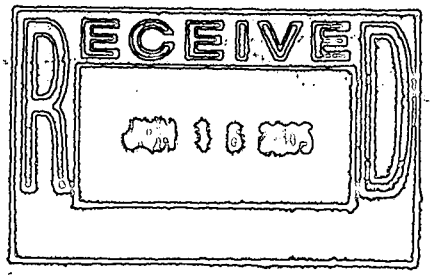
ANNUAL REPORT
FOR

RF18SS40

RFETS ASTD PERFORMANCE MONITORING

PASSIVE REACTIVE BARRIERS

FY 2000



October 20, 2000

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ACRONYM LIST

DOE	Department of Energy
EPA	Environmental Protection Agency
gpm	gallons per minute
ITS	Interceptor Trench System
FY	Fiscal Year
NPDES	National Pollutant Discharge Elimination System
pCi/l	picoCuries per liter
pCi/ug	picoCuries per microgram
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services
SCFA	DOE Subsurface Contaminant Focus Area
SITE	Superfund Innovative Technology Evaluation
ug/l	Micrograms per liter
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This report describes the annual activities and provides the available fiscal year (FY) 2000 performance monitoring data for the three groundwater collection and treatment systems at the Rocky Flats Environmental Technology Site (RFETS) that received funding from the Department of Energy Subsurface Contaminant Focus Area (SCFA).

These groundwater collection and treatment systems are reactive barriers designed to protect surface water. These were installed for the Mound Site Plume, the East Trenches Plume and the Solar Ponds Plume. The systems were installed near the distal ends of the associated plumes to intercept groundwater before it enters surface water. These systems are effective in low flow, low permeability regimes. This report provides information on the performance of each of the systems for FY2000 (October 1999 through September 2000).

2.0 MOUND SITE PLUME TREATMENT SYSTEM

The Mound Site Plume Treatment System uses reactive barrier technology to collect and treat contaminated groundwater derived from the Mound Site area. The source area was removed as an accelerated action in 1997. Installation of the 220-foot long collection system and two treatment cells containing reactive iron was completed in 1998. The system is designed to meet the Groundwater Action Level Framework Tier 2 concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996). The Mound Site Plume System employs innovative technology to treat groundwater contaminated with chlorinated organic compounds and low levels of radionuclides. The effectiveness and feasibility of using this technology on other contaminated groundwater plumes was demonstrated by this project.

The Mound Site Plume Treatment Project was a cooperative effort between RFETS and the Department of Energy Subsurface Contaminant Focus Area (SCFA), with support from the US Environmental Protection Agency (EPA) Superfund Innovative Technology Evaluation (SITE) Program. Funds were provided by SCFA in Fiscal Year (FY) 2000 for additional sampling beyond that required by the Mound Site Plume Decision Document (DOE 1997a). This additional sampling provided extensive data to various research organizations on the effectiveness and feasibility of reactive barriers.

2.1 Project Events

No maintenance was required for this collection and treatment system except for regular raking of the surface of the treatment media in the two treatment cells. The upper one-foot of media in each cell is a mixture of 90% pea gravel and 10% iron which facilitates raking and reduces crust formation. Quarterly water level monitoring and sample collection was performed by Tetra Tech for the EPA SITE Program. Site personnel performed monthly water level monitoring and sample collection.

2.2 Treatment Effectiveness

The total volume of groundwater flow through the system as of September 17, 2000 was approximately 572,567 gallons. For the period from September 19, 1999 through September 17, 2000, the 343,847 gallons of contaminated water were treated. Flow rates range from 0.07

gallons per minute (gpm) during January, to a high flow rate of 1.7 gpm in mid-July that was related to a 1.9-inch rainfall. Monthly average flow rates range from 0.14 to 1 gpm.

Water levels within the collection trench were monitored at five piezometers and measured monthly. Water levels measured at these piezometers are fairly constant, with water levels in these piezometers varying less than 0.4 feet over the year.

Water levels were also monitored quarterly at seven locations surrounding the collection trench (three upgradient, three downgradient and one to the east). Water elevation upgradient of the collection trench was approximately 5,920 feet. Water elevation downgradient of the collection trench was 10 feet lower at around 5,910 feet, with piezometer 15599 dry. These data indicate that the collection system is working as designed. Water levels in well 3586, near South Walnut Creek, fluctuated one foot over the year and are likely influenced by the nearby Creek.

Table 1. Mound Plume Upgradient and Downgradient Water Elevations

Well	Location	10/7/99	1/3/00	4/3/00	7/10/00
15199	Eastern	5921.33	5920.93	5921.01	5920.2
15299	Upgradient	5916.95	5916.82	5916.73	5916.62
15399	Upgradient	5919.75	5919.5	5919.56	5918.69
15499	Upgradient	5921.05	5919.87	5920.97	5919.79
15599	Downgradient	dry	dry	dry	Dry
15699	Downgradient	5910.9	5909.43	5911.04	5909.31
15799	Downgradient	5911.75	5911.2	5911.33	5910.55

2.2.1 Treatment System Effectiveness

Analytical results continue to show that the treatment system is continuing to effectively remove the volatile organic compounds (VOCs) and radionuclides. Monthly analytical sample results are detailed in the Quarterly Reports. These sample results are summarized below in Table 2.

Table 2. Summary of Mound Plume Fiscal Year 2000 Sampling Events

Contaminant	Influent (R1I) Concentration (ug/l)	Reactor 1 Effluent (R1E) Concentration (ug/l)	Reactor 2 Effluent (R2E) Concentration (ug/l)	RFCA Groundwater Tier 2 Action Levels (ug/l)
Trichloroethene	67-160	ND-1.7	ND	5
Tetrachloroethene	43-130	0.1 J-1.9	ND	5
Carbon Tetrachloride	54-130	ND	ND	5
Chloroform	12-26	ND-1	ND-1	100
Cis 1,2-Dichloroethene	21-62	2-11	2-4	70
1,1-Dichloroethene	5-12	ND-5	ND	7
1,1-Dichloroethane	ND – 4J	2-3	1-2	5
Methylene Chloride	3JB – 20B	0.3 JB-2B	ND -0.8 JB	5
Total Uranium (pCi/l)	ND-13	ND	ND	2.84

B = Present in the laboratory blank (possible lab contamination)
J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

2.2.2 Downgradient Water Quality

Analytical samples are collected from the three downgradient wells for the collection trench. As noted above, well 15599 is dry. Well 15699 contains sufficient water for regular sampling and well 15799 only occasionally contains sufficient water to collect a sample.

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As stated in the Decision Document (DOE 1997a), the collection system was installed near South Walnut Creek "to capture the contaminated groundwater to the extent practicable". The downgradient wells are located within the cut-off downgradient portion of the plume that was not intended to be treated; the so called "zone of sacrifice". Analytical results from these wells are provided below.

Well 15699 is located within the major preferential flow path for the Mound Site Plume and along the trend of the highest plume concentrations defined in the pre-remedial investigation (DOE 1997a). The analytical results from the sample collected during the pre-remedial investigation from groundwater in nearby geoprobe hole 10797 were 844 ug/l trichloroethene, and 261 ug/l tetrachloroethene. These analytical results are the same order of magnitude as those seen in well 15699. The collection trench collects groundwater from across the plume area, including lower concentration areas, the concentration of trichloroethene within the collection trench ranges from 67 to 160 ug/l. Because of the similarity between the pre-remedial downgradient water quality, and the disparity between the collection trench water, the contaminant concentrations in groundwater observed in well 15699 are a result of the pre-existing downgradient plume. This conclusion is supported by the groundwater elevation difference between the upgradient and downgradient wells that also indicate that the collection system is working as designed.

Table 3. Downgradient Well Analytical Results (in ug/l unless otherwise noted)

Well	15699				15799		3586				RFCA Tier II ALF
Analyte	11/10/99	1/25/00	5/19/00	8/2/00	11/10/99	6/28/00	10/19/99	1/31/00	5/18/00	7/27/00	
1,1,1-Trichloroethane	29 J	16 J	20J	19J	ND	ND	1 J	0.7 J	1 J	2	200
1,1-Dichloroethane	28 J	22J	26J	23J	ND	ND	38	36	30	33	3650
1,1-Dichloroethene	120	68J	94	79J	ND	ND	ND	ND	ND	ND	7
Cis-1,2-Dichloroethene	410	280	260	310	ND	ND	7	3	3	2	70
Methylene Chloride	ND	73JB	720B	330B	ND	0.2 JB	4 JB	0.2 JB	0.2JB	0.2JB	5
Tetrachloroethene	910	780	930	910	0.8 J	0.9 J	ND	ND	ND	ND	5
Trichloroethene	1900 E	1300	1700	1800	0.2 J	0.2 J	0.5 J	0.3 J	0.2 J	0.2 J	5
Vinyl Chloride	ND	ND	ND	ND	ND	ND	56	22	17	16	2
Uranium-233,234 (pCi/l)	13.35	11.9	9.12	-	-	-	3.35	2.63	2.60	2.53	1.06
Uranium-235 (pCi/l)	0.27 J	0.21 U	0.21U	-	-	-	-0.04	0.07 J	ND	ND	1.01
Uranium-238 (pCi/l)	9.68	10.78	7.57	-	-	-	2.19	1.98	1.57	1.74	0.768

B = Present in the laboratory blank (possible lab contamination)
E = Exceeded calibration range of instrument
J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

Well 15797 was installed in an area of the plume with much lower concentrations and the analytical data from both the well and the pre-remedial investigation geoprobe data reflect these lower concentrations (DOE 1997a). Well 3586 is downgradient of the collection system near South Walnut Creek. Water quality at this location has remained substantially unchanged over the reporting period as shown in Table 3.

