Work Plan for
Geotechnical Investigation of Treatment Cell Area
Solar Ponds Plume Treatment System

Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
Golden, Colorado

RF/RMRS-99-348
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APPROVAL SIGNATURES

This workplan is approved with respect to the data and conclusions relative to hazards, regulatory requirements, and overall (radioactive and chemical) characterization objectives of the Project

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Date

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Date

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ACRONYMNS

ASTM	American Society of Testing and Materials
ATT	Advanced Terra Testing
CME	Central Mine Equipment
FO	Field Operations
gpm	gallons per minute
HSA	Hollow-Stem Auger
IDM	Investigation Derived Material
mg/L	milligrams per liter
NGVD	National Geodetic Vertical Datum
NRC	Nuclear Regulatory Commission
OPS	Operating Procedures
Parsons ES	Parsons Engineering Science, Inc
pCi/L	picocuries per liter
PPE	Personal Protective Equipment
QA/QC	Quality assurance/quality control
QAPD	Quality Assurance Program Description
Site	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services, L L C
SOW	Statement of Work
USCS	Unified Soil Classification System

1.0 INTRODUCTION

1 1 PURPOSE AND OBJECTIVES

This work plan was prepared by Parsons Engineering Science, Inc , (Parsons ES) to outline the scope of work for collection of data necessary to conduct a geotechnical investigation in support of the design of the Solar Ponds Plume Treatment System at the Rocky Flats Environmental Technology Site (Site), Golden, Colorado The primary objectives of the geotechnical investigation are as follows

- Characterize worksite soils to support the design of the treatment cell foundation, and
- Characterize worksite soils to support the design of cut-back slopes or soil retaining structures in the vicinity of the treatment cell

1.2 BACKGROUND

The purpose of the Solar Ponds Plume Treatment System is to intercept and treat contaminated groundwater emanating from the solar ponds at the Site Based on information provided in the Statement of Work (SOW) for this project, this groundwater is contaminated with nitrate (average concentration of 260 milligrams per liter [mg/L]), maximum concentration of 350 mg/L and low levels of uranium (average concentration of 62 picocuries per liter [pCi/L], maximum concentration of 78 pCi/L) The collection and treatment system is conceived to consist of the following (see Figure 1 1, attached)

- An 850-foot long collection trench adjacent to the current north perimeter road, with gravity drainage of collected groundwater to a sump at the west end of the trench,
- A treatment cell consisting of a cast-in-place concrete vault with interior partitions, and
- An effluent infiltration area for discharge of treated groundwater

All flows will be designed for passive operation via gravity Average design flow for the system is based on annual flow of 2 4 million gallons per year (as described in the SOW), or approximately 5 gallons per minute (gpm) Peak design flow of up to 100 gpm (as discussed in the OHM proposal, in consultation with the Rocky Mountain Remediation Services, L L C [RMRS] project manager) will be discharged as surface water overflow

A geotechnical investigation is required for design of the treatment cell foundation, as well as the soil slope or retaining structure around the uphill portion of the treatment cell Two possible foundation types should be considered

- Alternative One is a standard spread footing foundation similar to that used at the existing treatment plant With acceptable subgrade soils, this is the more economical and preferred alternative
- Alternative Two is to build the foundation on drilled caissons This alternative requires the use of grade beams and two-way structural floor slabs supported by the drilled caissons This alternative may be required if the subsurface soils are found to be saturated, of insufficient strength to support building loads, or excessively expansive

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1 3 WORK PLAN ORGANIZATION

This work plan provides a detail work scope for collecting the geotechnical data necessary to support design of Solar Ponds Plume Treatment System Including this introduction, this work plan includes five sections, and one appendix

- A description of drilling activities to be performed is described in Section 2 0
- Field sampling and data collection requirements are described in Sections 3 0
- Geotechnical testing requirements are described in Section 4 0
- A project management plan including schedule and contacts is provided in Section 5 0
- Section 6 includes quality assurance/quality control procedures for inspection and acceptance
- Appendix A includes field forms to be used for this project

