Nevada
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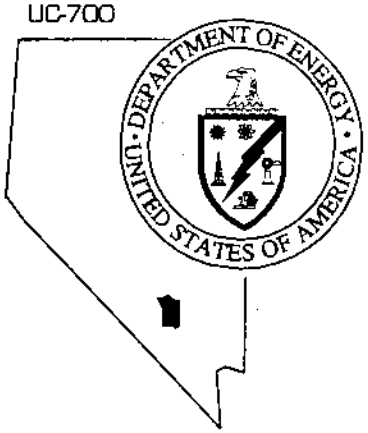
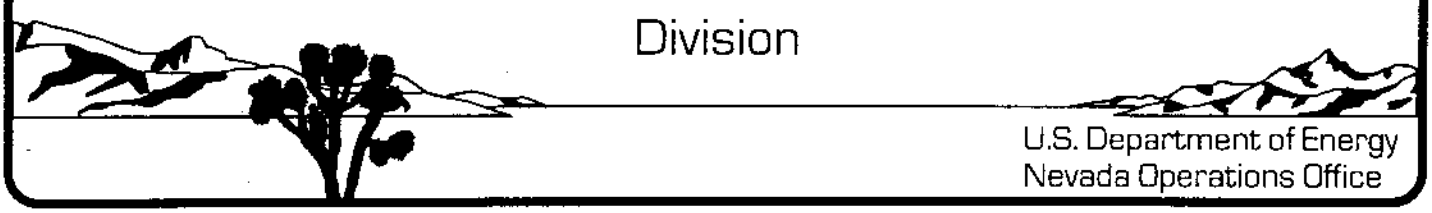


Rulison Site Corrective Action Report

September 1996

Environmental Restoration
Division



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RULISON SITE
CORRECTIVE ACTION REPORT

DOE Nevada Operations Office
Las Vegas, Nevada

September 1996

RULISON SITE
CORRECTIVE ACTION REPORT

Submitted by: Janet Appenzeller-Wing Date: 9/26/96
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List of Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
AQTESOLV	Aquifer Test Solver software program
BGS	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAP	Corrective Action Plan
CDPHE	Colorado Department of Public Health and Environment
cm/sec	Centimeter(s) per second
Cr	Chromium
DOE	U.S. Department of Energy
ERDA	U.S. Energy Research and Development Administration
ft	Foot (feet)
gpm	Gallon(s) per minute
HDPE	High-density polyethylene
in.	Inch(es)
IT	IT Corporation
km	Kilometer(s)
LTGMP	Long-Term Groundwater Monitoring Plan
m	Meter(s)
m^3	Cubic meter(s)
MCC	Maximum concentration of contaminants
MCL	Maximum contaminant level
mg/kg	Milligram(s) per kilogram
mg/L	Milligram(s) per liter
mi	Mile(s)
MS/MSD	Matrix spike/matrix spike duplicate
OTP	Organic Toxic Pollutants
pCi/g	PicoCurie(s) per gram
pCi/L	PicoCurie(s) per liter
PID	Photoionization detector
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act

SGZ	Surface ground zero
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
μg/kg	Microgram(s) per kilogram
μg/L	Microgram(s) per liter
VSAP	Verification Sampling and Analysis Plan
yd^3	Cubic yard(s)

1.0 Introduction

This Corrective Action Report describes the cleanup of petroleum hydrocarbon- and heavy-metal-contaminated sediments from an old drilling effluent pond and characterization of the mud pits used during drilling of the R-EX well at the Rulison Site. The Rulison Site is located approximately 65 kilometers (km) (40 miles [mi]) northeast of Grand Junction, Colorado. The effluent pond was used for the storage of drilling mud during drilling of the emplacement hole for the 1969 gas stimulation test conducted by the U.S. Atomic Energy Commission (AEC). The cleanup activities described in this report were conducted between August and mid-November of 1995 and were undertaken voluntarily by the U.S. Department of Energy (DOE) to clean up the contaminated pond sediments to meet State of Colorado and Federal soil quality standards and guidelines.

The cleanup activities were governed by the approved draft Rulison Corrective Action Plan (CAP) (DOE, 1995a), the draft Rulison Verification Sampling and Analysis Plan (VSAP) (DOE, 1995b), the draft Rulison Long-Term Groundwater Monitoring Plan (LTGMP) (DOE, 1995c), and the Rulison Quality Assurance Project Plan (QAPP) (DOE, 1995d). The project work plans were reviewed by the Colorado Department of Public Health and Environment (CDPHE), and their comments and concerns about the plans were addressed satisfactorily. However, the CDPHE desired to have the landowner review the plans prior to issuing formal approval. Project schedules were timed to complete the work within the seasonal window and for this reason work was commenced prior to receiving formal CDPHE approval of the plans. The plans were subsequently approved by the CDPHE without modification, and were issued as final documents in July 1996.

