TECHNICAL MEMORANDUM NO. 2 TO FINAL PHASE I RFI/RI WORK PLAN

MODIFICATIONS TO FIELD ACTIVITIES

ROCKY FLATS PLANT
SOLAR EVAPORATION PONDS
(OPERABLE UNIT NO. 4)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

EG&G ROCKY FLATS, INC.
ENVIRONMENTAL RESTORATION MANAGEMENT

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1.0 INTRODUCTION

1.1 BACKGROUND

The purpose of this Technical Memorandum (TM) is to document changes in the implementation of the Operable Unit No. 4 (OU4) Phase I RCRA Facility Investigation/Remedial Investigation (RFI/RI) Work Plan (EG&G, 1992). There are several reasons for the modifications described in this document including:

- Technical reassessment of methods or technologies described in the OU4 Phase I RFI/RI Work Plan;
- Clarification of confusing or vague language in the OU4 Work Plan;
- Establishment of procedures not defined in the OU4 Work Plan;
- An increased level of understanding of the hydrogeologic and geochemical environment at the OU4 site; and
- Inaccessibility of several of the Solar Evaporation Ponds due to the presence of liquids, a result of the delayed cleanout schedule of the Solar Ponds.

The field program currently being implemented in OU4 has been described in two separate documents, the OU4 Phase I RFI/RI Work Plan (EG&G, 1992), and Technical Memorandum No. 1 (TM1) to the OU4 Work Plan, Vadose Zone Investigation (EG&G, 1993). Each of these documents is described in the following sections.

1.1.1 OU4 Phase I RFI/RI Work Plan

The Final OU4 Phase I RFI/RI Work Plan was submitted to the agencies in January 1992, and was granted conditional approval for implementation in May 1992. Section 7.0 of the Work Plan is the Field Sampling Plan which includes radiological surveys, geophysical surveys, visual surveys, surficial soil sampling, borehole drilling and subsurface soil sampling, borehole drilling into bedrock for lithology, and piezometer installation and monitoring. Activities were described within three geographic areas, the Original Ponds, the Existing Solar Ponds, and the Interceptor Trench System and remainder of site. Figures from the Work Plan that identify field activities

in these three geographic areas are included in Appendix A of this TM. Figures A-1, A-2, and A-3 of this TM are the figures from the Field Sampling Plan as they appeared in the approved OU4 Phase I RFI/RI Work Plan, with the addition of borehole location numbers assigned for OU4.

1.1.2 Technical Memorandum No. 1 to OU4 Phase I RFI/RI Work Plan, Vadose Zone Investigation

Prior to granting unconditional approval of the RFI/RI Work Plan, the agencies required that a TM addressing vadose zone characterization activities at the OU4 site be prepared and approved. TM1, Vadose Zone Investigation, was conditionally approved by the agencies in November 1992. TM1 provided details of the proposed vadose zone monitoring activities that were not described in the RFI/RI Work Plan, and Standard Operating Procedures (SOPs) for vadose zone monitoring activities that did not have approved procedures. It also provided a preliminary interpretation of subsurface geology and contaminant migration pathways resulting from data evaluation activities completed as of December 1992, and identified some borehole location changes from the RFI/RI Work Plan. The borehole location changes proposed in TM1 were based on an increased level of understanding of the contaminant and groundwater movement at the OU4 site. Borehole locations from the three approved Work Plan maps were combined in Figure 2-2 of TM1, and relocation of a few Work Plan boreholes was also presented.

Figure 2-2 from TM1 is included in Appendix B of this TM. Figure B-1 presents the proposed vadose zone boreholes and analytical boreholes as they appeared in TM1, with the addition of borehole location numbers assigned for OU4. Figure B-2 is Figure A-7 from TM1, which shows the location of buried drainage channels in OU4. Site characteristics influencing contaminant migration pathways are discussed further in Section 2.0.

1.2 PURPOSE AND OVERVIEW

This Technical Memorandum (TM2) identifies changes in the proposed field program as presented in the Phase I RFI/RI Work Plan and the Vadose Zone Technical Memorandum (TM1). As discussed with the agencies, technical memoranda provide the mechanism to amend or clarify the Phase I RFI/RI Work Plan and therefore supersede the approved work plan. Increased

understanding of site characteristics as described in Section 2.0 prompted some of the changes, and technical reassessment of activities proposed in the OU4 Phase I RFI/RI Work Plan prompted others. The specifics of most of these changes were discussed in a meeting attended by the Colorado Department of Health (CDH), the U.S. Environmental Protection Agency, the U.S. Department of Energy (DOE), and EG&G on January 26, 1993. The minutes from that meeting are included in Appendix C. Many of the other minor changes have been discussed with CDH periodically in the program, and verbal agreement has been received prior to their implementation. The specific issues addressed in this TM are:

- Modification of the field radiological survey to include FIDLER gamma radiation surveys only instead of alpha surveys and FIDLER surveys (Section 3.1);
- Modification of the visual survey due to inaccessibility of Pond 207C, and Ponds 207B-North, 207B-Center, and 207B-South (Section 3.2);
- Modification of the geophysical survey due to pilot study results (Section 3.3);
- Modification of the surficial soil sampling procedure to comply with the CDH letter of September 1, 1992 (Section 3.4);
- Rationale for placement of random and discrete surficial soil samples (Sections 3.4.1 and 3.4.2 respectively).
- Placement of interim boreholes adjacent to Ponds 207B-North, 207B-Center, and 207B-South, and Pond 207C, to collect analytical data in the interim period until the ponds are emptied and accessible for drilling (Section 3.5.1);
- Postponement of construction of 12 boreholes originally scheduled for completion through the liners of Solar Ponds 207C, 207B-North, 207B-Center, and 207B-South, until such time as the Solar Ponds are emptied of liquids and sludges (Section 3.5.2);
- Modification of boreholes originally scheduled for exploration of bedrock materials to address alluvial materials only (Section 3.5.3);
- Installation of piezometers in alluvial boreholes that had been scheduled for abandonment (Section 3.5.4);
- Deletion of boreholes (Section 3.5.5);
- Relocation of Borehole 42893 (Section 3.5.6);

- Relocation of piezometer banks (Section 3.6);
- Clarification of standard subsurface sampling procedure (Section 3.7); and
- Modified sampling program in Pond 207A (Section 3.8).

Potential program impacts associates with these changes are discussed in Section 4.0. References are provided in Section 5.0.

2.0 SITE CHARACTERISTICS

Considerable data have been generated at OU4 since the submittal of TM1. Drilling of boreholes and piezometers in the buffer zone has been substantially completed, along with many of the boreholes in the Protected Area (PA). The lithologic data from these boreholes, as well as previously available lithologic and chemical data, have been reviewed and evaluated as field activities have progressed.

Significant progress has been made in understanding of the OU4 site since TM1 was prepared. It is currently understood that contaminant migration in the alluvial materials is largely governed by bedrock topography, and that bedrock topography in the OU4 area is much more complex than originally thought. Due to this complex bedrock topography, a number of discrete contaminant migration pathways in the alluvium may exist near the Solar Ponds. Previous interpretations had considered a single migration pathway consisting of an OU4-wide alluvial ground water surface. It is now understood that there are a number of separate preferential pathways controlled by channels scoured in the bedrock surface within the alluvial materials leading away from the Solar Ponds.

The preferential pathways indicated on Figure B-1 are understood to be an expression of the drainage channels in the surface of the alluvium north of the Solar Ponds that existed prior to significant reworking of the hillside surface in the early 1980s. Drainage channels observed in historical aerial photographs are located as shown in Figure B-2. Current data suggest that at least one preferential pathway may exist that does not follow the surface of the alluvium as shown on Figure B-1. Between the preferential pathways, the materials overlying bedrock are likely to be unsaturated for most of the year. Conditions within the vadose zone are, however, affected by fluctuations in the water table.

The bedrock control of the hydrogeologic system at OU4 is therefore an important consideration in targeting locations for vadose zone instrumentation. Efforts continue throughout the field activities to develop an accurate bedrock surface map, and many of the changes in borehole locations discussed in this TM are intended to generate data in locations where a better

understanding of bedrock elevation and ground water presence is critical to the site characterization activities.

3.0 MODIFICATIONS TO FIELD PROGRAM

Modifications to the field program are described in this section. Revisions to the radiological survey, pond liner visual survey, geophysical survey, surficial soil sampling, borehole locations, and piezometer bank locations are described in this section.

3.1 RADIOLOGICAL SURVEY

Implementation of the radiological survey, as described in the approved Work Plan, commenced in November 1992. The radiological survey described in the Work Plan included the use of alpha and gamma/beta detection meters, with readings to be taken at all node locations of an established grid.

During field implementation, attempts to obtain readings from the alpha radiation meter proved to be ineffective due to instrument limitations and site conditions. Alpha radiation meters must be held no further than one-quarter inch from the object being surveyed for accurate results. To meet this requirement, the area or object to be surveyed must have a flat, even surface. Attempts to survey soil at established grid nodes in OU4 resulted in puncturing of the mylar on the detector by vegetation and uneven surfaces. Difficulties have been experienced by other field programs in obtaining this information, and in most instances only questionable data have been collected. It was therefore proposed that alpha surveys be terminated on the ground surface, but that alpha readings continue to be taken on objects for health and safety screening.

After communication with and verbal agreement from CDH on November 17, 1992, alpha surveys were no longer attempted on the ground surfaces. Sample core, sample containers, equipment, and personnel continue to be surveyed using alpha radiation monitoring equipment.

The Work Plan also required that all radiological grid survey points be laid out using a tape or flagging, radiological readings taken, and all locations surveyed using standard land surveying techniques. Variations in radiation instrument readings commonly occur from day to day, depending on temperature, air pressure, and solar radiation, and do not allow collection of reproducible results. The inherent variability in the radiological survey data negated the need for

precise, land surveyed location data, and a change in procedure was proposed. The change included pacing or taping off a radiological survey grid, taking FIDLER readings, evaluating data and determining locations of potentially anomalous readings, collecting surficial soil samples, and land surveying the location of surficial soil sample collection points. CDH was contacted on this matter, and verbal agreement was received on November 17, 1992.

3.2 VISUAL SURVEY OF POND LINERS

A visual survey of Solar Pond liners is required in the approved Work Plan as a means of locating boreholes within the ponds. The rationale for the visual survey was to place boreholes both in areas of suspected liner deterioration and in areas where the liners appear to remain intact.

Because of the delayed cleanout of Solar Ponds 207C, 207B-North, 207B-Center and 207B-South, the visual survey could only be completed in Pond 207A in the Phase I program. The visual survey in Pond 207A was completed on February 26, 1993 and was used to locate boreholes in deteriorated and nondeteriorated liner locations. Revised borehole locations in Pond 207A are indicated on the borehole location map, Figure 3-1. Observations made during the visual survey indicated significant cracking and bubbling of the uppermost layer of liner material occurred throughout the western half of the pond. The depth of cracking could not be fully determined by visual observation, but no obvious deep liner breaches were observed. The deteriorated areas of the pond corresponded to the portion most exposed to direct sunlight and weather, while the east and northeast portions, which typically are covered by water, were less deteriorated. Results of a geophysical survey, described in the next section, complement the visual survey results.

3.3 GEOPHYSICAL SURVEY

The approved Work Plan required that a geophysical survey using Ground Penetrating Radar (GPR), be conducted in the Original Ponds areas and existing Solar Ponds area. The objectives of the geophysical survey are to attempt to locate the boundaries of the Original Pond and to locate any piping or other buried objects in the existing Solar Ponds. The use of GPR was attempted in the field with a pilot study, and the results were determined to be insufficient to meet the stated objectives. The depth of response obtained from the GPR was determined to be

more shallow than most objects would be buried, and was therefore unable to meet the objective of finding buried objects.

The pilot GPR investigation in Pond 207A included running test lines along the south and southwest side of the pond to observe the responses and identify subsurface utilities. Soils in the Solar Pond area are high in clay content and prevented detection of a known pipeline buried approximately six feet deep. GPR equipment was then brought into the pond and six lines spaced 20 feet apart were established in the southern portion of the pond. Only shallow responses were observed.

GPR was performed in the Original Ponds area in an attempt to locate the clay liners of the Original Ponds and to locate buried utilities. Engineering drawings of the Original Ponds area have been reviewed and indicate the presence of a significant number of buried pipelines in the area. The effectiveness of GPR in the Original Ponds was successful in verifying the presence of buried piping. No indications of clay liner occurred on the GPR record.

Geophysical methods were attempted to meet two other objectives not stated in the Work Plan, including potentially locating individual segments of the Interceptor Trench System, and for surveying the liner of Pond 207A for evidence of cracks or deterioration. GPR was unable to detect differences in soil conductivity from alluvial materials in the Buffer Zone and the Interceptor Trench System drains, and was therefore not useful in verifying the location of the drains. Electromagnetic technology was also attempted in the Buffer Zone to determine the location of the drains, again with no success.

GPR was also attempted in Pond 207A to determine the integrity of the liner. Ten lines established 20 feet apart were established in the southern, accessible portion of the ponds, using a smaller antennae than the one used to locate buried objects. The small antennae provided more detail on the liner and shallow subsurface. The responses received with the small antennae indicated potential subsurface deterioration throughout the liner, in areas that generally corresponded with visibly deteriorated areas.

3.4 SURFICIAL SOIL SAMPLING

At least 35 surficial soil samples are required to be collected in OU4 as specified in the approved Work Plan. The Work Plan specifies that 25 samples be collected in random locations, and that 10 discrete samples be located in areas of anomalous radioactivity as determined from surface radiological surveys. The method of sample collection described in the Work Plan followed the procedure in SOP GT.8, which specified collection of ten subsamples from the centers and corners of two one-square-meter areas located one meter apart, centered on the sampling point. The subsamples were described as being collected with the CDH sampler, and composited in a stainless steel bowl. Other requirements included the collection of duplicate samples at approximately 10 to 20 percent of the locations using the grab method described in SOP GT.8 to compare the grab and composite sample collection methods. Surficial soil samples were also required to be collected at each borehole location to allow data correlation.

Pursuant to a letter from CDH to DOE dated September 1, 1992, a different sampling methodology is being used. The letter is included in Appendix D. The letter requests that samples be collected with a jig and scoop at the center and four corners of a one-meter square centered on the sampling location and composited. In paved areas, such as under the liners in Pond 207A, the letter requests that grab samples be collected rather than composite samples collected with a jig and scoop. Samples from OU4 have been collected using the methodology requested in the September 1, 1992 letter.

3.4.1 Random Surficial Soil Samples

Random surficial soil sample locations were selected using a "simple random sampling" (Gilbert, 1987) methodology. The overall length and width of the OU4 area was determined, and the coordinates of the 25 random surficial soil samples were selected using a random number table (Huntsberger and Billingsley, 1981). The coordinates were then compared to areas of inaccessibility and discarded if they fell in areas inaccessible for sampling. Figure 3-2 indicates the surficial soil sampling locations determined from the random generation.

Three of the samples locations generated during random surficial sampling fell inside Pond 207A, an area accessible for sampling, but undesirable due to the need to cut through the pond liner.

In addition, the collection of random surficial soil samples under the pond liner would not provide data regarding aerosol contaminant dispersion and could not be compared to other random surficial soil sample results. Six boreholes in Pond 207A provide an alternative for the collection of six surficial soil samples, one at each borehole location. The grab soil samples can be compared to liner and underlying material analytical results. It is therefore proposed that the random surficial soil samples be moved from within Pond 207A out to the pond perimeters, because surficial soil data will be obtained from borehole locations. The revised locations of proposed random surficial soil samples are also on Figure 3-2. Locations were relocated slightly from the map presented previously due to the presence of asphalt.

3.4.2 Discrete Surficial Soil Samples

The collection of discrete surficial soil samples was stated in the approved OU4 Phase I Work Plan that approximately 10 soil samples be collected based on results of the FIDLER radiation survey. FIDLER surveys completed to date in the OU4 area were not significantly elevated and may not warrant collection of all 10 surficial soil samples at anomalous readings. DOE,CDH, and EPA held a meeting on March 25, 1993 where it was discussed to redistribute some of these surficial samples at anomalous radiological survey locations, seep locations, and to fill potential data gaps identified by risk assessors. The rationale for redistributing samples into these three categories was presented in a separate letter to the agencies which was approved on approximately May 12, 1993. The letter is described in the following paragraphs.

3.4.2.1 FIDLER Survey Locations

Anomalous FIDLER survey locations are considered for sampling based on several criteria. First, grid locations with the highest FIDLER readings are identified. Readings over approximately 2500 counts per minute (cpm) are considered potentially anomalous. Second, the proximity of the locations either to random surficial soil sampling locations or boreholes are determined. Third, results from adjacent radiological survey points are evaluated and trends identified, if possible, that represent either widespread aerial dispersion or localized anomalous areas.

After reviewing FIDLER radiological survey results, it was proposed to collect three surficial samples at the grid locations shown in Figure 3-2:

- Surficial soil sample number 27 is proposed to be collected at grid node T16. Grid node T16 is located near the southwest corner of Pond 207A. the FIDLER reading at this grid node was 3364 on January 18, 1993;

- Surficial soil sample number 28 is proposed to be collected at grid node M21. Grid node M21 is located near the soil/asphalt interface on the northeast berm of Pond 207A. The FIDLER reading at this grid node was 2443 on March 26, 1993. A surficial soil sample will be collected at the nearest soil covered location to this grid node; and

- Surficial soil sample number 29 is proposed to be collected at grid node V20. Grid node V20 is located near the southeast corner of Pond 207A in an asphalt covered location. The Fidler reading at this grid node was 2448 on March 26, 1993.

A total of three samples are proposed to address this data objective.

3.4.2.2 Seep Locations

Seeps have been identified on the hillside north of the Ponds throughout their existence, and even prior to pond construction. Vegetation stress has been observed in the area of these seeps since the 1960s. Although Nitrate has been detected historically in seepage liquid, but is a mobile compound and not anticipated to remain in the soils at elevated concentrations. It is, however, an indicator compound for other Solar Pond liquid constituents. It is therefore proposed that additional surficial samples be collected in seep locations to determine if residual radionuclides or heavy metals are present at these location.

