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Final
Solar Ponds Plume Project Closeout Report Fiscal Year 1999

RF/RMRS-99-444.UN

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Rocky Flats Environmental Technology Site

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FINAL
SOLAR PONDS PLUME PROJECT

CLOSEOUT REPORT
FISCAL YEAR 1999

Rocky Flats Environmental Technology Site

February 17, 2000

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ACRONYM LIST

CDPHE	Colorado Department of Public Health and Environment
DOE	Department of Energy
EPA	Environmental Protection Agency
HDPE	High-Density Polyethylene
ITS	Interceptor Trench System
ITPH	Interceptor Trench Pump House
mg/l	milligrams per liter
pCi/l	Picocuries per liter
PVC	Polyvinyl Chloride
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services

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1.0 INTRODUCTION

This report documents the completion of the Solar Ponds Plume Project at the Rocky Flats Environmental Technology Site (RFETS). This project was conducted in accordance with the Solar Ponds Plume Decision Document (RMRS 1999).

As a result of past waste storage practices at the Solar Ponds, nitrate and uranium are present in groundwater in excess of the Action Level Framework Tier II level groundwater concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE 1996). The contaminated groundwater has migrated away from the source area towards North Walnut Creek.

As defined in the Decision Document (RMRS 1999), the objectives of this project were to:

- Protect North Walnut Creek by reducing the mass loading of nitrate to surface water and ensure that surface water standards are met in the Creek.
- Design and install a passive system to intercept and treat the contaminated groundwater of the Solar Ponds Plume to remove nitrate.
- Design and construct the reactive barrier system in a manner which minimizes the generation of low-level mixed waste and/or hazardous waste and protects the habitat of Preble's Meadow Jumping Mouse, which was added to the Threatened Species List on May 18, 1998.
- Design the reactive barrier system to allow easy access for operation and maintenance and for reactive media replacement or removal.
- Evaluate the effectiveness of reactive barrier system in removing nitrate.
- Evaluate long-term effectiveness of the treatment system.

2.0 PROJECT BACKGROUND

Five Solar Evaporation Ponds, located in the northeast corner of the Protected Area, were used to store and evaporate radioactive and hazardous liquid wastes. These ponds were drained and sludge removal was completed in 1995. Removal of the sludges eliminated the nitrate and uranium source for the Solar Ponds Plume (RMRS 1999).

To dewater the hillside, six interceptor trenches were installed in 1971. The original six trenches were abandoned in place and the current Interceptor Trench System (ITS) was installed in 1981. The ITS is generally keyed into bedrock and effectively collects much of the water; however some groundwater underflows the collection system, and eventually discharges to North Walnut Creek. About 2.4 million gallons of water were collected from the ITS each year, pumped to the modular storage tanks for storage, and then pumped to Building 374 for evaporation (RMRS 1999).

The Solar Ponds are located on the flat surface at the northern edge of the pediment. A north facing hillside slopes downward to North Walnut Creek. In the Solar Ponds area, the Rocky Flats Alluvium is up to 23 feet thick. The area of the ITS is primarily covered with a thin layer of colluvium. Bedrock is

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composed of weathered claystone of the Arapahoe and Laramie Formations. In addition, the Arapahoe No. 1 Sandstone subcrops under the alluvium in the Solar Ponds area. The sandstone does not extend into the drainage, but tends to direct groundwater flow into the collection system (RMRS 1999).

The existing ITS system and the bedrock surface features primarily control groundwater flow. Areas of unsaturated colluvium and shallow bedrock are common. Groundwater flow in the colluvium follows small, north-south trending paleochannels cut into the underlying bedrock claystone.

The Solar Ponds Plume consists of nitrate and uranium contaminated groundwater that extends primarily northward from the source area towards the North Walnut Creek. The highest concentrations of uranium in groundwater are found adjacent to the Solar Ponds, while the higher concentrations of nitrates are found at a greater distance from the ponds. The nitrate plume has a greater areal extent than the uranium plume. The data suggest that while there is uranium in groundwater near North Walnut Creek it is naturally occurring and not part of the uranium plume. The ITS system does drain a portion of the uranium plume and the water from the ITS does contain uranium from that portion of the plume. The average concentration observed recently at the Interceptor Trench Pump House (ITPH) is 220 mg/l nitrate, and 61 pCi/l uranium.

3.0 SYSTEM INSTALLATION

A groundwater collection and treatment system was installed to passively capture and treat the contaminated groundwater. System installation began in June 1999 and was completed on September 22, 1999. The groundwater collection system extends approximately 1,100 feet in an east-west direction (Figure 1). Construction was restricted to the disturbed area around the North Perimeter Road to reduce impacts to Preble's Mouse habitat. Revegetation and regrading was completed in October 1999.

