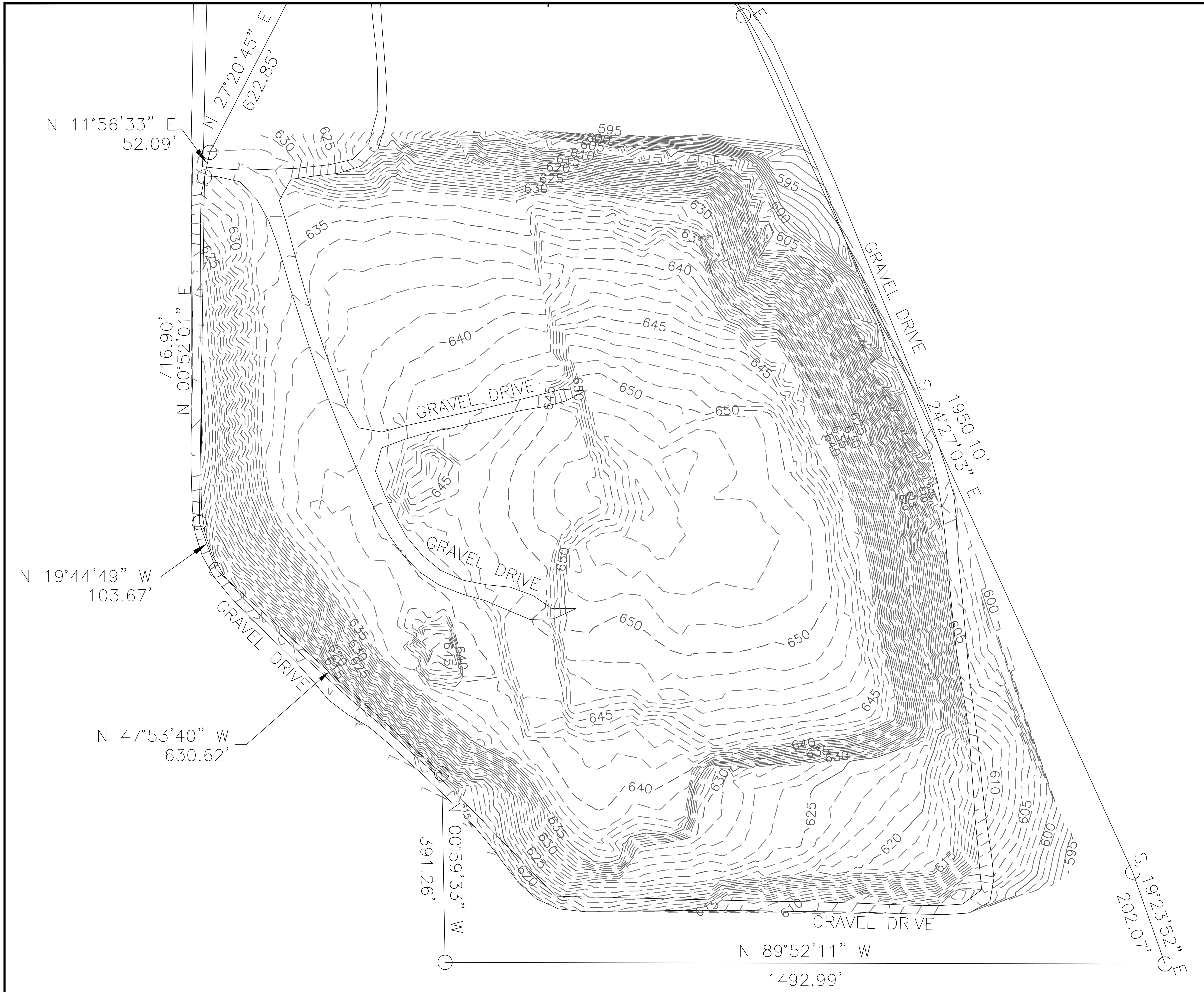
MASTER PLAN AS PROPOSED IN THE 1997 DESIGN AND OPERATION PLAN

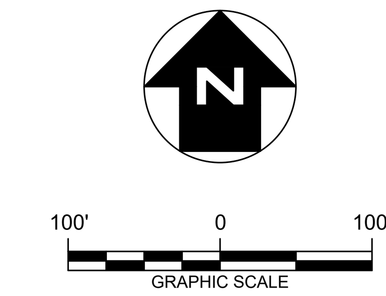
PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C03





LEGEND

— —650— — EXISTING SITE CONTOUR

NOTES

1. SURVEY OF THE C&D LANDFILL BY RONALD S. STROUP, A REGISTERED ENGINEER AND LAND SURVEYOR, STATE OF ALABAMA, AUGUST 16, 2022.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

EXISTING TOPOGRAPHIC SURVEY

PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C04

SHEET 4 OF 13

N

100' 0 100'
GRAPHIC SCALE

NOTES

1. REDSTONE ARSENAL. FINAL GRADING PLAN. APRIL 24, 1997.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

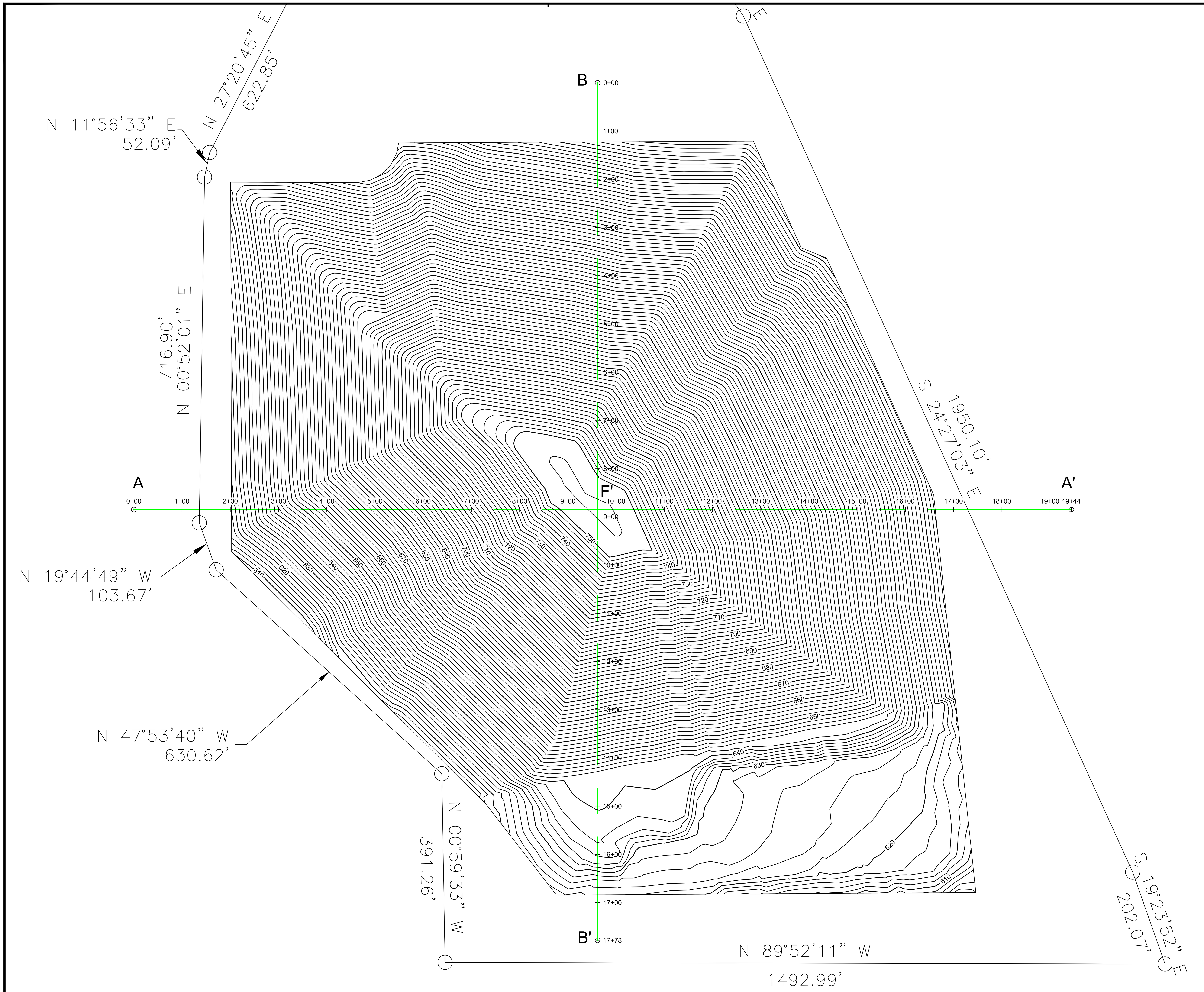
REV. NO.	DATE	DESCRIPTION

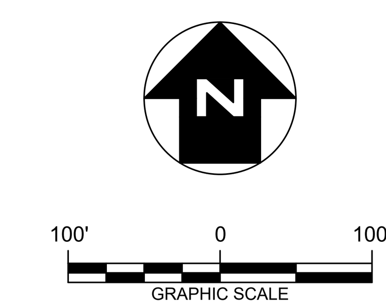
APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

INITIAL GRADING PLAN

PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES
DATE:	OCTOBER 2024
DRAWING NUMBER:	C05





LEGEND

CROSS SECTION

NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. THIS PLAN WAS UPDATED FROM THE 1997 PLAN TO INCLUDE UXO EXCLUSION SCENARIO AS OF 2022 SURVEY/EXHIBITS.
3. SURVEY GRADES OF THE C&D LANDFILL BY RONALD S. STROUP, A REGISTERED ENGINEER AND LAND SURVEYOR, STATE OF ALABAMA, AUGUST 16, 2022.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