Seeps were inventoried on the hillside in Fall 1992 and their approximate dimension shown on the attached figure. A site walk during March 1993 confirmed the location of seeps shown on the figure, but indicated the dimensions may be larger at this time of year. Based on this site walk and the locations of OU4 boreholes and random surficial soil samples on the hillside, the following surficial soil samples are proposed:

- Surficial soil sample number 30 is proposed to be collected in the elongated seep located north of and between Ponds 207A and Pond 207B-North. The seep is located downgradient of Old Sump 2 which was constructed as an outlet for drain tiles underlying the Pond 207A. A sample collected from this area will help to assess residual contamination from previous sump activity;

- Surficial soil sample number 31 is proposed to be collected in the large oval shaped seep located north of Ponds 207A and 207B-North. The area has been devoid of vegetation for many years. Random surficial soil sample number 13 was collected in

the southeast portion of this seep. Another surficial soil sample is proposed in the west-central part of the seep in the vicinity of Old Trench 2. Trench 2 was constructed in the 1970s as a remedial measure to capture seepage. The Interceptor Trench System was later constructed to achieve the same goal as Trench 2, except for the entire hillside;

- Surficial soil sample number 32 is proposed to be collected in the triangle shaped seep located north of and between ponds 207C and 207A. The seep is in the location where the Building 779 footing drain daylights; and

- Surficial soil sample number 33 is proposed to be collected in the small oval shaped seep located north of Pond 207A. During the March site walk, the seep was observed to be significantly larger than in Fall, 1992. The seep was observed to extend approximately 100 feet west of the location shown on the attached figure. Piezometer nest 04 was installed in the vicinity of this seep. It is proposed a surficial soil sample be collected in the seep.

A total of four samples are proposed to address this data objective.

3.4.2.3 Data Gaps for Baseline Risk Assessment

After reviewing the location of boreholes, random surficial soil samples, and environmental evaluation soil sample locations, a few potential data gaps were identified in the Buffer Zone. Locations were proposed based only on the criteria of spatial distribution. The following three surficial soil samples are described as follows:

- Surficial soil sample number 34 is proposed in the buffer zone in an area north of Pond 207C, midway between the PA fencing and the buffer zone access road;

- Surficial soil sample number 35 is proposed in the buffer zone approximately 125 feet southwest of Borehole 40593. The sample is located approximately midway between the piezometers of Piezometer array 3 and Borehole 40593; and

- Surficial soil sample number 36 is proposed in the buffer zone approximately 200 feet east-southeast of Borehole 40393. The location is located midway between the buffer zone access road and the PA security fencing.

A total of three samples are proposed to address this data objective.

3.4.3 Surficial Soil Sample Analytical Suite

The approved OU4 Work Plan required that surficial soil samples be analyzed for volatile organic compounds. The likelihood of volatile organic compounds being present in surficial soils is minimal, therefore analysis of volatile organic compounds has been excluded. The analytical

suite has been revised to include nitrate, TAL metals, radionuclides, semivolatile organic compounds, pesticides, and PCBs.

3.5 BOREHOLE REVISIONS

Several borehole location revisions have been made during the implementation of this OU4 Phase I RFI/RI program. The current OU4 borehole program is summarized in Table 3.1. This table identifies changes in current location or function of boreholes from the Phase 1 RFI/RI Work Plan or from TM1. In particular, program responses to existing conditions have led to 1) the development of "interim boreholes", 2) postponement of drilling 12 boreholes until waste materials are removed from 207B-series Ponds and Pond 207C, 3) the re-distribution of deep boreholes, 4) the installation of piezometers within alluvial boreholes, and 5) the deletion of four boreholes identified in the Phase I RFI/RI Work Plan as modified by TM1. All borehole locations discussed in this TM are identified in Figure 3-1. The tentative locations of the 12 boreholes within the 207B-series ponds and Pond 207A are identified in Figure 3-1 although these boreholes have been temporarily postponed until the ponds are drained.

3.5.1 *Interim Boreholes*

An original objective of the Phase I RFI/RI field program was to characterize the soil directly beneath the Solar Ponds. It is believed that the soils directly beneath the Solar Ponds will be primarily impacted by low mobility contaminants, such as some heavy metals and transuranic compounds. Data collection for this characterization was to be achieved through the completion of boreholes and sampling through the ponds and the installation of vadose zone monitoring equipment within some of these boreholes. The objective of characterizing the soils beneath the Solar Ponds will be met at Pond 207A, which represents approximately 45 percent of the area beneath the Solar Ponds, because the liquids and sludges have been removed from that Pond. However, because of the inability to drill inside the 207B Ponds and 207C Pond prior to removal of the waste they contain, the boreholes originally scheduled to be drilled within the ponds have been postponed and eight interim boreholes drilled outside of the pond perimeters. These boreholes will provide data to proceed with the OU4 investigation in the interim period until the ponds are drained. Potential data gaps remaining after interim borehole drilling may be addressed with horizontal drilling. Interim boreholes will provide data on lateral migration

of contaminants, as well as some indication of contaminant concentrations in soils underlying the ponds. Boreholes are still intended to be drilled in the 207B Ponds and 207C Pond when the ponds are emptied of liquids and sediments, and have been proposed as a subtask of future activities.

Borehole numbers previously assigned to OU4 boreholes in the ponds have been used to identify these interim boreholes. Identification numbers for three of the boreholes planned to be drilled in the 207B-series Ponds and equipped with vadose zone monitoring instruments were used on three interim vadose zone boreholes located outside of the 207B-series Ponds. In total, four interim boreholes have been located immediately outside of 207B-series Ponds, and one interim borehole has been located immediately outside of Pond 207C. All of these boreholes will provide geological and geochemical data.

3.5.1.1 Interim Vadose Zone Monitoring Boreholes

Contamination within the vadose zone may have a component that is dissolved in pore water, a component that is dissolved in air, and a component that is bound to soil. All of these components migrate through the vadose zone, both laterally and vertically. It is believed that the soil beneath the ponds may not be uniformly contaminated if leakage occurs in discrete locations rather than uniformly through the liners. Therefore, target areas beneath the ponds cannot accurately be determined without access to the bottoms of the ponds. No data have been gathered regarding ground water, soil, or pore water directly beneath the ponds because all except Pond 207A currently hold liquids and sludges. The movement of contaminants in the vadose zone is highly dependent on lithology. Should a lens of fine-grained material intersect the vertical pathway of leakage from a Solar Pond, that fine grained material could allow for preferential migration of the contaminants laterally as opposed to vertically. Even though the Ponds are not cleaned out to enable drilling as originally planned, it is believed that the placement of interim boreholes and vadose zone monitoring boreholes adjacent to the 207B-series Ponds and Pond 207C, supplemented with the vadose zone monitoring instruments in Pond 207A, will still largely meet the overall objectives of the vadose zone study. These interim borehole locations will help characterize the physical and chemical conditions of the vadose zone in the immediate vicinity of the Solar Ponds. The rationale for these interim locations is described in this section.

Borehole 41793

Interim Borehole 41793 is located near the southeast corner of Pond 207B-North. The borehole number was originally located within Pond 207B-North (Figure B-1). Data evaluation efforts indicate that a bedrock low exists near the southeast corner of Pond 207B-North, representing potentially the lowest point in the bedrock surface beneath all of the ponds. It is likely that potentially contaminated ground water could migrate in that direction beneath the Ponds. Based on water level measurements from nearby Well 2886, there is an approximate 3-foot average annual fluctuation in ground water in the general location, with the typical high water level approximately 4 feet below the ground surface. Vadose zone monitoring equipment to be installed in Borehole 41793 will monitor the potential contamination in the vadose zone which can be correlated and compared to data generated from an alluvial well in the area. Additionally, the placement of vadose zone monitoring instrumentation in this location is based on the fact that although the typical annual water level high is approximately 4 feet below the surface, a one-time recorded event in the alluvial well in the area indicated the ground water level was within approximately 1 foot of ground surface. Vadose zone monitoring equipment will therefore monitor potential residual contamination introduced into the soil by contaminated ground water and the leaching or removal of this contamination over time.

Borehole 43793

Interim Borehole 43793 is located in the area between Ponds 207A and 207B-Center. The borehole number was originally located within Pond 207B-South. During construction of Pond 207B in 1960, seepage was discovered east of Pond 207A suggesting an eastward migration of ground water. To remediate the condition, a drainage tile was installed east of Pond 207A to collect ground water and direct it to the north. Sump 2, located northeast of Pond 207A, is the collection point for the water discharged from this drainage tile. The ground water collected in Sump 2 was sampled routinely after installation of the sump. It is currently believed that vadose zone monitoring equipment installed in Borehole 43793 will be downgradient of vadose zone monitoring equipment installed within Pond 207A. Comparison of vadose zone data collected from Borehole 43793 with data from locations within Pond 207A will help to assess lateral migration of contaminants in the vadose zone. Data from Borehole 43793 may also provide criteria for interpretation of contamination beneath the 207B-series Ponds and Pond 207C.

Borehole 44093

Borehole number 44093 was originally located within Pond 207B-South, but interim Borehole 44093 is located near the southeast corner of Pond 207B-South. It appears from the data collected to date that there is a potential low point in the bedrock surface off of the southeast corner of Pond 207B-South. This suggests a local ground water flow direction to the southeast, rather than to the northeast as is more typical in OU4. Ground water contamination has been detected in alluvial wells southeast of the Solar Ponds, but the migration pathway has not yet been studied. The placement of vadose zone monitoring equipment within Borehole 44093 will allow for the collection of vadose zone data along this potential migration pathway.

The bedrock surface data also indicate a divide, or bedrock high, exists between the bedrock low southeast of Pond 207B-North and the low southeast of Pond 207B-South. The characterization of the vadose zone contamination in the area could prove useful in defining the nature of the pathway to the northeast and the pathway to the southeast. Borehole 44093, Borehole 41793, and Borehole 43193 will therefore aid in characterizing the migration of potential contamination from the 207B Ponds.

3.5.1.2 Geological/Analytical Boreholes

Borehole numbers 41693, 42293, 43493, 43993, and 42393 were originally located inside the Solar Ponds, but their numbers have been given to interim boreholes drilled on the pond perimeters due to the inaccessibility of the Solar Pond bottoms to drill rigs. The Work Plan and vadose zone program did not identify as many pond perimeter boreholes as are now proposed. However, useful data regarding potential contaminant presence under the 207B-series ponds and Pond 207C and lateral migration of potential contaminants is likely to be generated from these interim boreholes if placed adjacent to the berms of the ponds. It is evident that variations in alluvial lithology are not laterally extensive; therefore, these additional boreholes near the berms will provide necessary lithologic data. These boreholes, which will also be completed as piezometers as described in Section 3.5.4, will provide data most closely representing contaminant concentrations directly under the Solar Ponds.

3.5.2 Boreholes in Pond 207C and 207B-Series Ponds

Twelve boreholes were identified in the approved Phase I RFI/RI Work Plan for installation in the 207B-series Ponds and Pond 207C to obtain information regarding the subsurface conditions, especially chemical conditions immediately below the ponds. The pond cleanout schedule has delayed drilling activities inside four of the five ponds, and the ponds will not be available for this Phase I field activity. The twelve boreholes initally planned in the ponds are postponed until after the ponds are drained, however, interim boreholes, described in the previous section are intended to provide data on the lithology and chemistry of materials beneath the berms and perimeters of the ponds for characterization purposes.

Eight borehole numbers initially assigned to borings inside the ponds (Figure A-2) have been used to identify interim boreholes as shown on Figure 3-1. Borehole numbers 41393 and 41493, originally proposed in Pond 207C, as well as Boreholes 42793 and 43093, originally proposed in the 207B-series Ponds, were not given to interim boreholes, and have been postponed until the 207B-series Ponds and Pond 207C are cleaned of liquids and sludges. Drilling of twelve boreholes may be required to adequately characterize materials under the Solar Ponds after all waste is removed from the 207B-series Ponds and Pond 207C.

3.5.3 Modification of Bedrock Boreholes

The approved RFI/RI Work Plan initially identified the five following boreholes that were to be completed 40 to 60 feet into bedrock materials: 42693, 42993, 43293, 44193, and 44293. The need for these five deep boreholes has been re-evaluated during data evaluation, and it is proposed that two deep boreholes are required to support Phase I RFI/RI characterization activities. Two of the originally proposed deep boreholes, Boreholes 42993 and 43293, have been modified to be alluvial boreholes because lithologic and geochemical data have already been generated for bedrock conditions in nearby boreholes, and because additional data are required for alluvial conditions in the area. These two boreholes are discussed below. A third deep borehole, Borehole 44293, is proposed to be deleted from this characterization and is discussed in Section 3.5.5 of this TM. One of the two remaining deep boreholes (Borehole 42693) is to

Borehole 44193 remains as a deep geologic borehole as initially proposed with the intent of investigating potential subcropping sandstone units.

Borehole 42993 was initially proposed to be a deep borehole to gain bedrock geologic and analytical data. However, upon further review, it has been determined that more useful information would be gained from this borehole if it were completed as an alluvial piezometer instead of abandoned as a deep borehole. Bedrock Well P210189 (Figure A-1), located approximately 100 feet west of Borehole 42993, provides the desired bedrock data and will be considered in the development of the Phase I RFI/RI report.

Borehole 43293 was initially proposed to be a deep borehole in the area east of OU4. A borehole was drilled in this general area in support of Operable Unit 6 (OU6). When available, data will be obtained from the OU6 project in support of OU4 characterization activities. Therefore, Borehole 43293 was relocated to the northeast to be within a potential contaminant migration pathway and to avoid site access difficulties. Because the function of a borehole in this area is for the characterization of alluvial conditions, this borehole will only penetrate approximately five feet into bedrock.

Borehole 42693 was identified in the RFI/RI Work Plan to be located on the hillside north of the berm between Pond 207C and Pond 207A and penetrate bedrock to a depth of approximately 60 feet. In recent drilling at that location, bedrock was encountered at the surface, and drilling ceased at a depth of approximately 6 feet with no alluvial soil samples available for chemical analyses. It was decided that a borehole proposed for inside Pond 207A (Borehole 42193) would be more beneficial as a bedrock borehole for the following reasons. 1) It is currently believed that the soil beneath Pond 207A has the potential to contain the highest levels of contamination in the OU4 area. 2) The bedrock surface slopes toward the northeast beneath that pond with an estimated 4 to 15 feet of overlying alluvium. 3) Furthermore, the depth of weathered bedrock is not well characterized for the area and the role of secondary permeability through the weathered zone may impact the vertical transportation of contaminants from the source. Therefore, Borehole 42193, located approximately in the center of Pond 207A, will be drilled to approximately 50 feet and provide additional information with regard to bedrock geology and

geochemistry. Borehole 42193 is one of three analytical/geological boreholes drilled in Pond 207A, with three remaining boreholes instrumented with vadose zone monitoring equipment.

3.5.4 Borehole Piezometers

As discussed earlier in this TM, presence and direction of alluvial ground water flow in OU4 are now understood to be highly localized and governed by bedrock surface. After drilling activities commenced in OU4, it was recognized that valuable alluvial ground water data could be generated from the completion of several analytical boreholes originally scheduled for abandonment as alluvial piezometers. This change did not impact the original intent of the boreholes because lithologic and geochemical data would be generated from these boreholes as planned. The installation of piezometers in these boreholes will provide long-term data in the alluvium for minimal additional effort and cost. Analytical boreholes remaining to be drilled after the concept was recognized were constructed with alluvial piezometers including Boreholes 40193, 41193, 41693, 41993, 42293, 42393, 42993, 43293, 43493, 43593, 43893, and 43993. They are indicated with an asterisk on Figure 3-1.

3.5.5 Deleted Boreholes

The value of data to be obtained from each borehole in the program is continually being evaluated to maximize the overall program efficiency and benefit of data collected. After the development of interim borehole locations, several boreholes were identified which seem to provide redundant data or data not considered pertinent to the OU4 program. The following paragraphs identify the four boreholes along with the rationale for their suggested deletion from the program. Their locations are shown on Figure 3-1.

Borehole 41093

Borehole 41093 is proposed to be deleted from this program because the data it would generate is redundant with data to be generated in these OU4 field activities. Initially, there were three boreholes proposed in Pond 207C and four around the perimeter to aid in the characterization of Pond 207C and the original earthen ponds. Because Pond 207C is currently filled with liquid and sludge, the three boreholes earlier identified as being in the pond have been either relocated outside of the pond as interim boreholes or postponed. The re-evaluation of the boreholes in the

program led to the suggested deletion of Borehole 41093 because characterization of the area appears adequate based on the large number of boreholes and wells already completed or planned for completion in the area. The locations of Boreholes 40993 and 42093 have been modified and are located approximately 100 feet and 75 feet, respectively, from the proposed location of Borehole 41093. The geologic information and the chemical data obtained from these two boreholes are believed to be representative of the berm characteristics.

Borehole 41893

Borehole 41893 is proposed to be deleted from this program because the data generated by this borehole would be redundant with data generated in OU6 activities and other data generated in OU4 activities. Similarly, this borehole was not within a migration pathway. The characterization program for OU6 is concurrent with the OU4 program, and a portion of the drilling areas overlap. An advantage of the overlap of borehole and soil sampling locations for OU6 in the area east of the Solar Ponds is that geologic and analytical information can be used in the OU4 program. In addition to the OU6 boreholes, two OU4 boreholes are located in the area east of the Solar Ponds.

Borehole 44493

Borehole 44493 is proposed to be deleted from this program because of utility clearance difficulties and because the geologic, geochemical, and hydrologic information obtained from a new borehole in this location would be redundant with the information obtained by existing wells. Information from Wells 3787, and 3887, (Figure A-1) as well as data from OU4 Boreholes 43993, 44093, and 44593 will be used in the RFI/RI report in place of data from Borehole 44493. The lithologic logs for Wells 3787 and 3887 are provided in Appendix E.

Borehole 44293

Borehole 44293 is proposed to be deleted from this program because of utility clearance difficulties and because the data generated from this borehole would be redundant with existing boreholes. This borehole was proposed to be southwest of Pond 207A, and upgradient of OU4 to provide background data. Monitoring Wells 5687, P207389, P207489, and P207689 (Figure A-1) are located relatively close to the proposed location of Borehole 44293, providing

geologic, analytic, and hydraulic information. The lithologic logs for the four wells near the proposed location of Borehole 44293 are provided in Appendix E.

3.5.6 Location of Borehole 42893

This borehole was moved from the originally proposed location south of Pond 207C and west of Pond 207A, adjacent to the process waste evaporative cooling structure within the RFP 700 Building Area. The relocation was necessary due to underground utilities. The new location is located to the west of Borehole 43593. The intent behind the original locations of Boreholes 42893 and 43593 was to attempt to characterize the location, type of contaminants, variation in contaminants, and other unique features of the Original Ponds. These two boreholes were specifically targeted at investigation of Pond 2A.