To install the collection system, an excavation was dug at a variable depth of approximately 20 to 30 feet below ground surface and approximately 10 feet into claystone. An impermeable barrier was installed that consists of 80-mil high-density polyethylene (HDPE) panels fitted with an interlocking strip on each side. A hydrophilic cord was threaded through the entire length of the interlock. This cord swells when wet, further sealing the panels together. These panels are 15 feet wide and of a variable height depending on the installation depth. The collection trench cuts across the existing ITS system and intercepts the collected ITS water system upstream of the barrier. The existing ITS is now used to enhance recovery by the collection trench.

The bottom of the collection trench was filled with bentonite pellets to limit bypass or leakage. On the upgradient side of the barrier, approximately one foot of sand was placed over the bentonite. A four-inch perforated HDPE groundwater collection line was bedded into the sand, and piped to the reactor vessel. Sand was then placed around and several feet above the horizontal collection line. The trench was then backfilled. Four piezometers were installed in the collection trench for monitoring water levels within the collection system (Figure 1).

A 46-feet long by 21-feet wide (exterior dimensions) concrete treatment vessel was installed below grade to treat the contaminated groundwater. The location of the treatment vessel was determined by the Preble's Mouse habitat, and by the results of the geotechnical survey. Because of the Preble's Mouse

habitat limitations, the treatment cell could not be placed within the stream drainage. Therefore, approximately 12 feet of hydraulic head is required in the collection trench before water enters the treatment cells.

The exterior treatment vessel walls are 2 feet thick and extend approximately 25 feet to the ground surface, for ease in locating the cells and replacing the media. The vessel is divided into two treatment cells by an 18-inch thick, 12-feet high, internal wall. Treatment media occupies the lower 10 feet of each cell. Geomembrane was placed over the media to prevent backfilled materials from settling into the treatment media. The vessel was backfilled with wood chips to reduce the weight over the treatment media, with a final soil cap placed to reduce precipitation infiltration. Small weep holes were installed just above the geomembrane in the north wall of the treatment vessel. These small holes allow precipitation and runoff to drain out of the vessel without entering the treatment media.

The first cell is 31 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with a mixture of sawdust and leaf mold with 10% zero-valent iron by weight to induce denitrification and to remove the uranium by chemical reduction. The media was selected on the basis of bench scale tests conducted at the University of Waterloo. The second cell is 10 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with zero-valent iron to act as a final polisher. There is a one-foot thick layer of gravel at the bottom of both treatment cells. Wood chips at the top of the largest cell and a simple polyvinyl chloride (PVC) pipe dispersion gallery over the upgradient half of the cell spread out the contaminated groundwater over the treatment media. The two treatment cells can be run in series or in parallel. Figure 2 shows the details of the treatment vessel.

The uppermost (southernmost) trench of the ITS was designed to collect surface water from the Solar Ponds area. The trench was gravel filled to the ground surface. It is estimated that up to 700,000 gallons of water were collected and treated from this trench. Because the surface water is not contaminated, this trench was blocked to reduce surface water collection by the new system. A nominal 2-foot deep trench was excavated over the upper trench, 20 mil HDPE membrane was laid over the gravel, and the excavation was refilled with native soil mixed with the gravel removed from the trench.

4.0 DEVIATIONS FROM THE DECISION DOCUMENT

Two minor modifications were made to the design as presented in the Solar Ponds Plume Decision Document (RMRS 1999). In accordance with RFCA (DOE 1996), the minor modifications were discussed with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE). Verbal concurrence was obtained prior to implementing these changes.

A well cluster was installed north of the collection system to provide additional data and for performance monitoring purposes. Three wells were planned with the intent to monitor the colluvium, upper weathered bedrock, and lower weathered bedrock. When the first well was installed, it was noted that only 7 feet of weathered bedrock is present at this location. The decision was then made to install one well to monitor the entire weathered bedrock interval at this location as wells in the upper and lower weathered bedrock were expected to give similar results. Therefore, only two wells were installed; one to monitor the colluvium (70099) and one to monitor the weathered bedrock (70299).

To expedite installation of the collection trench, a working bench was cut approximately 10 feet deep to reduce the depth of the excavation required for installation of the collection system. Barrier panels were originally planned to extend from the bottom of the collection trench to about 2 feet below ground surface as shown in the Decision Document. However, as groundwater flow is generally in the colluvium immediately above the bedrock surface and in the weathered bedrock, the panels were shortened to approximately the depth of the working bench. In addition, the pre-existing ITS now funnels the groundwater into the new collection system along pre-existing laterals. Based on the depth to water and the depth of the existing ITS piping, downgradient flow is effectively blocked, and the groundwater plume is effectively captured. Modifications are as follows.