2.3 Conclusions and Planned Changes

The Mound Site Plume Treatment Project is fully operational and treating contaminated groundwater to below specified system performance concentrations. Ongoing maintenance,

raking the iron media and retrieving flow rate and water level data are the only required activities. Media raking will be reduced because the crust formation was minimal this quarter.

Monthly sample collection was funded in part by the DOE SCFA, with support from the EPA SITE Program. This funding support ends this fiscal year. While system sampling will continue to verify the performance of the treatment system, beginning October 1, 2000 (Fiscal Year 2001), the sampling frequency will change to semiannual sampling of the influent and effluent, as specified in the Mound Site Plume Decision Document (DOE 1997).

3.0 EAST TRENCHES PLUME TREATMENT SYSTEM

The East Trenches Plume Treatment System collects and treats the contaminated groundwater derived from the Trench 3 and Trench 4 area to the Groundwater Action Level Framework Tier 2 level concentrations defined in the RFCA (DOE, 1996). The sources for the contaminated groundwater plume were remediated in 1996 as an accelerated action.

Installation of the 1,200-foot collection system and two reactive iron treatment cells, similar to the Mound Plume System, was completed in September 1999. This system requires little maintenance and provides long-term protection of surface water by collecting and treating the contaminated groundwater before it reaches South Walnut Creek.

3.1 Project Events

No maintenance was required for this collection and treatment system except for regular raking of the surface of the treatment media in the two treatment cells to minimize crust formation. Site staff performed system maintenance along with water level monitoring and sample collection.

Water levels within the two treatment cells fluctuated up to 18 inches during the period October through December 1999. These fluctuations did not create a problem with the operation of the treatment system, but apparently contributed to crust formation. The system has stabilized and fluctuations no longer sufficient large to cause problems.

In October, during one of the earlier increases in the treatment cell water level, a black filamentatious material was observed in the eastern treatment cell. The material blocked the outlet from the treatment cell, causing a rise in water elevations. When normal flow was restored, much of the material was flushed out. Enviromental, Inc. believes that the black material is an iron bacteria, expected to be easily treated if treatment is necessary. While the material is still occasionally observed, it is not present in sufficient quantity to block flow or cause problems.

3.2 Treatment Effectiveness

Total volume of groundwater treated by the system as of September 17, 2000 was approximately 2.5 million gallons. Approximately 2.1 million gallons were treated for the period October 1, 1999 through September 17, 2000. Flow rates ranged from 1.6 to 8 gpm and averaged 3.5 gpm. As at the Mound Plume System, the highest flow rates correlate very well with precipitation. However the change in flow rates at the East Trenches System is not as dramatic because this treatment system has a higher base flow volume.

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Water levels within the collection trench were measured monthly at three piezometers. Water levels at the well downgradient of the collection trench were also measured monthly. Monitoring results are presented in Table 4.

Table 4. East Trenches Plume Piezometer and Well Water Levels (elevation above sea level)

Well	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
23296	5852.2	5852.4	5852.5	5852.6	5852.6	5852.6	5853.2	5853.0	5852.6	5851.6	5851.7	5851.5
95099	5841.3	5841.7	5847.4	5849.6	5849.6	5849.5	5844.0	5847.3	5842.4	5847.7	5842.4	5847.5
95199	5870.3	5864.3	5872.2	5872.1	5871.8	5871.5	5871.4	5871.5	5868.1	5870.1	5867.9	5870.0
95299	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
95699	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
95799	5882.2	5882.1	5880.8	5880.4	5879.0	5878.8	5879.3	5878.5	5878.1	Dry	5877.0	5877.0
95899	5890.0	5889.7	Dry	5888.7	5888.5	5888.5	5888.5	5888.5	5888.5	5888.5	5888.5	5886.1

The water elevations at this area demonstrate a strong downgradient trend to the east, with the water elevations in the piezometers within the collection trench generally 10 feet higher than the corresponding piezometers downgradient of the collection trench. The water elevation at the western collection trench piezometer (95899) declined three feet over the year. This may reflect that the Arapahoe Number One Sandstone that was intersected at this location is dewatering. The associated downgradient piezometer (95299) was dry.

The water elevation at 95799 (middle collection trench piezometer) dropped five feet over the year. The water elevation in the associated downgradient piezometer (95199) fluctuated from 5,864 feet above sea level to 5872 feet above sea level, but was generally around 5,870 feet above sea level. Finally, at the far eastern end of the collection trench, the collection trench piezometer 95699 was dry.

The water elevation in well 23296 by South Walnut Creek was relatively constant elevation of around 5,852 feet above sea level. Well 23296 is downgradient of the B-2 Dam adjacent to South Walnut Creek. Water levels at this location probably reflected some influence from surface water, including the B-2 Pond, in addition to monitoring the downgradient plume.

The water elevation at 95099, located east of the collection trench, fluctuated the most, from 5,841 to 5,849 feet above sea level. These water elevations, combined with the water volumes collected, indicate that the collection trench is working as designed.

3.2.1 Treatment System Effectiveness

Analytical samples were collected monthly at the influent and effluent of the treatment system to monitor treatment effectiveness and a summary of these sampling events is provided below. The contaminants of concern for this plume are primarily trichloroethene, tetrachloroethene and carbon tetrachloride.

All contaminants were reduced to levels below the RFCA Action Levels with the exception of methylene chloride, which was above action levels in the effluent and also reported in the laboratory blanks. Methylene chloride is consistently noted in many samples including the effluent samples from the East Trenches Plume treatment system, usually with the qualification that detectable concentrations were observed in the associated lab blanks. As the concentrations were less than 10 times the detection limit, methylene chloride was probably due to laboratory contamination.

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Table 5. Summary of East Trenches Plume FY 2000 Sample Results

Compound	Influent Concentration (ug/l)	Effluent Concentration (ug/l)	RFCA Groundwater Tier 2 Action Levels (ug/l)
Trichloroethene	2,700 D – 4,500	ND – 2	5
Tetrachloroethene	250 – 490	ND – 2	5
Carbon Tetrachloride	130 J – 240	ND	5
Chloroform	82 J – 140 J	ND –18	100
Cis-1,2-Dichloroethene	23 – 38	10 – 38 E	70
Methylene chloride	6 JB – 470 B	8 – 24 B	5

B = Detected in blank
D = Detected in diluted sample
J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

3.2.2 Downgradient Water Quality

Analytical samples were collected where possible from the three downgradient wells and one well east of the collection trench. As noted above, well 95299 was dry. However, wells 23296, 95099 and 95199 contain sufficient water for regular sampling (table 6).

Table 6. Downgradient Well Analytical Results (in ug/l)

Well	Date	Carbon Tetrachloride	Chloroform	Cis-1,2-Dichloroethene	Methylene Chloride	Tetrachloroethene	Trichloroethene
23296	10/28/99	3J	8J	170	3JB	10J	280
	2/15/00	37J	51J	71J	30JB	36J	960
	3/10/00	40J	41J	53	120B	28J	780
	4/17/00	14J	21J	55	48B	19J	450
	7/18/00	3J	6J	120	14JB	15J	390
95099	10/26/99	0.2J	0.4J	ND	0.1JB	ND	ND
	3/16/00	0.1J	0.3J	ND	0.2 JB	ND	0.1J
	5/19/00	0.2J	0.3J	ND	0.3JB	ND	ND
	7/17/00	0.3J	0.2J	ND	0.1JB	ND	ND
95199	10/25/99	ND	0.3J	1J	0.3JB	1J	38
	3/16/00	ND	0.3J	3	1JB	2J	69E
	5/19/00	ND	ND	2J	5JB	2J	54
	7/17/00	ND	ND	2J	4JB	2J	61
RFCA Tier II ALF		5	100	70	5	5	5

B = Present in the laboratory blank (possible lab contamination)
E = Exceeded calibration range of instrument
J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

Wells 23296 and 95199 show consistent VOC concentrations higher than the RFCA Tier 2 Action Levels (table 6), although much lower than the concentrations seen at the treatment cells (Table 4). These downgradient wells are located within the cut-off downgradient portion of the plume that was not intended to be treated; the so called "zone of sacrifice". Well 95099 is located east of the collection system and outside of the East Trenches Plume. It was installed to monitor that the plume was not spreading to the east as a result of the collection system. Water quality at this location has remained substantially unchanged over the reporting period as shown in Table 6.

Well 23296 is located near South Walnut Creek where the East Trenches Plume exits to surface water. Higher VOC concentrations observed at this well were an early indication that a remedial action should be considered for this plume. Trichloroethene was the primary contaminant observed, with concentrations ranging between 280 ug/l in October 1999 to 960 ug/l in February 2000. Well 95199 exhibits the same pattern as well 23296 with the highest concentrations of trichloroethene observed in March 2000 and the lowest concentration in October 1999.