The need for relocation of Borehole 42893 arises from the high density of buried utilities in the area of the originally proposed location. The inability to verify the exact locations of these utilities, especially process waste transfer lines, led to the need to change the location of the borehole as shown in Figure 3-3. Further constraining the location of this borehole is the requirement to remain within the target overlap area defined by the discrepancy between the Pond 2A "as-built" drawings and 1962 aerial photographs of the Original Pond configuration (EG&G, 1993). Remaining within this target area ensures the best chance of encountering any remaining indications of Pond 2A.

Apparent repetition through relocation of Borehole 42893 in such close proximity to Borehole 43593 is addressed by examination of the role of each borehole. The original intent of Borehole 43593 was limited to geochemical sampling. Completion of this borehole as a piezometer will enhance long term programmatic needs with respect to local hydrogeologic conditions. Borehole 42893 is proposed to be instrumented with vadose zone monitoring equipment. The long-term monitoring of pore water chemistry will provide indications of any contaminants that remain within the vadose zone media resulting from the Original Ponds, even though the ponds were abandoned and attempts at remediation occurred in 1962.

3.6 PIEZOMETER BANK RELOCATIONS

Phase I Work Plan objectives for the installation of piezometers banks include the following:

- Identify and monitor alluvial ground water elevation in the vicinity of the Interceptor Trench System (ITS);
- Identify bedrock elevation relative to the ITS;
- Provide information on hydrologic characteristics of the alluvium through the drawdown curves into the ITS; and
- Estimate ground water flow directions.

In meeting these objectives, information on the overall efficiency of the ITS will be established.

Four banks of piezometers were identified in the OU4 Work Plan with the stated objective of providing information on the water table configuration at the primary interceptor trench. It was also stated that data will be used to optimize piezometer spacing and that the locations of the piezometers may be modified. The four banks of piezometers were reconsidered after review of available data, and the locations of the piezometer banks have been modified. Figure 3-1 identifies the new locations and orientations of the four piezometer banks labelled PZ01 through PZ04. Borehole numbers have been assigned to individual piezometers.

Piezometer Bank PZ01

This bank consists of three piezometers oriented perpendicular to the southern extension of the ITS. The piezometer bank was initially intended to be located approximately 200 feet east of the current location, but was unable to be installed in that location due to rig access. It was relocated to the west, with similar configuration. This location is inside the PA and will straddle the ITS in the anticipated direction of local ground water flow. Piezometer 46093 will be installed approximately 5 feet downgradient of the Interceptor Trench and approximately 25 feet east of the line between Piezometers 46193 and 46293. The piezometer location is 25 feet east to avoid underground cables in the vicinity. It is anticipated that Piezometer 46093 will be dry and the piezometer will confirm the efficiency of the ITS at this location. It is believed that the ITS is

keyed into bedrock at this location and is relatively efficient in collecting alluvial ground water. Piezometer 46193 will be located approximately 10 feet upgradient of the Interceptor Trench of the ITS. It is anticipated that ground water will be present in this piezometer and will define part of the drawdown curve into the trench. Piezometer 46293 will be located approximately 10 feet upgradient of old Trench No. 2, which continues to serve as a ground water collection trench. It is anticipated that ground water will be present in this piezometer and will define an area of seepage on the hillside. The local hydrology of the hillside is governed by the ITS as well as the historical trenches. The location of Trench 2 is marked by a sump constructed using a 55-gallon drum. In addition, these piezometers will help to identify bedrock topology.

Piezometer Bank PZ02

This bank straddles both the northern end of Leg 6 of the ITS and the ITS header pipe. It is located in the buffer zone and consists of Piezometers 40193, 46393, and 46493. It is believed that both the header pipe and Leg 6 are keyed into bedrock at this location. The identification of bedrock elevation will be correlated with the estimated depth of the ITS pipes to confirm that the pipes are indeed keyed into bedrock.

Piezometer Bank PZ03

The seven piezometers in this bank will be installed in phases outward from the center. The first phase will consist of the three piezometers in the center. The bank will trend perpendicular to the anticipated direction of ground water flow and straddle the location of a bifurcated drainage that was present prior the construction of the PA which drastically altered the hillside in this location. Piezometer 44893 will be located midway between Legs 5 and 6 of the ITS approximately 40 feet north of the Northeast Access Road. The legs are spaced 100 feet apart, and, therefore, the piezometer will be approximately 50 feet from either leg. Piezometers 44993 and 45293 will be located at 25-foot spacings parallel to the road and midway between Piezometer 44893 and the ITS legs, one northwest of Piezometer 44893 and one southeast of Piezomemter 44893. These piezometers will serve to better define a buried bifurcated drainage that is believed to be present in this area. It is believed that the ITS is not keyed into bedrock at this location, so it is anticipated that these three piezometers will have ground water present near the bedrock surface. Additional piezometers (45093 and 45393) will be located on the other

side of ITS legs 5 and 6, respectively. This will place the piezometers approximately 35 feet along the same northwest-southwest trend as the previous piezometer. These additional piezometers will further meet the stated objectives and define the local cross-section of the bifurcated drainage. It is not anticipated that Piezometers 45493 and 45193 will provide significantly greater definition of the system drawdown. The bifurcated drainage is believed to be an expression of the bedrock surface and a primary controller of ground water flow. If this is true, it represents a significant potential contaminant migration pathway and must be characterized.

Piezometer Bank PZ04

It is proposed that this bank consist of five piezometers in a tee configuration inside the PA and in the immediate vicinity of a seep on the hillside. The bank will straddle the Interceptor Trench of the ITS and circumscribe the seep in the anticipated direction of ground water flow. In addition, the tee array will be perpendicular to ground water flow and a potential buried drainage. Piezometer 45593 will be located approximately 10 feet downgradient of the Interceptor Trench. It is anticipated that Piezometer 45593 will be dry. Both top of bedrock elevation and the efficiency of the ITS at this location will be evaluated from this data. It is believed that the ITS is keyed into bedrock at this location and prevents ground water movement at this location. Piezometer 45693 will be located approximately 5 feet upgradient of the Interceptor Trench, between the ITS system and the seep area. It is anticipated that water will be found in this borehole if bedrock does not outcrop very close to the surface. The seep may be created by bedrock outcropping very near the ground surface at the uphill side of the seep, causing discharge of ground water to the ground surface. Therefore, this piezometer will yield valuable information downhill from the seep. Piezometer 45893 will be located approximately 120 feet north of the ITS and centered on upgradient portion of the seep. It is anticipated that this piezometer will produce ground water and will sufficiently characterize the upgradient or source area of the seep. In addition to these three piezometers trending parallel to the anticipated direction of ground water flow, it is also proposed that two additional piezometers be drilled perpendicular to the first three piezometers, forming a tee configuration. Piezometers 45793 and 45993 are proposed to be located approximately 15 feet apart in an area near the surface egression of the seep. These piezometers will help to more accurately define the bedrock expression of an old buried drainage

in this location that is believed to govern ground water flow. These five piezometers will also help in the identification of the vadose zone in this area.

3.7 STANDARD SUBSURFACE SAMPLING PROCEDURE

The subsurface sampling procedure described in the approved Work Plan included compositing three 2-ft cores, with samples selected at a minimum of 5-ft intervals from near the ground surface to the water table. If the alluvium is unsaturated, boreholes would be extended up to 5 feet into bedrock. Using this procedure, six foot composite samples would be collected with up to 5 ft of unsampled alluvium between samples. The procedure described in the Work Plan was reassessed and determined to be both unclear and potentially a detriment to data interpretation. In some circumstances, anticipated that interpretation of analytical results collected with this procedure would be applied to intervals of alluvium up to 11 feet. The borehole sampling plan was therefore revised for clarification and to provide data that can be more easily interpreted.

The revised borehole sampling plan provides for the continuous collection of 6-foot composite samples in alluvial materials. The 6-ft composite sample is collected in three 2-ft runs, with a sample collected every other 2-ft drive for volatile organic analysis. Boreholes are advanced only to water table or bedrock. According to SOPs, a volatile organic analysis sample is collected from the first verified core run into bedrock. A revision to this approach included the continuation of drilling in boreholes encountering ground water until bedrock is reached, and installing a piezometer to monitor the water levels in the piezometers. Boreholes drilled through saturated materials into bedrock will be used to define the thickness of alluvium, thickness of vadose zone and saturated materials, and depth to bedrock in the vicinity of the Ponds. Sampling continues only until saturated materials or bedrock are encountered.

The sampling protocol described in the approved Work Plan varied depending on the following geographic locations: the Original Pond and existing Solar Ponds; the ITS and remainder of site; and surficial soil samples. The analysis parameters varied slightly depending on geographic location, with a more complete analysis of radionuclides in the existing Solar Ponds and Original Pond than in the ITS and remainder of site. Analysis suites have been clarified and expanded

slightly from the approved work plan parameters during field implementation described as follows.

Boreholes drilled in Original Ponds and Existing Solar Ponds are sampled and analyzed for:

- Nitrate;
- TAL Metals
- Uranium 233/234, 235, 236 and 238;
- Plutonium and americium;
- Cesium 137 and Strontium 90;
- Gross Alpha and Gross Beta;
- Tritium;
- TCL Volatile Organics;
- TCL Semivolatile Organics;
- Cyanide;
- Sulfide;
- Pesticides; and
- Polychlorinated biphenyls (PCBs).

The list varies from that in the approved Work Plan only by the specification of cyanide and sulfide as the "inorganic" parameters, and the inclusion of PCB analysis.

Boreholes drilled in the ITS and remainder of site are sampled and analyzed for:

- Nitrate
- TAL Metals
- Uranium 233/234, 235, 236 and 238;
- Gross Alpha and Gross Beta;
- Tritium
- TCL Volatile Organics;
- Cyanide; and
- Sulfide.

The list varies from that in the approved Work Plan only by the specification of cyanide and sulfide as "inorganic" parameters. In both lists, there are no other "inorganic" parameters that have been deleted.

Surficial soil samples are sampled and analyzed for:

- Nitrate;
- TAL Metals;
- Uranium 233/234, 235, 236 and 238;

- Plutonium and americium;
- Cesium 137 and strontium 90;
- Gross Alpha and Gross Beta;
- Tritium;
- TCL semivolatile organics;
- Pesticides; and
- PCBs.

The list varies from that in the approved Work Plan only by the addition of pesticides and PCBs.

Changes made to field analysis parameter suites occurred prior to drilling of boreholes to clarify requests for analyses, and to include pesticides and PCBs.

3.8 MODIFIED SAMPLING PROGRAM IN POND 207A

Bedrock was encountered at shallow depths in many boreholes during the around ponds investigation. It is anticipated that shallow bedrock may be encountered beneath Pond 207A, and that insufficient data would be obtained from the 6-foot composite samples collected in this important location within OU4. A modified sampling plan was therefore prepared in an attempt to obtain additional data from beneath Pond 207A, in the event shallow depths to bedrock or ground water are encountered.

The first component of the modified sampling plan included collection of asphalt liner samples for analysis. Collection of asphalt was not required in the approved Work Plan, but the option to conduct asphalt samples was stated. Samples of asphalt are to be analyzed for TAL metals and the following radionuclides:

- Uranium 233/234, 235, 236, and 238;
- Plutonium;
- Americium;
- Cesium-137;
- Strontium-90;
- Gross Alpha and Gross Beta; and
- Tritium.

Samples of subgrade material are also collected using the surficial soil sampling procedure described in Section 3.4. As drilling begins, samples are intended to be collected every 2 feet for the high priority analytes in the pond, radionuclides and TAL metals. Four-foot composite samples are to be collected for nitrate analysis, and six-foot composite samples are collected for semivolatile organic compounds, pesticides, PCBs, cyanide, and sulfide. Volatile organic analysis samples continue to be collected every other 2-ft core run. This alluvial sampling procedure continues throughout alluvial materials to a maximum of 2 feet into bedrock. If saturated materials are encountered, samples will continue to be collected as sample recovery allows with high priority analyses being radionuclides and TAL metals. This procedure applies to all six boreholes located in Pond 207A, and is depicted on the schematic diagrams in Figures 3-4 and 3-5.

Borehole 42193

Borehole 42193 is proposed to be a deep geologic borehole inside Pond 207A, with an estimated total depth of 50 ft. This deep geologic borehole was initially intended to be drilled north of Pond 207A on the hillside, at the location shown as 42693. The original purpose of the deep borehole was to confirm the suspected presence of subcropping sandstones in the area of Borehole 42693. When drilling commenced at this location, bedrock was encountered within one foot of the surface, and was identified as claystone, not as sandstone. Drilling of a deep geologic borehole was then reconsidered in this location, and believed to be better located within Pond 207A. The objectives of drilling the borehole thus expanded not only to determine the location of potential subcropping sandstones, but to provide geologic information below the potential source of contamination. Surface casing will be installed to minimize the potential for downward spread of contamination from drilling activities.

The proposed sampling procedure for Borehole 42193 is presented in Figure 3-4. Sampling of the pond liner and alluvial components of Borehole 42193 are as described in the previous paragraph. Deeper bedrock sampling from this borehole is proposed to be conducted using the standard 6-ft composite intervals throughout the bedrock until either a maximum depth of 50 feet or evidence of sandstone or ground water is encountered. It is preferred that an offset casing be installed in the deep hole to allow geologic logging to proceed with neutron, gamma, and

induction tools. The casing will reduce the risk of hole cave-in on the tools, and minimize direct contact of the tool with potentially contaminated materials. Presence of the thin-walled casing will cause minimal interference with the quality of logging results.

Borehole 42593 and 43393

Boreholes 42593 and 43393 are the two remaining analytical boreholes in Pond 207A. Sampling procedures for these boreholes are consistent with that described above for the alluvial materials, but at least one sample is also proposed in the underlying bedrock. Figure 3-5 depicts the proposed sampling scheme. After alluvial material are sampled, a surface casing will be installed, and the borehole advanced 6 to 8 feet into bedrock. A 6-ft composite sample will be collected and analyzed from bedrock to allow comparison of geochemical data between alluvial and bedrock materials. The boreholes will be abandoned upon completion.

Vadose Zone Boreholes in Pond 207A

The three remaining boreholes in Pond 207A are scheduled for completion as vadose zone boreholes. Because sampling instruments are being installed in the boreholes during completion, alluvial sampling will terminate once bedrock has been verified. Alluvial sampling procedures will follow those described above for other Pond 207A boreholes, but drilling will be terminated a maximum of 2 feet into bedrock. Vadose zone monitoring equipment will be installed in these boreholes as discussed in TM1.

4.0 PROGRAM IMPACT

The changes in the field program presented in this TM will allow for more efficient use of the resources allocated to OU4, will better characterize migration pathways at the Solar Ponds, and will eliminate the generation of redundant data than the program specified in the approved Work Plan. In addition, these changes will allow progress to be made regarding characterization of source and soils even through the 207B-series and Pond 207C are not yet drained. Data from historical borings in the pond area and from adjacent OUs has been identified, and used to minimize the collection of redundant data in OU4. Although these changes will better define contaminant migration pathways from the Solar Ponds, a potential data gap will exist with respect to the generation of soil chemistry data under the 207B-series Ponds and Pond 207C. This potential data gap will be addressed in field characterization activities related to OU4 that will be completed at a later date. The data generated from the field activities as identified in the Phase I RFI/RI Work Plan, as modified by TM1 and TM2, should allow for adequate preliminary characterization of the soils and sources at OU4.

5.0 REFERENCES

EG&G, 1992: Final Phase I RFI/RI Work Plan. Solar Evaporation Ponds. Operable Unit No. 4. January, 1992.

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Gilbert, 1987: Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Huntsberger, D.V. and P. Billingsley, 1981: Elements of Statistical Interference. Allyn and Bacon. Massachusetts.

TABLE 3.1
CURRENT OU4 BOREHOLE PROGRAM

BOREHOLE #	LOCATION	FUNCTION				COMMENTS
40093	North of NE Access Rd between ITS Legs 12 & 13		•			Approved Work Plan location
40193	North end of ITS Leg 6		•	•		Moved approximately 40 feet southeast of original work plan location to be part of piezometer array PZ02
40293	South of NE Access Rd between ITS Legs 14 & 15	•	•			Approved work plan location
40393	South of NE Access Rd between ITS Legs 6 & 7	•	•			Relocated from TM1 location across road to the southwest to fill a data gap
40493	North of ITS Leg 3		•			Approved work plan location
40593	North of ITS Leg 5	•	•			Relocated in TM1 to be within potential migration pathway
40693	Hillside north of 207C	•	•			Relocated in TM1 to be within potential migration pathway
40793	Hillside north of berm between 207A & 207C	•	•			Relocated in TM1 due to rig access
40893	North of 207B-N		•			Approved work plan location
40993	Northwest corner of 207C	•	•			Relocated in TM1 from west of OU4 boundary
41093	North of 207C		•			Deleted from program
41193	Northeast of 207A		•	•		Relocated slightly north of approved work plan location due to rig access
41293	Northeast of 207B-N	•	•			Relocated slightly north of approved work plan location due to rig access
41393	Inside 207C		•			Postponed until pond is drained
41493	Inside 207C		•			Postponed until pond is drained
41593	Inside 207A	•	•			Approved work plan location may be relocated slightly pending the extent of ice in that portion of the pond

TABLE 3.1

CURRENT OU4 BOREHOLE PROGRAM

BOREHOLE #	LOCATION	FUNCTION				COMMENTS
41693	Between 207A & 207B-N		•	•		Interim borehole given identification number from a postponed Pond 207B-N borehole
41793	East of 207B-N	•	•			Interim borehole given identification number from a postponed 207B-N borehole
41893	OU6		•			Deleted from program
41993	West of 207C		•	•		Approved work plan location
42093	Northeast corner of 207C		•			Relocated from TM1 location to the north due to rig access
42193	Inside 207A		•		•	Changed to be a deep borehole as well as analytical/geological borehole
42293	Between 207B-N & 207B-C		•	•		Interim borehole using identification number from a postponed 207B-N borehole
42393	Southwest of 207C		•	•		Interim borehole using identification number from a postponed 207C borehole
42493	Inside 207A	•	•			Relocated in TM1 to be inside Pond 207A instead of west of berm
42593	Inside 207A		•			Approved work plan location. May be relocated slightly pending the extent of ice in that portion of Pond 207A
42693	Hillside north of 207A		•			Bedrock at surface. Abandoned with no soil samples collected
42793	Inside 207B-C		•			Postponed until pond is drained
42893	South of 207C	•	•			Relocated from TM1 location to the southwest due to underground utilities
42993	Southeast of 207C		•	•		Originally planned as a deep borehole, now revised to be alluvial borehole with piezometer
43093	Inside 207B-C		•			Postponed until pond is drained