2.0 DRILLING ACTIVITIES

Universal Environmental Services, Inc , will perform drilling and sampling of soil using Hollow-Stem Auger (HSA) and solid stem auger drilling equipment for the Solar Ponds Plume Treatment System Borehole clearances will be performed in accordance with the Site standard operating procedure RMRS/OPS-PRO 102, Borehole Clearing Drilling will be performed in accordance with RMRS/OPS-PRO 114, Drilling and Sampling Using Hollow-Stem Auger Techniques General procedures for drilling activities will include the following

- Boring locations will be field-located by Parsons ES, with representation by RMRS, and clearly marked with lath and flagging
- Prior to drilling, all necessary soil disturbance permits will be obtained by RMRS
- Drilling and collection of subsurface soil samples will be supervised by an field engineer provided by the OHM team
- The decontamination procedures to be used for drilling equipment are described in Section 2 3
- Soil cuttings, decontamination water, disposable sampling equipment, and personal protective equipment (PPE) will be disposed according to the investigation-derived material (IDM) management procedures described in Section 2 4

2 1 GEOTECHNICAL BORINGS

HSA drilling will be required for drilling two geotechnical borings (estimated at 20 feet deep each) at the locations shown on Figure 1 1 HSA borings will be drilled using a Central Mine Equipment 75 or similar drilling rig The borehole will be advanced with 5-foot-long by approximately 8-inch-outside-diameter HSAs Soil samples will be collected for geotechnical analysis from the two borings at the proposed treatment cell location to support foundation design, as described in Section 3 1

2 2 DECONTAMINATION PROCEDURES

Decontamination of the drill rig, augers, drill rods, and sampling equipment will be conducted at the Site decontamination pad in accordance with Document No OPS-PRO 127, Field Decontamination Operations, prior to mobilization to the project site, and following completion of drilling activities Because the samples to be collected are for geotechnical analysis (rather than

chemical analysis), decontamination of sampling equipment or the rig between borings will not be required

Equipment will be decontaminated with high-pressure hot water If this is ineffective (i e , unable to remove adhering soil based on visual observations), the equipment will be scrubbed with laboratory-grade, low-phosphate detergent, and then cleaned with high-pressure hot water

2 3 MANAGEMENT OF IDM

IDM that will be generated during field activities will include soil cuttings or excess soil samples, fluids from decontamination of drilling equipment, and PPE

- Soil cuttings from HSA drilling will be containerized in 55-gallon steel or polyethylene drums, labeled appropriately, and managed in accordance with the procedures and requirements in Documents No OPS-PRO 115, Monitoring and Containerizing of Drilling Fluids and Cuttings Disposition will be in accordance with FO 23 Management of Soil and Sediment Investigation Derived Material, and FO 29 Disposition of Soil and Sediment Investigation-Derived Materials
- Equipment decontamination fluids will be managed in accordance with the procedures and requirements in Document No RMRS/OPS-PRO 112, Handling of Decontamination Water and Wash Water
- If used, disposable PPE such as protective gloves will be containerized separately and managed in accordance with the procedures and requirements in Documents No FO-29 and 1-PRO-079-WGI-001, Waste Characterization, Generation, and Packaging

3.0 FIELD SAMPLING AND DATA COLLECTION

3.1 GEOTECHNICAL SOIL SAMPLES

HSA drilling will be required to allow collection of relatively undisturbed samples in Shelby tubes (minimum 18 inches long by two inches in diameter) and in split-spoon samplers The augers will be used to advance the boring to the depth where soil samples are required Split spoon samples will be collected using standard penetration test in accordance with the American Society of Testing and Materials (ASTM) D1586 (i e , hammer driven with collection of blow counts data) for every 2 5 feet of drill depth for lithologic characterization Two Shelby tube samples will be collected per borehole using the hammer tool technique The final sample depth will be determined in the field by the field engineer, with the intent of sampling the soil that is representative of the soil backfilled against the treatment cell walls, and the base of the proposed foundation (approximately 6 feet and 13 feet below ground surface, respectively) The driller will provide the Shelby tubes for sample collection, however, brass or stainless steel liners for split spoon samples are not required