This report also describes the activities performed to determine whether contamination is present in mud pits used during the drilling of well R-EX, the gas production well drilled at the site to evaluate the effectiveness of the detonation in stimulating gas production. The investigation activities described in this report were conducted during the autumn of 1995, concurrent with the cleanup of the drilling effluent pond. This report describes the activities performed during the soil investigation and provides the analytical results for the samples collected during that investigation.

1.1 Roles and Responsibilities

The specific roles and responsibilities of DOE, IT Corporation (IT), and subcontractor personnel involved with the field work described in this report are described in the Rulison VSAP (DOE, 1995b). In addition to the personnel identified in the Rulison VSAP (DOE, 1995b), the IT Construction Manager was responsible for overseeing and directing the excavators and laborers performing the sediment excavation, stabilization, and removal work.

With the exception of the first week in October 1995, the DOE Site Manager was on site to provide approval of the work being conducted. In addition, the DOE Site Manager was responsible for providing technical input to the project, communicating with the CDPHE representative on issues and the status of the work being done, and interacting with the local public and press. The CDPHE representative visited the site periodically to observe the work.

2.0 Site Identification and Description

The Rulison Site is located in the North ½ of the Southwest ¼ of Section 25, Township 7 South, Range 95 West, Garfield County, Colorado, approximately 19 km (12 mi) southwest of Rifle, Colorado, and approximately 65 km (40 mi) northeast of Grand Junction, Colorado (Figure 2-1). The site is situated on the north slope of Battlement Mesa, on the upper reaches of Battlement Creek, at an elevation of approximately 2,500 meters (m) (8,200 feet [ft]). The valley in which the site is located is open to the north-northwest, and is bounded on the other three sides by steep mountain slopes that rise to elevations above 2,927 m (9,600 ft). A detailed description of the site's physical and environmental setting is presented in the Draft *Corrective Action Plan, Rulison Drilling Effluent Pond* (CAP) (DOE, 1995a).

Project Rulison was a joint AEC and Austral Oil Company (Austral) experiment, conducted under the AEC's Plowshare Program, to evaluate the feasibility of using a nuclear device to stimulate natural gas production in low-permeability gas-producing geologic formations. The experiment was conducted on September 10, 1969, and consisted of detonating a 40-kiloton nuclear device at a depth of 2,568 m (8,426 ft) below ground surface (BGS). Natural gas production testing was conducted in 1970 and 1971.

The site was deactivated by the AEC and Austral in 1972. Cleanup associated with site deactivation consisted of removing all equipment and materials not needed for potential future gas production activities, and characterizing the site's radiological condition through extensive surface soil sampling. In 1977, the site was abandoned by the U.S. Energy Research and Development Administration (ERDA), the successor agency to the AEC and predecessor to DOE, and Austral, since neither ERDA nor Austral planned on commercially producing gas from the site. Cleanup associated with site abandonment consisted of removing all remaining equipment and materials, plugging the emplacement (R-E) and reentry (R-EX) wells (Figure 2-2), backfilling the mud pits adjacent to the R-EX well, removing the tritium-contaminated soils, and further characterizing the radiological condition of the site through extensive surficial soil sampling. Detailed descriptions of the site deactivation and abandonment activities and radiological characterizations are presented in the *Rulison Site Cleanup Report* (AEC, 1973), the *Project Rulison Well Plugging and Site Abandonment Final Report* (ERDA, 1977), and the *Rulison Radiation Contamination Clearance Report* (Eberline, 1977).