TABLE 3.1

CURRENT OU4 BOREHOLE PROGRAM

BOREHOLE #	LOCATION	FUNCTION				COMMENTS
43193	East of 207B-C	•	•			Approved work plan location relocated slightly east due to rig access
43293	OU6		•	•		Relocated in TM1; Originally planned as a deep borehole, revised to be an alluvial borehole with piezometer
43393	Inside 207A		•			Location moved slightly south as a result of visual survey
43493	Between 207B-C & 207B-S		•	•		Interim borehole using identification number from postponed 207B-C borehole
43593	South of 207C		•	•		Approved work plan location
43693	Inside 207A	•	•			Approved work plan location
43793	Between 207B-C & 207A	•	•			Interim borehole using identification number from postponed 207B-S and selected for vadose zone monitoring
43893	Southeast of 207A		•	•		Relocated in TM1 to south berm of Pond 207A due to rig access
43993	Between 207B-S & 207A		•	•		Interim borehole using identification number from postponed 207B-S borehole
44093	East of 207B-S	•	•			Interim borehole using identification number from postponed 207B-S borehole
44193	OU6		•		•	Approved work plan location
44293	South of Bldg 782		•		•	Deleted from program
44393	South of 207A	•	•			Approved work plan location
44493	South of 207B-S		•			Deleted from program
44593	Southeast of 207B-S		•			Approved work plan location
44693	Northeast of ITS Leg 2		•			Relocated in TM1 to the south due to rig access
44793	East of ITS Leg 1		•			Relocated from TM1 to the north due to rig access

TABLE 3.1

CURRENT OU4 BOREHOLE PROGRAM

BOREHOLE #	LOCATION	FUNCTION				COMMENTS
PZ01: 46093 46193 46293	North of 207B-N		• • •	•		Relocated from the Phase I RFI/RI Work Plan to be in the vicinity of Trench No. 2
PZ02: 40193 46393 46493	North end of ITS Leg 6		•	• • •		Relocated from the RFI/RI Work Plan to be in the vicinity of potential migration pathways
PZ03: 44893 44993 45093 45293 45393	North of NE Access Rd, between ITS Legs 6 & 7		•	• • • • • • •		Relocated from the Phase I RFI/RI Work Plan to be in the vicinity of potential migration pathways. Piezometers 45193 and 45493 deleted.
PZ04: 45593 45693 45793 45893 45993	Hillside north of 207C		•	• • • • •		Relocated from the Phase I RFI/RI Work Plan to be in the vicinity of potential migration pathways

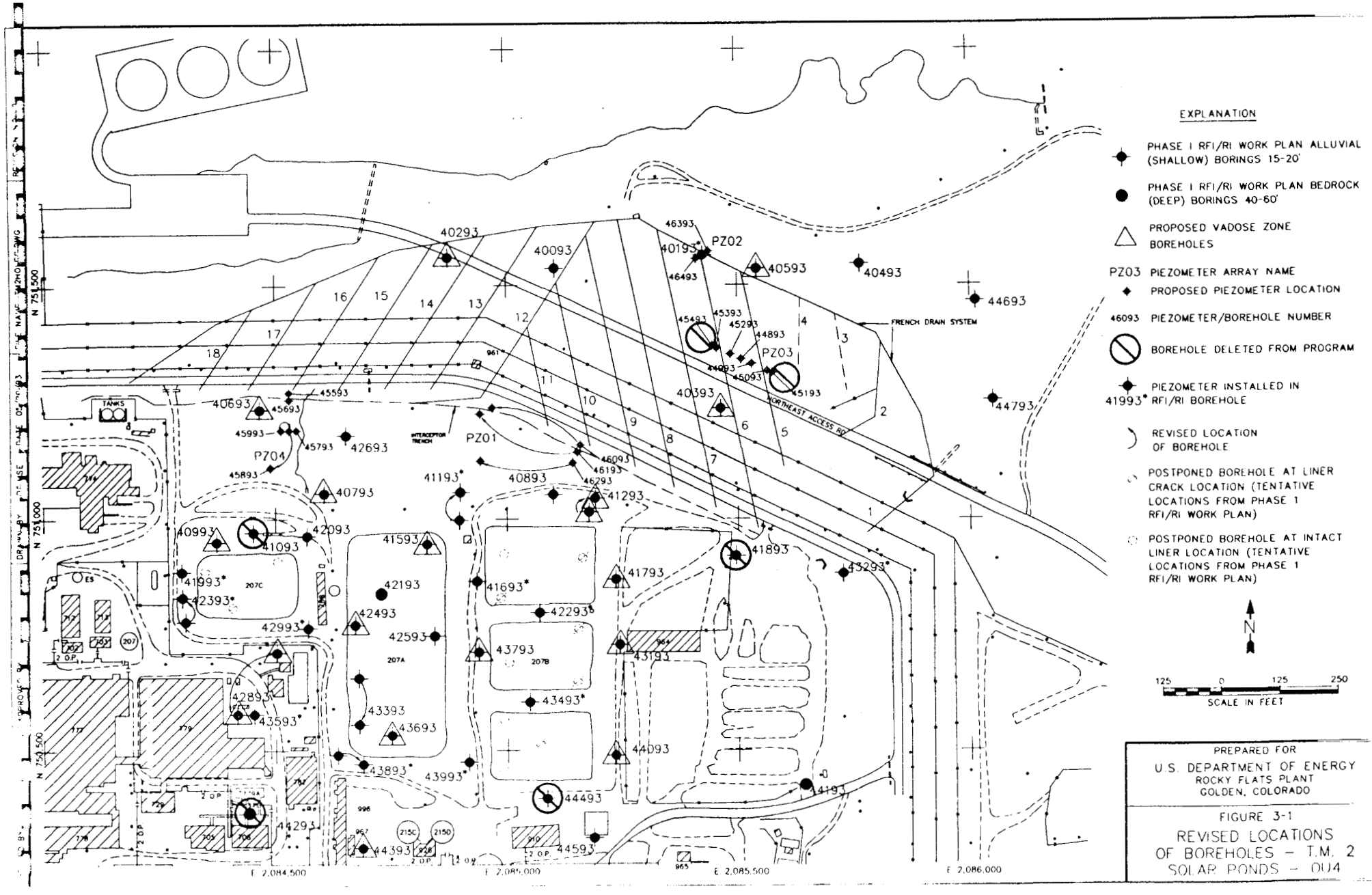

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FIGURE 3-1
REVISED LOCATIONS OF BOREHOLES – T.M. 2
SOLAR PONDS – OU4

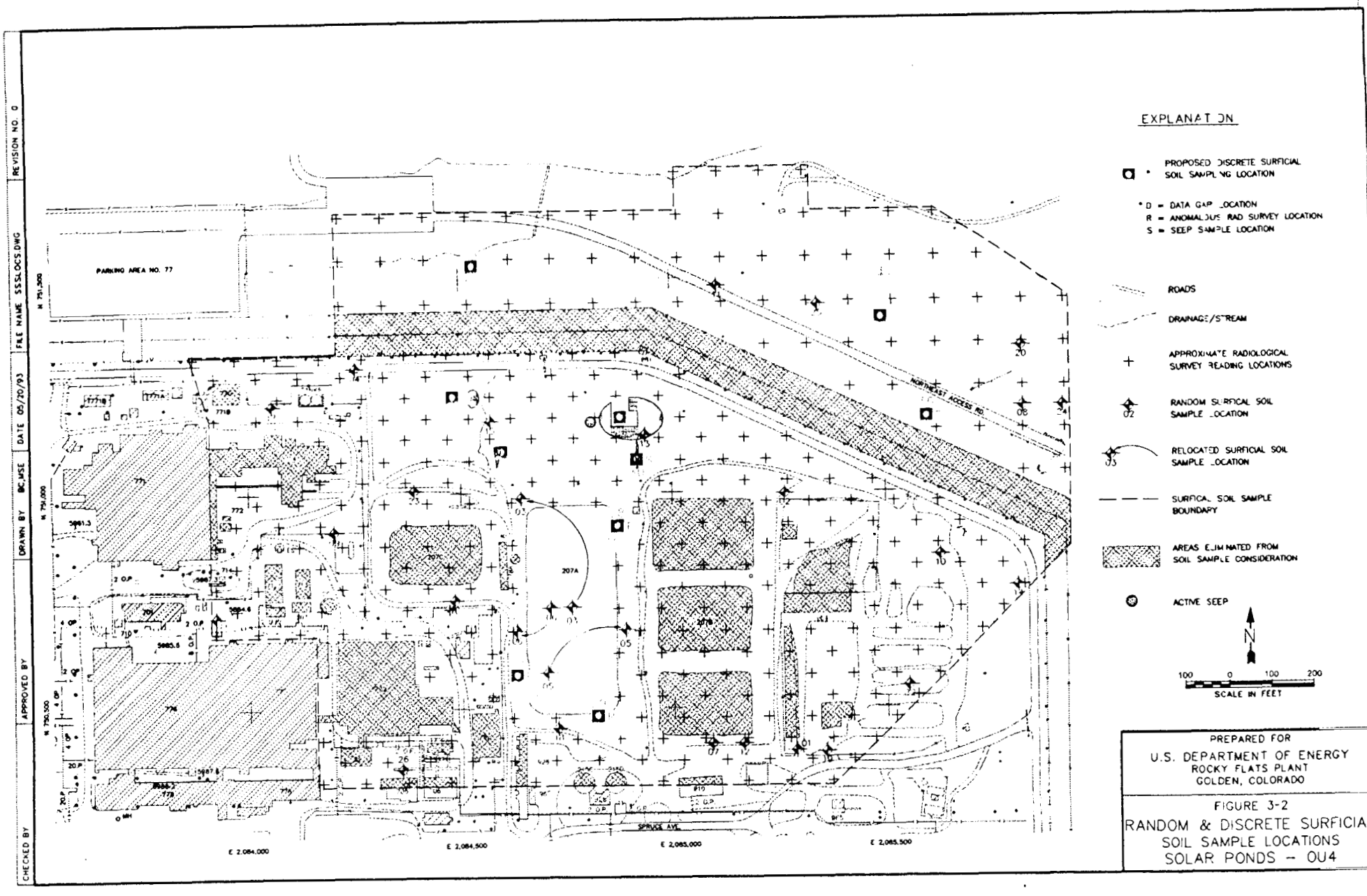

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FIGURE 3-2
RANDOM & DISCRETE SURFICIAL SOIL SAMPLE LOCATIONS
SOLAR PONDS – OU4

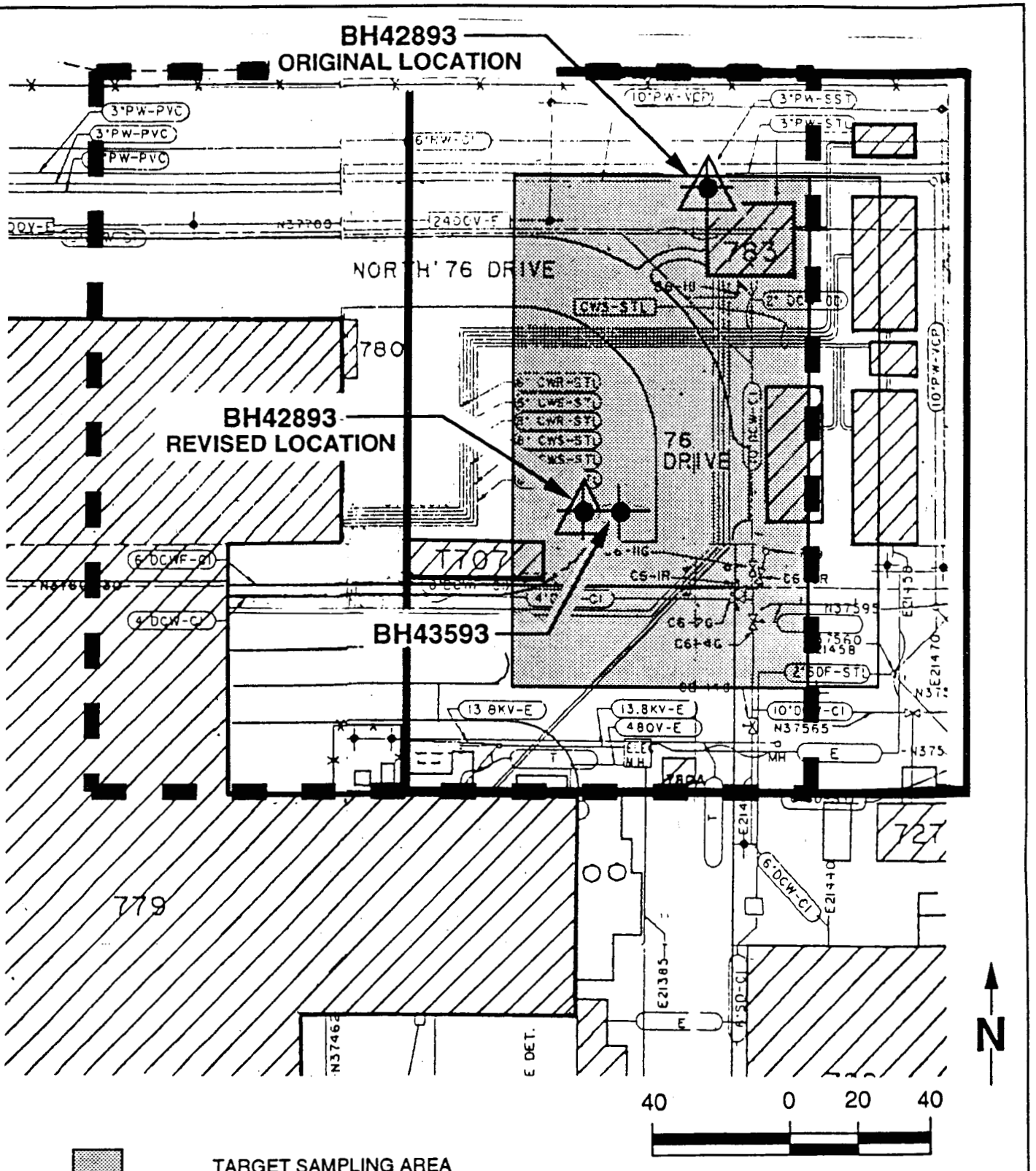

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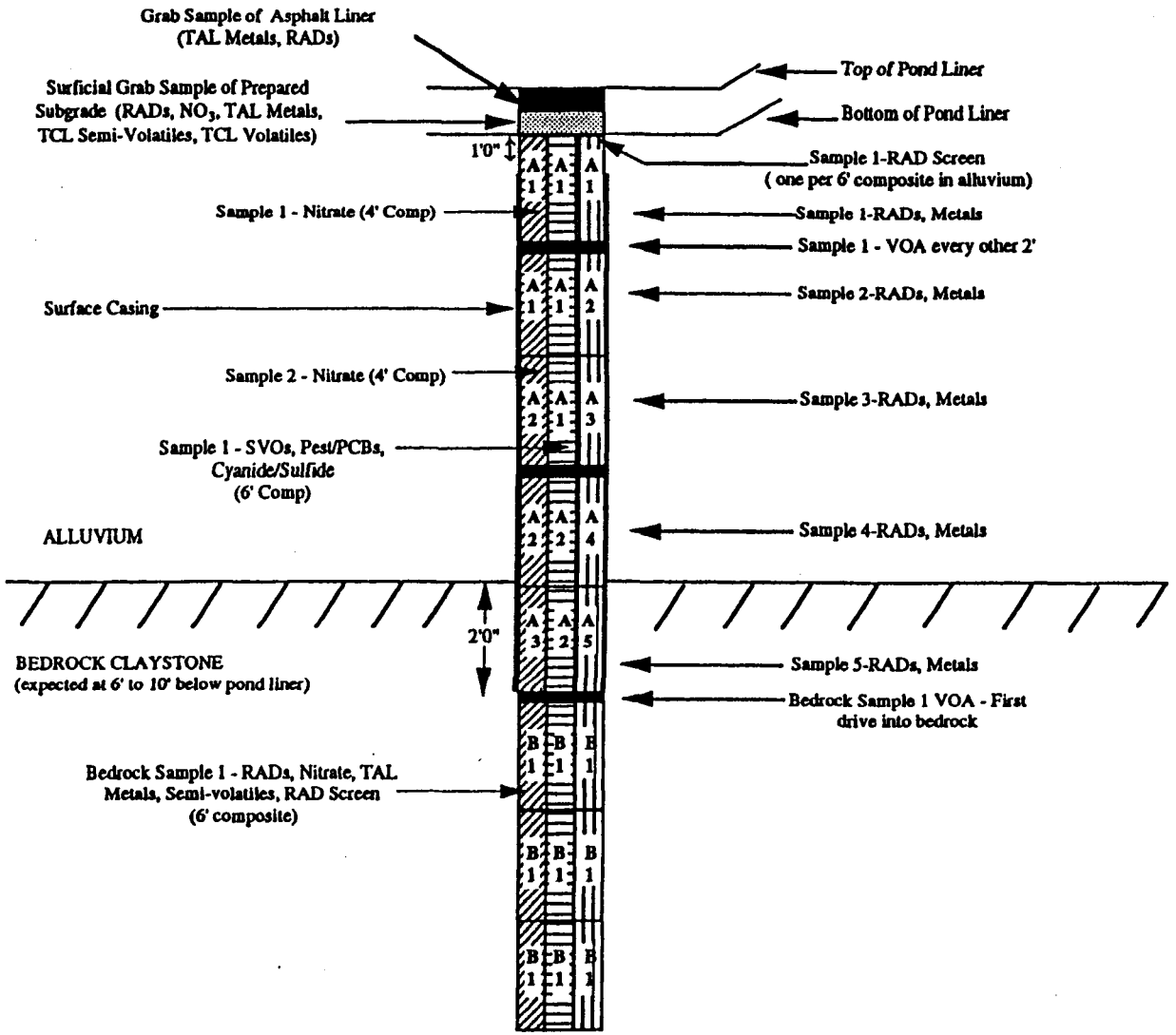
FIGURE 3-3
REVISED LOCATION OF BOREHOLE 42893
SOLAR PONDS - OU4

REVISION: 0
FILE NAME: ALLUVIAL BORE HOLE
DATE: 03/18/93
DRAWN BY: CLW
APPROVED BY:
CHECKED BY:



Bedrock sampling will continue with 6' composites for full suite for entire depth of borehole. Final depth of BH42193 will be dictated by the occurance of subcropping sandstone or total depth of 50', whichever is encountered first.