APTIM

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

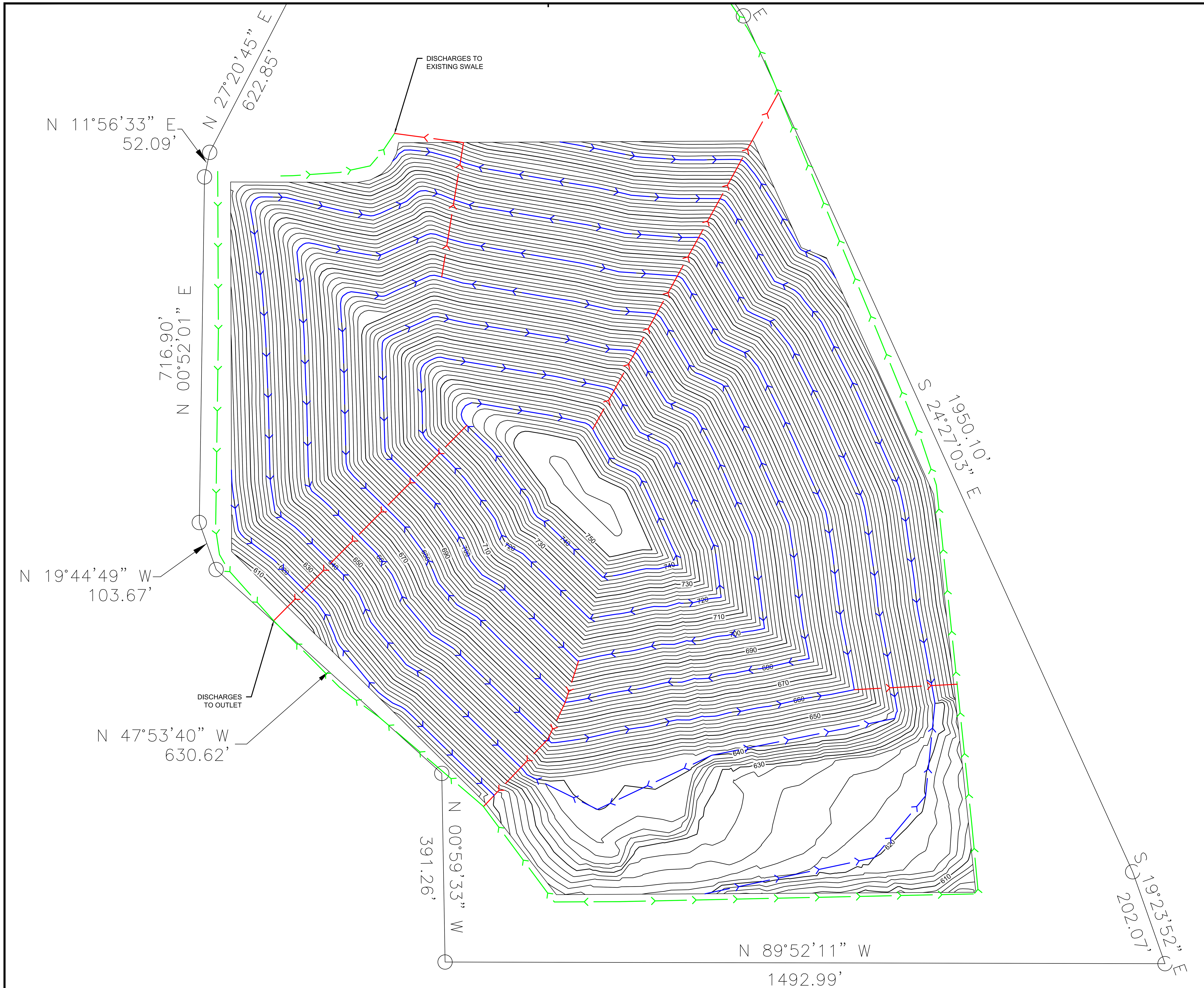
FINAL GRADING PLAN

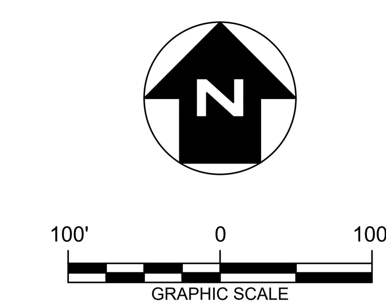
PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C06





LEGEND

- TERRACE DRAIN
- DOWN DRAIN
- PERIMETER DRAIN

NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. THIS PLAN WAS UPDATED FROM THE 1997 PLAN TO INCLUDE UXO EXCLUSION SCENARIO AS OF 2022 SURVEY/EXHIBITS.
3. SURVEY GRADES OF THE C&D LANDFILL BY RONALD S. STROUP, A REGISTERED ENGINEER AND LAND SURVEYOR, STATE OF ALABAMA, AUGUST 16, 2022.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

REV. NO.	DATE	DESCRIPTION

APTIM

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

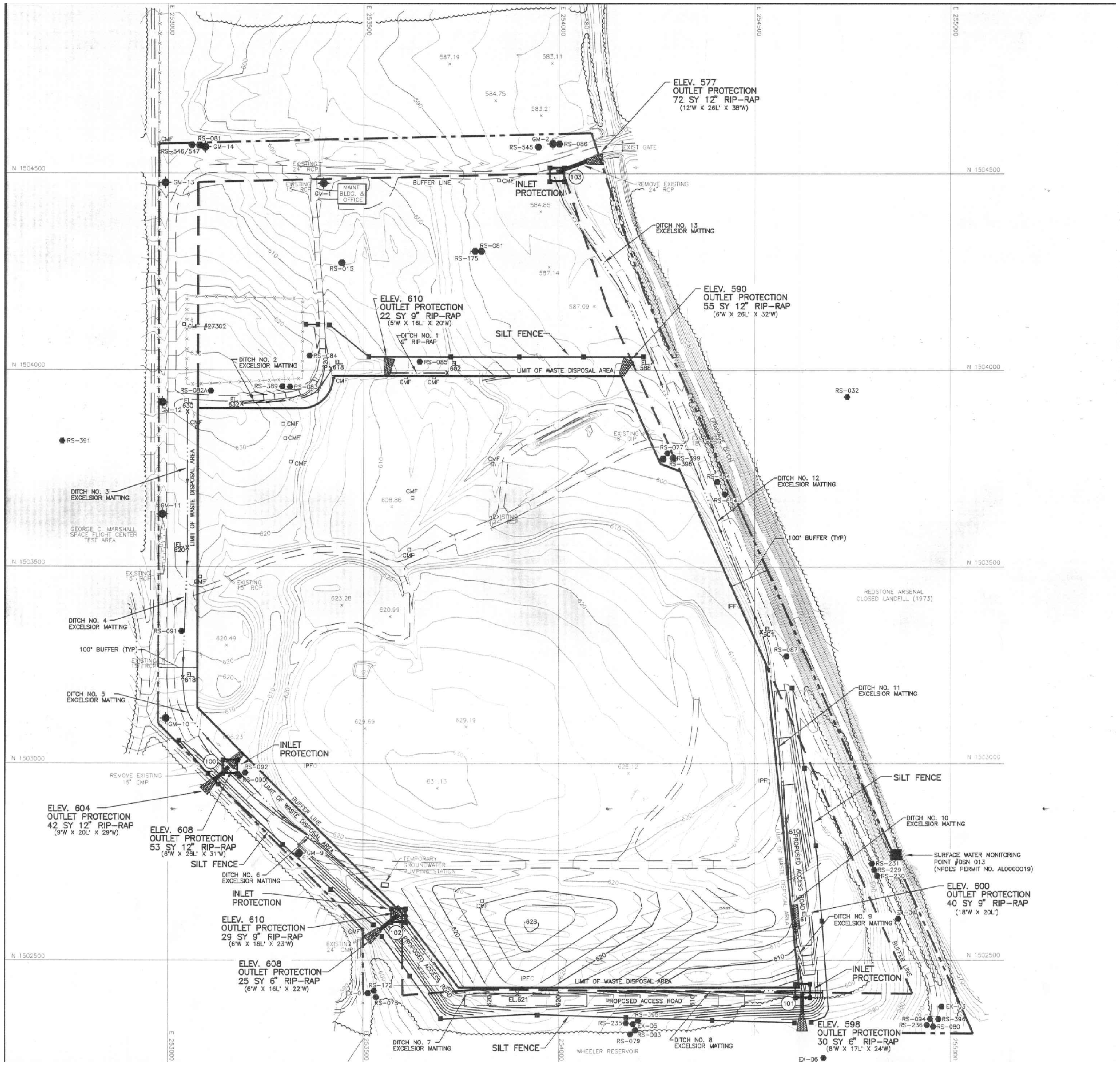
FINAL DRAINAGE PLAN

PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C07



This map was produced by BEI Aerial Mapping, Manchester, Georgia
for Hodges, Harbin, Newberry & Tribble, Inc.
of Redstone Arsenal Landfill, Huntsville, Alabama
BEI PROJECT # 96-11121
DATE OF PHOTOGRAPHY: November 22, 1996
DATE OF SUBMITTAL: November 25, 1996

NEW DRAINAGE STRUCTURES

PIPE NO.	SIZE	LENGTH	SLOPE	MATERIAL	UPSTREAM INVERT	DOWNSTREAM INVERT
100	36"	54'	1.00%	RCP	606.00	605.46
101	~~18"~~ 24"	54'	3.70%	RCP	600.00	598.00
102	24"	60'	3.33%	RCP	610.00	608.00
103	48"	100'	1.00%	RCP	578.00	577.00

NOTES:

1.) OPERATOR WILL CONSTRUCT DITCHES AS WASTE IS PLACED NEXT TO ACCESS ROAD OR AS NEEDED TO CONTROL STORM WATER RUN-OFF, WHICHEVER OCCURS FIRST.
2.) OPERATOR WILL INSTALL TEMPORARY DITCH MATERIALS AS NEW DITCHES ARE CONSTRUCTED AND IN EXISTING DITCHES AS THEY ARE RECONSTRUCTED TO HELP ESTABLISH VEGETATIVE COVER.
3.) OPERATOR WILL INSTALL RIP-RAP OUTLET PROTECTION FOR DOWNDRAINS AS DOWNDRAINS ARE INSTALLED.
4.) OPERATOR WILL INSTALL DRAINAGE PIPES NO. 100 – 103 AS NEW ACCESS ROAD IS CONSTRUCTED.

N

150' 0 150'
GRAPHIC SCALE

NOTES:

1. THIS MAP HAS BEEN REPROJECTED FROM 1" = 100' TO 1" = 150'.

REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

EROSION CONTROL PLAN AS PROPOSED IN THE 1997 DESIGN AND OPERATION PLAN

PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	**C08**	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 8 OF 13	

This map was produced by EEI Aerial Mapping, Manchester, Georgia
for Hodges, Harbin, Newberry & Tribble, Inc.
of Redstone Arsenal Landfill, Huntsville, Alabama
EEI PROJECT # 96-11121
DATE OF PHOTOGRAPHY: November 22, 1996
DATE OF SUBMITTAL: November 25, 1996

MONITORING NOTES:

(1) GROUNDWATER WELLS ON SITE WILL BE MONITORED UNDER RCRA PROGRAM
(2) METHANE GAS WILL NOT BE MONITORED PER SECTION VIII OF PERMIT 45-03
(3) METHANE GAS WELLS CURRENTLY PRESENT ON SITE:
GM-1 - WEST OF OFFICE
GM-2 - NORTHEAST CORNER OF SITE
GM-9 - SOUTHWEST CORNER OF SITE
GM-10 - WEST EDGE OF SITE
GM-11 - WEST EDGE OF SITE
GM-12 - WEST EDGE OF SITE
GM-13 - NORTHWEST CORNER OF SITE
GM-14 - NORTHWEST CORNER OF SITE
GM-15 - INSIDE OFFICE AND MAINTENANCE BUILDING (NEW POINT)

N

150' 0 150'
GRAPHIC SCALE

NOTES:

1. THIS MAP HAS BEEN REPROJECTED FROM 1" = 100' TO 1" = 150'.

REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

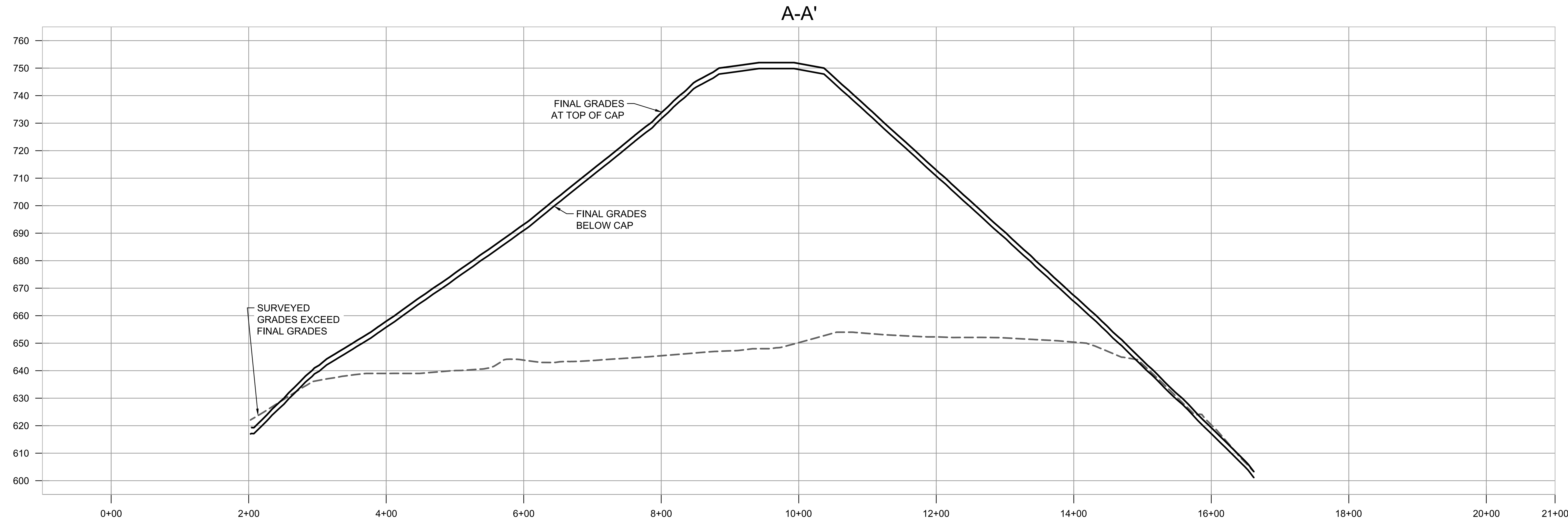
ENVIRONMENTAL MONITORING PLAN AS PROPOSED IN THE 1997 DESIGN AND OPERATION PLAN

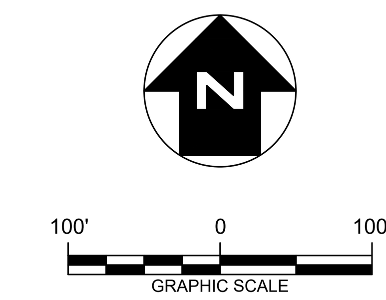
PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C09





VERTICAL EXAGGERATION = 4X

LEGEND

- - - - - SURVEYED GRADES

——— MODIFIED FINAL PROPOSED GRADES

— — — UNMODIFIED FINAL GRADE

NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. SURVEY GRADES OF THE C&D LANDFILL BY RONALD S. STROUP, A REGISTERED ENGINEER AND LAND SURVEYOR, STATE OF ALABAMA, AUGUST 16, 2022.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

REV. NO.	DATE	DESCRIPTION

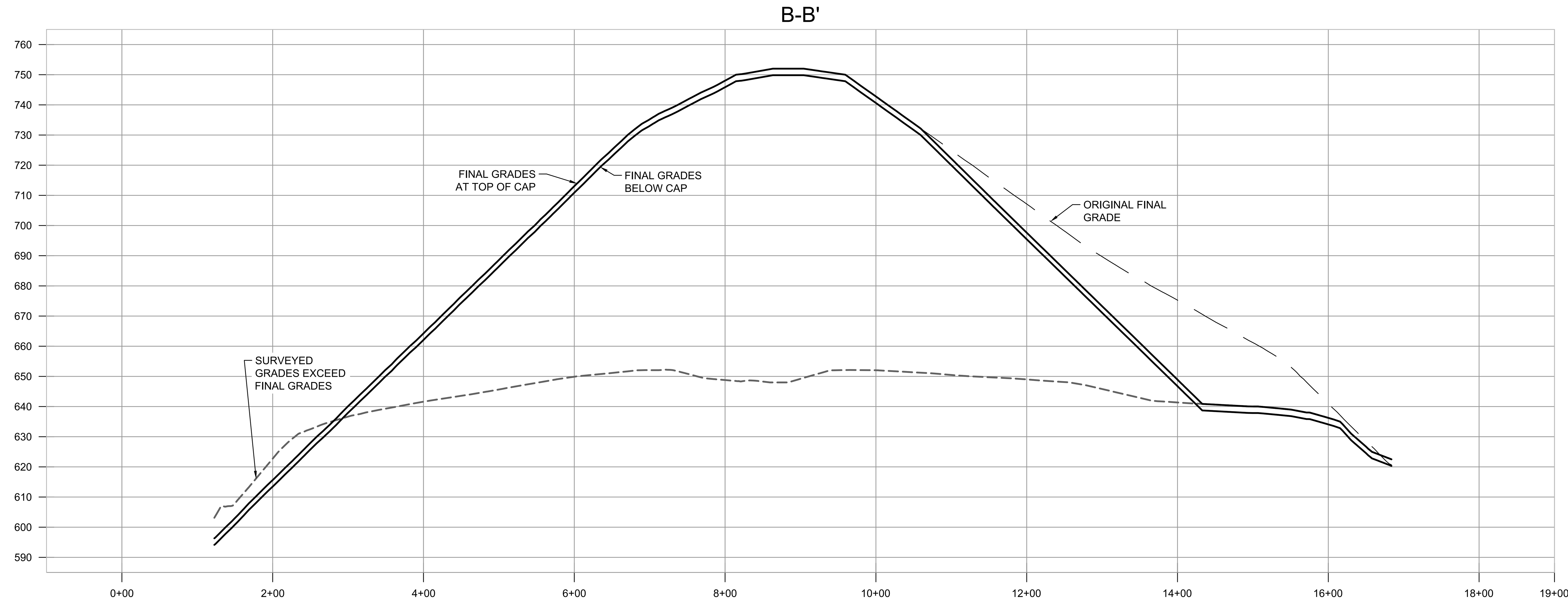
APTIM Environmental & Infrastructure, LLC

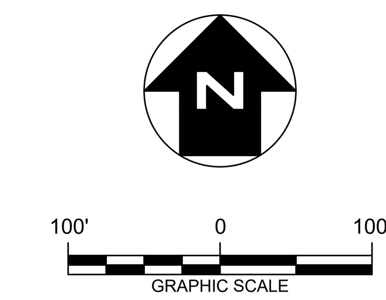
APTIM

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

CROSS SECTION A-A'

PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	C10	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 10 OF 13	





VERTICAL EXAGGERATION = 4X

LEGEND

- SURVEYED GRADES
- MODIFIED FINAL PROPOSED GRADES
- UNMODIFIED FINAL GRADE

NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. SURVEY GRADES OF THE C&D LANDFILL BY RONALD S. STROUP, A REGISTERED ENGINEER AND LAND SURVEYOR, STATE OF ALABAMA, AUGUST 16, 2022.
4. THE NEED FOR FLEXIBILITY TO ACCOMMODATE ADJUSTMENTS AND MODIFICATIONS IS ANTICIPATED CONSIDERING THE SIZE, COMPLEXITY, AND LIFE OF THE PROJECT.

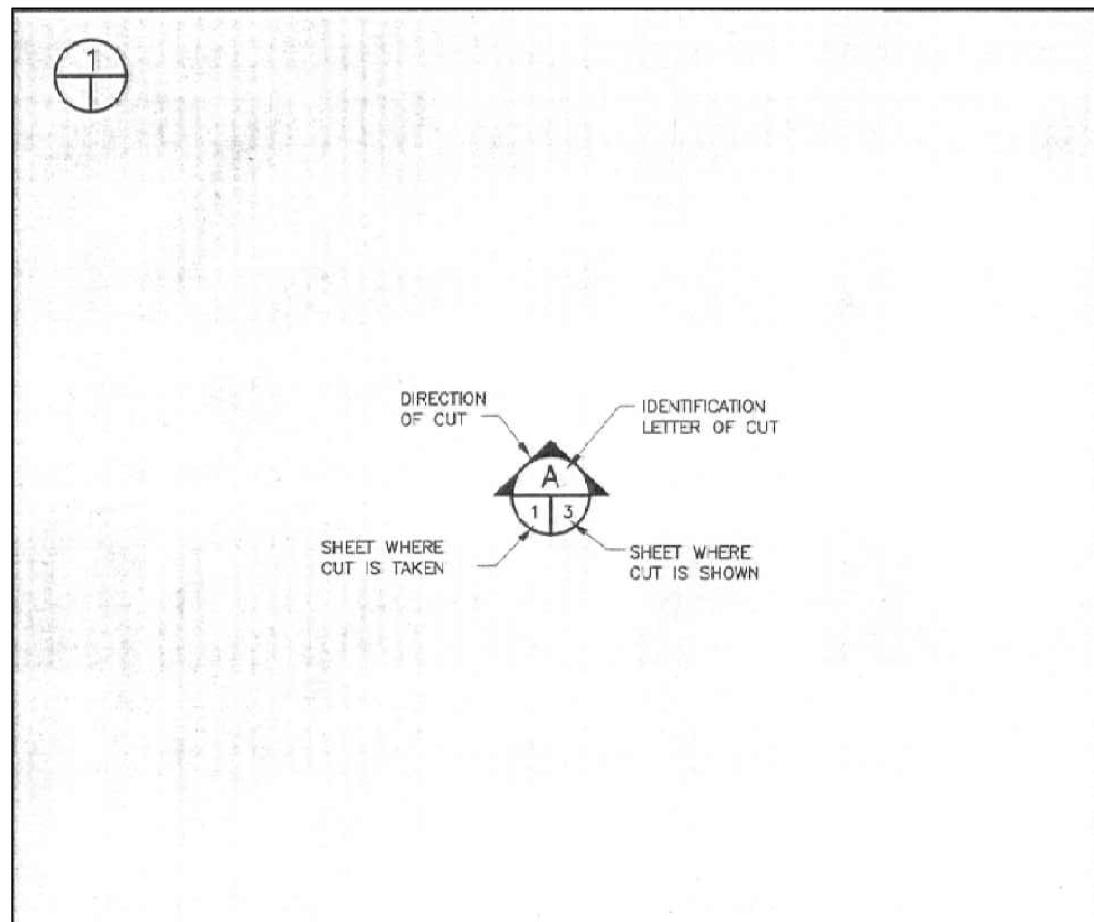
REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

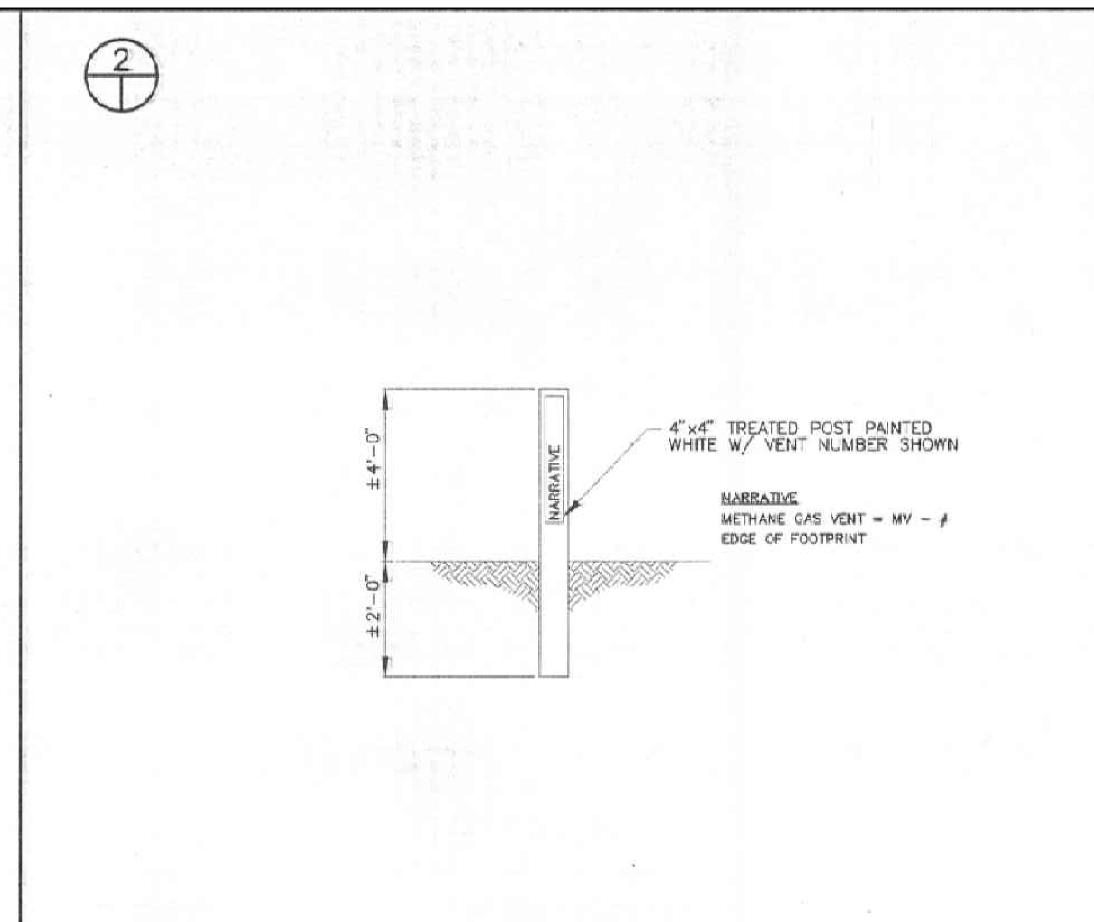
RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