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This indicates that the concentrations may be a result of precipitation, with wet weather resulting in lower concentrations. Little rainfall was observed in February, with wetter weather from mid March (immediately following sampling) through July. Because infiltration is a major source of plume recharge, the rainfall apparently caused a decrease in sample concentrations. Almost 2 inches of rain fell on July 16, 2000. Samples were collected from wells 23296 and 95199 immediately afterward. While concentrations in 23296 are much lower indicating dilution by precipitation, the concentration in well 95199 did not decrease substantially. This may indicate that the heavy precipitation may have run off and did not infiltrate as much on the hillside where well 95199 is located.

3.3 Conclusions and Planned Changes

The East Trenches Plume Treatment System is fully operational and treating contaminated groundwater to below the specified system performance requirements. Ongoing maintenance, raking the iron filings and retrieving flow rate and water level data, are the only required activities. Next quarter, the top foot of media in each reactor is expected to be replaced with a mixture of 90% pea gravel and 10% iron that is effectively minimizing crust formation at the Mound Plume system.

Beginning in October 2000 (Fiscal Year 2001), the monthly sampling frequency will be reduced to semiannual sampling as specified in the East Trenches Plume Decision Document (DOE 1999a).

4.0 SOLAR PONDS PLUME TREATMENT SYSTEM

The Solar Ponds Plume is a groundwater plume containing low-levels of nitrate and uranium, derived from storage and evaporation of radioactive and hazardous liquid wastes in the Solar Evaporation Ponds. These ponds were drained and the sludge was removed by 1995. Six interceptor trenches were installed in 1971 to de-water the hillside. The original six trenches were abandoned in place and the Interceptor Trench System (ITS) was installed in 1981. Installation of the 1,100-foot long collection system and passive treatment cell containing iron and wood chips was completed in September 1999. This system intercepts the water collected by the pre-existing ITS.

The maintenance requirements for the wood chip/iron media consist of water level monitoring and sample collection, which are performed by Site staff. Raking or other manipulation of the media is not required based on information from other, similar systems. Media replacement is expected to be required after 10 years based on information from other similar systems.

The Solar Ponds Plume system is different from the passive, flow-through systems installed for the Mound Plume and East Trenches Plume. As originally designed, the treatment cell was to be located near North Walnut Creek. Water was expected to be intercepted and flow by gravity to the treatment cell without detention in the collection trench. Because the Preble's Meadow Jumping Mouse (a Federally Listed Threatened Species) is present at the optimal location of a flow-through treatment cell, the treatment cell was located immediately adjacent to the collection trench, not 400 feet downgradient as was originally planned. As a result, the collection trench for this system must hold approximately 11 feet of groundwater to develop sufficient hydraulic head for the groundwater to flow into the treatment cell.

4.1 Project Events

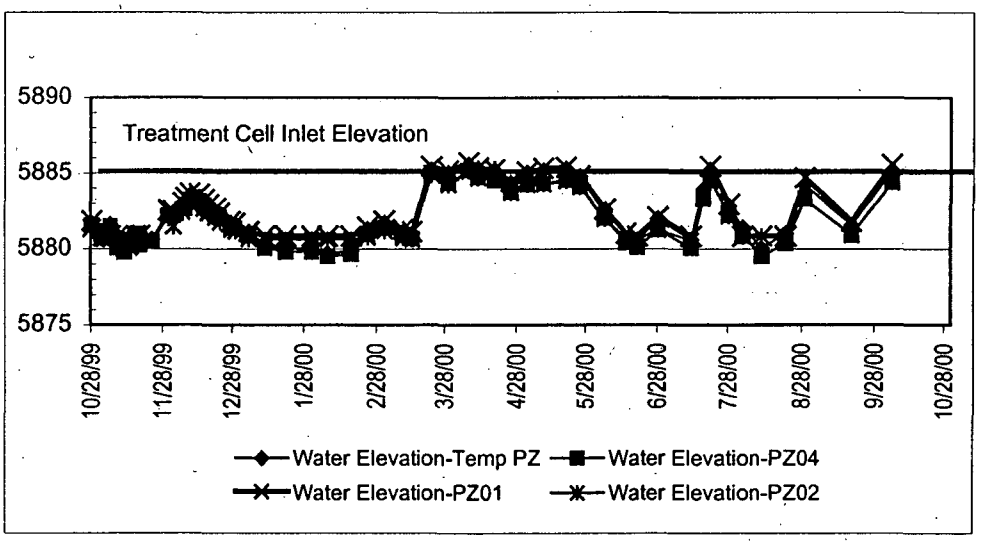
On August 16th and 17th, because of dry conditions, approximately 3,000 gallons of water were transferred from the discharge gallery area directly into the Solar Ponds Plume treatment cell to ensure that the cell remained full of water and to provide nutrients for the bacteria. Influent and effluent samples were collected at that time. No other maintenance activities were performed for this collection and treatment system. Site staff performed regular water level monitoring and sample collection.

4.2 Treatment Effectiveness

As of September 17, 2000, the total water volume treated by the system since installation was 46,905 gallons, with all treatment occurring between March 2000 and the present. Flow through the treatment cell occurs following precipitation events. Flow rates ranged from 0 to 3.8 gpm. The maximum flow rate occurred on April 3rd because of rain between March 28th and April 2nd.

Water levels within the collection trench are monitored frequently at four piezometers. The bottom of the collection trench is approximately 5,875 feet above sea level and the inlet into the treatment cell is at 5,885 feet above sea level. Water levels fluctuate between 5,880 and 5,885 feet above sea level (Figure 1). While higher elevations are associated with precipitation events, a quicker response to precipitation and a slight rising trend may be present which may indicate that the hillside is beginning to saturate.

Figure 1. Solar Ponds Plume Collection Trench Piezometer Water Levels



Water levels in the newly installed wells downgradient of the system are monitored monthly and these data are provided in Table 7 and shown on Figure 2. Water elevations in the colluvial well (70099) fluctuate approximately 6 feet while the bedrock well (70299) has a more constant water elevation. At the same time, water levels within the collection trench fluctuated between 5,880 and 5,885 feet above sea level.

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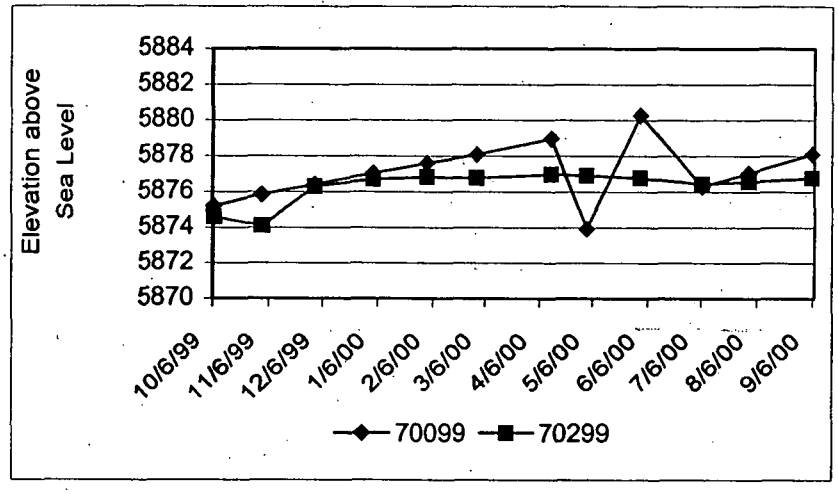
Table 7. Elevation of Groundwater in Solar Ponds System Wells

	10/6/99	11/2/99	12/1/99	1/3/00	2/2/00	3/1/00	4/12/00	5/2/00	6/1/00	7/6/00	8/1/00	9/5/00
70099	5875.2	5875.9	5876.4	5877.0	5877.6	5878.1	5879.0	5873.9	5880.3	5876.3	5877.1	5878.1
70299	5874.6	5874.1	5876.3	5876.7	5876.8	5876.8	5877.0	5876.9	5876.8	5876.5	5876.6	5876.8

Figure 2. Solar Ponds Plume System Downgradient Well Water Elevations



4.2.1 Treatment System Effectiveness

Analytical samples were collected monthly or whenever possible at the influent and effluent of the treatment system to monitor treatment effectiveness. A summary of these sampling events is provided below in Table 8. The effluent concentrations continue to be much lower than predicted. At this time, this is most likely a result of the increased residence time due to low flow rates. However, sufficient effluent data have been collected to indicate that the treatment system is functioning appropriately.

Table 8. Summary of Solar Ponds Plume Treatment System FY00 Analytical Results

Analyte	Influent Concentration	Effluent Concentration
Nitrate (mg/l)	130 – 170	1.1 to ND
Total Uranium (pCi/l)	19.6 – 28.3	0.06 - 0.96

ND – Not detected

4.2.2 Downgradient Water Quality

Analytical samples were collected quarterly where possible from the two downgradient wells and data are provided in Table 9. The bedrock well consistently contains sufficient water for sampling while the adjacent colluvial well does not. The bedrock contact is lower at the bedrock well, possibly indicating a preferential groundwater flow path. There is fracturing in the claystone in the bedrock well and this appears to contain more water than the colluvium in this area. Site Groundwater personnel speculate that with a return of normal precipitation, the colluvium may also contain additional water; potentially sufficient for sampling.

Nitrate concentrations are lower than anticipated in both wells. The uranium activity found in the colluvial well (70099) is higher than elsewhere in the collection and treatment system, and also much higher than that of the adjacent bedrock well. This order of magnitude difference may indicate that this well potentially intersects naturally occurring uranium-rich cobbles or other native material.