- At the western end of the system, (the western 350 feet) groundwater within the collection trench will be at the highest elevation. Panels were installed at an elevation of 5893, approximately 8 feet above the projected groundwater table and between 5 and 10 feet below ground surface.
- For the middle 350 feet of the collection system, the tops of panels are approximately 10 feet below ground surface.
- At the eastern end of the system, (the eastern 250 feet) the top of panels are approximately 5 below ground surface due to the location of ITS collection pipes about 10 feet below ground surface.

Two minor changes in the design were necessitated by utilities that were not located as shown on the Site drawings. The first minor change was required by the ITS line entering the ITPH at a lower elevation than anticipated. When the discharge system was initially excavated, it was noted that the discharge area would be 3 feet higher than the ITS line. The discharge area was then moved about 20 feet further east to the lowest point along the road. Water from the system now drains into the discharge gallery.

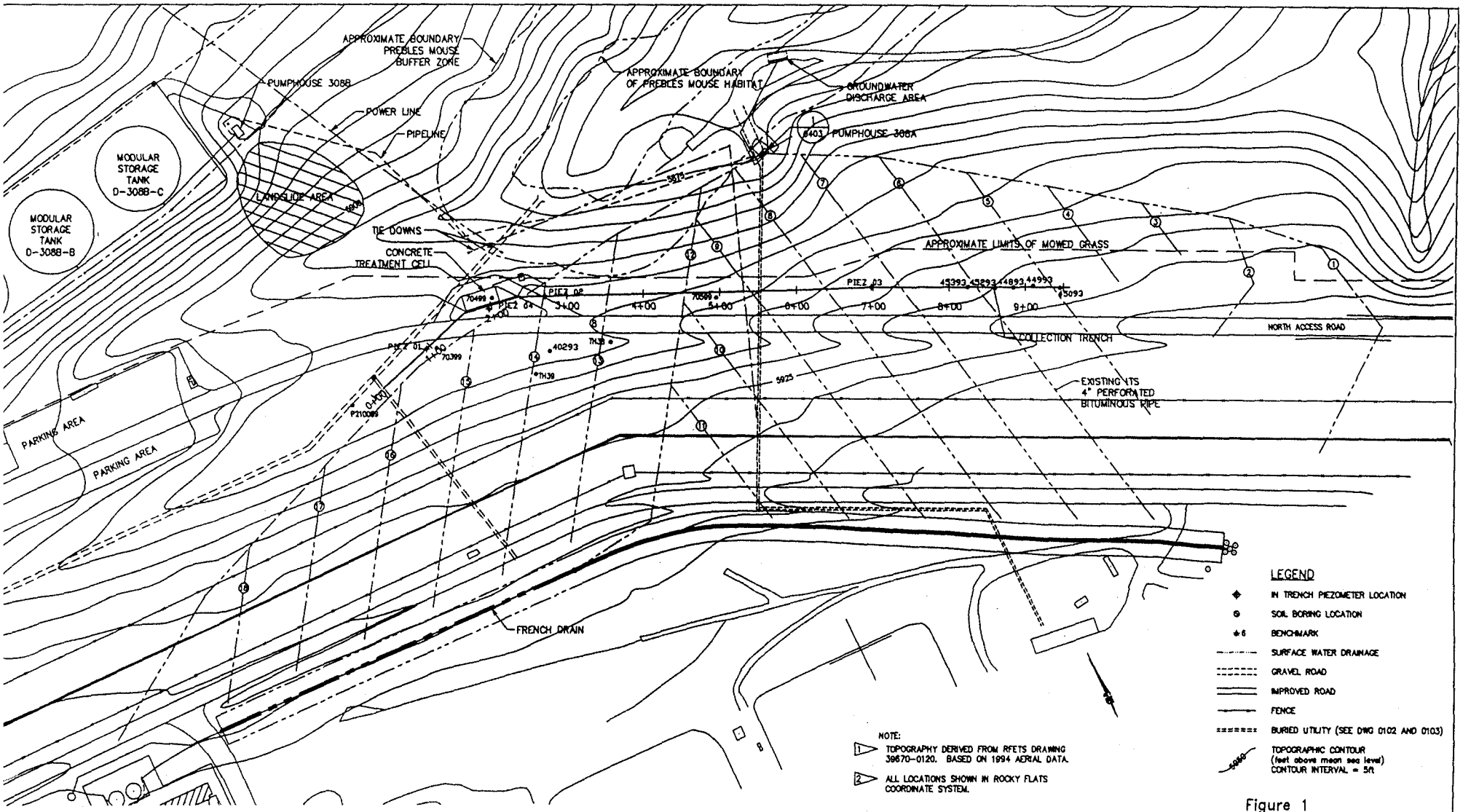
The second minor design change was caused by the location of the 60-inch reinforced concrete storm drain that was approximately 30 feet east of where it is shown on Site drawings. The storm drain could not be relocated, and it interfered with placement of the last panel. The top of the storm drain is above the level of groundwater in the trench and above the ITS lines. Placing the panel on top of the storm drain would not result in capture or storage of groundwater. Placing the panel underneath the storm drain could weaken it, and would open a preferential pathway for groundwater to leave the system. Therefore, the last panel was not placed. Instead, 10 supersacks of bentonite, at approximately 3,500 pounds each, were used to seal off the western end of the collection trench including the area around the storm drain. This is sufficient to keep water in the collection trench and to block discharge of water around the storm drain.