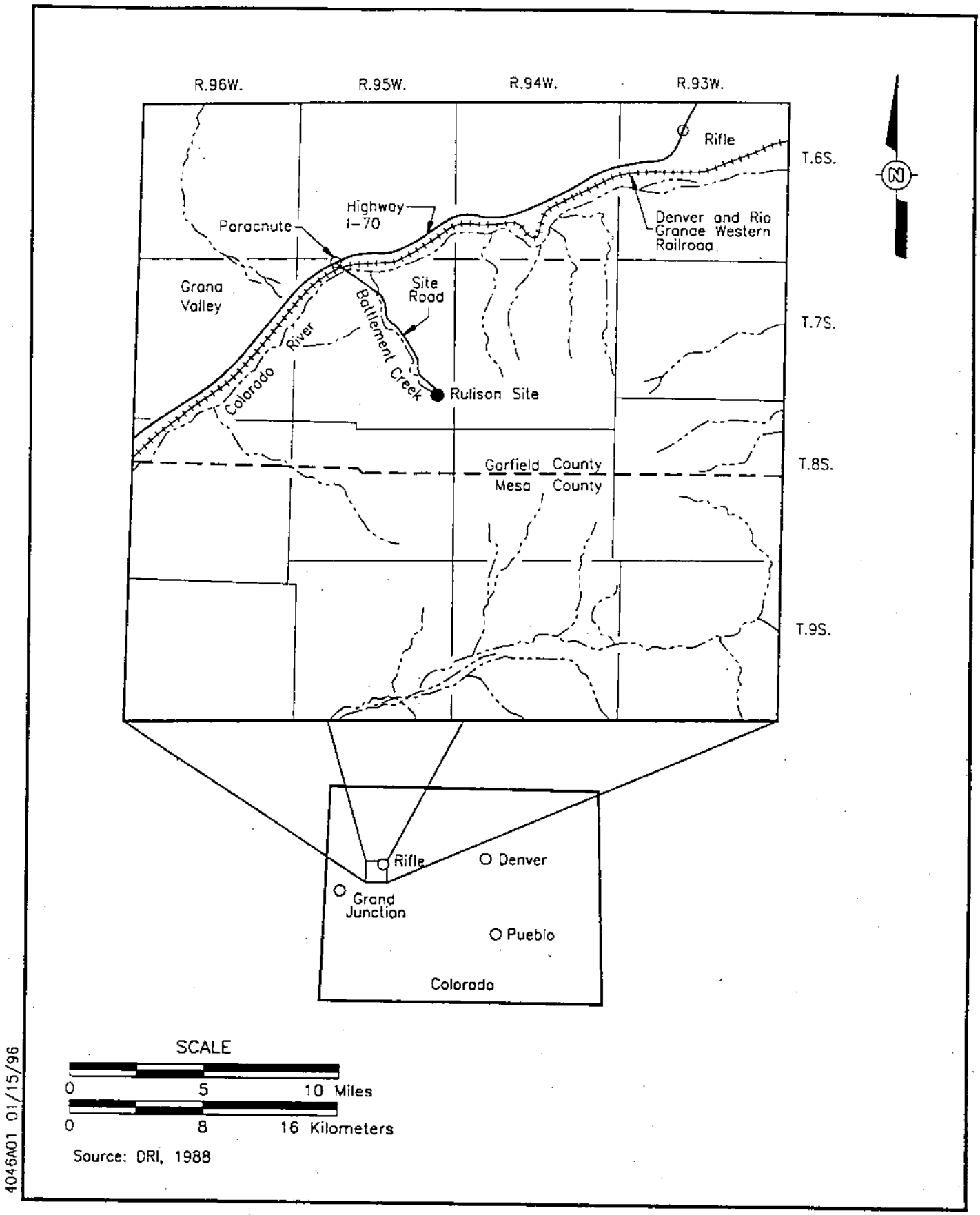

Figure 2-1
Rulison Site Location Map

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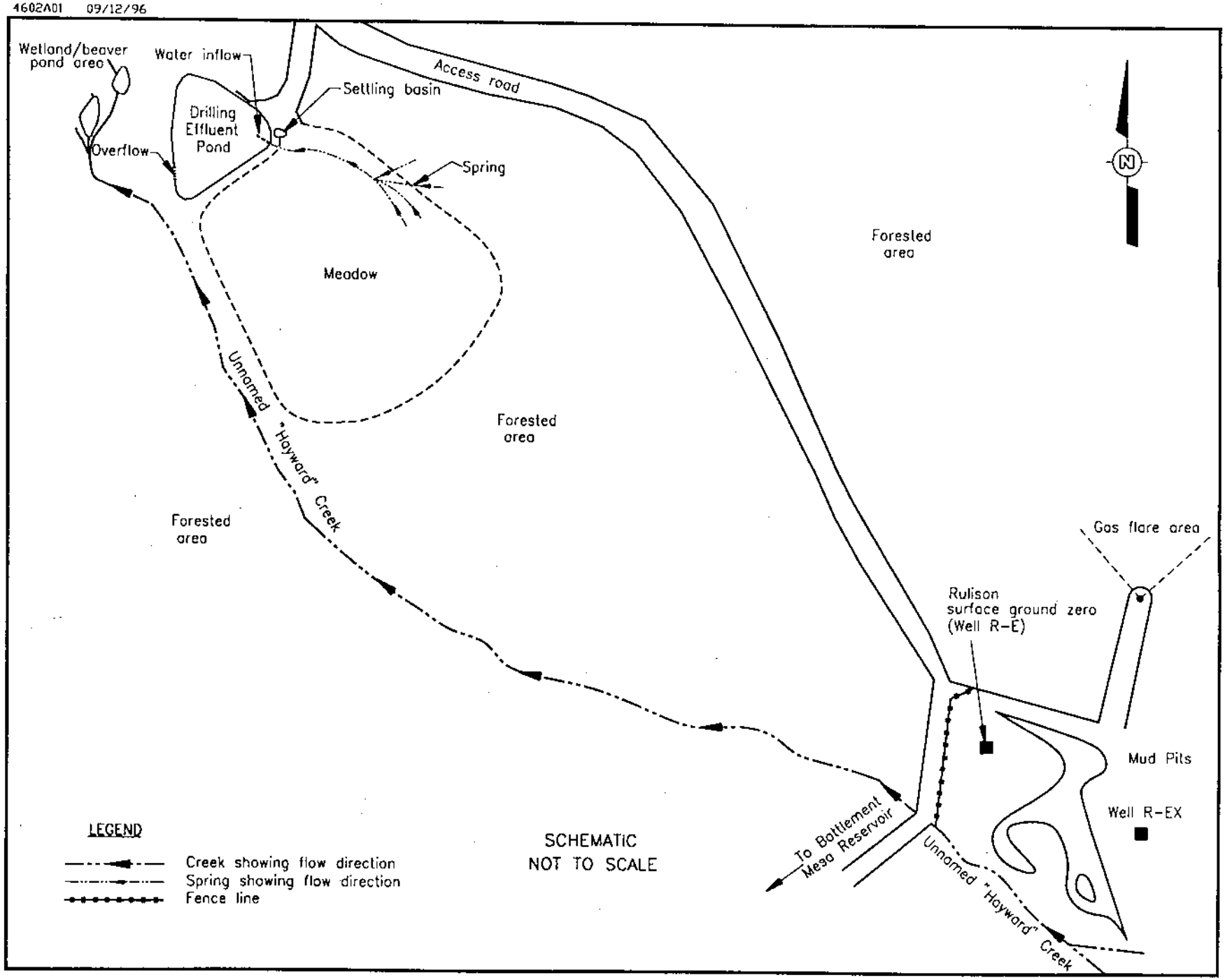

Figure 2-2
Rulison Site Map

2.1 Drilling Effluent Pond

The drilling effluent pond is an engineered structure located approximately 400 m (1,312 ft) north-northwest of the surface ground zero (SGZ) emplacement well (Well R-E) (Figure 2-2). The pond covers approximately 0.5 hectare (1.2 acres) as measured at the top of the berm, is triangular in shape, and is approximately 6 m (20 ft) deep from the top of the berm to the pond bottom.

The drilling effluent pond was used to store nonradioactive drilling fluids generated during drilling of the device emplacement well R-E. The drilling fluids consisted of bentonite drilling mud with additives such as diesel fuel and chrome lignosulfonate, used to improve drilling characteristics. Most of the drilling wastes were removed from the pond when the site was cleaned up and decommissioned in 1976; however, some drilling fluid was left in the pond. At the request of the property owner, the pond structure was left in place following completion of site decommissioning and was subsequently converted by the property owner to a freshwater holding pond containing aquatic vegetation, amphibians, and stocked rainbow trout.

In 1994 and 1995, four pond sediment sampling events were conducted to evaluate the extent of residual contamination from drilling wastes remaining in the pond. During the four sampling events, a total of 17 pond sediment samples, seven pond water samples, one stream sediment sample, one stream water sample, one spring water sample, five soil samples, and three fish tissue samples were collected. Concentrations of total petroleum hydrocarbons (TPH) and chromium were found in 11 pond sediment samples and the 5 soil samples taken from the old settling basin located adjacent to the pond. One pond sediment sample also contained elevated levels of lead, and elevated levels of barium were found in four of the soil samples collected from the settling basin and in one of the pond sediment samples. None of the analytes measured in the pond water, stream water, or spring water samples exceeded regulatory limits. A more detailed discussion of the 1994 and 1995 sampling events is presented in the Rulison CAP (DOE, 1995a).

Based on the results of the 1994 sampling events, the DOE decided to conduct a voluntary cleanup action at the drilling effluent pond to reduce the levels of TPH and chromium in pond sediments and soils in and adjacent to the pond.