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Table 9. Solar Ponds Plume Downgradient Well Analytical Results

Well	Date	Nitrate/Nitrite (mg/l)	Uranium-233,-234 (pCi/l)	Uranium-235 (pCi/l)	Uranium-238 (pCi/l)
70099	6/6/00	0.87	117	5.04	84.6
70299	8/24/99	2.1	5.1693	0.177	2.9828
	10/26/99	0.1	11.1677	0.5505	10.7035
	6/2/00	0.05	5.46	0.319	3.85

Water quality was measured at the Solar Ponds Plume discharge gallery, surface water station GS13 located in North Walnut Creek immediately downgradient of the Solar Ponds Plume, and downgradient Pond A-3 which accepts the water that passes through GS13. GS13 and Pond A-3 were monitored frequently to verify that concentrations at both locations are well below the temporary stream standard of 100 mg/l. Table 10 provides a summary of the analytical data.

The discharge gallery nitrate concentrations were higher than the concentrations observed in the collection trench. The pre-existing downgradient part of the plume adjacent to the discharge gallery has nitrate concentrations above 500 mg/l. This part of the nitrate plume is believed to be seeping to the surface at the discharge gallery, contributing to the higher nitrate concentrations.

Table 10. Solar Ponds Plume Summary of Downgradient Surface Water Locations

Analyte		SPP Discharge Gallery	GS13	Pond A-3
Nitrate (mg/l)	Range	150-390	3.6 – 42	.05 – 20
	Average	243	21	5.5
Total Uranium (pCi/l)	Range	26.2 – 45	3.2- 8.0	NM
	Average	34.9	5.7	NM

NM – not measured at this location

GS13 is the performance monitoring location for the Solar Ponds Plume System (DOE 199b). Nitrate concentrations measured at GS13 in North Walnut Creek have risen since the Solar Ponds Plume groundwater system was installed. The nitrate concentrations fluctuate depending upon the precipitation and other factors, but are generally below 40 mg/l. At Pond A-3, located downstream of GS13, nitrate concentrations have been steadily declining since March 2000 and are now consistently below 10 mg/l.

Lower nitrate concentrations were observed at GS13 during June and July and were probably the result of incipient phytoremediation. Water leaving the discharge gallery flows along a pre-existing dirt road that now is totally reclaimed by volunteer vegetation. The road is no longer in service. As expected, a volunteer wetland developed at the discharge gallery. In the water, there are rushes and cattails; in the saturated soils there are foxtail grass and robust barnyard grass. Wetland plants in general are known to have relatively high nitrate uptake rates. With the shorter days in August, the vegetation began to senesce, and nitrate levels increased at GS13.

The Pond A-4 Outfall is a RFCA Point-of-Compliance for uranium, and there had been a concern that uranium activities may approach the Surface Water standard of 10 pCi/l due to the discharge of Solar Ponds Plume water into this drainage. However, samples collected during discharge contained uranium activities of approximately 3 to 4 pCi/l, well below the standard. These data were within the range of historical uranium activities for this location.

4.3 Conclusions and Planned Changes

The Solar Ponds Plume system is currently collecting groundwater containing nitrate and uranium from the Solar Ponds Plume. The treatment cell is providing treatment for nitrate and uranium as designed. Water levels in the collection trench, however, continue to fluctuate rather than holding a constant level of 11 feet. However, some untreated groundwater is also reaching surface water causing a rise in nitrate and uranium levels in North Walnut Creek. Performance monitoring data shows that the surface water is well below the applicable standards of 10 pCi/l uranium and 100 mg/l nitrate as specified in the Decision Document (DOE 1999b). The 100 mg/l nitrate standard is a temporary modification of the underlying stream standard for nitrate (10 mg/l) in North Walnut Creek (DOE 1999b). System performance continues to be evaluated through monitoring water levels in the collection trench, collecting samples at additional locations and at increased sampling frequency.

Water levels within the collection trench and nearby wells will be monitored on a monthly basis. Samples at GS13, treatment system influent, effluent and discharge gallery will be collected on a monthly basis to monitor system performance and the impact to surface water. Results for this reporting period suggest that there may be seasonality to the system performance with normal treatment during fall and winter, and treatment augmented by phytoremediation during the spring and summer. At this time, the Site plans to continue to monitor the system for an additional year to document seasonal impacts and to determine if other actions are required.

5.0 BUDGET SUMMARY

Total funding of $100,000 was provided for the continued increased performance monitoring of the Rocky Flats Passive Reactive Barrier systems. All scope was completed this fiscal year. However, a year-end change in the Site's burdening rate resulted in a $700 cost over run.

6.0 REFERENCES

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

DOE, 1997, *Final Mound Site Plume Decision Document*, RF/RMRS-97-024, September.

DOE, 1999a, *Final Proposed Action Memorandum For The East Trenches Plume*, RF/RMRS-98-258.UN.

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

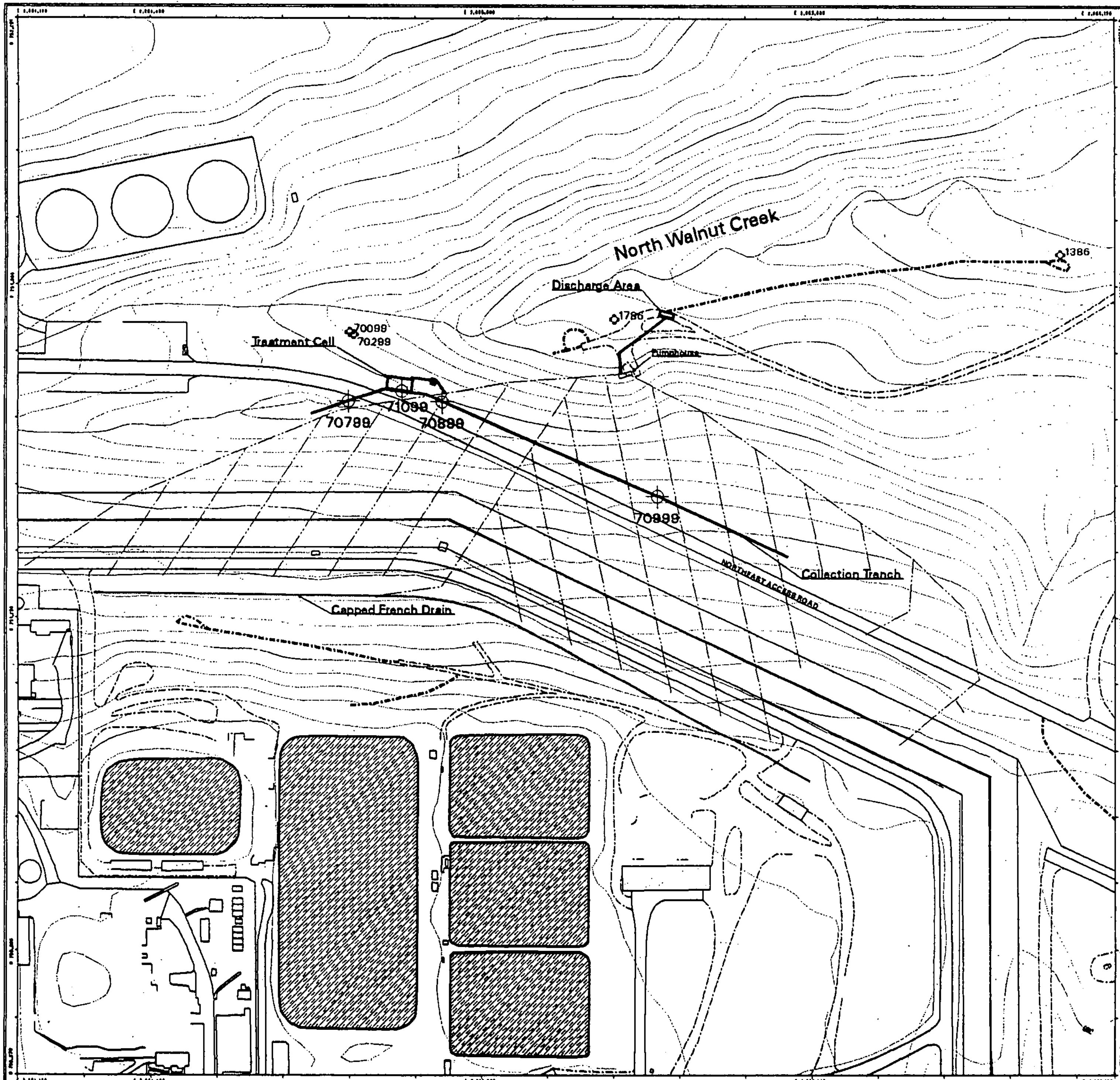

Figure 3
Solar Ponds Plume Treatment System Locations

EXPLANATION

- ITS
- In Trench Piezometer Location
- Monitoring Well

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2060
1 inch represents approximately 257 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by:
DynCorp
THE ART OF TECHNOLOGY