Also of note, a large tear occurred in the panels immediately adjacent to the treatment cell. The tear was patched using hot welding techniques. Two bags of bentonite were placed in front of the repaired area to further prevent leakage.

5.0 REFERENCES

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO, July.

RMRS, 1999, *Final Solar Ponds Plume Decision Document*, RF/RMRS-98-286.UN.



COORDINATES FOR 1999 GEOTECHNICAL BORINGS 2

Northing	Easting	Ground Elevation	Description
38601.93	21870.86	5899.48	DRILL HOLE (No. 1) 70399
38632.20	21784.99	5900.83	DRILL HOLE (No. 2) 70499
38507.04	22030.69	5908.44	DRILL HOLE (No. 3) 70599

SITE PLAN

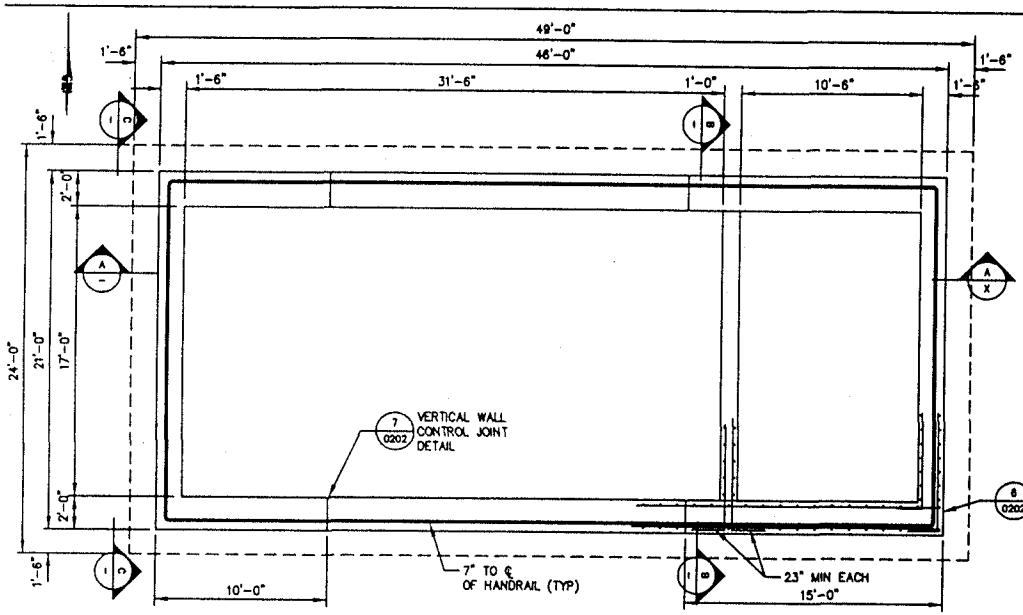
60' 0 60'