CROSS SECTION B-B'

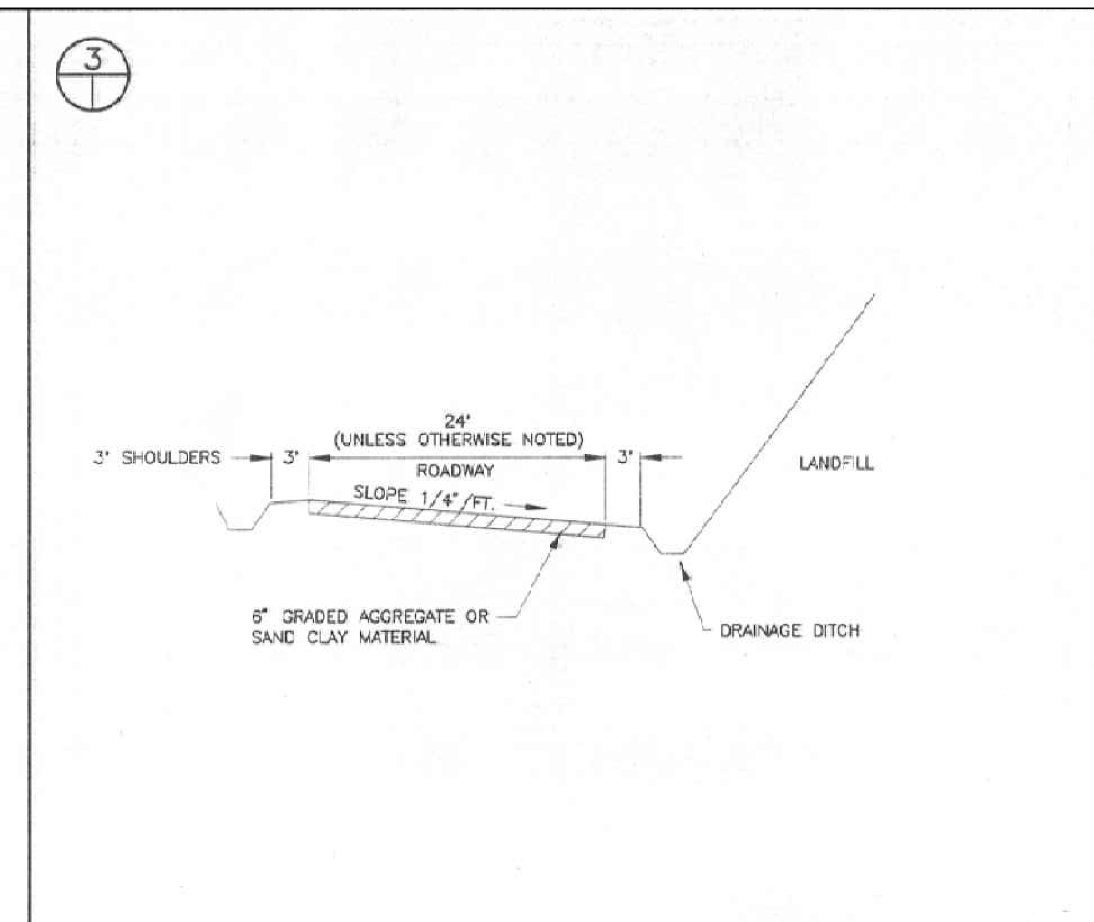
PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	**C11**	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 11 OF 13	



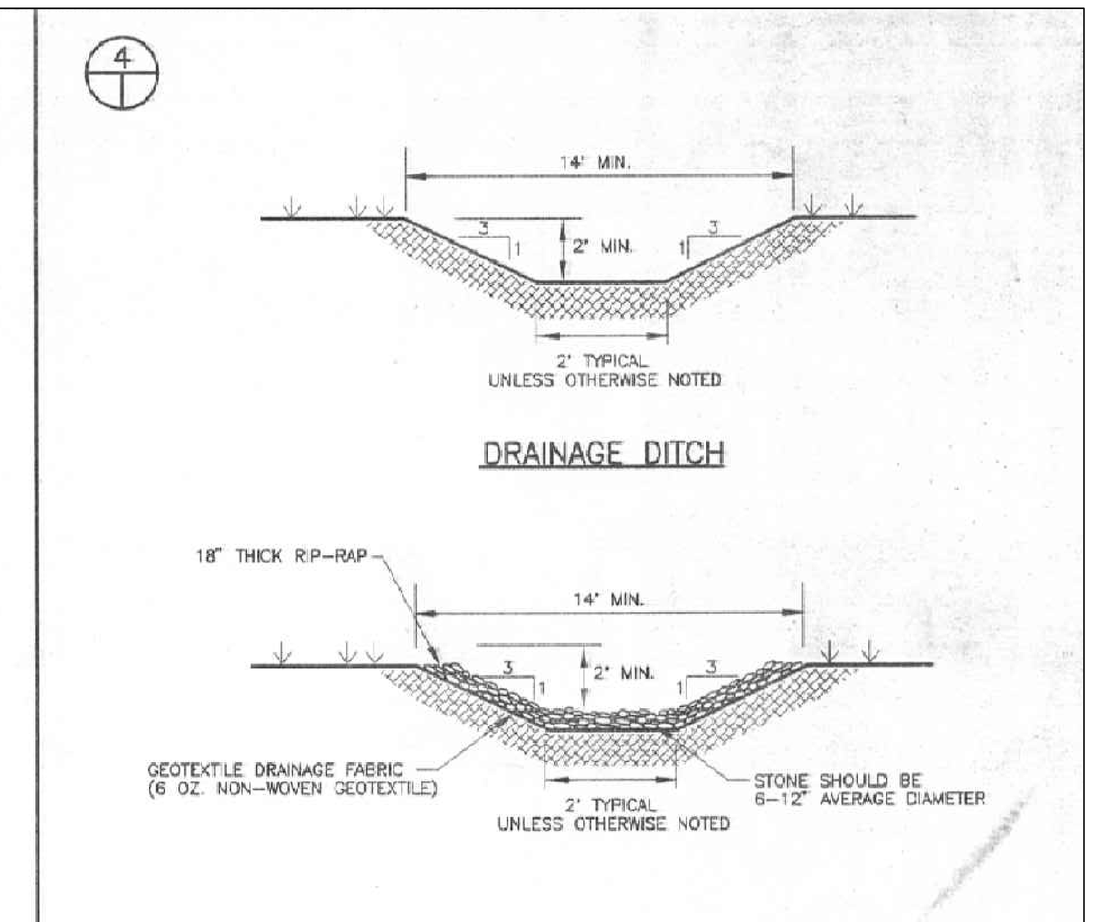
EXAMPLE – SECTION SYMBOL



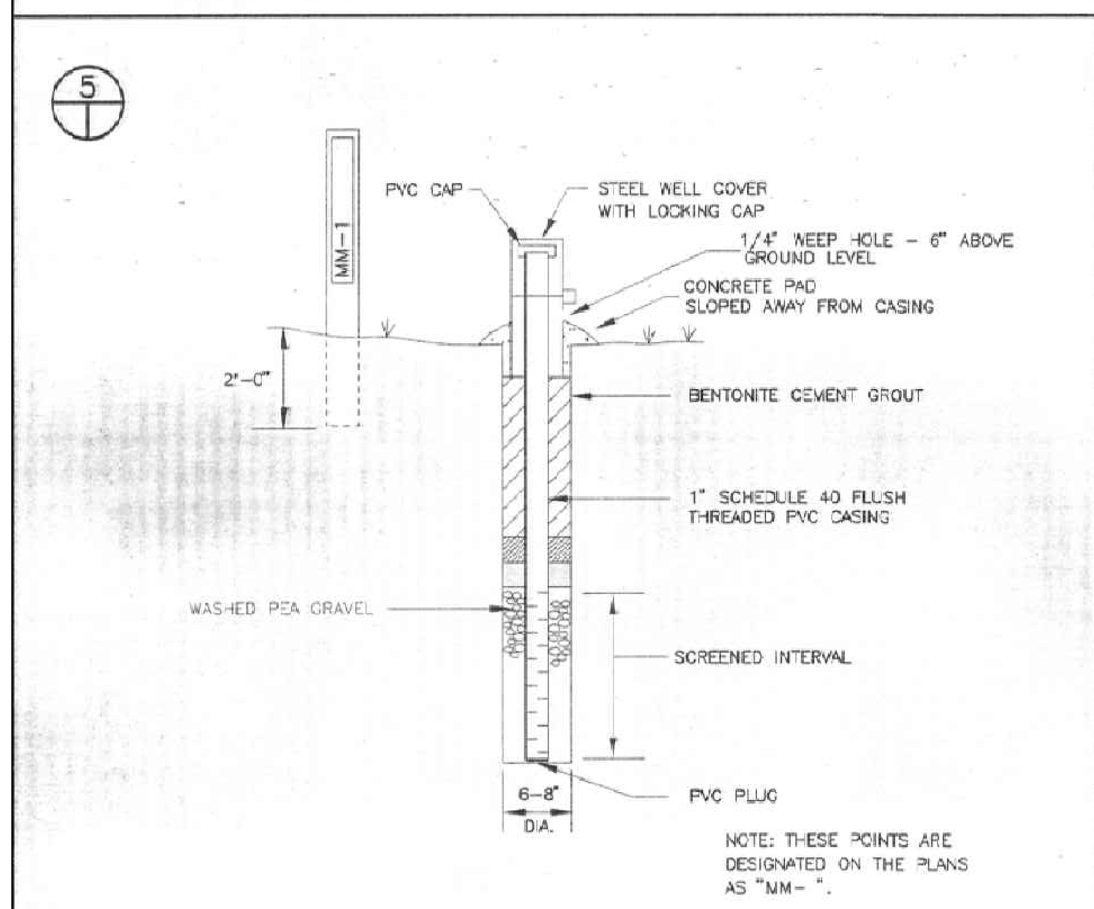
METHANE GAS VENT OR EDGE OF FOOTPRINT MARKER