Volumetric Calculations per 2'sampler spoon

NO_3	240 ml
TAL Metals	240 ml
RADs	250 ml
VOA	240 ml
SVOC	80 ml
Cyanide/Sulfide	80 ml
RAD Screen	35 ml
	1165 ml

Total Volume = 1930ml
1165/1930 ml =
60% Recovery Required

- NO_3 (4' composite)
- SVOC/Pesticides/PCBs, Cyanide/Sulfide Radiological Screen (6' composite)
- VOA (3" sleeves every 4')
- RADs* and TAL Metals (2' composite)

*Analyzed for: U233/234, 235, 236, 238; Plutonium/Americium; Cesium 137 & Strontium 90; Gross Alpha & Beta; Tritium

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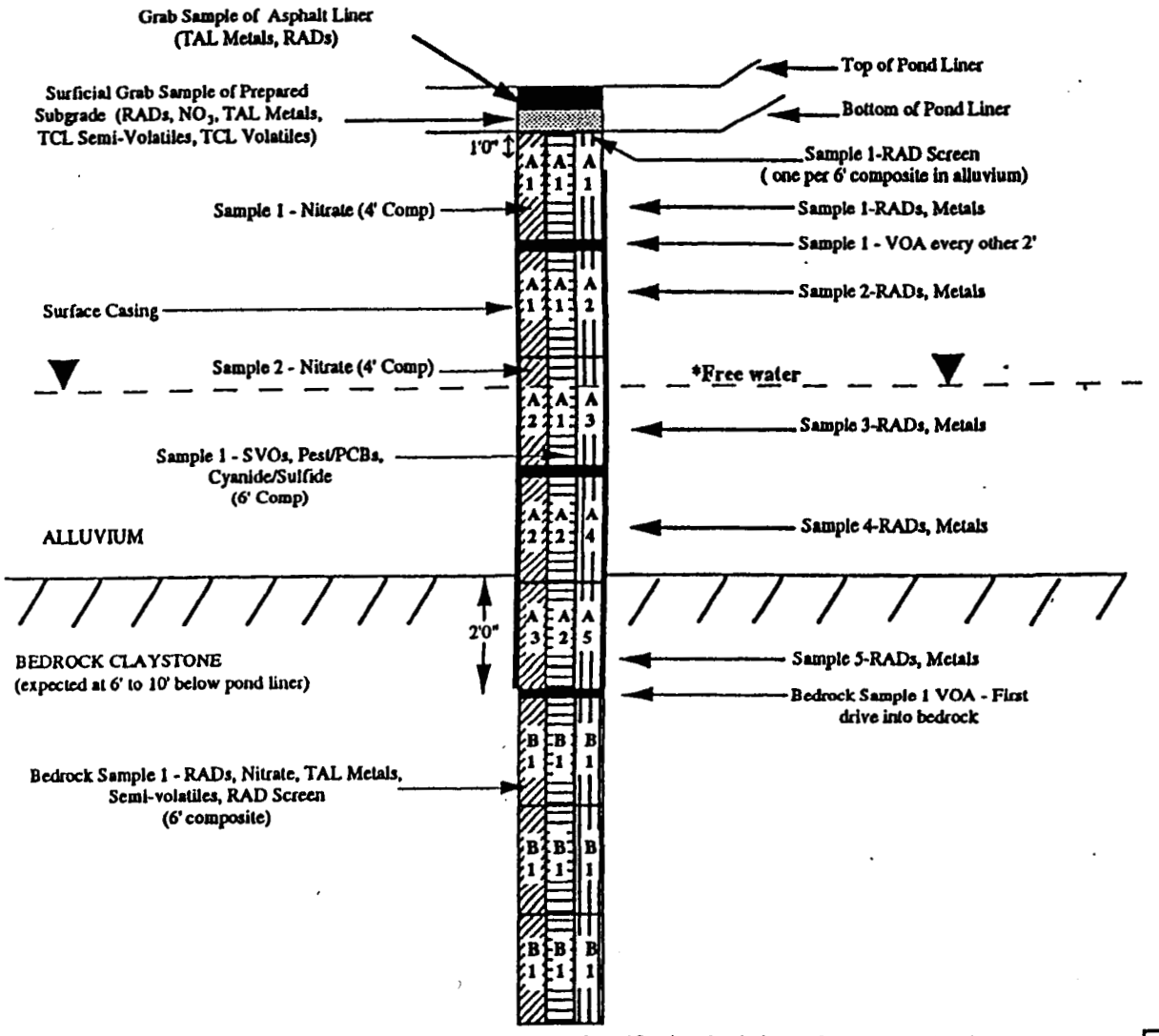
FIGURE 3-4

PROPOSED SAMPLING PLAN WITHIN POND 207A—BOREHOLE 42193



*If free water is encountered, alluvial sampling continues to bedrock verification depth (bedrock contract +2') as long as samples are recoverable. Set surface casing and collect 6' composite from bedrock.

Volumetric Calculations per 2'sampler spoon

NO_3	240 ml
TAL Metals	240 ml
RADs	250 ml
VOA	240 ml
SVOC	80 ml
Cyanide/Sulfide	80 ml
RAD Screen	35 ml
	1165 ml

Total Volume = 1930ml
1165/1930 ml =
60% Recovery Required

- NO_3 (4' composite)
- SVOC/Pesticides/PCBs, Cyanide/Sulfide Radiological Screen (6' composite)
- VOA (3" sleeves every 4')
- RADs* and TAL Metals (2' composite)

*Analyzed for: U233/234, 235, 236, 238; Plutonium/Americium; Cesium 137 & Strontium 90; Gross Alpha & Beta; Tritium

REVISION: 0
FILE NAME: ALLUVIAL BOREHOLE.2
DATE: 02/19/93
DRAWN BY: CLW
APPROVED BY:
CHECKED BY:

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FIGURE 3-5

PROPOSED SAMPLING PLAN WITHIN POND 207A—BOREHOLES 43393 AND 42593

Appendix A

APPENDIX A

OU4 PHASE I RFI/RI WORK PLAN FIGURES

- Figure A-1: Field Sampling and Geophysical Investigation in Original Pond Area.
- Figure A-2: Field Sampling and Geophysical Investigation at Existing Solar Evaporation Ponds.
- Figure A-3: Field Sampling and Geophysical Investigation in Interceptor Trench System, and Remaining Areas.

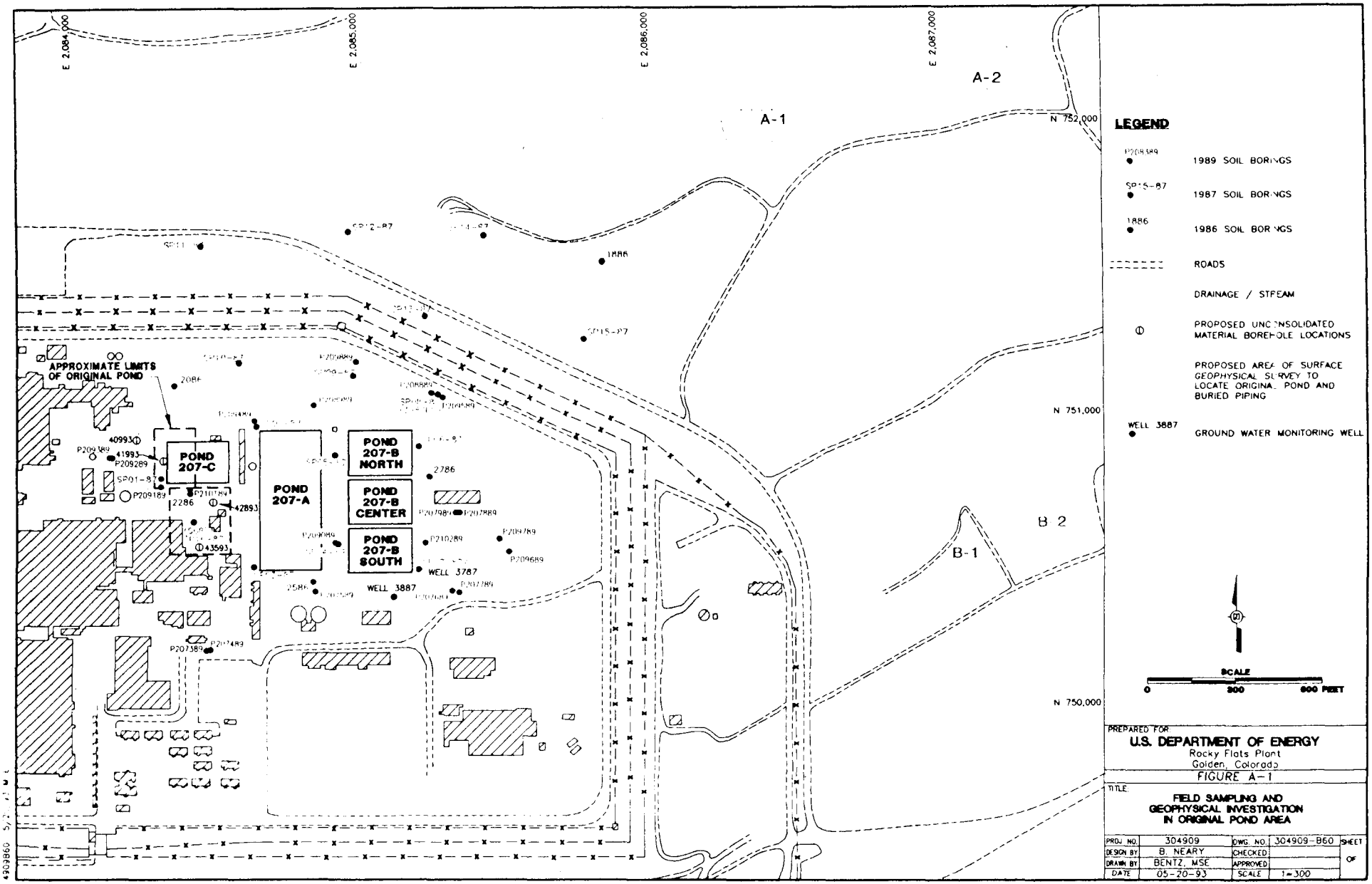

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FIGURE A-1

TITLE:
FIELD SAMPLING AND GEOPHYSICAL INVESTIGATION IN ORIGINAL POND AREA

PROJ. NO.	304909	DWG. NO.	304909-B60	SHEET
DESIGN BY	B. NEARY	CHECKED		OF
DRAWN BY	BENTZ, MSE	APPROVED		
DATE	05-20-93	SCALE	1=300	

4909860 5/2

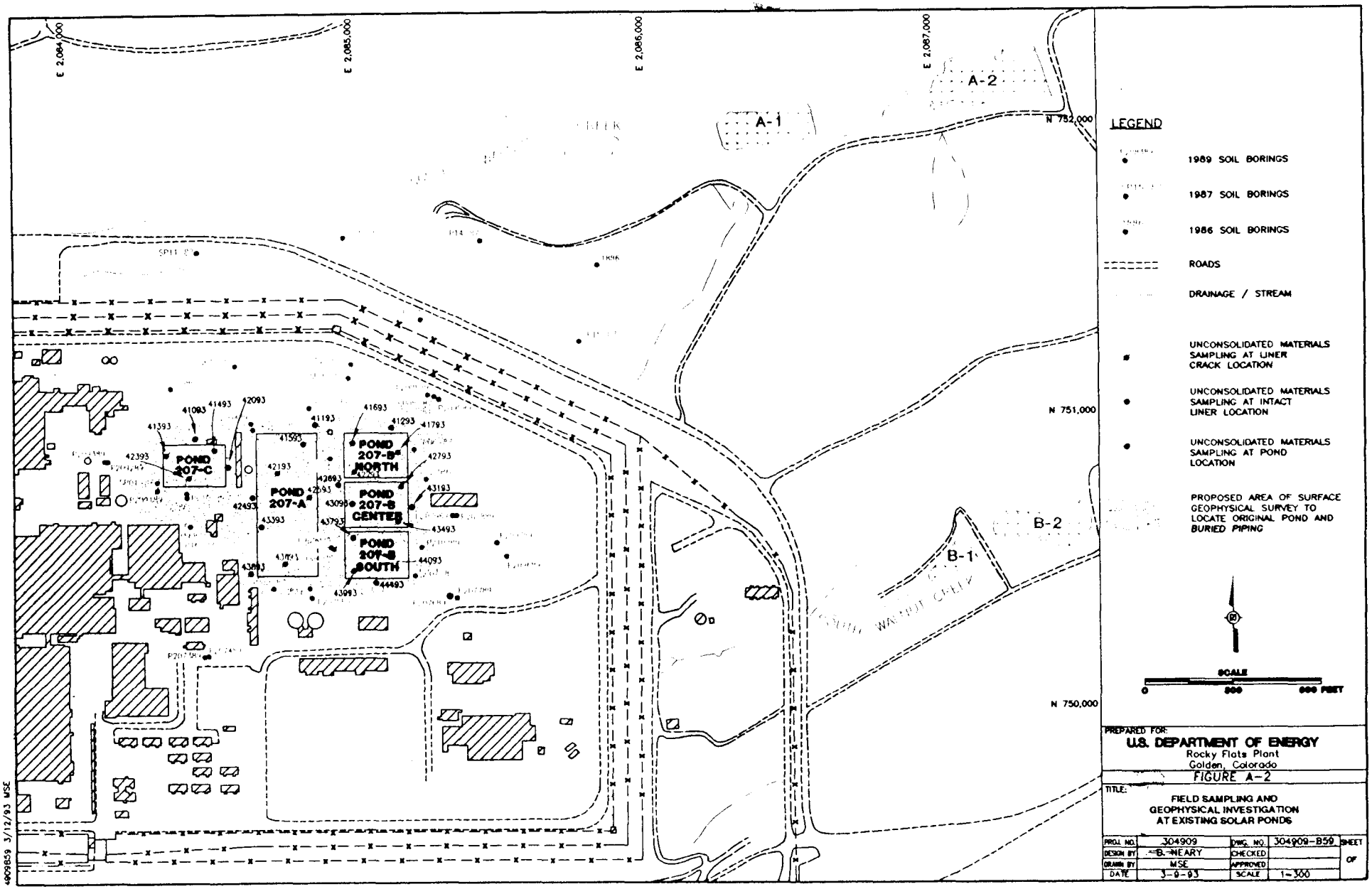

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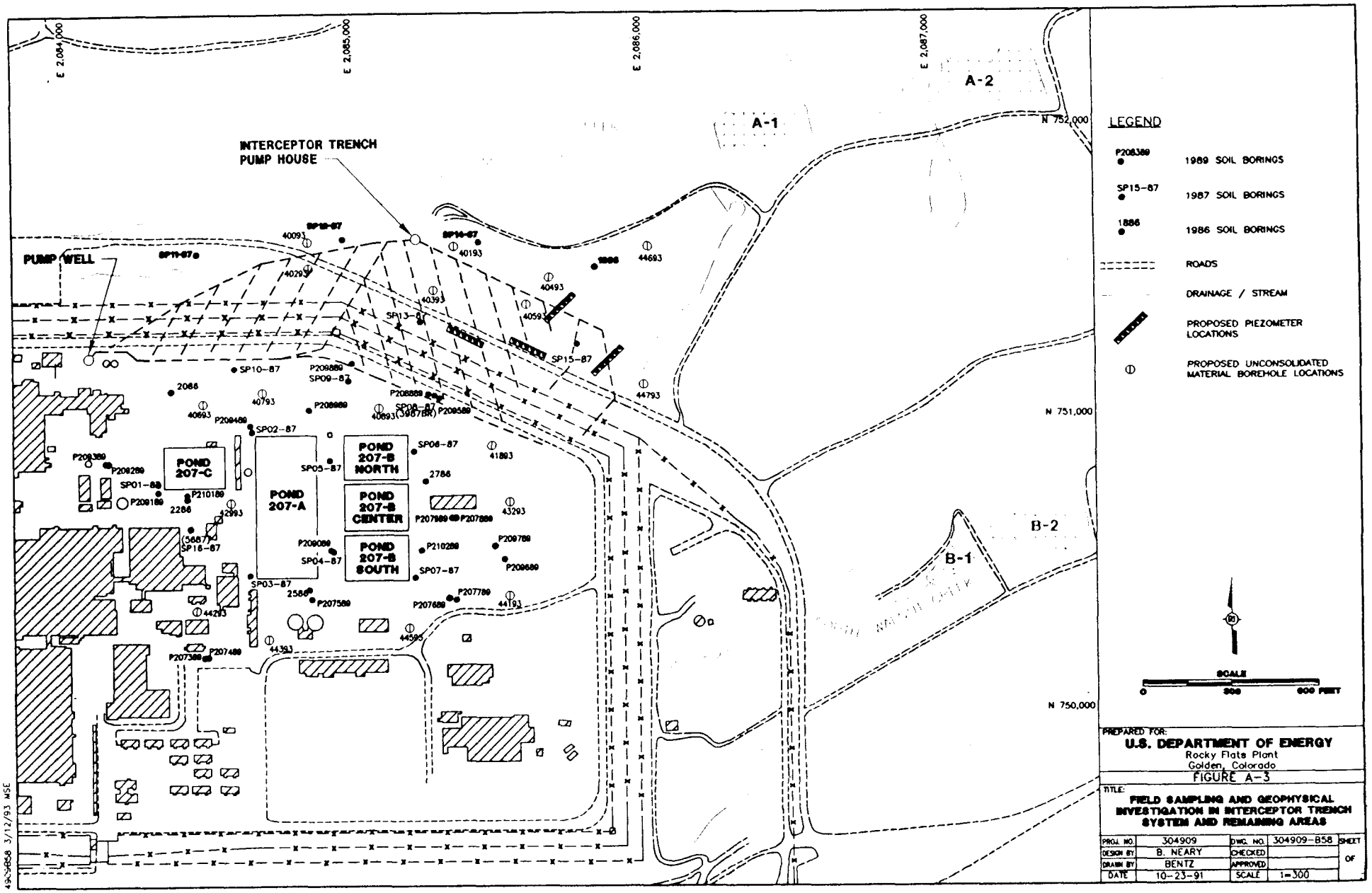
FIGURE A-2

TITLE:
FIELD SAMPLING AND GEOPHYSICAL INVESTIGATION AT EXISTING SOLAR PONDS

PROJ. NO.	304909	DWG. NO.	304909-B59	SHEET
DESIGN BY	B. NEARY	CHECKED		OF
DRAWN BY	MSE	APPROVED		
DATE	3-9-93	SCALE	1=300	

4909859 3/12/93 MSE



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Golden, Colorado

FIGURE A-3

TITLE:
FIELD SAMPLING AND GEOPHYSICAL INVESTIGATION IN INTERCEPTOR TRENCH SYSTEM AND REMAINING AREAS

PROJ. NO.	304909	DWG. NO.	304909-858	SHEET
DESIGN BY	B. NEARY	CHECKED		OF
DRAWN BY	BENTZ	APPROVED		
DATE	10-23-91	SCALE	1=300	

304909-858 3/12/93 MSE

Appendix B

APPENDIX B

LOCATIONS OF SOIL BORINGS PRESENTED IN TECHNICAL MEMORANDUM NO. 1

- Figure B-1: Locations of Soil Borings Presented in TM No. 1 Solar Ponds-OU4.
- Figure B-2: Approximate Locations of Buried Drainage Channels Solar Ponds-OU4.