Figure 1
Groundwater System Locations

RMRS

Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80402-8200

2k-0094

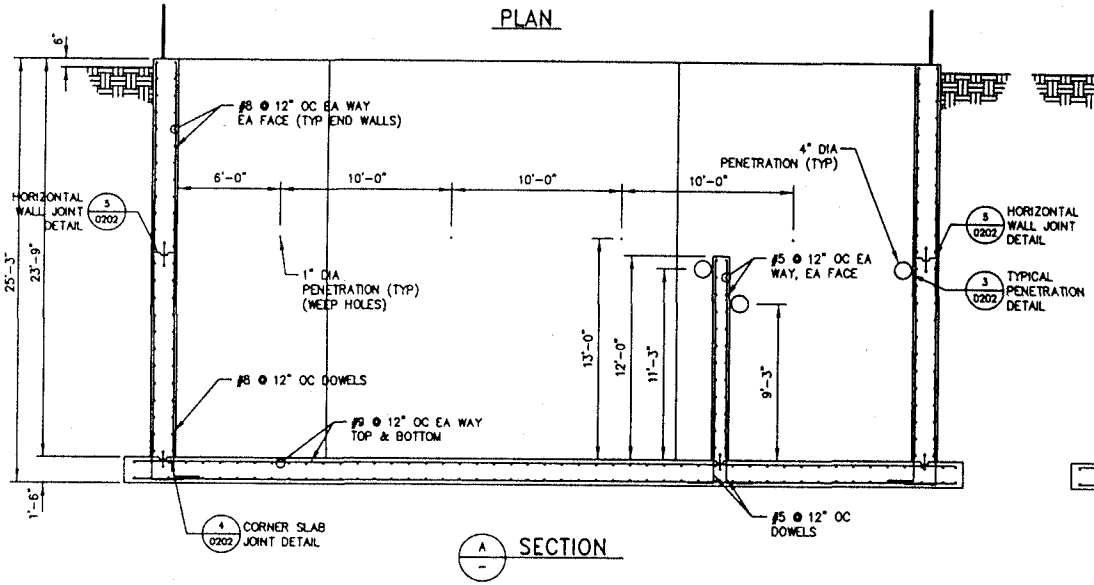


PLAN

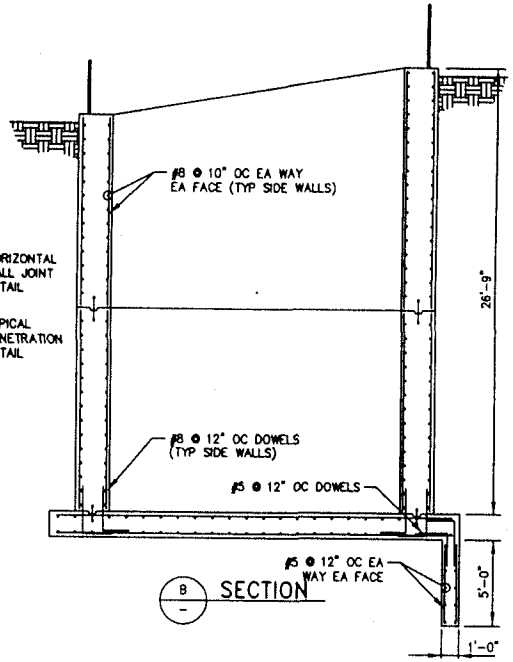
NOTES:

1. CONCRETE MINIMUM STRENGTH: 4000 PSI AT 28 DAYS.
2. REINFORCING STEEL: DEFORMED BARS CONFORMING TO ASTM A 615 GRADE 60. DOWEL BARS: DEFORMED BARS CONFORMING TO ASTM A 615 GRADE 60.
3. ALL CONCRETE AND REINFORCING STEEL SHALL BE FURNISHED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE ACI STANDARD BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE ACI 318-95.
4. ALL REINFORCING STEEL DETAILED IN ACCORDANCE WITH THE MOST RECENT VERSION OF ACI 315 "DETAILS AND DETAILING OF CONCRETE REINFORCEMENT".
5. PRIOR TO PLACING CONCRETE, ALL REINFORCING STEEL, DOWELS, WATERSTOPS, AND SLEEVES FOR PENETRATIONS, WERE WELL SECURED IN POSITION AND APPROVED BY THE CONTRACTOR.
6. LOCATION OF ALL CONSTRUCTION JOINTS OR OTHER TYPES OF JOINTS OTHER THAN THOSE SPECIFIED, AND DETAILS OF ALL SLEEVES, OPENINGS, OR OTHER ATTACHMENTS NOT SHOWN ON THE DRAWINGS AS APPROVED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
7. VERTICAL CONTROL JOINTS IN LONG WALLS, PLACED WHERE INDICATED OR WHERE APPROVED BY CONTRACTOR, BUT NOT MORE THAN 25' APART AND WITHIN 10' TO 15' OF CORNERS. NOT PLACED IN LOCATIONS WHERE DEVELOPEMENT LENGTH OF DOWELS WILL BE LESS THAN REQUIRED.
8. EXPOSED EDGES OF CONCRETE 3/4" CHAMFER.
9. REINFORCING STEEL FURNISHED AND INSTALLED ARE FREE OF EXCESSIVE RUST, GREASE, MILL SCALE, OR ANY MATERIAL WHICH MAY AFFECT ITS BOND WITH CONCRETE.
10. SPLICES USED ONLY WHERE REQUIRED BASED ON AVAILABLE REINFORCEMENT LENGTHS. WHERE REQUIRED, SPLICES ARE CLASS B SPLICE CONFORMING TO ACI 318-95. LAP #9 BARS 81" MINIMUM, LAP #8 BARS 46" MINIMUM AND LAP #5 BARS 18" MINIMUM. ENCLOSE WITH STIRRUPS OR TIES. TRANSVERSE SPACING OF #8 BARS AND #9 BARS NO GREATER THAN 8" AND SPACING OF #5 BARS NO GREATER THAN 3". SPLICES STAGGERED A MINIMUM OF 24" LONGITUDINALLY.
11. MINIMUM CONCRETE COVER OVER REINFORCING STEEL AS FOLLOWS, UNLESS OTHERWISE NOTED:
    A. BOTTOM OF SLAB, 3"
    B. ELSEWHERE, 2"
12. DESIGN LOADS:

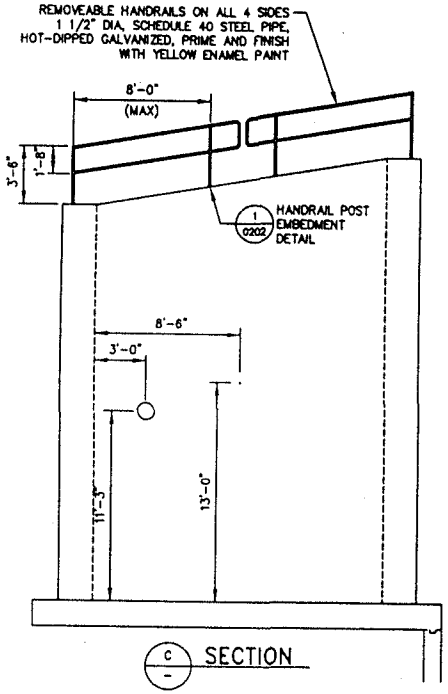
EXTERIOR SURCHARGE	300psf
INTERIOR SURCHARGE	75psf
NATIVE SOIL	118pcf
CONCRETE SAND	130pcf
ALLOWABLE BEARING PRESSURE	4000psf



A SECTION



B SECTION



C SECTION

4' 0 4'

Figure 2
Treatment Cell Details

1 0105 TREATMENT SYSTEM STRUCTURAL PLAN

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80402-8200

2k-0094

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Overviews of Solar Ponds Plume Project

RMRS Rocky Mountain Remediation Services, L.L.C.

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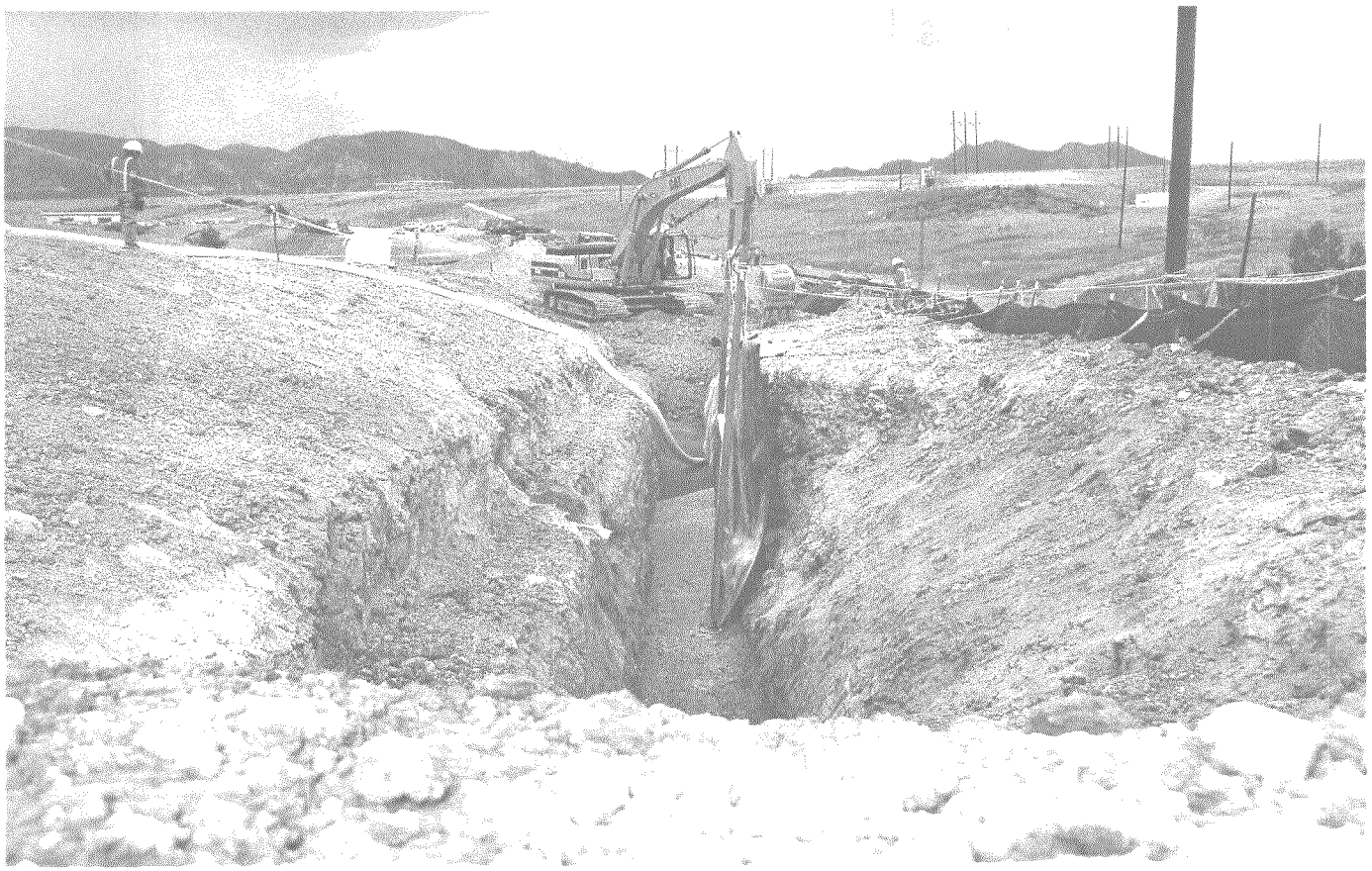