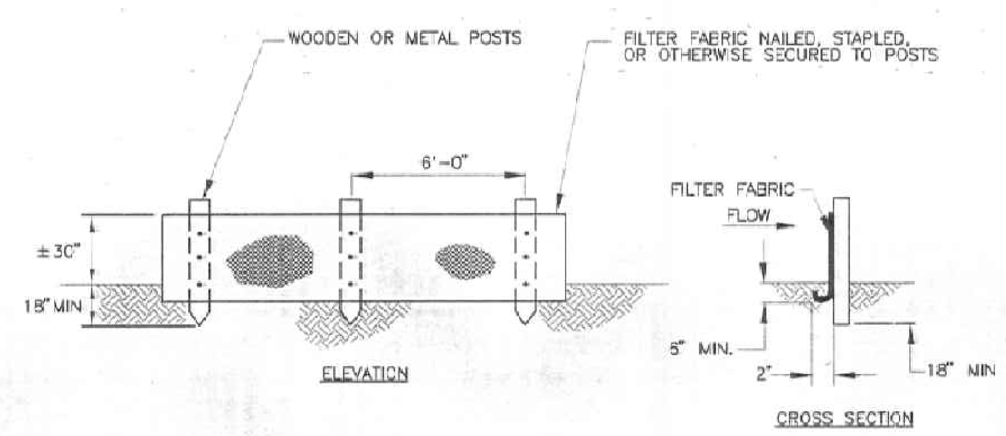
ALL WEATHER ACCESS ROAD SECTION



RIP-RAP DITCH
(DRAINAGE DITCH NO. 1 ONLY)



METHANE SAMPLING WELL

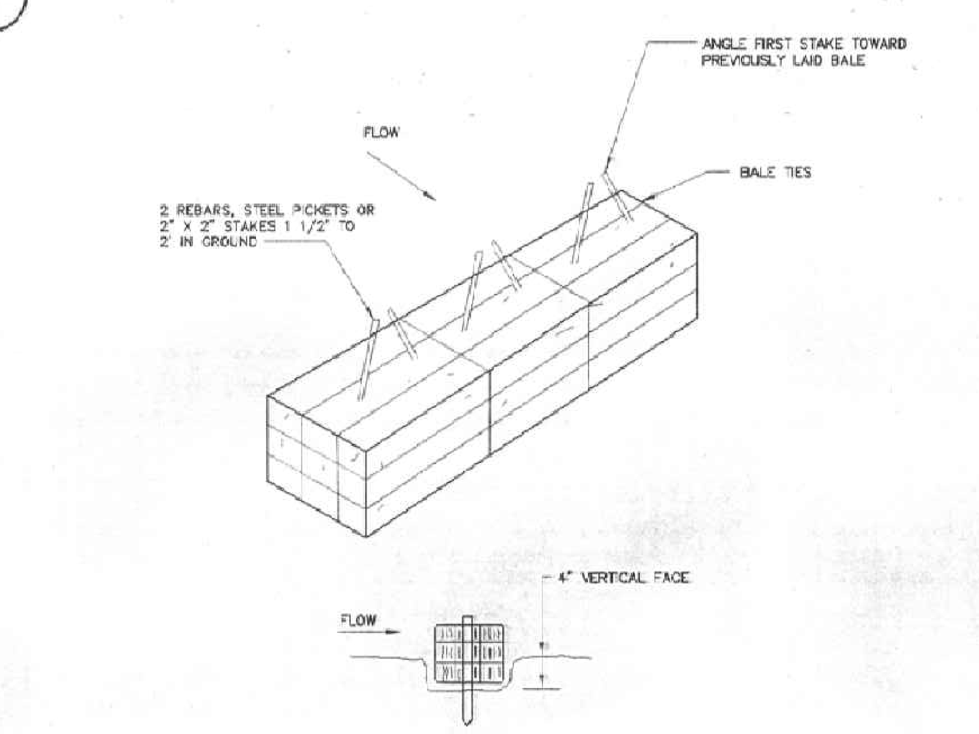


SILT FENCE SPECIFICATION:
USE A SYNTHETIC FILTER FABRIC OF POLYPROPYLENE, NYLON, POLYESTER OR POLYETHYLENE YARN, CONFORMING TO THE REQUIREMENTS LISTED BELOW. SYNTHETIC FILTER FABRIC SHALL CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS TO PROVIDE A MINIMUM OF 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT A TEMPERATURE OF 0° TO 120°F.

PHYSICAL PROPERTY	REQUIREMENTS
FILTERING EFFICIENCY	85% (MIN.)
TENSILE STRENGTH AT 20% (MAX.) ELONGATION	STANDARD STRENGTH – 30 LBS./LIN. IN. (MIN.) EXTRA STRENGTH – 50 LBS./LIN. IN. (MIN.)
SLURRY FLOW RATE	0.3 GAL./SQ. FT./MIN. (MIN.)

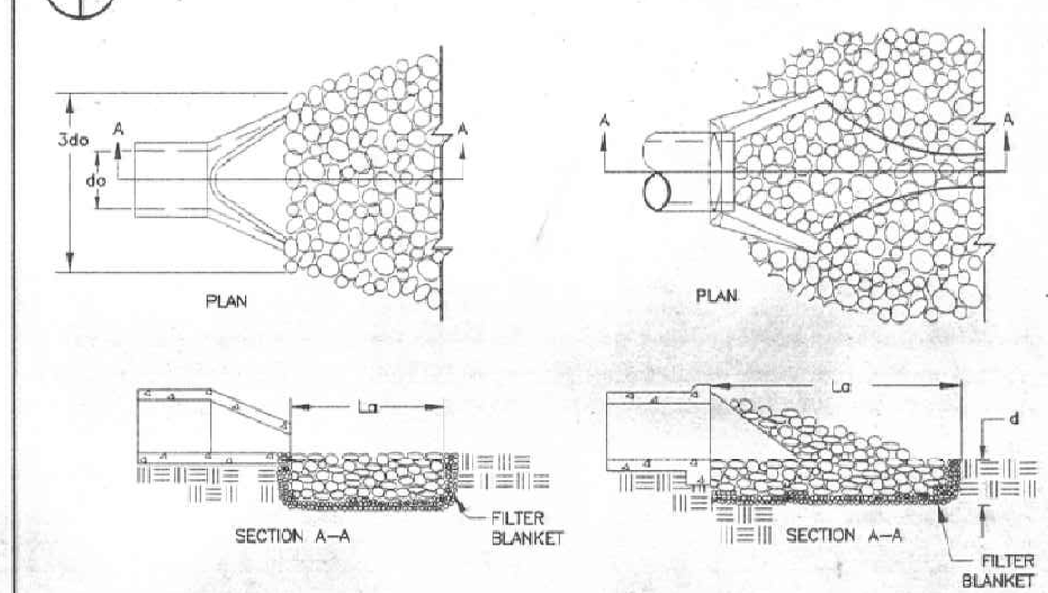
NOTES:
1. FLOWS MAY NECESSITATE THE PLACEMENT OF HAYBALES IN FRONT OF FILTER FABRIC
2. HAYBALES MAY BE USED IN LIEU OF SILT FENCING AT THE OPERATOR'S DISCRETION.

SILT FENCE



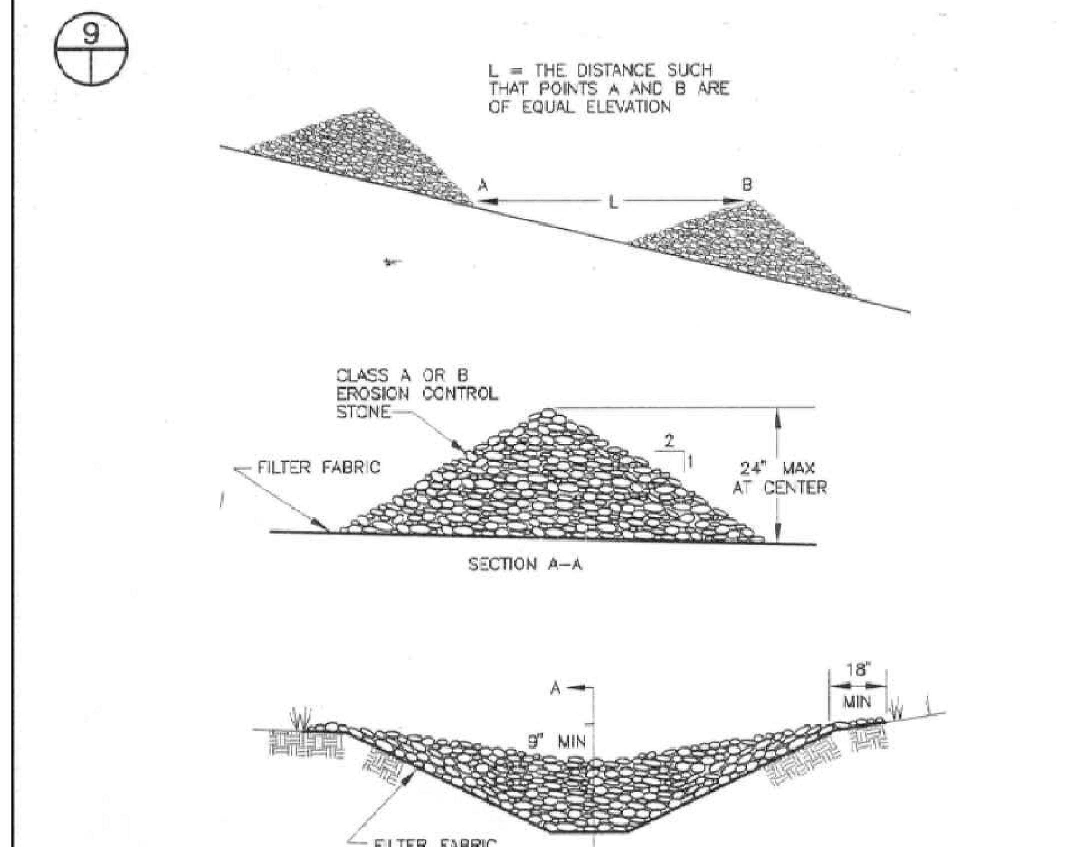
NOTES:
1. SILT FENCING MAY BE USED IN LIEU OF HAY BALES AT THE OPERATOR'S DISCRETION.