Geotechnical samples for laboratory analysis will be potentially contaminated with radioactive constituents Screening, handling, packaging, and transport will be in accordance with the Site requirements The borings will be abandoned in place by filling with cement bentonite grout in accordance with the requirements and procedures in Document No RMRS/OPS-PRO 117, Plugging and Abandonment of Boreholes

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3 2 BOREHOLE LOGGING PROCEDURES

A log of each borehole will be prepared by a qualified field engineer in accordance with the requirements and procedures in Document No RMRS/OPS-PRO 101, Logging Alluvial and Bedrock Material Boxing and storage of core will not be required for this project, excess samples will be handled as soil cuttings IDM as described in Section 2 3 Use the standard form PRO 101A for the geologic log which will be used for this project, which is included in Appendix A Logs will be prepared in the field as boreholes are drilled Each log will be signed by the preparer and verified by the Project Manager All log entries will be printed in indelible ink The following list will be included for borehole logs

- Borehole depth information will be from direct measurements accurate to 0 5 foot
- Logs will include blow counts
- All relevant information blanks in the log heading and log body will be completed Location sketches referenced by measured distances from prominent surface features will be shown on, or attached to, the log
- Each and every material type encountered will be described in "Description of Materials" column of the log form (Appendix A)
- Unconsolidated materials will be described as outlined in the following sequence
- Descriptive Unified Soil Classification System (USCS) classification in accordance with ASTM Method D2488-84,
- Consistency of cohesive materials or apparent density of noncohesive materials,
- Moisture content assessment (e g , moist, wet, saturated),
- Color,
- Other descriptive features such as bedding characteristics, organic materials, macrostructure of fine-grained soils (e g , root holes, fractures), and
- Depositional type (e g , alluvium, till, loess)
- Rock materials will be described according to the following sequence and in accordance with standard geologic nomenclature, including

    - Rock type,
    - Relative hardness,
    - Density,
    - Texture,
    - Color,
    - Weathering,
    - Bedding,
    - Fractures, joints, bedding planes, and cavities, including any filling material and whether open or closed,
    - Rock quality designation, and
    - Other descriptive features (e g , fossils, pits, crystals)

- Stratigraphic/lithologic changes will be identified in the "Description of Materials" column (Appendix A) by a solid horizontal line at the appropriate scale depth on the log that corresponds to measured borehole depths at which changes occur, measured and recorded to the nearest 0 5 foot Gradational transitions and changes identified from cuttings or methods other than direct observation and measurement will be identified by a horizontal

dashed line at the appropriate scale depth based on the best judgment of the logger All lines will be drawn with a straightedge ruler and not be freehand-drawn

- Logs (Appendix A) will clearly show the depth intervals from which all samples are collected
- Logs will identify the depth at which water is first encountered, the depth to water at the completion of drilling, and the stabilized depth to water The absence of water in boreholes also will be indicated
- Logs will show borehole and sample diameters and depths at which drilling or sampling methods or equipment changed
- Logs will show total depth of penetration and sampling The bottom of the hole will be clearly identified on the log with the notation "Bottom of Hole "
- Logs will identify any areas of hole instability
- Any special drilling or sampling problems will be recorded on logs, including descriptions of problem resolutions

3 3 SAMPLE HANDLING AND ANALYSIS

3.3.1 Sample Containers and Preservation

Provide containers and preservation in accordance with the applicable portions of Document No RMRS/OPS-PRO 069, Container, Preserving, Handling and Shipping of Soil and Water Samples Samples will be containerized in the Shelby tubes for transfer to the geotechnical laboratory The sample will be wrapped in plastic sheeting or placed in a plastic bag, and sealed with adhesive tape to minimize moisture losses No additional preservation is required Samples will also be required for radiological screening prior to shipment of geotechnical samples to the testing laboratory