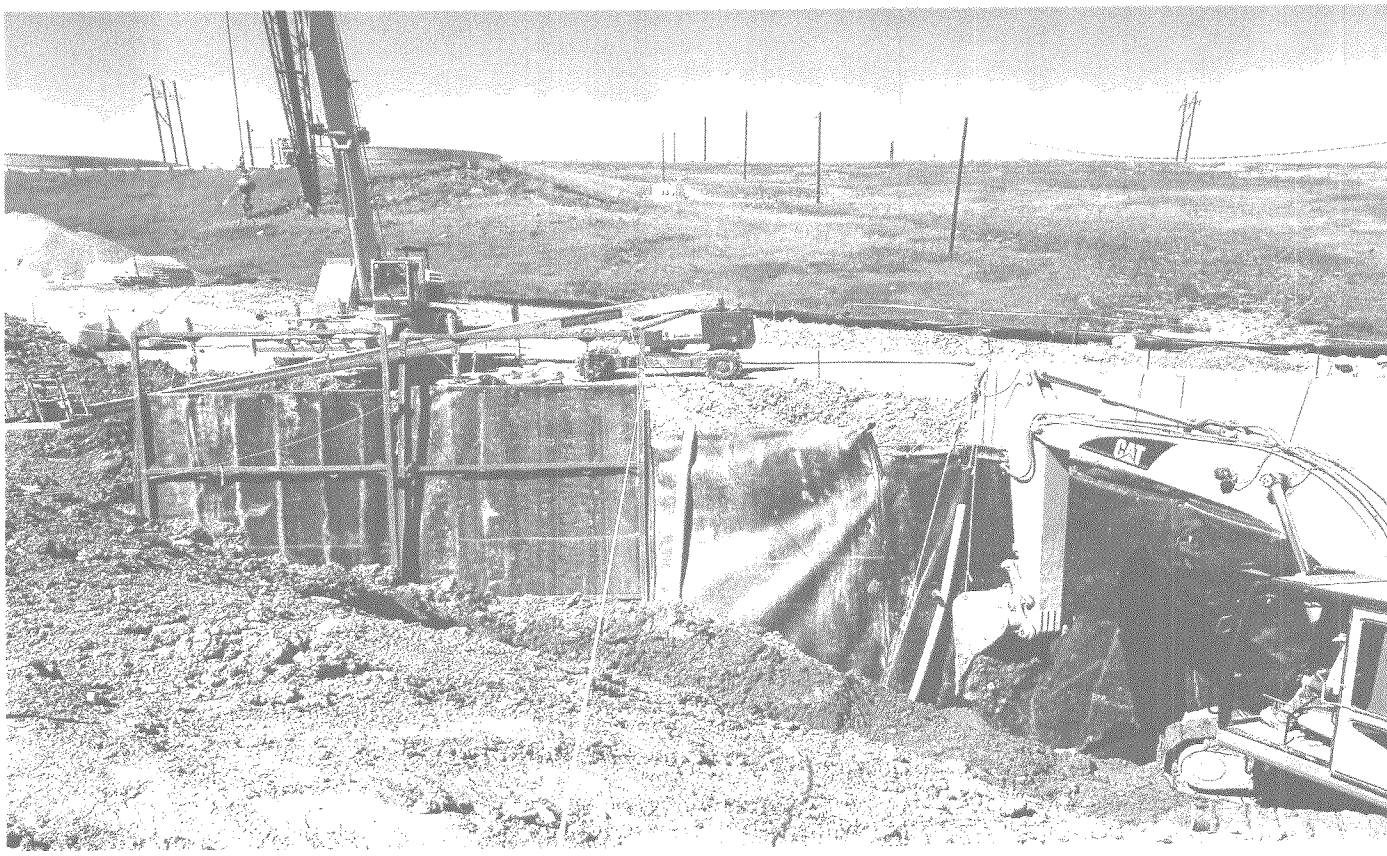

Panel Installation at Solar Ponds Plume

RMRS Rocky Mountain Remediation Services, L.L.C.