Prepared for:
KAISER-HILL

MAP ID: 01-0345/solar_pond.aml

March 27, 2001

NT_Svr w:/projects/fy2001/01-0345/solar_pond.aml

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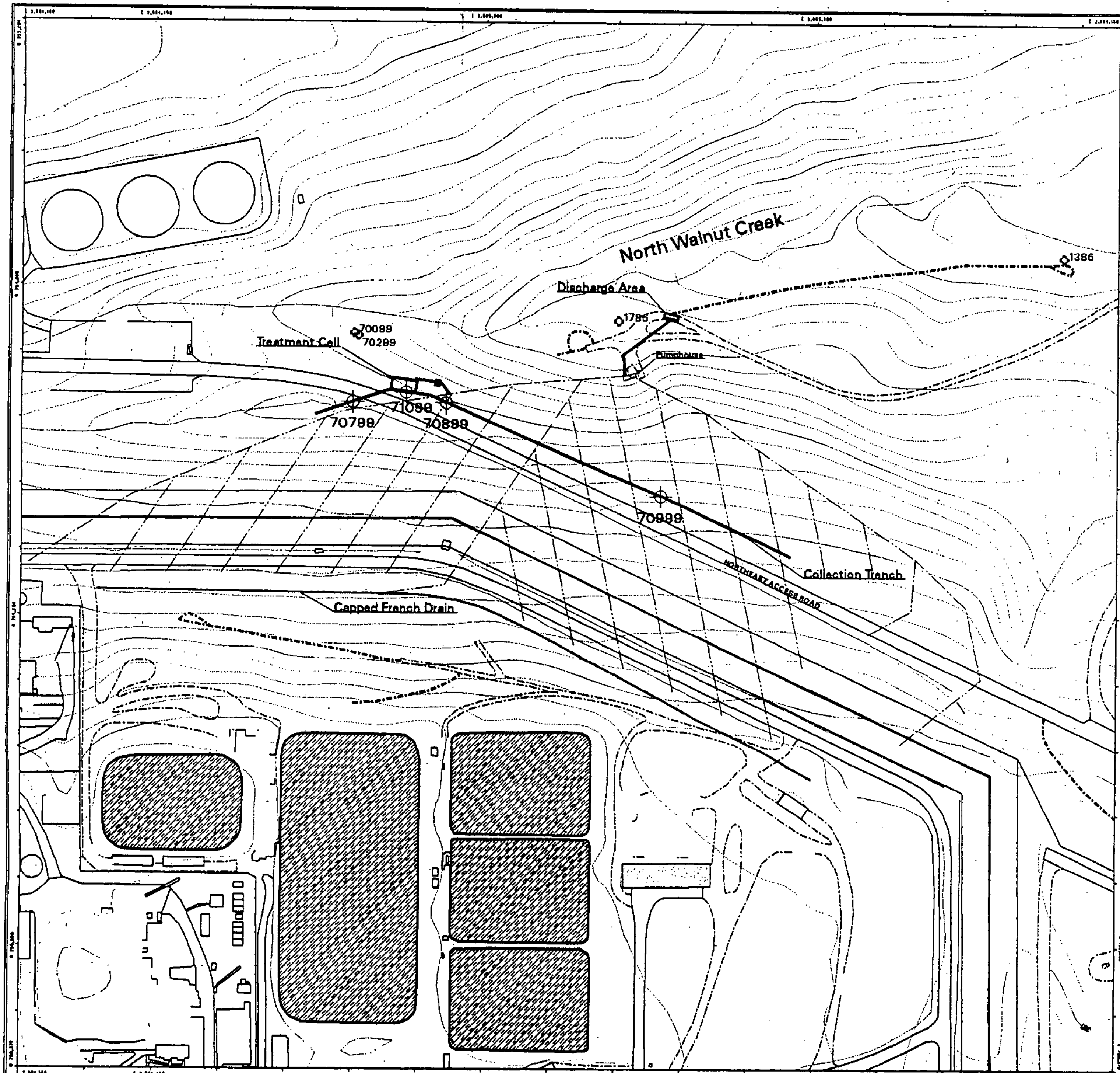

Figure 3
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EXPLANATION

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- Monitoring Well

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- Solar Evaporation Ponds (SEP)
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- Paved roads
- Dirt roads

Scale = 1 : 3080
1 inch represents approximately 257 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by: DynCorp THE ART OF TECHNOLOGY

Prepared for: KAISER-HILL COMPANY

MAP ID: 01-0345/solar_pond.aml

March 27, 2001

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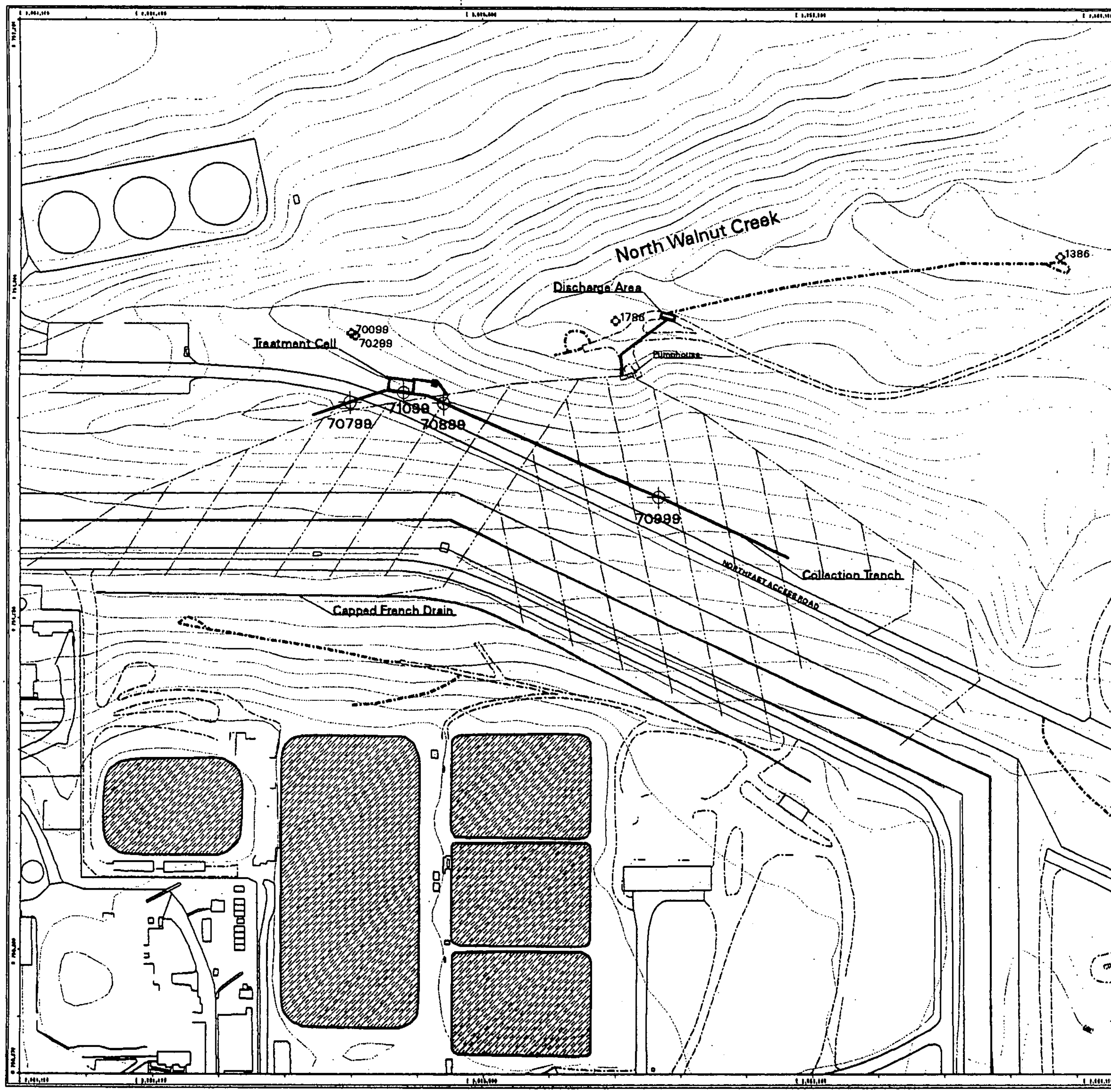

Figure 3

Solar Ponds Plume Treatment System Locations

EXPLANATION

ITS

In Trench Piezometer Location

Monitoring Well

Standard Map Features

Buildings and other structures

Solar Evaporation Ponds (SEP)

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Contour (5-Foot)

Paved roads

Dirt roads

Scale = 1 : 3080
1 inch represents approximately 257 feet

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Colorado Central Zone
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MAP ID: 01-0345/solar_pond.aml