3.3.2 Sample Labeling

All sample containers will be labeled immediately after sealing in accordance with the applicable portions of Document No RMRS/OPS-PRO 069, Container, Preserving, Handling and Shipping of Soil and Water Samples The label will identify the Site name, field identification or sample station number, sample type (e g , soil, grab, composite), sample name, sampling location and depth, collection time, sampling date, analysis, and preservation This information also will be duplicated in the field notebook

3 3 3 Chain-of-Custody Records

Chain-of custody will be maintained in accordance with the applicable portions of Document No RMRS/OPS-PRO 069, Container, Preserving, Handling and Shipping of Soil and Water Samples A chain-of-custody record will be completed for each shipment of samples to track the movement of samples and to provide a written record of persons handling the samples A sample chain-of-custody record form is included in Appendix A A chain-of-custody record will accompany the sample during shipment to the laboratory and through the laboratory
The information provided on the chain-of-custody record will include the following

- Project name,
- Signature of the samplers,
- Sampling station number or sample number,
- Date and time of collection,

- Signature of individuals involved in the sample transfer,
- Time and date of sample receipt,
- Type of matrix, and
- Sample methods required

Chain-of-custody records initiated in the field will be placed in a plastic cover and taped to the inside of the lid of the shipping containers used for sample transport from the field to the laboratory The original, signed chain-of-custody form will be used for sample transport Copies of the chain-of-custody form will be maintained in the field

3 3 4 Sample Packing and Shipping

Following radiological screening at the worksite, soil samples will be hand-delivered by the field engineer to the following geotechnical laboratory

Advanced Terra Testing (ATT)
833 Parfet Street, Unit A
Lakewood, CO 80215
Phone (303) 232-8308
Attention Kerry Repola

Note that ATT is licensed by the Nuclear Regulatory Commission (NRC) to handle potentially radioactive samples within the specific constraints of their NRC license

3 4 FIELD NOTEBOOK RECORDS

Reference procedure ADM-05 14 Use of Field Logbooks and Forms, which is due to be completed by June 5, 1999 Field notebooks will be controlled as functional documentation in accordance with the OHM Program Engineering Plans and Procedures, Procedure No PPM-D 9, and will be kept for all investigations conducted at worksites at the Site All field observations and measurements will be recorded promptly into the field notebook Each page in the field notebook will be consecutively numbered Information to be recorded on a daily basis includes the following

- Date,
- Times of entries,
- Description, location, and purpose of activity,
- Names and responsibilities of field personnel,
- Names and titles of worksite visitors,
- Sample numbers,
- Sample matrix (i e , soil),
- Sample types (grab, composite),
- Sample descriptions,
- Field measurements,
- Equipment decontamination, and
- Comments and field observations (suitable for reconstructing the incident without memory)

All entries will be made in waterproof ink and signed and dated by the author Any errors will be corrected by drawing a single line through the mistake, and signing and dating the correction All field notebooks are to be turned over to the RMRS Project Manager for the project history file, with copies made for Parsons ES project files when the project assignment has been concluded

3 5 SURVEYING

After drilling activities are completed, sampling locations will be surveyed by a certified land surveyor subcontracted to OHM Horizontal locations will be located to the nearest 0 1 foot and referenced to the Rocky Flats Coordinate System Elevations will be recorded in feet amsl, specifically to the National Geodetic Vertical Datum (NGVD) of 1983 If the 1983 Datum is not available, the 1929 NGVD will be used Ground surface elevations will be measured to the nearest 0 1 foot

4.0 GEOTECHNICAL TESTING

A maximum of six soil samples will be collected for the following geotechnical testing (note that field conditions may dictate changes in the total sample quantity)