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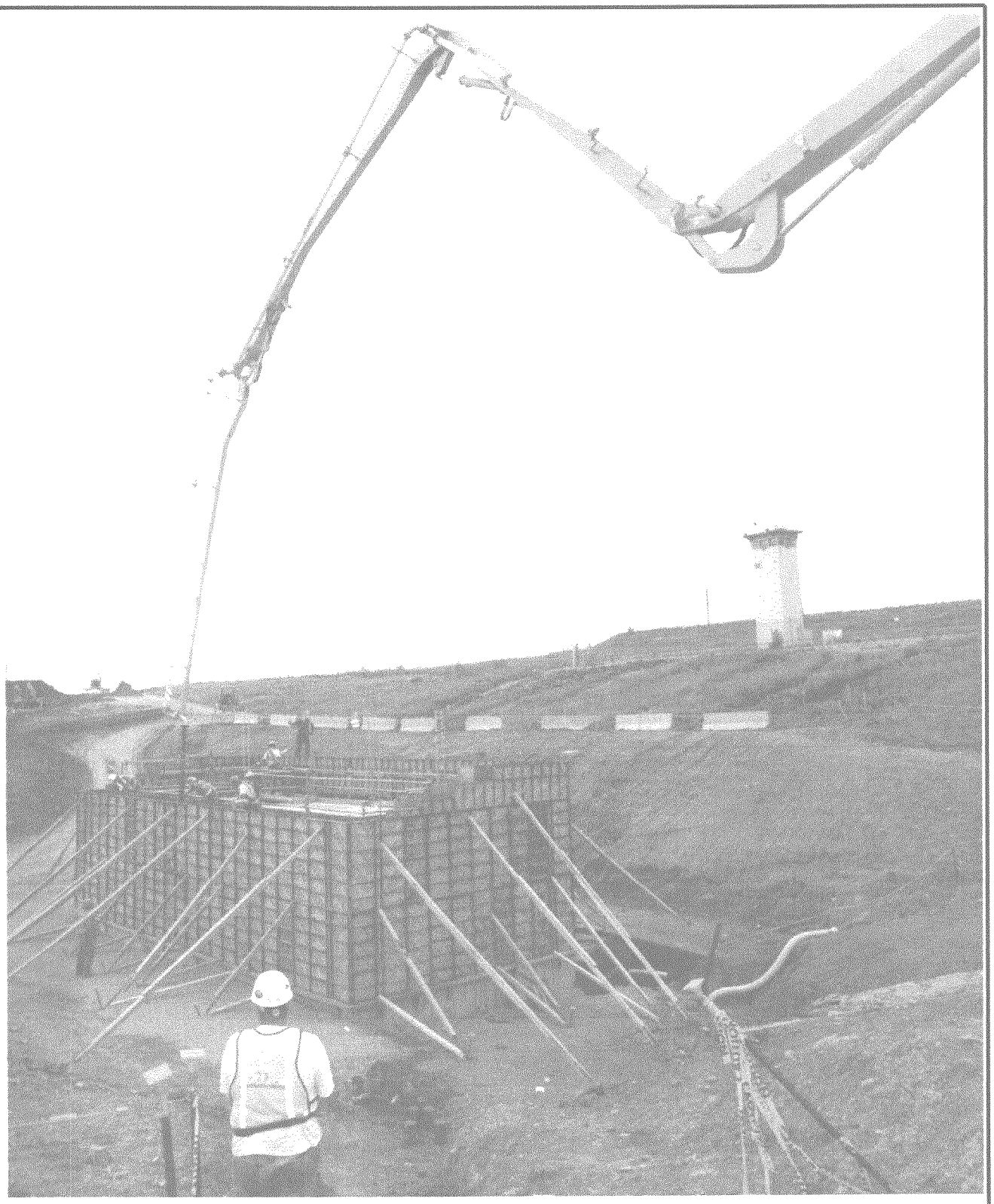

Solar Ponds Plume Treatment Cell

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