March 27, 2001

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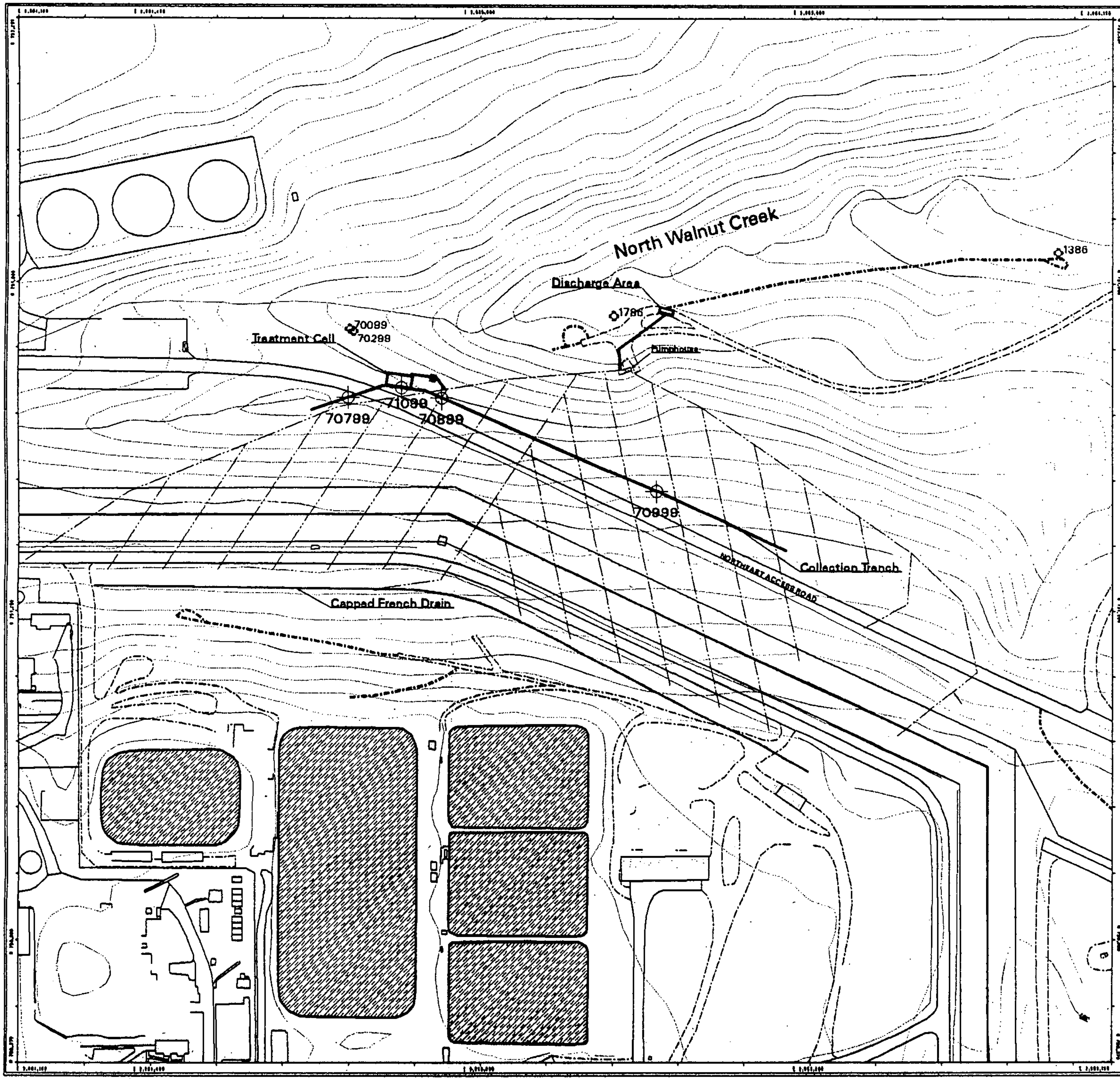

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Colorado Central Zone
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Prepared for: KAISER-HILL

MAP ID: 01-0345/solar_pond.aml

March 27, 2001

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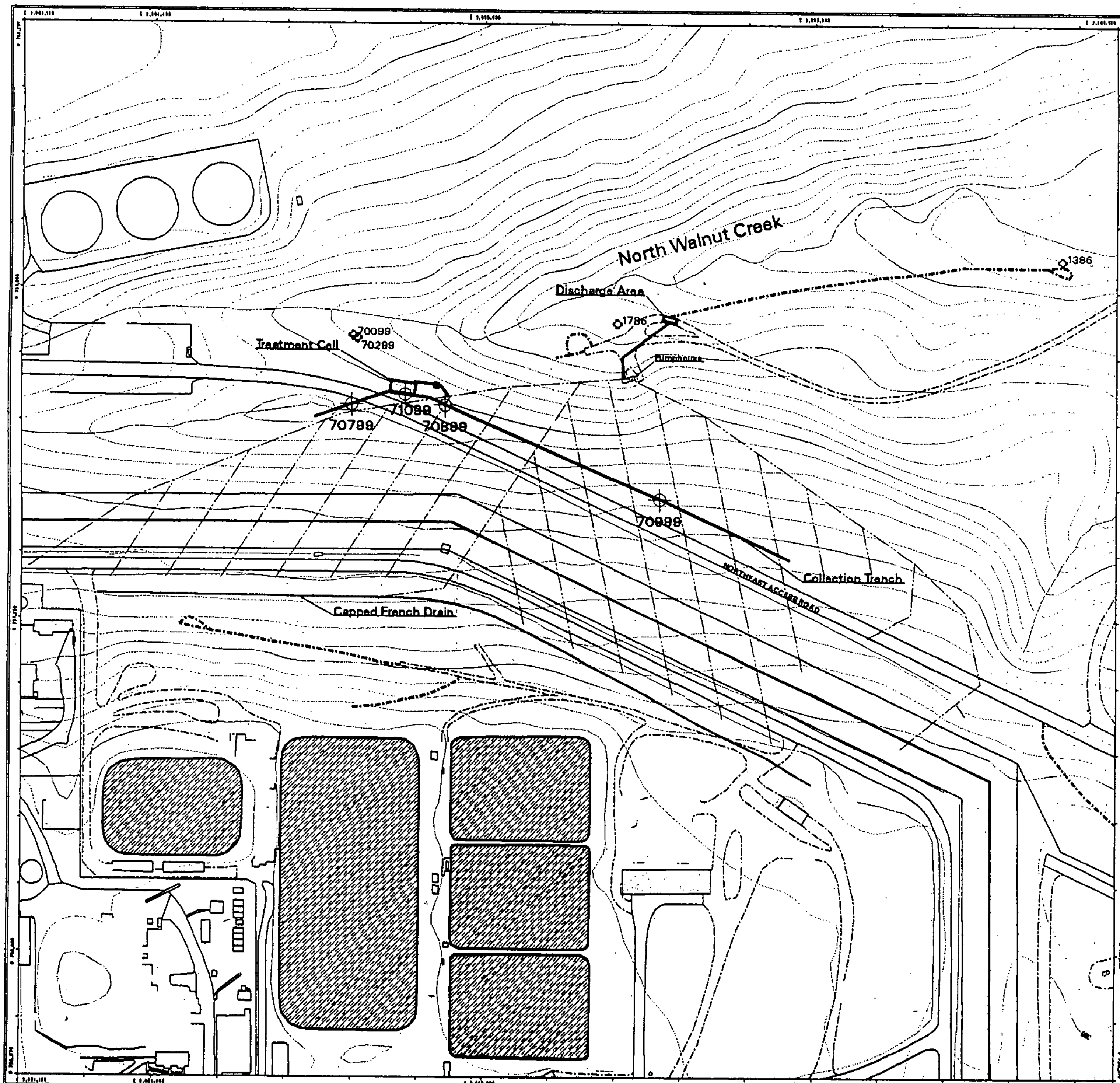

Figure 3
Solar Ponds Plume Treatment System Locations

EXPLANATION

ITS

In Trench Piezometer Location

Monitoring Well

Standard Map Features

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Colorado Central Zone
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MAP ID: 01-0345/solar_pond.aml

March 27, 2001

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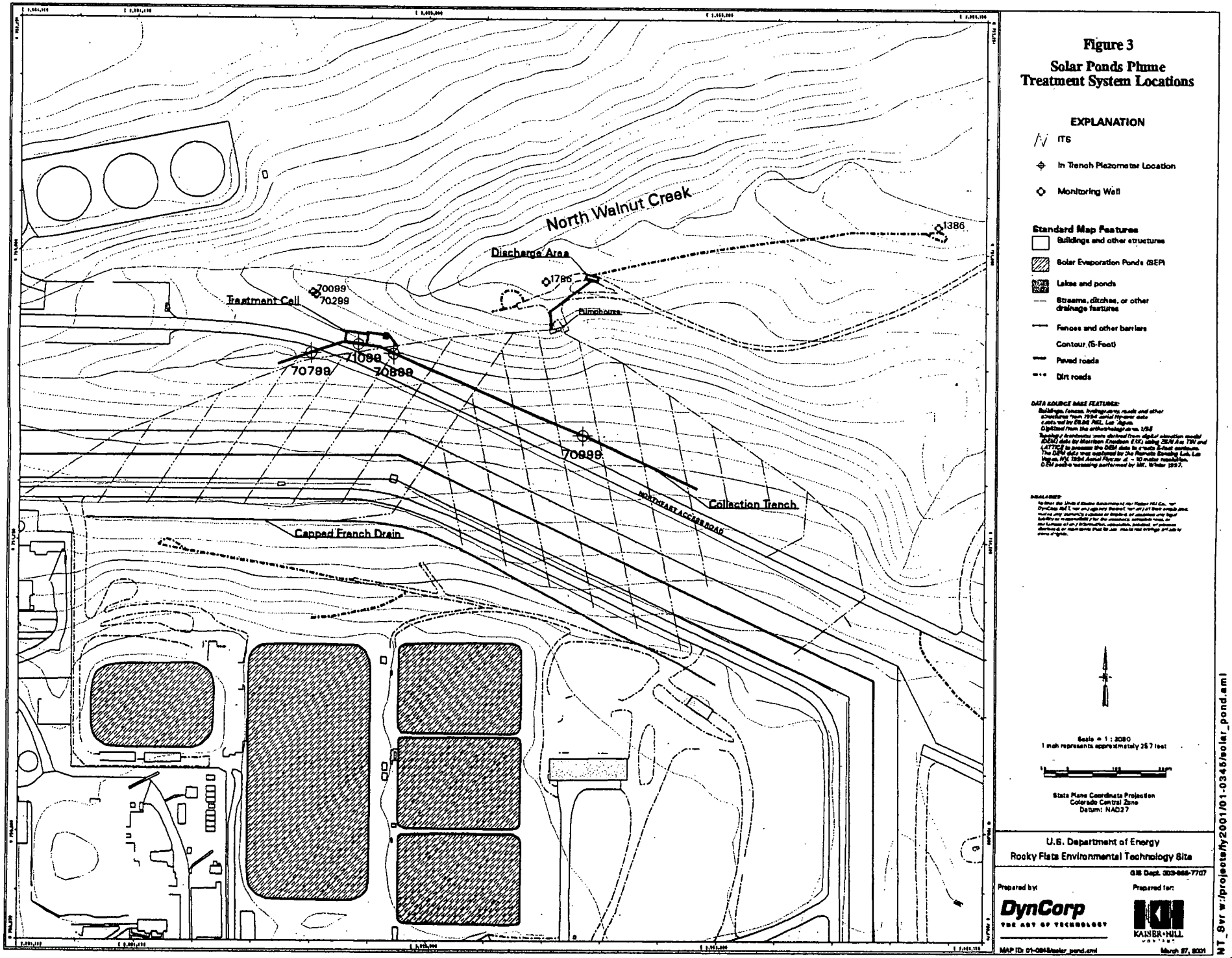