- Consolidation test (ASTM D 2435)
- Consolidation/swell test (ASTM D 4546, Method B)
- Triaxial shear strength (consolidated/undrained) with pore pressure measurements (ASTM D 4767) (total of six points tested, which is adequate for calculation of cohesion and friction angle for two material types)
- Atterberg Limits (i e , liquid and plastic limits)(ASTM D-4318)
- Gradation, w/hydrometer testing (ASTM D-422)
- Unit weight (ASTM D 2937)
- USCS classifications (ASTM 2487)
- Moisture content (ASTM D-2216)
- Specific gravity (ASTM D 854) (one test total)
- Standard Proctor (ASTM D 698) (one test total)

Note that the bearing strength of the soils, which is required for structural design of the foundation, will be generated in accordance with standard accepted engineering practice upon evaluation of the above collected data

5.0 PROJECT MANAGEMENT PLAN

5 1 PROJECT SCHEDULE

The following schedule is proposed for this work

Event	Date
Drilling and sampling	May 3 to May 7, 1999
Geotechnical testing	May 3 to May 19, 1999
Design evaluation	May 3 to June 4, 1999

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5 2 POINTS OF CONTACT

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6.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) will be maintained in accordance with the OHM Engineering Quality Assurance Procedures, Rev 0, dated July 17, 1998 This document is in substantive compliance with the Quality Assurance Program Description (QAPD), Document No *RMRS-QAPD-001* Because the data to be collected from the geotechnical boring program will be used to support design of the Solar Ponds Plume Treatment System, the QAPD reference to

design requirements and principles apply Following are the task-specific QA/QC measures to be implemented for this project

6 1 INSPECTION

The design engineer will inspect the work product from the field engineer and drilling crew prior to shipment of samples to the geotechnical laboratory, or prior to demobilization from the field, whichever is sooner The inspection will consist of verification of the following

- Adequate number, types and depths of soil samples,
- Adequate geotechnical testing requested,
- Preparation of boring log and field notes in accordance with project requirements

Additional inspection of the completeness of geotechnical testing performed, as well as a preliminary review of the adequacy of the data produced, will be performed by the field engineer This will be performed during engineering evaluation of the data prior to preparation of final recommendations of soil input parameters for structural design of the treatment cells

6.2 ACCEPTANCE

Acceptance of the field data collection by the design engineer will be contingent on the following

- Completeness of field data collection as defined in this work plan, and
- Adequacy to support the intended design

Appendix A

SAMPLING OF DRUM SOIL MEDIA FOR WASTE CHARACTERIZATION

SAMPLING OF DRUM SOIL MEDIA FOR WASTE CHARACTERIZATION

1.0 PURPOSE AND SCOPE

Investigation Derived Material (IDM) will be generated during the geotechnical investigation for the Solar Ponds Plume Treatment System project area at the Rocky Flats Environmental Technology Site (Site) This Sampling and Analysis Plan (SAP) provides for IDM sampling for waste characterization The objective of this SAP is to define specific data needs, sampling and analysis requirements, data handling procedures, and associated Quality Assurance/Quality Control (QA/QC) requirements for field activities planned under this project All work will be performed in accordance with the Rocky Mountain Remediation Services (RMRS) Quality Assurance Program Description (QAPD) (RMRS, 1997) Implementation of this project will be performed in accordance with applicable Federal, State, and local regulations, as well as DOE Orders, the Site policies and procedures, and RMRS Operating Procedures

2.0 IDM DRUM SAMPLING

Prior to sampling, each drum must be cracked open, and the interior lining opened for field screening with an Flame Ionization Detector (FID) or a Photoionization Detector (PID) in accordance with 5-1000-OPS-FO 15, *Photoionization Detectors and Flame Ionization Detectors*, for health and safety purposes If a positive reading for volatile organic compounds (VOCs) is obtained, the sampling team should consult with the Health and Safety Specialist (HSS) prior to sampling the drum