TEMPORARY SEDIMENT BARRIER – HAY BALES



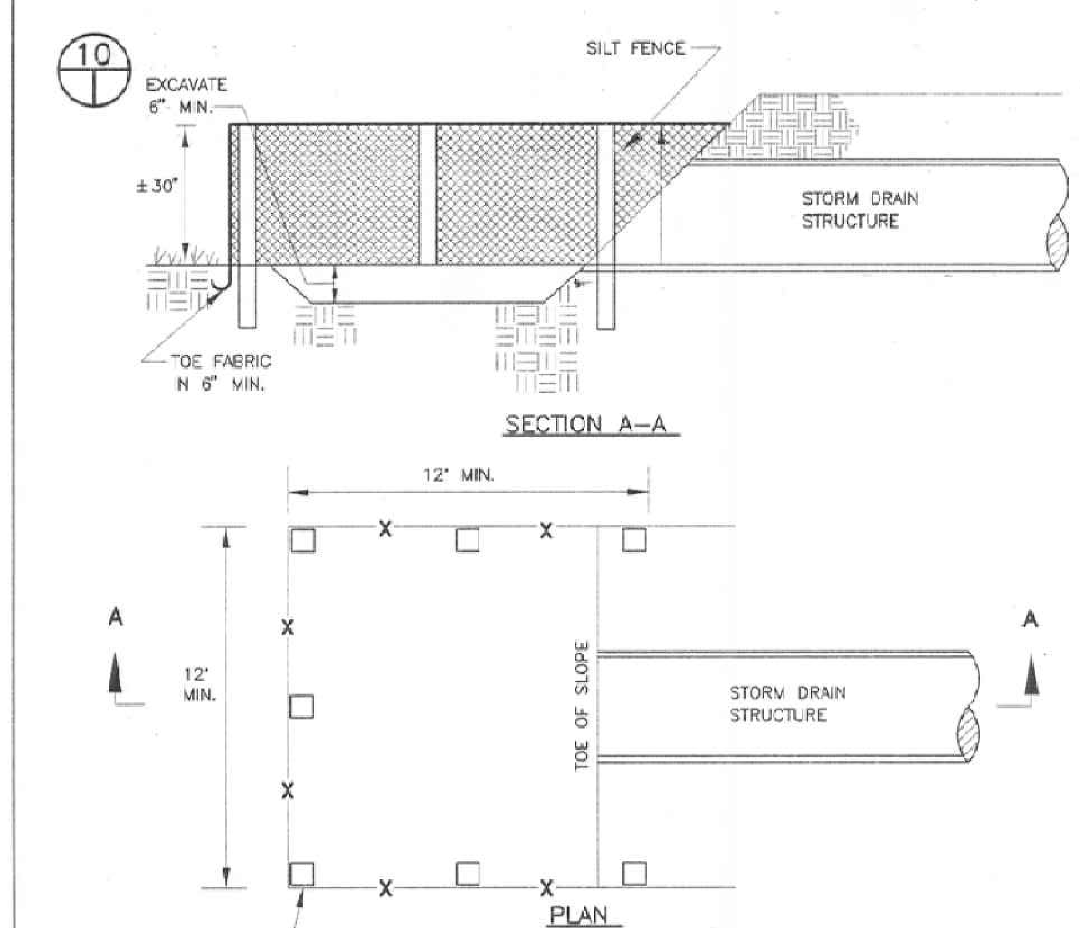
NOTES:
1. La IS THE LENGTH OF THE RIPRAP APRON.
2. d=1.5 TIMES THE MAXIMUM STONE DIAMETER BUT NOT LESS THAN 6".
3. IN A WELL-DEFINED CHANNEL, EXTEND THE APRON UP IN THE CHANNEL BANKS TO AN ELEVATION OF 6" ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS LESS.
4. A FILTER BLANKET (AASHTO #57 STONE) OR FILTER FABRIC (6 OZ. NON-WOVEN GEOTEXTILE) SHALL BE INSTALLED BETWEEN THE RIP-RAP AND SOIL FOUNDATION.
5. SEE EROSION CONTROL PLAN (SHEET 8 OF 13) FOR WIDTHS AND LENGTHS OF RIP-RAP OUTLET PROTECTION.

OUTLET PROTECTION

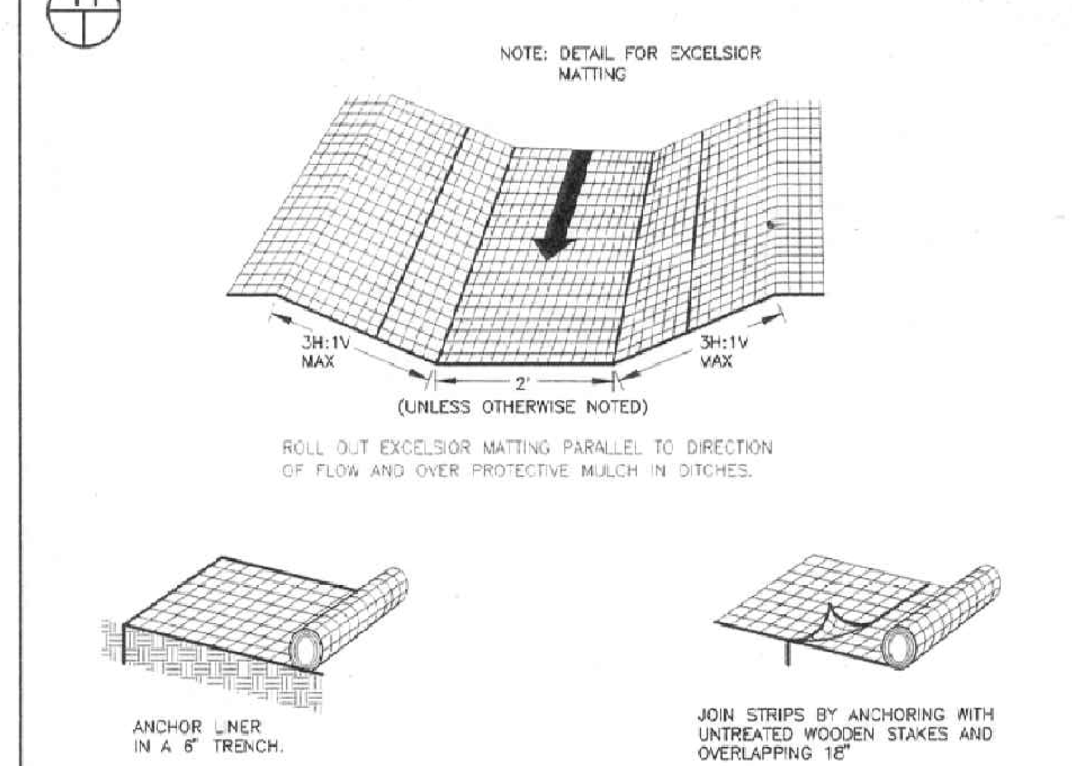


NOTE: OPERATOR MAY INSTALL CHECK DAMS AS NEEDED TO CONTROL SURFACE WATER RUN-OFF. HAYBALES MAY NOT BE USED IN LIEU OF STONE CHECK DAMS.

CHECK DAM



INLET PROTECTION



EXCELSIOR MATTING DITCH LINER

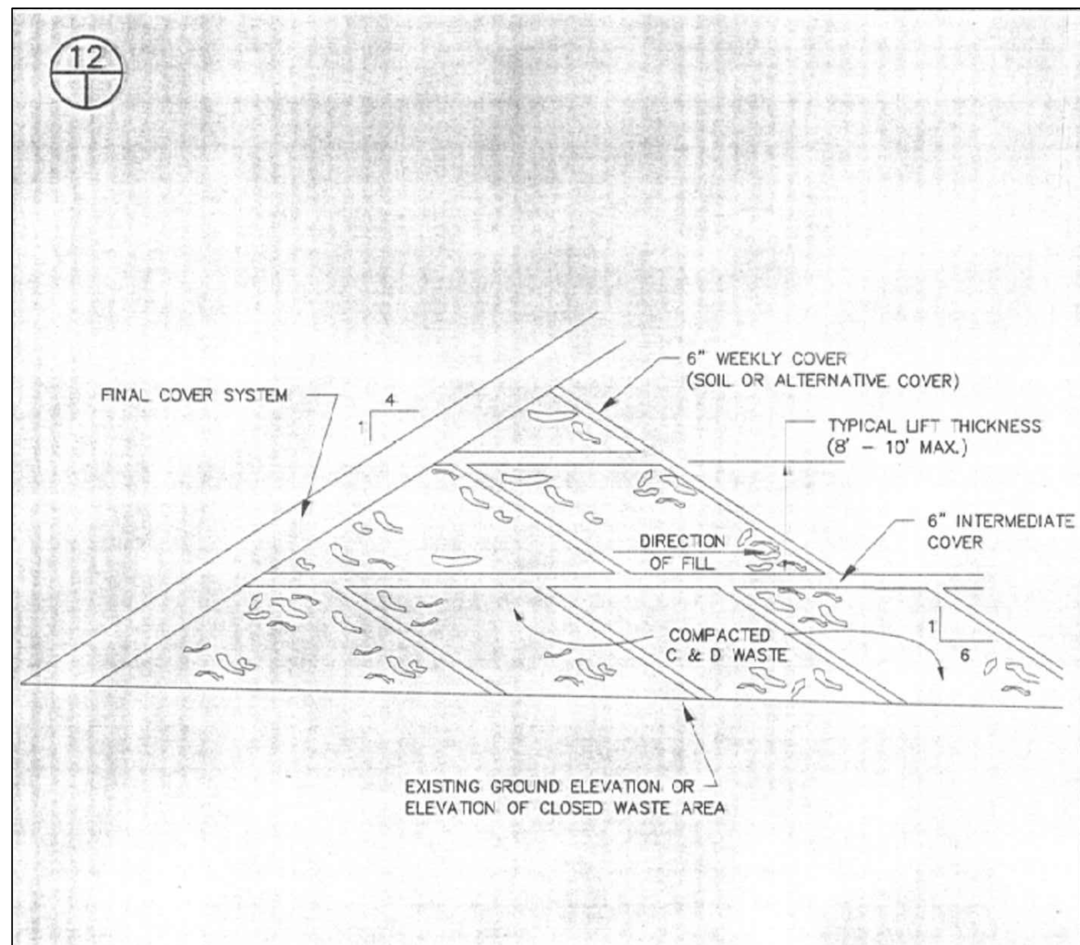
REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

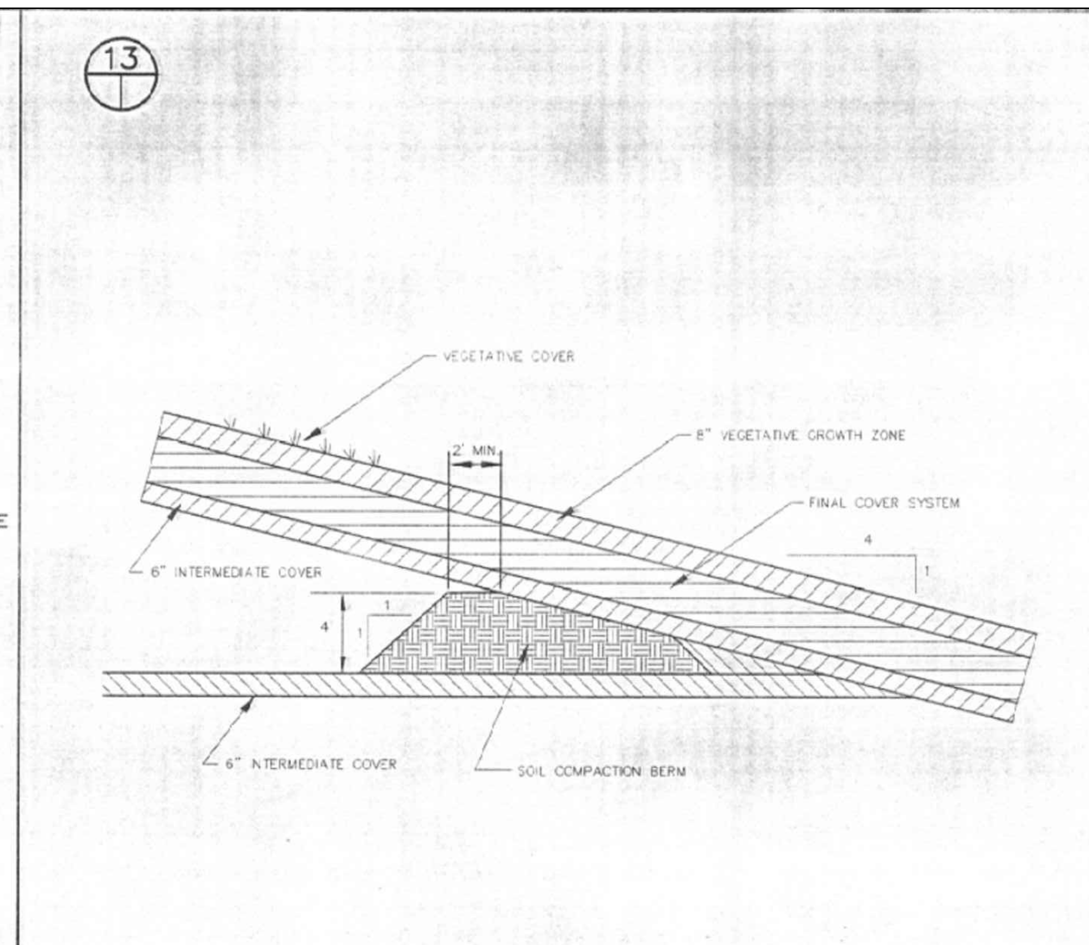
RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