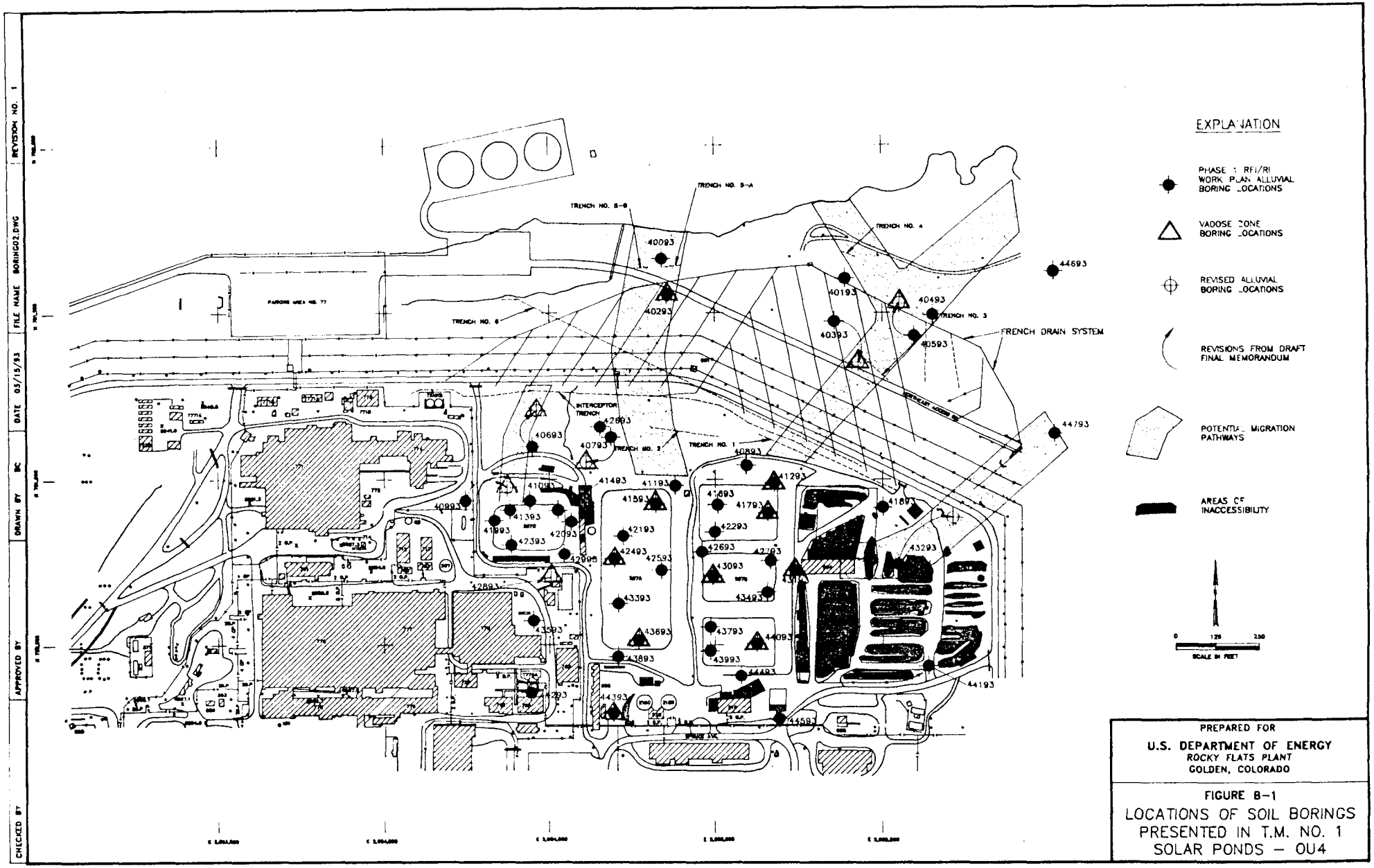

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FIGURE B-1
LOCATIONS OF SOIL BORINGS PRESENTED IN T.M. NO. 1
SOLAR PONDS – OU4

REVISION NO. 1 | FILE NAME BORING02.DWG | DATE 03/15/93 | DRAWN BY BC | APPROVED BY | CHECKED BY

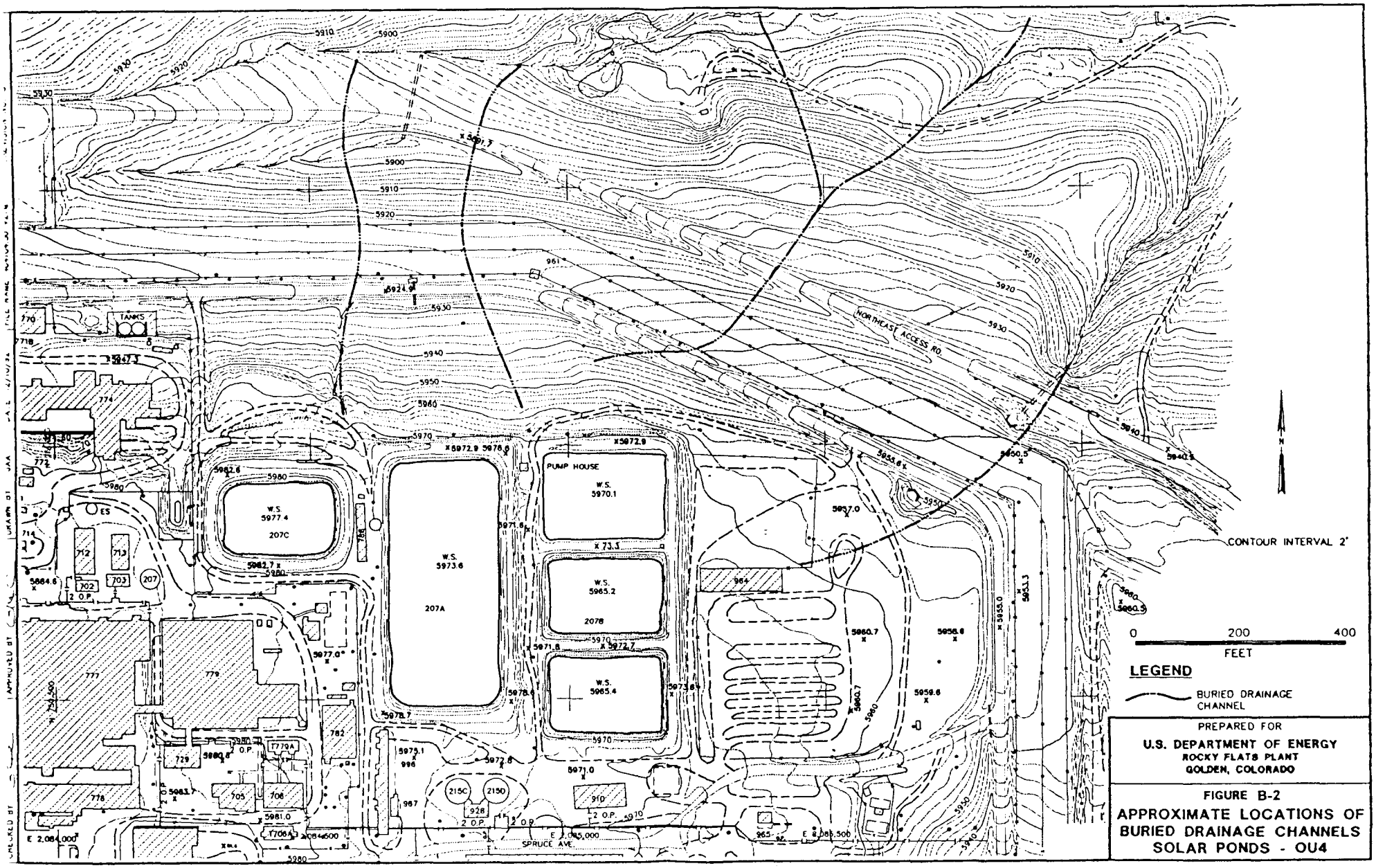

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FIGURE B-2

APPROXIMATE LOCATIONS OF BURIED DRAINAGE CHANNELS SOLAR PONDS - OU4

APPENDIX C

MEETING MINUTES OF CDH/EPA MEETING
OU4 SOLAR PONDS PROJECT STATUS
JANUARY 25, 1993

Meeting Minutes
OU4 Solar Ponds Project Status
January 26, 1993

An OU4 project status meeting was held on January 26, 1993 at 1:00 PM, at the Colorado Department of Health Offices, 700 S. Ash, Denver, CO. An agenda is attached. The following people were in attendance:

Name	Affiliation	Phone
Mr. Arturo Duran	USEPA	294-1080
Mr. Harlen Ainscough	CDH	692-3337
Ms. Caren Johannes	CDH	692-3347
Mr. Scott Surovchak	USDOE	966-3551
Mr. Randy Ogg	EG&G	966-8608
Mr. Steve Paris	EG&G	966-8543
Ms. Kim Ruger	EG&G	966-8608
Mr. Willis Wilcoxen	PRC Env Mgt	295-1101
Ms. Shaleigh Whitesell	PRC Env Mgt	295-1101
Ms. Barb Neary	Applied Environmental	469-6660
Mr. Tom Henderson	Applied Environmental	694-6660
Mr. Henry Leighton	Applied Environmental	469-6660
Mr. Frank Blaha	Wright Water Engineers	480-1700

Introductions were made followed by a general discussion regarding disposition of these meeting minutes. The minutes are scheduled for transmittal from EG&G to DOE within two weeks of the meeting date, February 9, 1993. Mr. Ogg then moved on to the formal agenda items.

Agenda Item I - Relocation of Boreholes/Vadose Zone Locations

Discussion began with Mr. Ogg briefly explaining the supplemental materials that had been brought to the meeting to support the rationale for any borehole/vadose hole relocations. He explained that the proposed Phase I drilling activities within Ponds 207B and 207C were now inappropriate due to the presence of liquids/sludges still within the ponds. In addition, the schedule for removal of the pond liquids/sludges proposed by RFP Operations will conflict with the Phase I RFI/RI program schedule.

Mr. Ogg then gave a brief explanation of each proposed contingency borehole location around Pond 207C and the B-series ponds and the supporting rationale. The rationale included consideration of the following: keeping the location as close as possible to a suspected contaminant source, drilling equipment logistics, and obtaining EG&G construction management concurrence with respect to avoidance of buried utilities.

CDH questioned any potential hindrance to drilling caused by the concrete access barriers that block berm access and the reasoning behind the move of borehole 40993. Mr. Ogg indicated the barriers could be moved and addressed the 40993 move to the satisfaction of the group. Other questions were asked regarding the status of the pond emptying activities, especially the issue of exactly when the removal operation was to begin, and if DOE was anticipating returning to the ponds at a later date to perform supplemental drilling and sampling. Mr. Surovchak addressed this issue, agreeing with the EPA representative that future sampling would be prudent

once emptying activities were complete. Mr. Duran reiterated the need to formally recognize the necessity to revisit the ponds at a later date; not just "consider" revisiting.

Mr. Ainscough questioned the correlation of the proposed relocations to suspected preferential flowpaths presented in the Vadose Zone Technical Memorandum. Mr. Henderson distributed maps of the pathways and Mr. Blaha gave a brief historical overview of site activities to support the theory of the pathways, and answered questions regarding the construction of the ponds and the old interceptor trenches. Additional questions about bedrock surface features gave way to extended discussion of the relationship between bedrock surface, preferential pathways, and the proposed borehole locations.EPA added discussion emphasizing the virtue of revisiting 207B and 207C ponds once they are emptied. Mr. Surovchak reiterated that DOE was not intending to replace the pond boreholes with these proposed boreholes.

The location of Borehole 43193 was proposed based on review of historical contaminant data and based on recent interpretations of irregular bedrock surface in the area. Borehole 42993 was proposed to be changed from a deep geologic boring to a shallow borehole with a piezometer. The data regarding local groundwater conditions in the vicinity of borehole 42993 was explained to be more beneficial data than bedrock geology in this instance. Borehole 44293 was proposed to be deleted due to its distant location from the solar ponds and presence of existing wells in the vicinity. Borehole 41893 was proposed to be deleted because it is outside the OU4 boundary and not within suspected contaminant migration pathways. Borehole 44493 was proposed to be deleted because it was unable to be cleared in that location due to the presence of several underground utilities. In addition, existing wells drilled prior to utility installation are very near 44493 and will provide valuable data. The proposed location of Borehole 42094 differs from that proposed in the Vadose Zone Technical Memorandum. It was relocated from due west of Building 788 (Pond 207C) to a location off the northeast corner of Pond 207C. The relocation was necessary due to rig access and will provide better data on suspected contaminant migration pathways. Finally, it was proposed that Borehole 41093 be deleted because the increased number of boreholes north of Pond 207C minimizes the data need and cost effectiveness of this borehole. As discussed later in these meeting minutes, all of the proposed items were verbally approved by the agencies.

An inquiry was made as to the validity of the 1989 data (ie., data from existing wells), and Mr. Ogg felt that the cleanup level specified in the IAG was restrictive enough to ignore the validity question with respect to final disposition of the property.

Agenda Item II - Innovative Drilling - Horizontal/Angled

Mr. Ogg began the discussion of this item by presenting a brief background of the need for horizontal drilling and the recognition that there is a specific need to collect data under the ponds. He outlined the overall proposal of drilling an east-west borehole from the east side of each B series pond, approximately 1'-3' beneath pond bottom elevation, and a north-south borehole beneath pond 207C, at a similar depth, drilled from the mid-point of the north pond berm. Mr. Ogg emphasized the concern over the potential for pond liner damage and for breaching the liner, causing an undesirable discharge of pond contents into the environment.

CDH questioned the expense of such activities, and there was extended discussion over estimated costs for horizontal drilling, as well as available methodologies, the need to have a contingency plan in place, the desire to use horizontal drilling and methods that avoid the generation of drill cuttings. General statements were made by Mr. Ogg regarding preliminary cost figures that were reasonable with respect to vertical drilling. He emphasized that current cost estimates were only preliminary and, should prohibitive costs become an issue, he would certainly be in contact with the regulatory agencies.

There was more discussion over pond construction assumptions, liability issues, conceptual sampling scenarios, and overall applicability/utility of the horizontal drilling application. CDH commented that the desire to sample close to the pond liner may be dangerous and the potential downfall to the activity. EPA was particularly concerned about the long term utility of the application of horizontal drilling with respect to streamlining the schedule and usefulness of the data gathered. In general, Mr. Duran was concerned that utilization of horizontal drilling would not get the site any closer to closure, especially since vertical drilling and sampling would be revisited once the ponds were drained and cleaned. EPA stated they would prefer to wait on drilling under the ponds.

Mr. Ainscough did not necessarily agree with the suggestion to wait and drill under the ponds once cleaned. He stated that he felt the pond draining schedule contained some float with respect to the February 1994 completion date and the actual date when the ponds could be accessible for drilling operations. In addition, he said that proceeding with evaluation and/or implementation of horizontal drilling would benefit the RFI, and could provide information on characterizing the source and soils. There was also general discussion as to whether collecting uncontaminated soils beneath a pond would be as useful as contaminated soils, given the overall uncertainty of horizontal drilling results. The consensus was that all information is useful for establishing an extent of contamination. He also felt that should the cost escalate significantly over Mr. Ogg's preliminary figures it would be wise to re-evaluate at that time, but that implementation of the horizontal drilling could put the OU4 work that much farther ahead. DOE emphasized that acquiring the data would be extremely valuable, not just research.

Agenda Item III - Deletion of Analytical/Geologic Boreholes

This item was basically discussed as a part of Agenda Item I although Mr. Ainscough wished to clarify whether these were deletions or deferrals to a later date. Mr. Surovchak stated that these were in fact deletions and recalled the justification information that was presented earlier. This question lead the group into the next agenda item.

Agenda Item IV - Work Plan Deviations

IV a. Deletion of Boreholes

Mr. Ainscough felt that a method of addressing these changes would be the vehicle of the Technical Memorandum (TM), such as for OU6 as an example. He did emphasize that a TM can be as simple as one or two pages; it is not required to be of a scope similar to the OU4 Vadose Zone TM.

This lead into general conversation as to what constitutes either a minor or major change to a stated program objective. The example of moving a borehole location by fifty to one hundred feet was agreed to fit the overall definition of a minor change. Contingency locations of the boreholes/vadose zone wells initially intended to be within the ponds was agreed to constitute a major change. An additional example of a major change was the relocation of the piezometer banks from the locations described in the work plan, as follows.

IV b. Piezometer Banks: PZ01, PZ04

Piezometer bank relocations were proposed based on recent interpretations of preferential pathways, as well as the issue of drill rig accessibility to the original locations. In response to a question by Mr. Duran, Mr. Blaha discussed the relationship of the ITS system to bedrock surface, and how this interface affects the ITS performance. He also described the need to update the piezometer locations due to increasing knowledge of local groundwater conditions, bedrock conditions, and being able to adapt as new data are collected. Mr. Ainscough agreed on the need to be adaptable; to not be overly focused on the work plan. He also felt that documentation of these relocations could be well suited to the TM scenario.

IV c. Document Change Notices (DCN)

Mr. Ogg wished to know how the regulatory agencies desired to handle accounting of DCN items. He used the example of analytical prioritization in instances when core recovery was low and there was inadequate sample material to analyze for the complete suite. The priority listing in the Vadose Zone TM was discussed as an example of how to categorize important analyses versus less than necessary analyses. Tritium concerns were expressed as well as those for VOC sampling. Mr. Ainscough was in agreement to use the TM priority listing, but wished to see the issue presented in a written format to which he could give conditional approval.