Figure 3
Solar Ponds Plume Treatment System Locations

EXPLANATION

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- Contour (5-Foot)
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

Buildings, fences, buildings etc., roads and other miscellaneous from 1994 aerial topographic data Lasers mail by EG&G RES, Las Vegas. Digitized from the orthorectified photo no. 1/58

Topography (contours) were derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using SEN A as TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Photos at a ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

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Scale = 1 : 2080
1 inch represents approximately 257 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: 01-0345/solar_pond.eml

March 27, 2001

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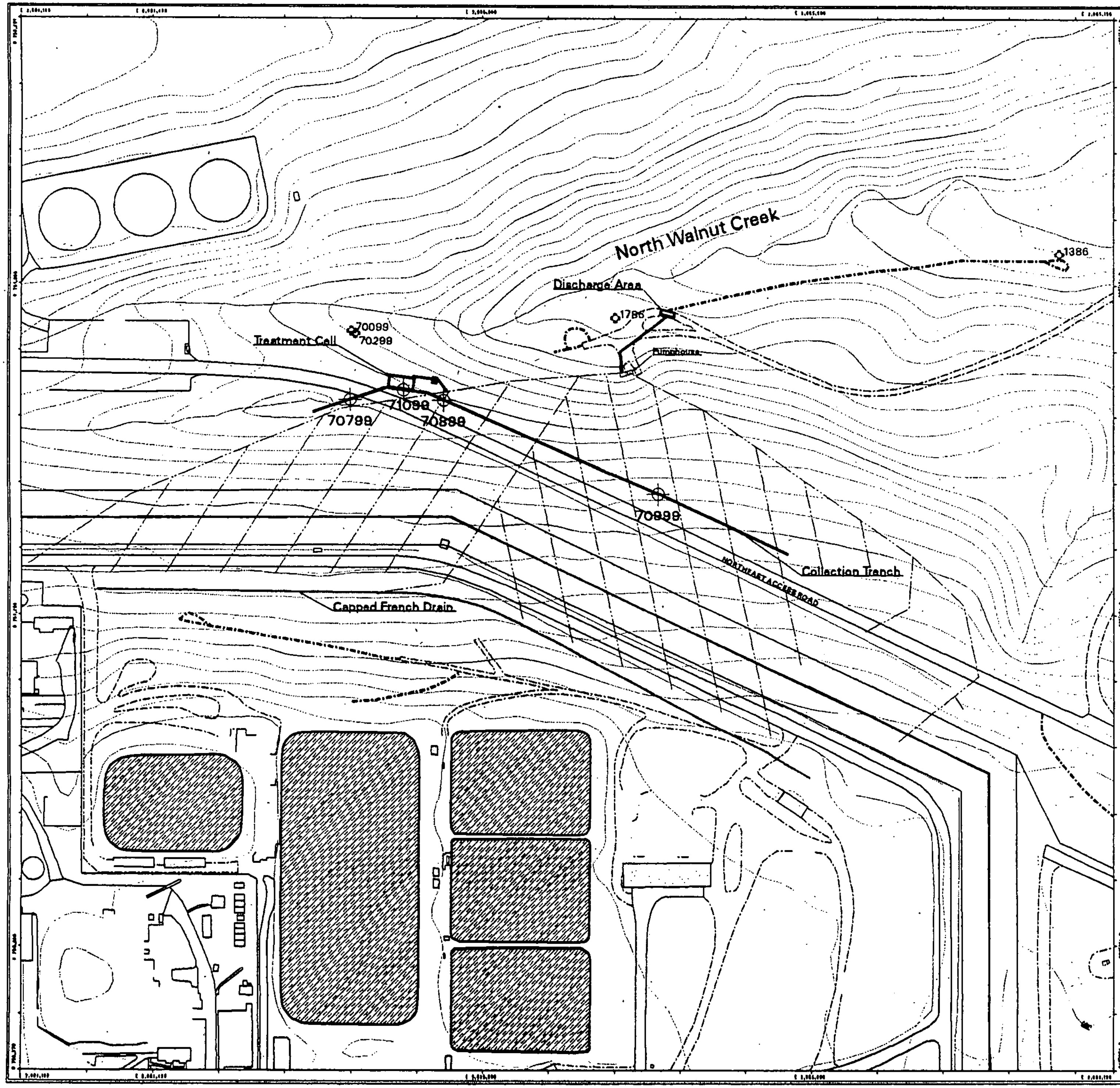

Figure 3

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EXPLANATION

- ITS
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- Monitoring Well

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Scale = 1 : 3080
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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 01-0345/solar_pond.aml

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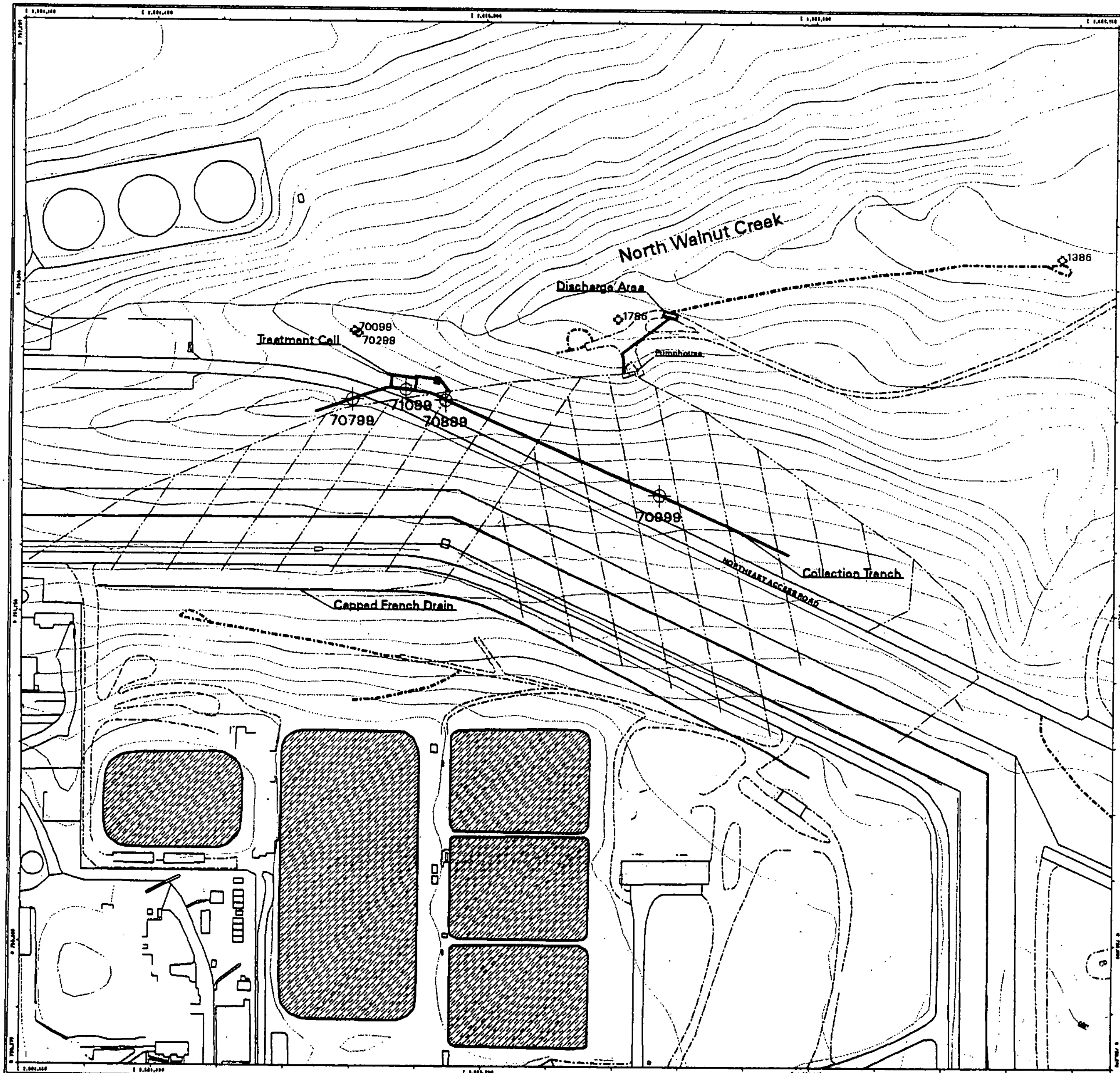