Each drum shall be sampled for CLP VOAs Sampling will begin by collecting one soil grab sample taken from the middle of each drum Using an auger, the sampler will remove a sample from approximately the middle of the drum and put it in a 60-mil wide mouth glass jar with a Teflon lined lid and cool to 4° C The sample container(s) shall be sealed, labeled, and packaged in accordance with RMRS/OPS-PRO 069, *Containing, Preserving, Handling and Shipping of Soil and Water Samples* Since samples are undergoing VOC analysis, Kaiser-Hill, Analytical Services Division (KH-ASD) sample numbers and labels will be applied to the container in the field Remaining sample portions shall be placed back in the original drum from which it originated If necessary, the HSS or Radiological Control Technician (RCT) will scan each sample with a Field instrument for the Detection of Low Energy Radiation (FIDLER) Equipment will also be monitored for radiological contamination during and after sampling activities

Sampling equipment must be field decontaminated prior to sampling each drum Decontamination of equipment shall be performed in accordance with 5-21000-OPS-FO 03, *Field Decontamination Procedures*, and RMRS/OPS-PRO 112, *Handling of Field Decontamination Water and Field Wash Water* Personal protective equipment shall be disposed of in accordance with 5-21000-OPS-FO 06, *Handling of Personal Protective Equipment*

Radiological monitoring by the onsite RCT is required prior to the sampling team leaving the sample area (for both personnel and sample containers), and after resealing the drums a random survey shall be performed

Samples will be submitted to an offsite, EPA-approved laboratory for analysis under a 30-day result turnaround time Analytical requirements for each sample will be EPA SW-846, Method 8026

3.0 DATA MANAGEMENT, ORGANIZATION, AND QUALITY CONTROL

A project field logbook will be created and maintained by the project manager or designee in accordance with 2-S47-ER-ADM-05 15, *Use of Field Logbooks and Forms* The logbook will include time and date of all field activities, drum identification numbers, and any additional relevant information not specifically required by this SAP The originator will legibly sign and date the logbook page

All personnel performing tasks under this SAP will be trained in accordance with the requirements stipulated in the RMRS Training Scheduling and Records Database Sample coordination will be implemented through a groundwater sampling subcontractor This includes ensuring that all data are collected, verified, transmitted and stored in a manner consistent with relevant operating procedures The Sample Coordinator, or designee, will obtain from the ASD, sample numbers (RINs) and will ensure that appropriate location codes are used

Sampling personnel will be responsible for data collection, documentation, and transfer of samples for analysis Field data collection will include sampling and obtaining screening results Documentation will require field logs and completing appropriate forms for data management and chain-of-custody shipment The sampling manager is responsible for verifying that chain-of-custody documents are complete and accurate before the samples are shipped to the analytical laboratory All components and processes within this project will comply with RMRS-QAPD-001, January 1, 1997, which is consistent with the K-H Team QA Program (K-H, 1997) The RMRS QA Program is consistent with quality requirements and guidelines mandated by the EPA, CDPHE and DOE

The project manager will be in direct contact with QA to identify and correct issues with potential quality affecting issues Field sampling quality control will be conducted to ensure that data generated from all samples collected in the field for laboratory analysis represent the actual conditions in the field The confidence levels of the data will be verified by the collection of QC and duplicate samples, equipment rinsate samples, and trip blanks Due to the small number of samples to be collected (less than 10), QC samples for this project will consist of one duplicate, one equipment rinsate, and one trip blank sample

- Duplicate This sample will be submitted blind to the laboratory The duplicate sample will be collected using the same sampling equipment used for collection of the regular samples Sampling equipment will not be decontaminated while collecting regular and QC samples from the same location

- Equipment rinsate blank This sample will be prepared by collecting distilled water, poured over decontaminated sampling equipment, between collection of regular samples This blank will be submitted with the regular samples

- Trip blank Since the samples will be analyzed for VOCs, a trip blank sample will be shipped in the cooler with the regular samples This trip blank will be pre-prepared (not in the field) with minimal headspace and preserved to a pH<2 with hydrochloric acid (HCl)