MISCELLANEOUS DETAILS AS PROPOSED IN THE 1997 DESIGN AND OPERATION PLAN

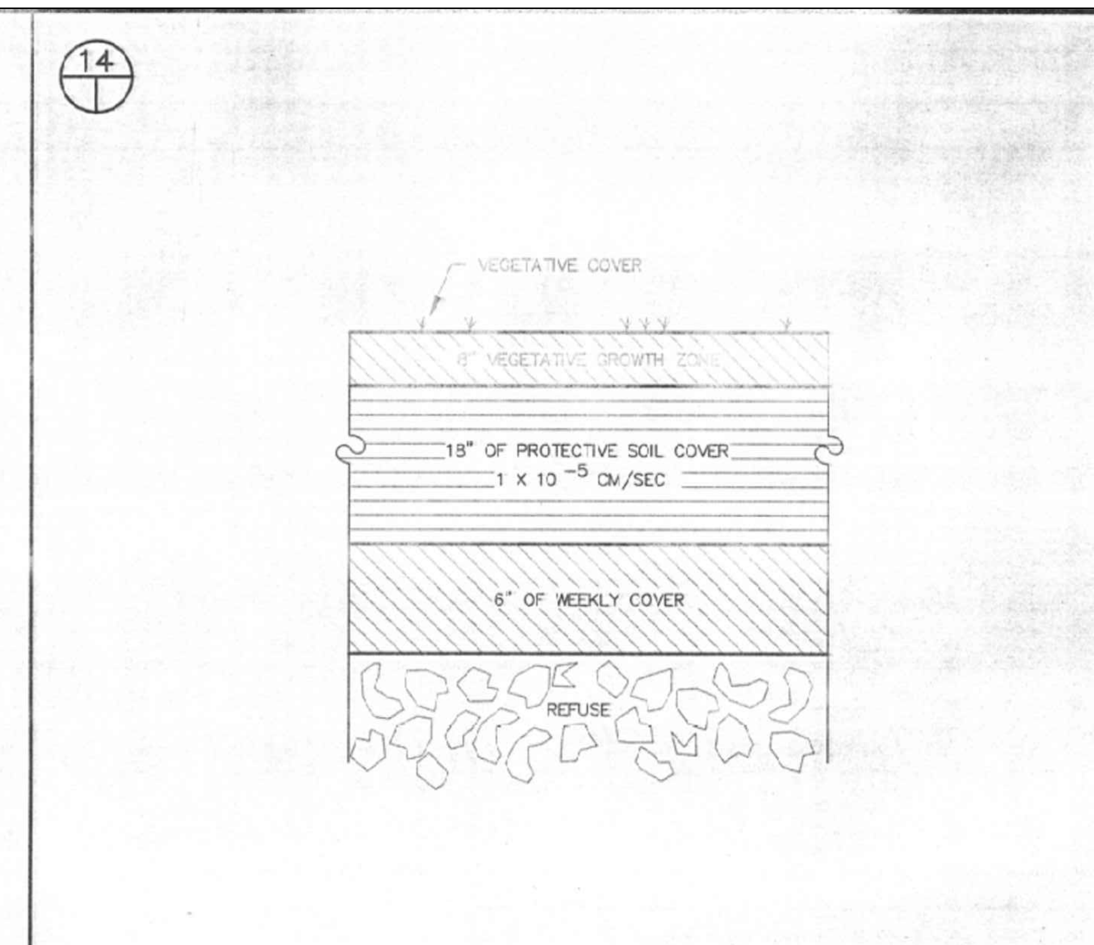
PROJECT NO.:	77501895	DATE:	OCTOBER 2024
DESIGNED BY:	KMM	DRAWING NUMBER:	
DRAWN BY:	KMM	C12	
CHECKED BY:	ES		
APPROVED BY:	ES	SHEET 12 OF 13	



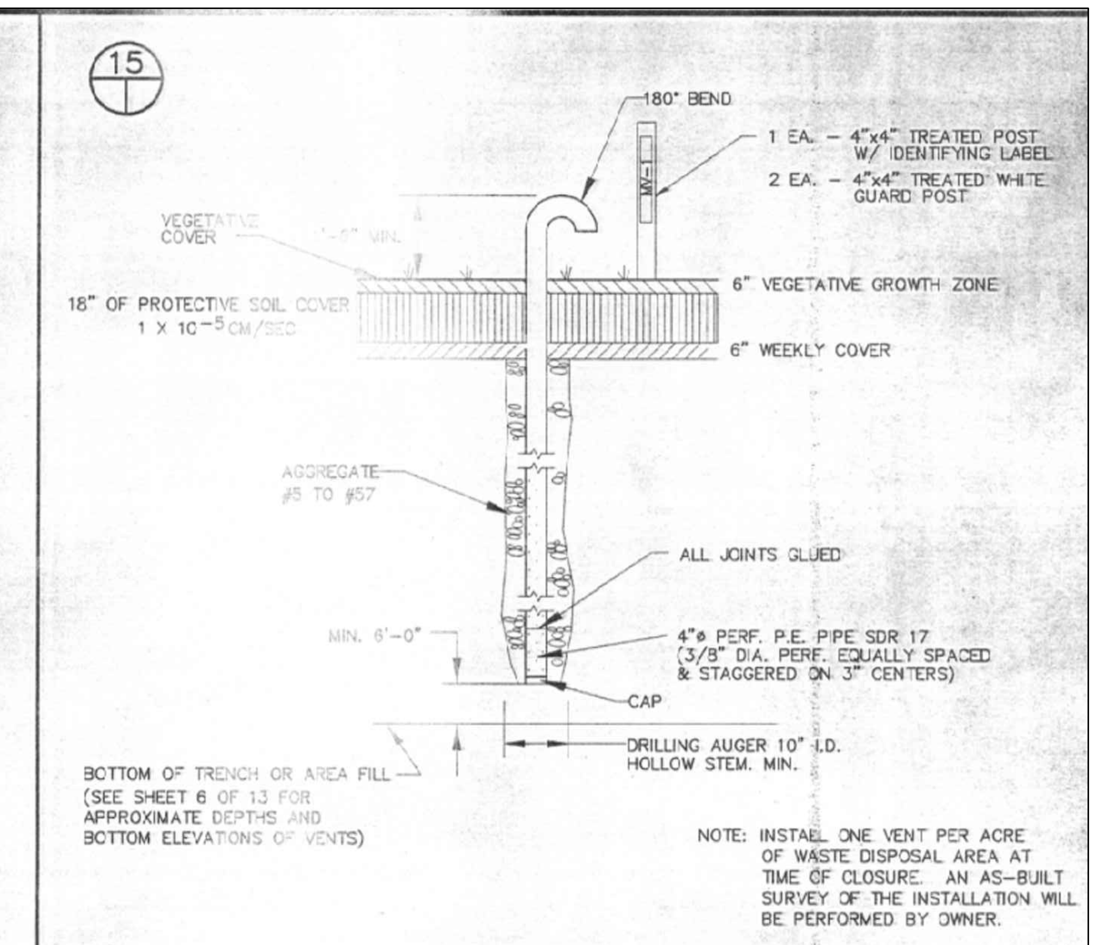
TYPICAL AREA FILLING & LIFT CONSTRUCTION