Mr. Surovchak further pursued the general issue of DCNs. It was agreed that the existing informal procedure was acceptable where DOE informs both Mr. Ainscough and Mr. Duran by phone to explain the general nature of issues as they arise. This phone contact would be followed up by a letter.

Agenda Item VI - Schedule

Mr. Ogg began the review of the schedule status by giving the group a briefing on overall project progress, maintaining that all personnel involved were making a diligent effort to minimize impact to the IAG. He stated that the anticipated submittal date of the draft RFI report had slipped to May 1994, approximately one year behind schedule. Mr. Surovchak supported Mr. Ogg and added that all parties needed to realize that certain aspects of the program were out of his immediate control.

Mr. Ainscough then lead into a general review of program activities that followed the conditional approval of the work plan that was granted on May 8, 1992. Mr. Ogg presented the scope and relative chronologic position of the activities that had occurred to date. Mr. Duran felt that certain activities should have occurred more promptly. There was further discussion of events following the conditional approval date including: procurement activities, contract award,

training requirements, personnel reassignments, definition of the scope of the Applied Environmental contract, specific planning document preparation, and delay to the technical evaluation of the OU4 proposals.

Mr. Duran stated that the EPA does not consider delayed procurement activities as appropriate justification to lengthen a schedule, and that internal EG&G problems should have no bearing upon schedule issues. Mr. Surovchak stated that attorneys would have to decide upon that question. Mr. Ainscough stated that this format was inappropriate for the "negotiation" direction in which the conversation was heading. He also stated that Mr. Ogg and Mr. Surovchak should prepare a written request for extension of the schedule. This request should chronicle all events from the conditional approval date until the present in order to adequately describe the situation for justification purposes. Mr. Ainscough also wished that a listing of both required training courses and necessary permits be prepared for his review.

Mr. Duran inquired when a TM for horizontal drilling could be expected. Mr. Ogg said it could be prepared within four to six weeks. Content of the TM should cover the aspects of cost and reliability, in addition to revisiting the issue of overall applicability of the horizontal drilling aspect to the goals of the OU4 program. Mr. Duran reiterated his position regarding the horizontal drilling applicability but recognized the RFI report would be incomplete without vertical drilling in the ponds. He also recognized the advantages horizontal drilling could provide by generating data to justify or refute the need for vertical drilling once the ponds have been emptied.

Current progress of the field program was then discussed, and the group became aware of the immediate needs of the field program with respect to approval of the proposed borehole locations. It was agreed upon by the regulators to verbally approve the piezometer bank relocations, the pond 207B and 207C contingency borehole/vadose zone locations, and the proposed borehole deletions. Documentation to support the verbal approvals was agreed to be submitted to the regulators within six weeks and would include a discussion of the preferential pathways and buried drainage channels. A second TM should be submitted within this same time period to address the issue of horizontal drilling beneath ponds 207B and 207C.

Agenda Item VII - Miscellaneous Items

VII a. RCRA Monitoring Wells

This item was included for Mr. Ogg to inform the group of the intent to coordinate OU 4 RFI boring efforts with the Well Abandonment and Replacement Program. In an attempt to economize, Mr. Ogg feels that OU4 could potentially incorporate RCRA monitoring well installation into four RFI/RI boreholes. This corresponds with the needs of the WARP program. Ms. Johannes agreed that this would be a beneficial step and suggested that she could be of assistance if needed.

VII b. <100% Data Validation

This topic was suggested for discussion because Mr. Surovchak and Mr. Ogg are of the option

that the current EG&G practice of 100% data validation was not only excessive when such stringent QA/QC of laboratory procedures is mandated by DOE, but also could potentially cause additional delays to the IAG schedule. Mr. Ainscough agreed that 100% was excessive. Mr. Duran felt that the level of data evaluation was up to the EPA and that he would like the opportunity to investigate the issue with his experts.

VII c. Piezometer Installations in RI/RFI Boreholes

Mr. Ogg included this item to gain concurrence from the regulators on the idea of taking advantage of the RI/RFI sampling activities by placing piezometers in selected boreholes in order to fill in data gaps in existing wells. There was general agreement that, although this was better suited to the Phase II activities, the data would be valuable now, necessary ultimately, and that the idea was economically sound.

VIII d. EPA/CDH Comments

There were no further specific comments made by any parties present. To clarify the data validation issue, Mr. Ainscough stated that a DCN would be sufficient to cover any proposed change to the specific level of validation to be accomplished. Mr. Duran wished to know the status/background of radiation surveys that had been completed to date. Mr. Ogg informed him that the surveys had been completed in all areas except within the radiologically controlled area (RCA), and that there were no significantly elevated readings. It was stated that radiological survey reports would be forwarded to the agencies.

There was general discussion of recent findings regarding the investigation of the vadose zone, and implications of an apparent seasonal nature. A brief discussion on the merits of the Phase I/Phase II concept followed.

The meeting was adjourned at approximately 4:30 PM.

APPENDIX D

CDH LETTER DATED SEPTEMBER 1, 1992
SOIL SAMPLING METHODOLOGY FOR INDUSTRIALIZED AREA

COLORADO
DEPARTMENT
OF HEALTH

ROY ROMER
Governor

PATRICIA A. NOLAN, MD, MPH
Executive Director

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Ptarmigan Place, Denver
(303) 320-1529

First National Bank Building, Denver
(303) 355-6559

Grand Junction Office
(303) 248-7198

Pueblo Office
(719) 543-8441

September 1, 1992

Mr. Frazer Lockhart
U. S. Department of Energy
Rocky Flats Office
P.O. Box 928
Golden, Colorado 80402-0928

RE: Soil Sampling Methodology for Industrialized Area OU

Dear Mr. Lockhart,

As you are aware, RFI/RI Workplans for all of the OUs within the industrialized areas of the Rocky Flats Plant are either under review or recently reviewed. Only two of these workplans (OUs 9 and 10) have been approved. During our review of the workplans, we have noticed many inconsistencies in the surficial soil sampling proposed. We believe these inconsistencies are caused by various subcontractors applying the standard operating procedure for surficial soil sampling (SOP GT.8) differently.

Therefore, in an effort to correct the workplan inconsistencies, we are taking this opportunity to provide input to DOE and EG&G on the soil sampling program that we feel needs to be included in the industrialized area workplans. This input concerns when and how different sampling procedures included in SOP GT.8 will be employed rather than the equipment and the procedural methods used. Much of this information was originally included in Technical Memorandum 5 to the Phase III RFI/RI Workplan for OU 1. We have modified it slightly for application within industrialized area IHSSs.

As you will see from these proposals, the Division has not distinguished between radionuclide and non-radionuclide samples. This was done to keep implementation simple as well as to keep costs as low as possible and because we feel that one sample set can be successfully analyzed for all analytes. We recognize that further research into sampling techniques and data results may show that rad and non-rad sampling should be different. If so, we will defer to whatever changes are needed and can be agreed upon.

The items important to CDH for inclusion in the workplans are as follows:

1) The CDH method for surficial soil sampling was designed for evaluating large tracts of land which are remote from the source of windblown contamination. For these reasons, we do not believe this method is applicable for evaluating most IHSSs within the industrialized portions of the plant.

2) Screening surveys are proposed for the first stage of RFI/RI field work in the workplans. The Division believes that the screening surveys should always include, in addition to the radiation and soil gas surveys, a surficial soil sampling survey carried out across each IHSS or area of concern on an appropriate grid. The soil samples should be taken in the following manner:

- in an area where the ground surface is covered with paving, soil samples should be taken using the "Grab Sampling" method presently outlined in SOP GT.8. These samples should be taken from the soil substrate underlying whatever base materials are immediately beneath the paving and would be located, when possible, in holes cut through the paving for the soil gas survey.
- in an area where the ground surface is unpaved, soil samples should be taken by the "RFP method" presently outlined in SOP GT.8 using the 10 cm x 10 cm x 5 cm sampling jig. However, the Division proposes that each point on the sampling grid be overlain with the one square-meter template proposed in TM 5. In this case, five discrete subsamples will be collected from each grid point and composited into a 2500 cm^3 sample. Details of this procedure need to be incorporated into SOP GT.8.

3) In some of the workplans, vertical soil profile samples are proposed for use in conjunction with the rad surveys. We believe this type of sampling is a good idea because it will provide further understanding of both the rad survey results as well as rad contamination distribution. Vertical soil profiles, with samples collected from intervals consistent with those proposed in SOP GT.7, and analyzed for radionuclides, should be included in all industrialized Ous. Vertical profile sampling will need to be coordinated between those doing the soil sampling and those doing the radiation surveys. Procedures for vertical profile sampling should be incorporated into SOP GT.8 even if they are also included in radiation survey SOPs.

4) The Division proposes that all of the soil samples collected be analyzed for a complete suite of contaminants appropriate for the history of the IHSS. In formulating this analytical suite, consideration should be given to radionuclides, metals, and semi-volatiles. The reasons that the Division considers a comprehensive

analysis necessary are:

- there is currently no other way to screen for metals contamination using other survey types,
- the rad surveys cannot assess radionuclide contamination beneath paving, and
- soil gas surveys are not always effective for organic compounds with relatively low volatility.

5) After the soil sampling results from the first stage of the RFI/RI are analyzed, additional soil sampling may be necessary in subsequent RFI/RI stages. Unless specifically approved by EPA and CDH, these samples should be taken in the same manner as those taken previously.

While the Division feels strongly that a consistent soil sampling program needs to be developed for the entire industrialized area of RFP, the points included in this letter are open for discussion. However, the Final OU 8 RFI/RI Workplan is due to us September 29, 1992. If discussions have not taken place by that date, we expect these points to have been included in the OU 8 workplan and all other workplans in preparation. In addition, SOP GT.8 needs minor revisions as indicated.

If you have any questions regarding these matters, please call Joe Schieffelin of my staff at 331-4421.

Sincerely,

Gary W. Baughman

Gary W. Baughman, Chief
Facilities Section
Hazardous Waste Control Program

cc: Martin Hestmark, EPA

APPENDIX E

BOREHOLE DATA FROM PREVIOUS DRILLING PROGRAMS

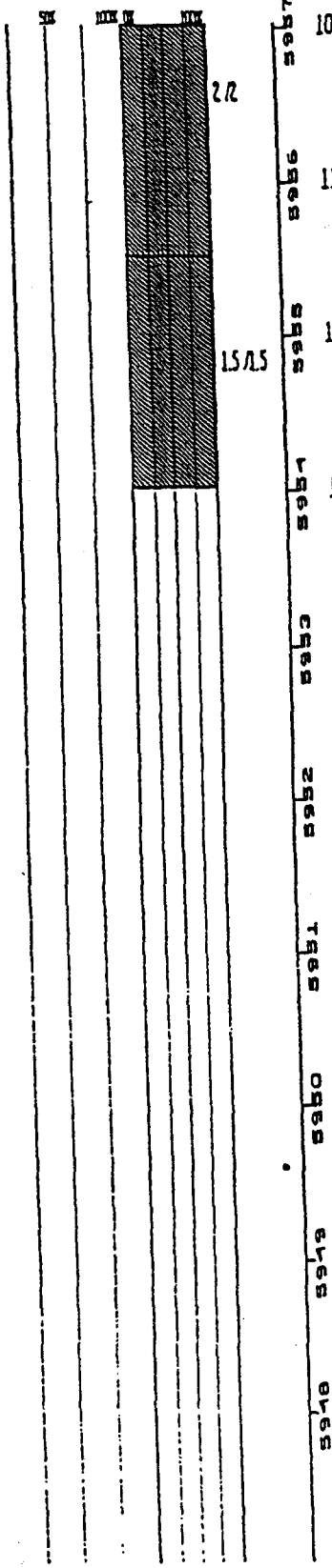
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 13	GROUND ELEVATION (FT):	5957.03	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	750454	AREA: SOLAR POND	CASING DIAMETER (IN):	2 ID	GEOLOGIST:	DCB	37-87
EAST:	2085224	LOCATOR NUMBER: NAD	BOREHOLE DIAMETER (IN):	7.5	DATE DRILLED:	10/26/87	

REMARKS: Hollow Stem Auger.

SAMPLE TYPE AND SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	ELEVATION (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SDK	100% OR 100%	1.3/2	5957	0			GC:	GRAVEL - very light gray (N8), to medium light gray (N6), angular to sub-rounded, poorly graded to moderately graded, max. size 5 cm., some clay, brownish gray (5YR 4/1), clay matrix has a calcareous component. Clay grades to moderate reddish brown (10R 4/6) with trace of silt and sand below 2.0 ft.
			5956	1				
		2/2	5955	2			GC:	Same as above.
			5954	3				
			5953	4	10/25/87		GC:	Same as above but clay matrix is coupled with caliche below 4.0 ft.
		1/3	5952	5	11/12/87			
			5951	6				
			5950	7			CL:	Clay/Caliche - very light gray (N8)/white (N9), clay exhibits moderate plasticity.
		2.5/2.5	5949	8			CLAYSTONE:	Top of Bedrock Claystone/Caliche - very light gray (N8)/white (N9), clay exhibits moderate plasticity.
			5948	9			CLAYSTONE:	Same as above.
				10				

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 13	GROUND ELEVATION (FT):	5957.03	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	750494	AREA: SOLAR POND	CASING DIAMETER (IN):	2 ID	GEOLOGIST:	DCB	37-87
EAST:	2085224	LOCATOR NUMBER: N10	BOREHOLE DIAMETER (IN):	7.5	DATE DRILLED:	10/26/87	

REMARKS: Hollow Stem Auger.



CLAYSTONE: Yellowish gray (5Y 7/2), high plasticity, localized carbonate mineralization.

NOTE: No water encountered while drilling.

STATE PLANE COORDINATE:
NORTH: 751057
EAST: 2065125

TOTAL DEPTH (FT): 15.2
AREA: SOLAR POND
LOCATOR NUMBER: 810

GROUND ELEVATION (FT): 5971.79
CASING DIAMETER (IN): 2 ID
BOREHOLE DIAMETER (IN): 7.5

PROJECT NUMBER: 667.11
GEOLOGIST: TSD
DATE DRILLED: 10/27/87

LOG OF BORING NUMBER: 38-87

REMARKS: Hollow Stem Auger.

PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT) DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
100% OR 100%	1.05 ft	5971 / 0			CALICHE:	Very pale orange (10YR 8/2), some sand and gravel (max. size approx. 6 cm.) trace clay and roots.
	0.8 ft	5970 / 1			GC:	GRAVEL - matrix is grayish brown (5YR 3/2), angular to sub-angular, mod. - well graded, max. size = 6 cm. some clay and sand, becoming calcareous at bottom of interval.
	0.95 ft	5969 / 2				
		5968 / 3			CALICHE:	Very pale orange (10YR 8/2), some sand and gravel (max. size approx. 5 cm.) trace clay.
		5967 / 4				
		5966 / 5	11/12/87 ▽			
		5965 / 6				
		5964 / 7			CALICHE:	Same as above; less sand and gravel, (top 10" of interval). Next 1.75 ft. consists of caliche - white (N9), some clay in pockets.
	3 ft	5963 / 8			SILTY CLAYSTONE:	Top of Bedrock Lt. gray and caliche - white (N9), trace FG sand, med. plast. becoming more clay at bottom of interval.
		5962 / 9				
		/ 10			SILTY CLAYSTONE:	Lt. gray and caliche - white (N9), trace FG sand, med. plast. becoming more clay at bottom of interval

STATE PLANE COORDINATE:
NORTH: 750057
EAST: 2065125

TOTAL DEPTH (FT): 15.2
AREA: SOLAR POND
LOCATOR NUMBER: N10

GROUND ELEVATION (FT): 5971.79
CASING DIAMETER (IN): 2 ID
BOREHOLE DIAMETER (IN): 7.5

PROJECT NUMBER: 667.11
GEOLOGIST: TSD
DATE DRILLED: 10/23/87

LOG OF BORING NUMBER: 38-87

REMARKS: Hollow Stem Auger.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT) / DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SAND	100%	2.1/2.1	5961 / 10				SILTY CLAYSTONE: Mottled lt. gray (N7) and dark yellowish orange (10YR 6/6). Becomes more dk. yellowish orange below top 8" of sample, mod. - high plasticity, calcareous in top 8" of sample becoming slightly calcareous, trace of fine sand and carb. staining.
			11				
			5960 / 12				
		1.6/1.6	5959 / 13				SILTY CLAYSTONE: Same as above (description below top 8").
			5958 / 14				
		1.2/1.2	5957 / 15				SILTY CLAYSTONE: Same as above; no CaCO3 or carb. staining. Note: No water encountered during drilling.
			5956 / 16				
			5955 / 17				
			5954 / 18				
			5953 / 19				
			5952 / 20				

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 13.4	GROUND ELEVATION (FT):	5978.51	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	750638	AREA: SOLAR POND	CASING DIAMETER (IN):	2 ID	GEOLOGIST:	DCB	56-87
EAST:	2084423	LOCATOR NUMBER: L10	BOREHOLE DIAMETER (IN):	7.5	DATE DRILLED:	01/07/88	

REMARKS: BORING NO. 56-87/SP16-87. Hollow Stem Auger.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	USCS OR ROCK TYPE	DESCRIPTION
		1.5 /2	5978	0			SP:	GRAVELLY SAND - light olive gray (5Y 6/1), angular to sub-rounded, well graded, some silt.
			5977	1			GC:	Clayey Gravel - very light gray (N8), sub-angular to sub-rounded, poorly graded. Clay fraction is dark reddish brown (10R 3/4).
		1.7 /1.5	5976	2			GP:	SANDY GRAVEL - very light gray (N8), sub-angular to sub-rounded, poorly graded, some silt and a trace of clay.
		1 /0.5	5975	3				NO SAMPLE:
		1.85 /2	5974	4			GW:	Clayey Gravel - light gray (N7), sub-angular to rounded, moderately graded, some sand and silt. Clay fraction is dark yellowish brown (10YR 4/2). At 4.1 ft. (est.) this interval grades to a sandy gravel, light gray (N7) angular to sub-rounded, moderately graded with caliche mineralization. Caliche and sand are white (N9).
				5	01/25/88			
				6	01/27/88		GW:	As above, as given for interval below 4.1 ft.
		1.5 /2	5971	7				
			5970	8				NO SAMPLE:
		1 /2.2	5969	9				
				10			NO SAMPLE:	Top of Bedrock