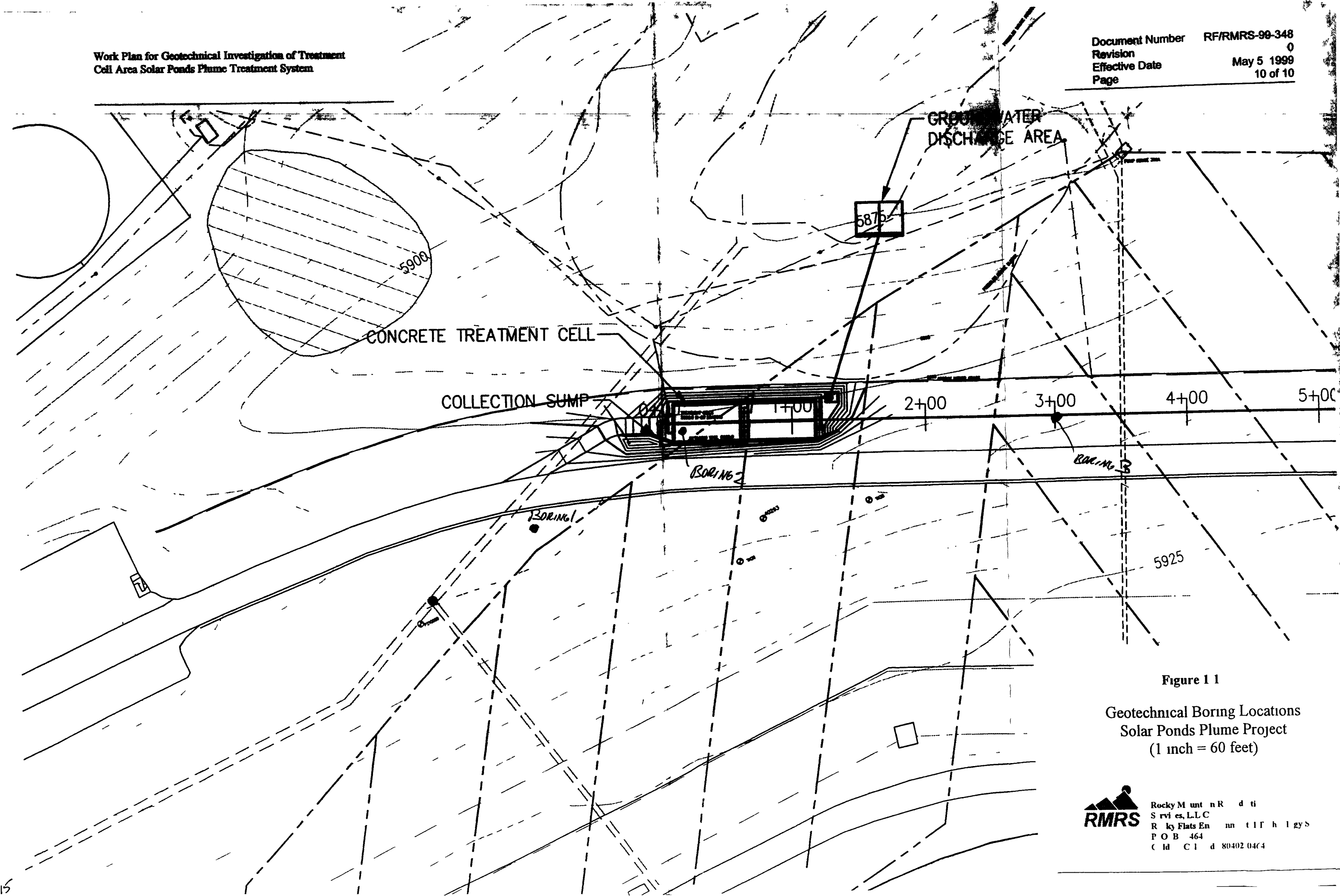

Figure 1 1

Geotechnical Boring Locations
Solar Ponds Plume Project
(1 inch = 60 feet)

RMRS
Rocky M unt n R d ti
S rvi es, L.L C
R ky Flats En nn t l Γ h l gy S
P O B 464
(ld C l d 80402 0464