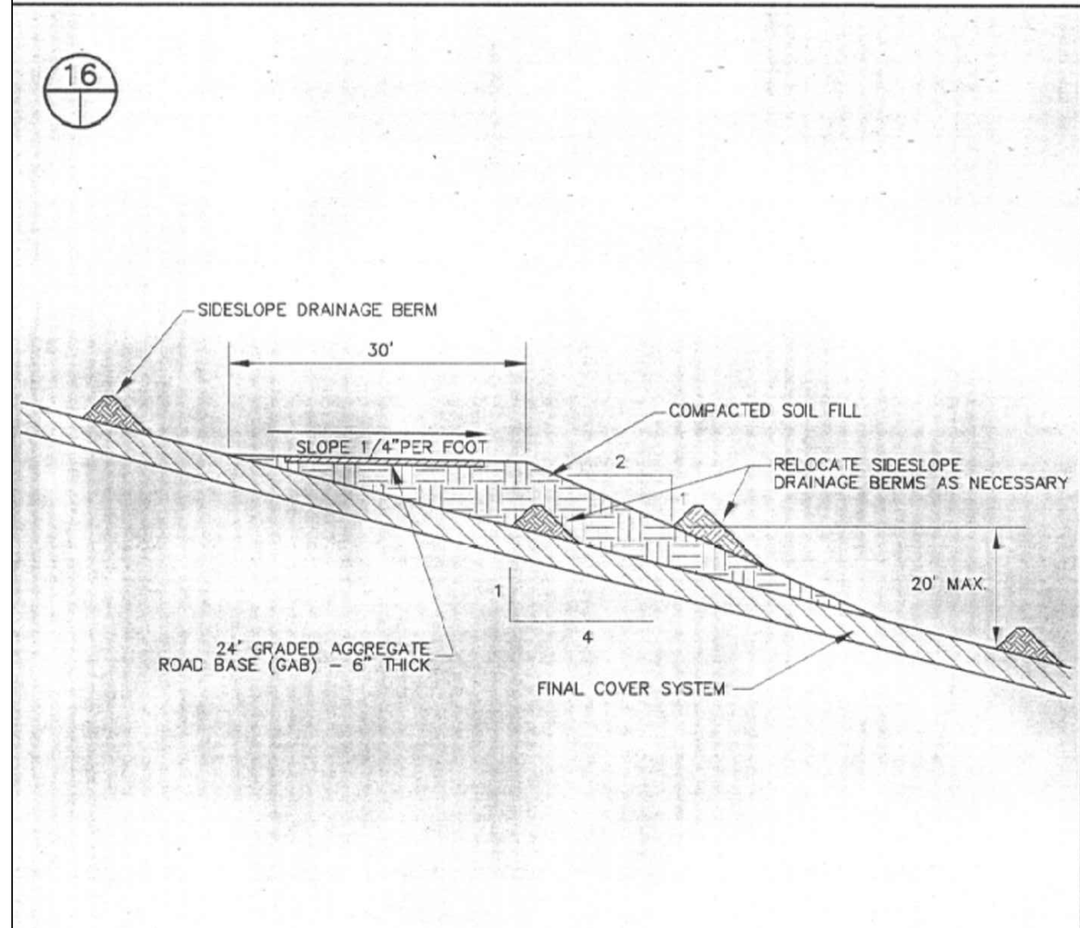
TYPICAL SOIL COMPACTION BERM



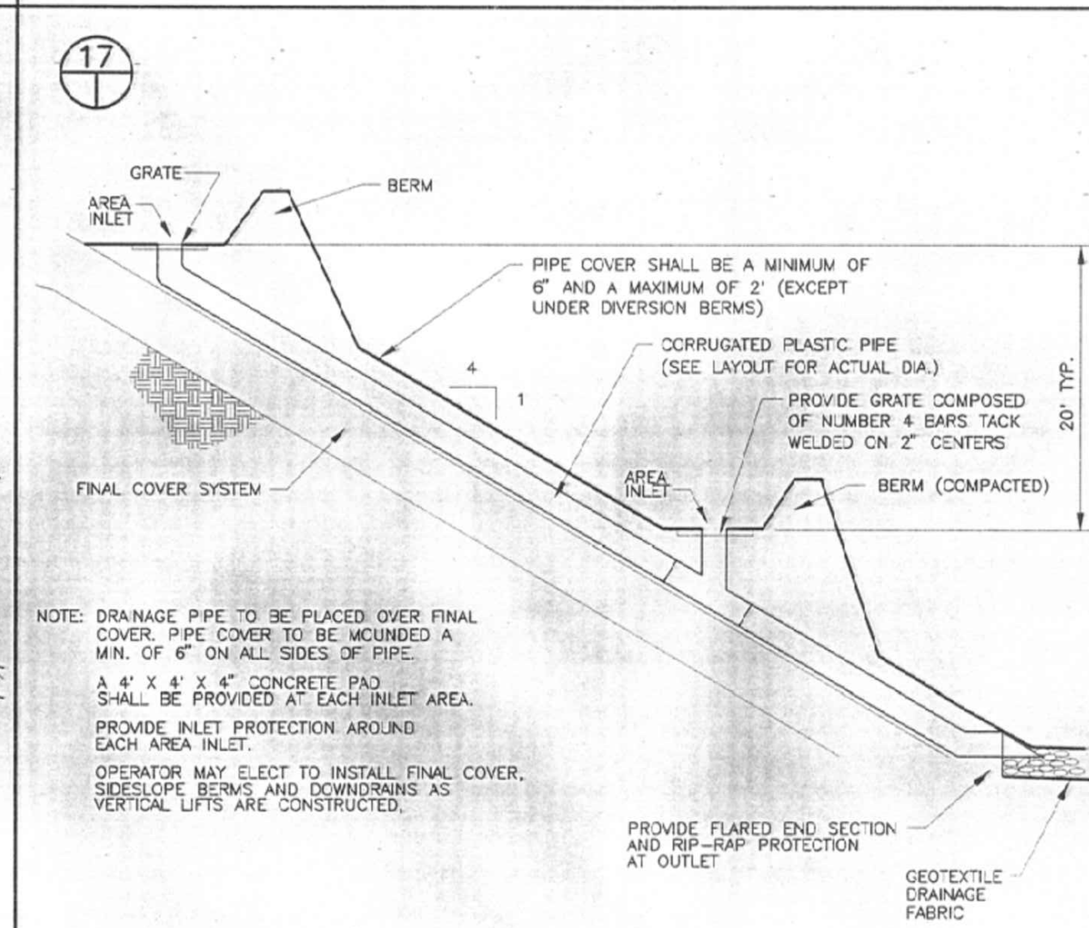
FINAL COVER SYSTEM



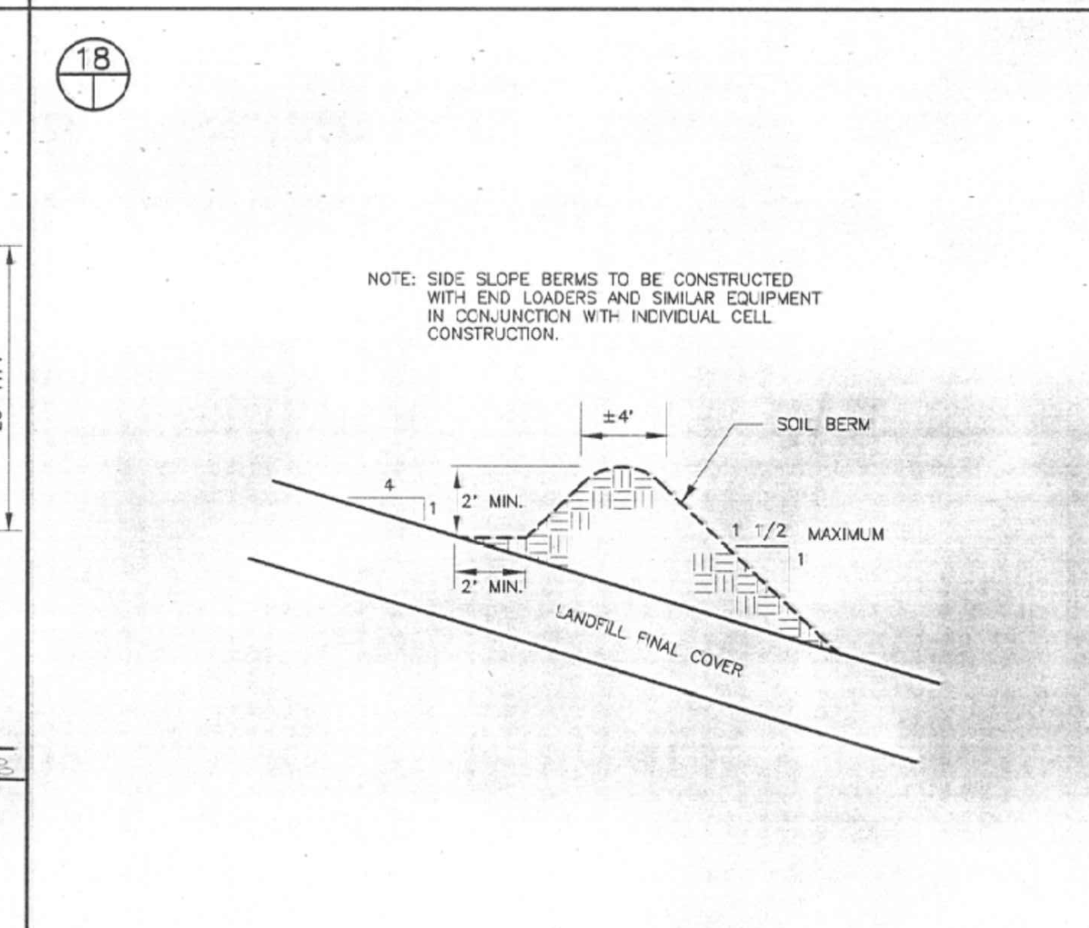
METHANE GAS VENT



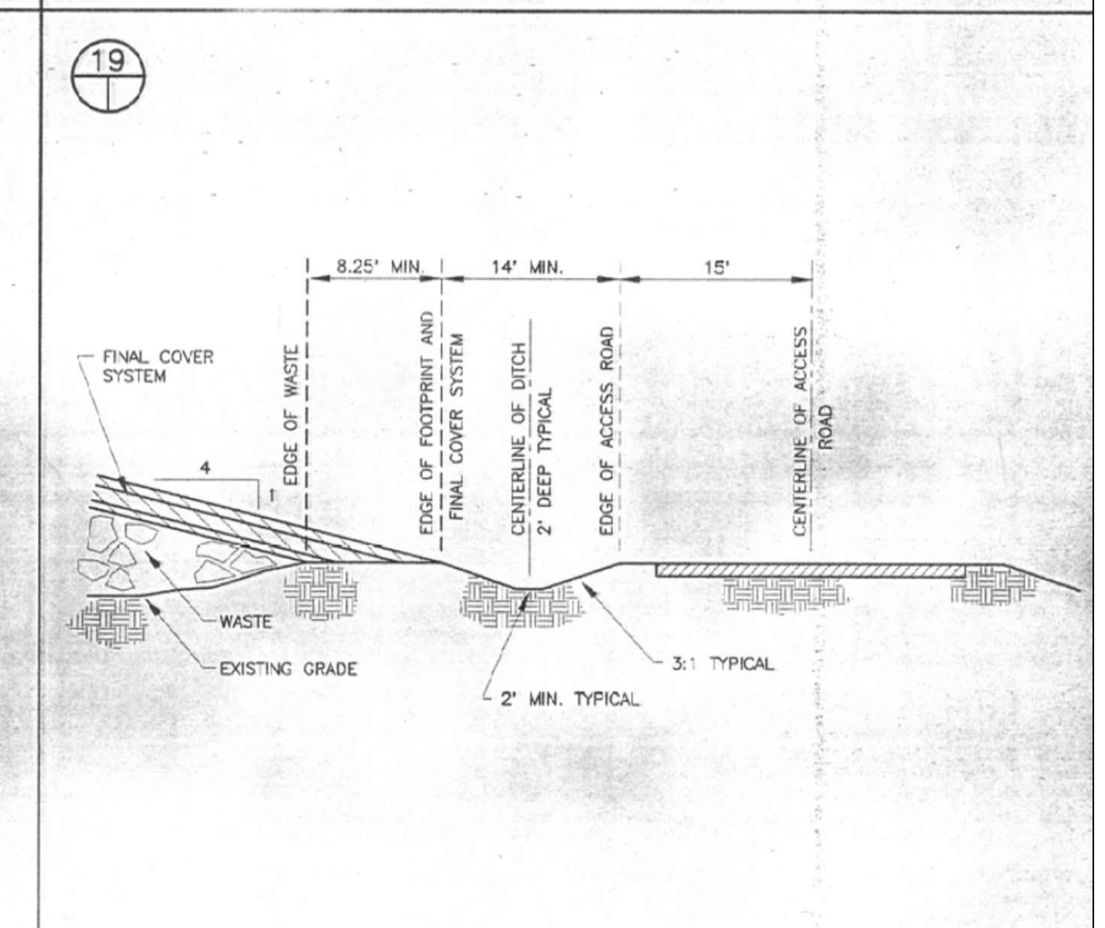
ACCESS ROAD TO TOP OF LANDFILL



AREA INLET DOWNDRAIN



LANDFILL SIDE SLOPE BERM



LOCATION OF EDGE OF WASTE AND EDGE OF FOOTPRINT

REV. NO.	DATE	DESCRIPTION

APTIM

APTIM Environmental & Infrastructure, LLC

RSA-10 BNDRY/C&D LANDFILL
WEST MADISON COUNTY, ALABAMA
DESIGN AND OPERATION PLAN

MISCELLANEOUS DETAILS AS PROPOSED IN THE 1997 DESIGN AND OPERATION PLAN

PROJECT NO.:	77501895
DESIGNED BY:	KMM
DRAWN BY:	KMM
CHECKED BY:	ES
APPROVED BY:	ES

DATE: OCTOBER 2024

DRAWING NUMBER:

C13

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON, REDSTONE
4488 MARTIN ROAD
REDSTONE ARSENAL, ALABAMA 35898-5000

Environmental Management Division 5 FEB 26

Mr. Johnathan Crosby
Alabama Department of Environmental Management
Solid Waste Engineering Section, Land Division
Post Office Box 301463
Montgomery, Alabama 36130-1463

Dear Mr. Crosby:

The US Army Garrison requests a continuation of the variance granted by the Department from ADEM Rule 335.13-4-.16 (Explosive Gases) at the US Army Garrison –Redstone Arsenal Construction and Demolition landfill in the upcoming renewal of ADEM permit number 45-03. The Redstone Construction and Demolition Landfill has been granted an explosive gas monitoring waiver since 2008 and can continue to do so without adverse impact to human health and the environment. The original permit application package for permit number 45-03 was submitted to the Department in August of 2023. Permit 45-03 was modified in 2022 and expired February 5, 2024.

For further information, please contact the Environmental Management Division, Directorate of Public Works, at 256-313-3258, or email gregory.l.hicks22.civ@army.mil.

Sincerely,

Jason K Braxton
US Army Garrison-Redstone Arsenal
Chief, Environmental Division