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 13.4	GROUND ELEVATION (FT):	5978.51	PROJECT NUMBER:	667.11	LOG OF BORING NUMBER:
NORTH:	751638	AREA: SILVA POND	CASING DIAMETER (IN):	2 ID	GEOLOGIST:	DCB	56-87
EAST:	2084923	LOCATOR NUMBER: L10	BOREHOLE DIAMETER (IN):	7.5	DATE DRILLED:	01/07/88	

REMARKS: BORING NO. 56-87/SP16-87. Hollow Stem Auger.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT) DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		1.5/1	10				SILTY CLAYSTONE: Mottled, light gray (N7), to dark yellowish orange (10YR 6/6), moderate plasticity, caliche occurs in localized bodies throughout this interval notably in its upper 3 ft., black carbonaceous mineralization is disseminated throughout.
		1.5/2.2	11				SILTY CLAYSTONE: As above, less caliche occurs in this interval.
			12				NOTE: No water encountered while drilling.
			13				
			14				
			15				
			16				
			17				
			18				
			19				
			20				

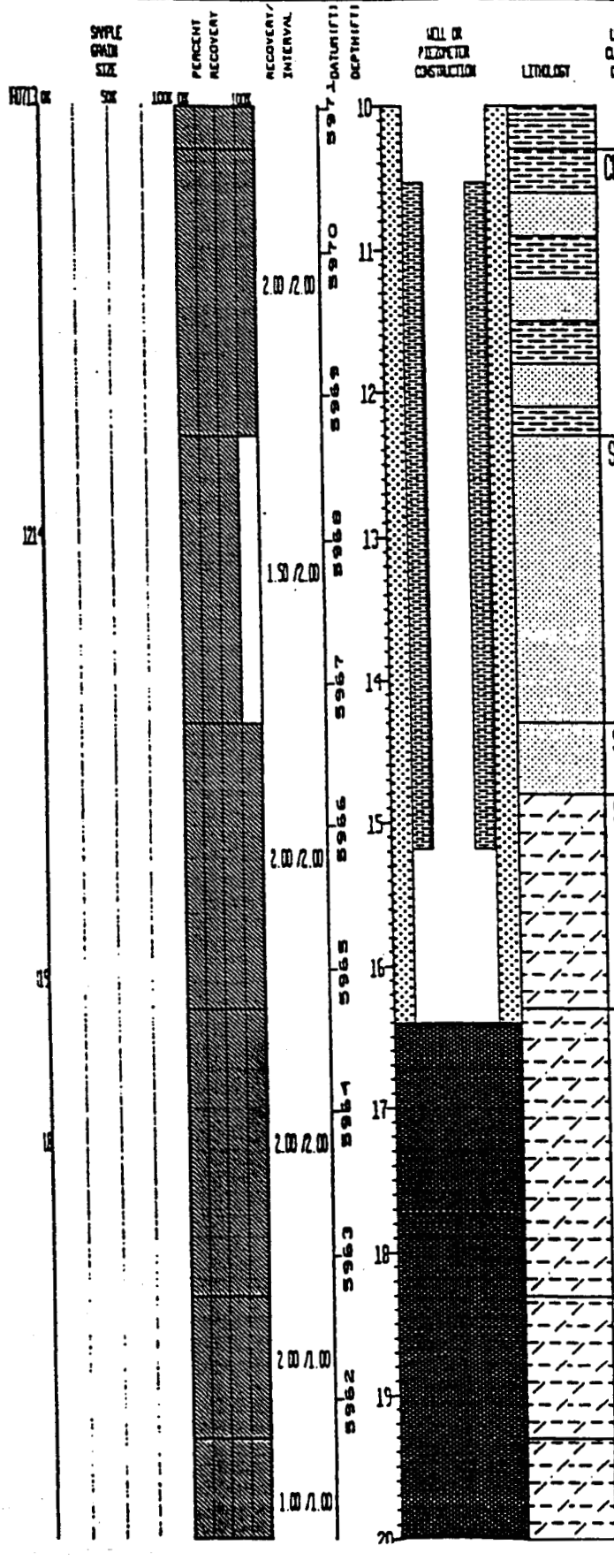
STATE PLANE COORDINATE:	TOTAL DEPTH (FT): 23.3	GROUND ELEVATION (FT):	5981.02	OLD WELL NUMBER:	SEPOL-6958	LOG OF BORING NUMBER:
NORTH: 750155	AREA: SOLAR POND	CASING DIAMETER (IN):	4.5 O.D.	GEOLOGIST:	RAC	P207389
EAST: 2084468	LOCATOR NUMBER: L10	BOREHOLE DIAMETER (IN):	7.25	DATE DRILLED:	06/05/89	

REMARKS: Hollow Stem Auger. Weston Log.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT) / DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		2.30 /2.30	5980			SC	Clayey Sand and Gravel (Artificial Fill) - grayish orange (10 YR 7/4). Lower 1.5' mod. brown (5 YR 4/4). F.g. to c.g. sand, poorly sorted, sub-angular to sub-rounded. Gravel poorly sorted, sub-rounded. Med. plastic fines, soft, unconsol., moldable, moist (sc-sm?) (Gravelly Sand with some Fines). 25% gravel, 50% sand, 25% fines.
		1.70 /2.00	5978			SC	Clayey Sand and Gravel - mod. brown (5 YR 4/4) to pale yellowish brown (10 YR 6/2). F.g. to c.g. sand, poorly sorted, sub-angular to sub-rounded, quartzose. Gravel poorly sorted, sub-angular to sub-rounded, quartzose, max. size 6 cm. Non to med. plastic fines, soft, weakly consol., moist. (sc-sm?) (Gravelly Sand with some Fines). 25% gravel, 60% sand, 15% fines
		1.10 /2.00	5976	09/21/89		SC	Clayey Sand and Gravel - same as above. Angular to sub-rounded sand. Max. gravel size 9 cm (sc-sm?) (Gravelly Sand with some Fines)
		2.20 /2.00	5974			SC	Clayey Sand and Gravel - same as above (reference interval 2.3' to 9.3') (sc-sm?) (Gravelly Sand with some Fines)
						CLAYSTONE	Top of Bedrock. Pale olive (10 Y 6/2). Low to med. plastic fines, soft, moldable, abundt. caliche to 3 in thick, moist.
		2.00 /2.00	5972			CLAYSTONE	Claystone and Sandstone - Claystone same as interval 7.0' to 8.3'. Sandstone - very light gray (N 8/0). F.g. to v.f.g. sand, interbedded, lensed, mod. well sorted, angular to sub-angular. Maximum lense 0.5', speckled. Normal to med. plastic fines, soft, moldable, moist. 80% sand, 20% fines

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 23.3	GROUND ELEVATION (FT):	5981.02	OLD WELL NUMBER:	SEPOL-8988	LOG OF BORING NUMBER:
NORTH:	750195	AREA: SOLAR POND	CASING DIAMETER (IN):	4.5 O.D.	GEOLOGIST:	RAC	P207389
EAST:	2084468	LOCATOR NUMBER: L10	BOREHOLE DIAMETER (IN):	7.25	DATE DRILLED:	06/05/89	

REMARKS: Hollow Stem Auger. Weston Log.



CLAYSTONE:	Claystone and Sandstone - Claystone some as interval 7.0' to 8.3'. Dark yellowish orange (10 YR 6/01 to light gray (N 7/0). Sandstone some as interval 8 3" to 10'3", lensed soft, moldable, moist.
SANDSTONE:	Light gray (N 7/0). F.g. to v.f.g. sand, mod. well sorted, angular to sub-angular. Non to med. plastic fines, soft, very slightly moist. (Sandstone with some Cloy). 80% sand, 20% fines.
SANDSTONE:	Some as above. 80% sand, 20% fines.
SILTY CLAYSTONE:	Dark yellowish orange (10 YR 6/6) to yellowish gray (5 Y 7/2). Non to med. plastic fines. Abundt. f.g. sand, well sorted, sub-angular, quartzose. Iron stained, moldable soft to firm, caliche zones, scattered lignite, black (N 1/0), slightly moist. (Silty Claystone with abundt Sand) 30% sand, 70% fines.
SILTY CLAYSTONE:	Some as above - low to med. plastic fines. Trace v.f.g. sand. Scattered lignite, black (N 1/0). Scattered caliche, weakly consol., moist. (Silty Claystone with trace Sand). 5% sand, 95% fines.
SILTY CLAYSTONE	Some as above - V f g sand, iron stains, scattered caliche. Lignite, black (N 1/0), moist (Silty Claystone with some Sand) 10% sand.
SILTY CLAYSTONE:	Some as above (Silty Claystone with some Sand) 10% sand.

STATE PLANE COORDINATE:
NORTH: 750195
EAST: 2084168

TOTAL DEPTH (FT): 23.3
AREA: SOLAR POND
LOCATOR NUMBER: L10

GROUND ELEVATION (FT): 5981.02
CASING DIAMETER (IN): 4.5 O.D.
BOREHOLE DIAMETER (IN): 7.25

OLD WELL NUMBER: SCP01-8988
GEOLOGIST: RAC
DATE DRILLED: 06/05/89

LOG OF BORING NUMBER: P207389

REMARKS: Hollow Stem Auger. Weston Log.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM(FT) DEPTH(FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
GR SD	100% OR 100%		5961 20				
		1.50 /1.00	5960 21			SILTY CLAYSTONE	Same as above - soft to firm. (Silty Claystone with some Sand). 10% sand.
		1.50 /1.00	5959 22			SILTY CLAYSTONE	Same as above - iron staining in layers. (Silty Claystone with some Sand). 10% sand.
		1.50 /1.00	5958 23			SILTY CLAYSTONE	Same as above. (Silty Claystone with some Sand). 10% sand.
			5957 24			:	Total Drilled Depth = 23.3'.
			5956 25				
			5955 26				
			5954 27				
			5953 28				
			5952 29				
			30				

STATE PLANE COORDINATE:	TOTAL DEPTH (FT): 10.0	GROUND ELEVATION (FT):	5980.71	OLD WELL NUMBER:	SEP02-89
NORTH: 7501.57	AREA: SOLAR POND	CASING DIAMETER (IN):	4.5 O.D.	GEOLOGIST:	RAC
EAST: 2084.81	LOCATOR NUMBER: L10	BOREHOLE DIAMETER (IN):	7.25	DATE DRILLED:	06/06/89

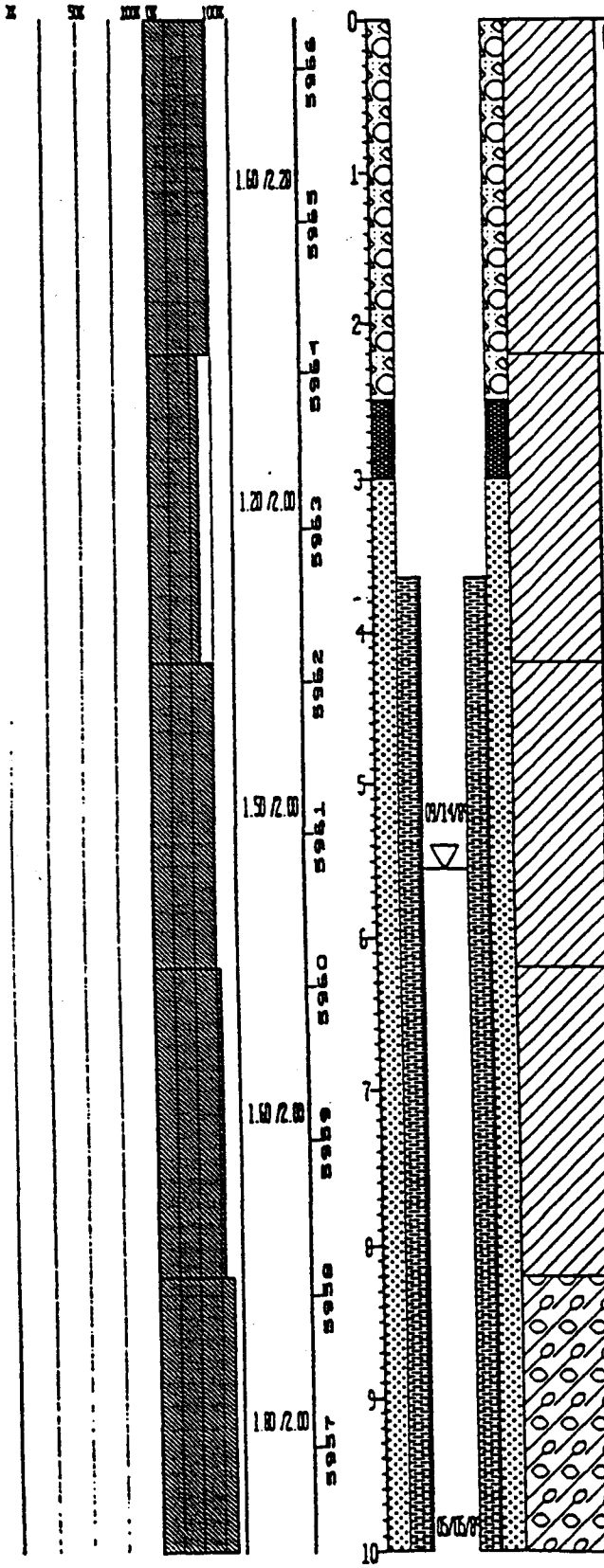
REMARKS: Hollow Stem Auger. Weston Log.

LOG OF BORING NUMBER: P207489

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		2.00 /2.00	5980	0			SC:	Clayey Sand and Gravel - grayish orange (10 YR 7/4) (Artificial Fill). Lower 1.5' mod. brown (5 YR 4/4). F.g. to c.g. sand, poorly sorted, quartzose, sub-angular to sub-rounded, non to med. plastic fines. Gravel maximum size 5 cm., poorly sorted, quartzose, weakly consol., soft, (sp-gp), damp. (sc-sa?) (Clayed Sand with some Gravel). 15% gravel, 60% sand, 25% fines.
			5979	1				
			5978	2				
		2.00 /2.00	5977	3			CL:	Gravelly Clay - mod. brown (5 YR 4/4). Med. to highly plastic fines. Gravel, sub-angular, quartzose. F.g. to c.g. sand, poorly sorted, sub-angular to sub-rounded, quartzose, weakly consol., soft to firm, dry. (Gravelly Clay with some Sand). 35% gravel, 15% sand, 50% fines.
			5976	4				
		1.00 /2.00	5975	5	04/20/89		SM:	Silty Clayey Sand and Gravel - mod. brown (5 YR 4/4). Gravel poorly sorted, sub-angular, quartzose, maximum size 5 cm. F.g. to c.g. sand, poorly sorted, sub-angular to sub-rounded, quartzose. Non to med. plastic fines, soft, crumbly (sa-gc), dry. (Gravelly Sand with abundt. Fines) 35% gravel, 35% sand, 30% fines.
			5974	6				
		2.00 /2.00	5973	7			SM:	Silty Clayey Sand and Gravel - same as above. (sa-gc)
			5972	8			CLAYSTONE:	Top of Bedrock. Pale olive (10 Y 6/2). Med. to highly plastic fines, soft. Caliche zones to 2 cm., moldable, iron staining, damp.
		2.00 /2.00	5971	9			CLAYSTONE:	Pale olive (10 Y 6/2). Non to med. plastic fines. Trace v.f.g. sand, sub-angular to sub-rounded, soft to firm, crumbly in part, caliche, iron staining, sandier toward bottom, weakly consol., dry. (Claystone with trace Sand). 5% sand, 95% fines. Total Drilled Depth = 10.0'.
			5970	10				

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 18.2	GROUND ELEVATION (FT):	5966.32	OLD WELL NUMBER:	SCP04-89	LOG OF BORING NUMBER:
NORTH:	750398	AREA: SOLAR POND	CASING DIAMETER (IN):	4.5 O.D.	GEOLOGIST:	KDH	P207689
EAST:	2085318	LOCATION NUMBER: N10	BOREHOLE DIAMETER (IN):	7.25	DATE DRILLED:	05/05/89	

REMARKS: Hollow Stem Auger. Weston Log.



CL: Gravelly Sandy Clay - olive black (5 Y 2/1) to light brown (5 YR 6/4). C.g. to f.g. sand. Coarse to fine gravel, quartzite, sub-rounded, loose. Low plasticity, damp.

CL: Gravelly Sandy Clay - same as above. Grading to very pale orange (10 YR 8/2), light brown (5 YR 5/6). High reaction to HCl (calcareous). Iron stains, dark yellowish orange (10 YR 6/6).

CL: Gravelly Sandy Clay - light brown (5 YR 5/6). C.g. to f.g. sand lenses, very pale orange (10 YR 8/2). Calcareous cemented. Coarse to fine gravel. Low to med. plasticity, damp.

CL: Sandy Clay - mod. brown (5 YR 4/4). Some gravel, quartzite, coarse to fine, sub-rounded, broken. C.g. to f.g. quartz sand, sub-rounded, calcareous cemented (HCl reactive), firm to loose. Low plasticity, moist.

GC: Sandy Clayey Gravel - light brown (5 YR 5/6) to light brown (5 YR 6/4). C.g. to f.g. quartz sand. Coarse to fine gravel, quartzite, sub-rounded to 3 cm. Trace silt, loose, non to low plasticity, moist.

STATIC PLANE COORDINATE:
NORTH: 751398
EAST: 2085318

TOTAL DEPTH (FT): 18.2
AREA: SOLAR POND
LOCATOR NUMBER: MW

GROUND ELEVATION (FT): 5566.32
CASING DIAMETER (IN): 4.5 O.D.
BOREHOLE DIAMETER (IN): 7.25

OLD WELL NUMBER: SEP04-89
GEOLOGIST: KCR
DATE DRILLED: 05/05/89

LOG OF BORING NUMBER: P207689

REMARKS: Hollow Stem Auger. Weston Log.

SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
GR SD	100% 0% 100%			10			SC:	Clayey Sand - light brown (5 YR 5/6). Some gravel, quartzite, rounded. C.g. to f.g. quartz sand, non-calcareous, loose, non-plastic, wet.
		8.10 /2.00	5555	11				
			5554	12			SC:	Clayey Sand - same as above.
		2.20 /2.00	5553	13			SILTY CLAYSTONE:	Top of Bedrock. Light olive gray (5 Y 6/1), mottles of dark yellowish orange (10 YR 6/6). Very stiff, low to med. plasticity, weathered caliche, high HCl reaction, damp.
			5552	14			SILTY CLAYSTONE:	Same as above.
		1.10 /2.00	5551	15				
			5550	16			NO SAMPLE:	NO SAMPLE.
		0.00 /2.00	5549	17				
			5548	18			:	Total Drilled Depth = 18.2'.
			5547	19				
				20				