Figure 3
Solar Ponds Plume Treatment System Locations

EXPLANATION

ITS

In Trench Piezometer Location

Monitoring Well

Standard Map Features

Buildings and other structures

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March 27, 2001

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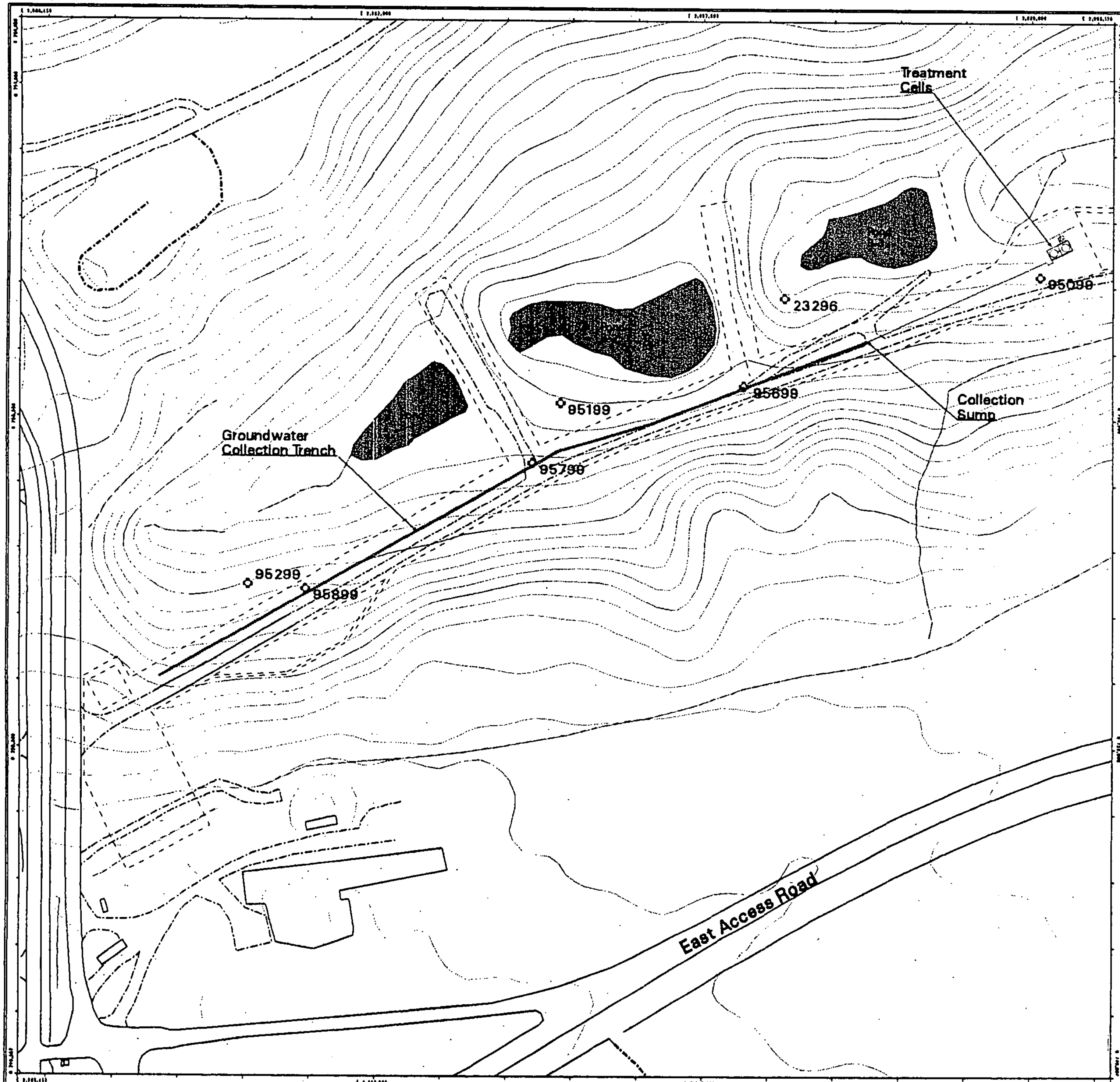

Figure 2
East Trenches Plume Treatment System Locations

EXPLANATION

- Surface Water Drainage
- Collection Trench
- Monitoring Well

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2580
1 inch represents 215 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Rocky Flats Environmental Technology Site

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MAP ID: 01-0346/east_trench.aml

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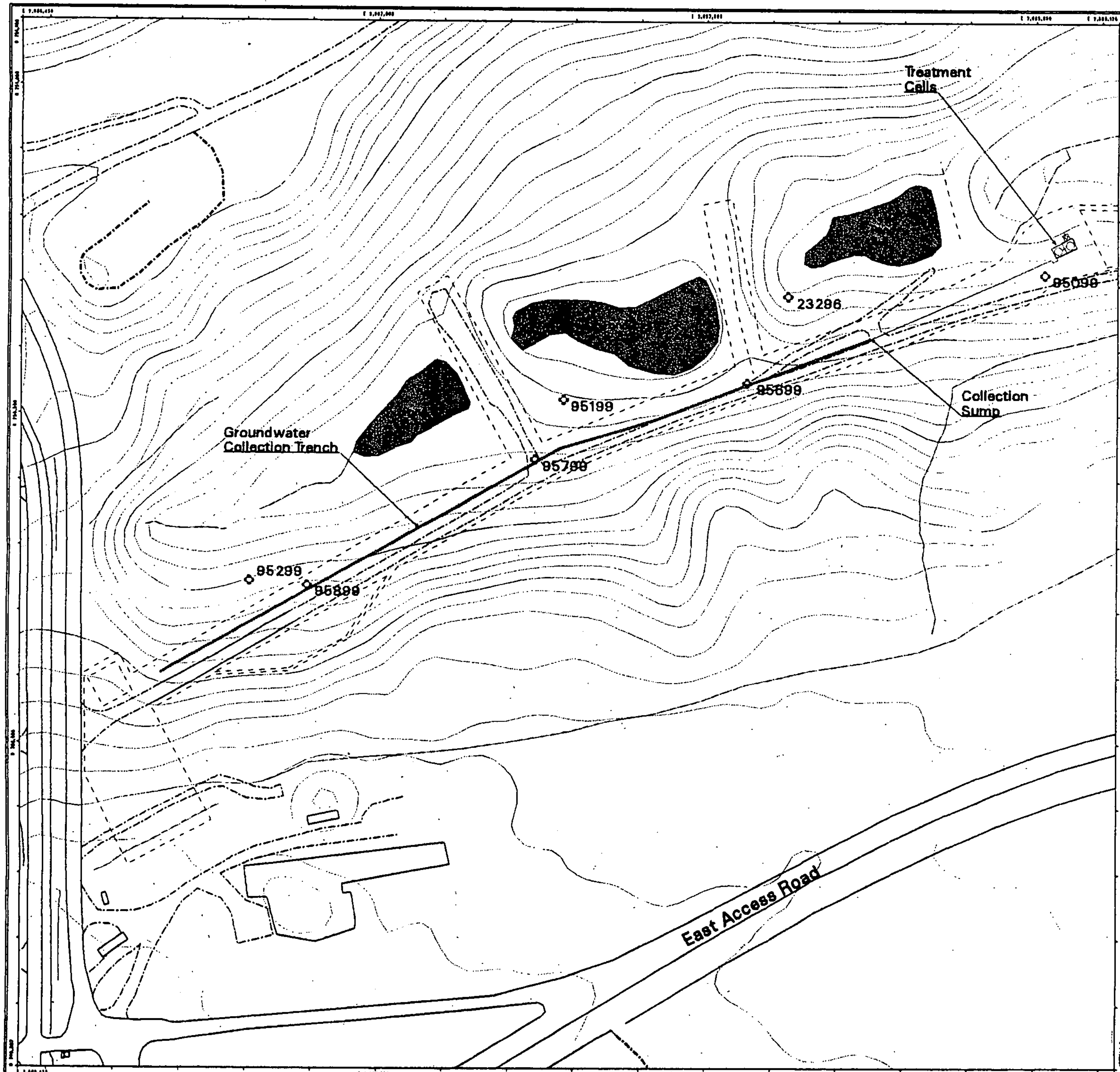

Figure 2
East Trenches Plume Treatment System Locations

EXPLANATION

- Surface Water Drainage
- Collection Trench
- Monitoring Well

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2580
1 inch represents 215 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by: DynCorp THE ART OF TECHNOLOGY

Prepared for: KAISER-HILL COMPANY

MAP ID: 01-0346/east_trench.aml

March 07, 2001

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