2.2 Surface Ground Zero Area

The soil samples collected from the SGZ area during the 1972 site deactivation and 1976 site abandonment activities were only analyzed for radiological constituents. Because historical

records and data from the well R-E drilling effluent pond indicated that the fluids used for drilling well R-E contained non-radioactive contaminants (mainly TPH and chromium), which were not previously analyzed for, the DOE decided to conduct a soil investigation in the vicinity of the R-EX well mud pits to evaluate the potential extent of non-radioactive contamination associated with storing the drilling fluids for that well.

3.0 Corrective Action Description

The cleanup alternative selected for the Rulison Site drilling effluent pond was sediment stabilization and disposal at an approved landfill. The cleanup consisted of the following activities:

- Removing the fish from the pond and transplanting them to Hayward Creek or the beaver ponds
- Draining the pond
- Construction dewatering as necessary
- Excavating and stabilizing the contaminated pond sediments
- Transporting the stabilized sediments to an approved solid waste landfill for disposal
- Installing groundwater monitoring wells
- Restoring the pond and other areas which had been disturbed by the cleanup operation

The Rulison CAP (DOE, 1995a), VSAP (DOE, 1995b), LTGMP (DOE, 1995c), and QAPP (DOE, 1995d) (collectively referred to as the project Work Plans in this document) provide detailed discussions of the selected cleanup alternative. The cleanup, as implemented at the site, was governed by the approved project Work Plans. A number of variances from the approved project Work Plans occurred in response to field conditions and as a result of efforts to maximize the efficiency, performance, and cost-effectiveness of the cleanup. A list of these variances, including the rationale and justification for each change, is presented in Appendix A. Significant variances are also discussed in the text.

A total of five separate laboratories were used to conduct the analyses described in this report. The initial laboratory selected was unable to perform the analytical method specified for TPH in the Rulison QAPP (DOE, 1995d) (modified SW-846 Method 8015A). Instead, the laboratory used EPA Method 418.1 for the TPH analyses. While Method 418.1 is able to quantitate TPH concentrations at levels significantly below the cleanup criteria specified in the Rulison CAP (DOE, 1995a), it generally is not capable of distinguishing between gasoline, diesel, and other forms of TPH. Use of this laboratory was discontinued after the funds allocated to it for analyses were exhausted. The TPH concentrations determined using Method 418.1 are indicated as "nonspecific TPH" on the tables presented in this report.

3.1 Pond Draining and Construction Dewatering

Prior to draining the pond, a dam was constructed to divert surface water flow from the spring to Hayward Creek using a flexible 10-centimeter (cm) (4-inch [in.]) high-density polyethylene (HDPE) pipe (Figure 3-1). For the initial pond draining effort, two pumps were used with floating intakes, and the discharge was routed to the riprap slope of the pond outfall, outside the southwest corner of the pond berm. The discharge was routed to the riprap rather than directly to the adjacent stream to minimize the potential for stream erosion. The pond dewatering pumps were operated continuously for five days; then a third, smaller volume pump was added. The three pumps were operated continuously for another three days, at which time the water level in the pond became low enough to cause concern about picking up contaminated sediments if pumping was continued at a high rate. The two original pumps were then removed, and the third, lower volume pump was operated intermittently at low pumping rates. The pond was completely drained approximately 12 days after the two pumps were removed. Approximately 14,025,000 liters (3,705,000 gallons) of water were pumped from the pond.

During the initial days of the pond draining activity, an attempt was made to capture the fish in the pond and transplant them to the adjacent stream and beaver ponds. Recreational fishing tackle with barbless lures was used to capture the fish. A total of 25 fish were captured and transplanted to the stream and beaver ponds. An additional 10 to 15 fish were found in the pond after it was completely drained. No State-listed tiger salamanders were observed in the pond during or after the pond-draining activity. Once the pond was drained, stabilization and removal of the contaminated sediments was initiated (see Section 3.2).

Once removal of the sediments began, the floor of the pond was quickly lowered to below the static groundwater level. To control the groundwater, a construction dewatering trench was excavated into the pond floor along the southeast berm, the hydraulically upgradient side of the pond (Figure 3-1). A water sample was collected from the trench before pumping began to determine whether treatment was necessary before discharge (see Section 3.1.1). Based on the analytical results of the sample, it was determined that treatment was not necessary, and the groundwater was pumped from the trench intermittently (and at varying pumping rates) each day and discharged to the riprap overflow channel located outside of the southwest corner of the pond.

Discharge of the pond water and construction dewatering effluent to the adjacent stream was permitted by the Colorado Department of Public Health and Environment under the Colorado Water Quality Control Act (Permit Number COG-310084, as modified). The permit also

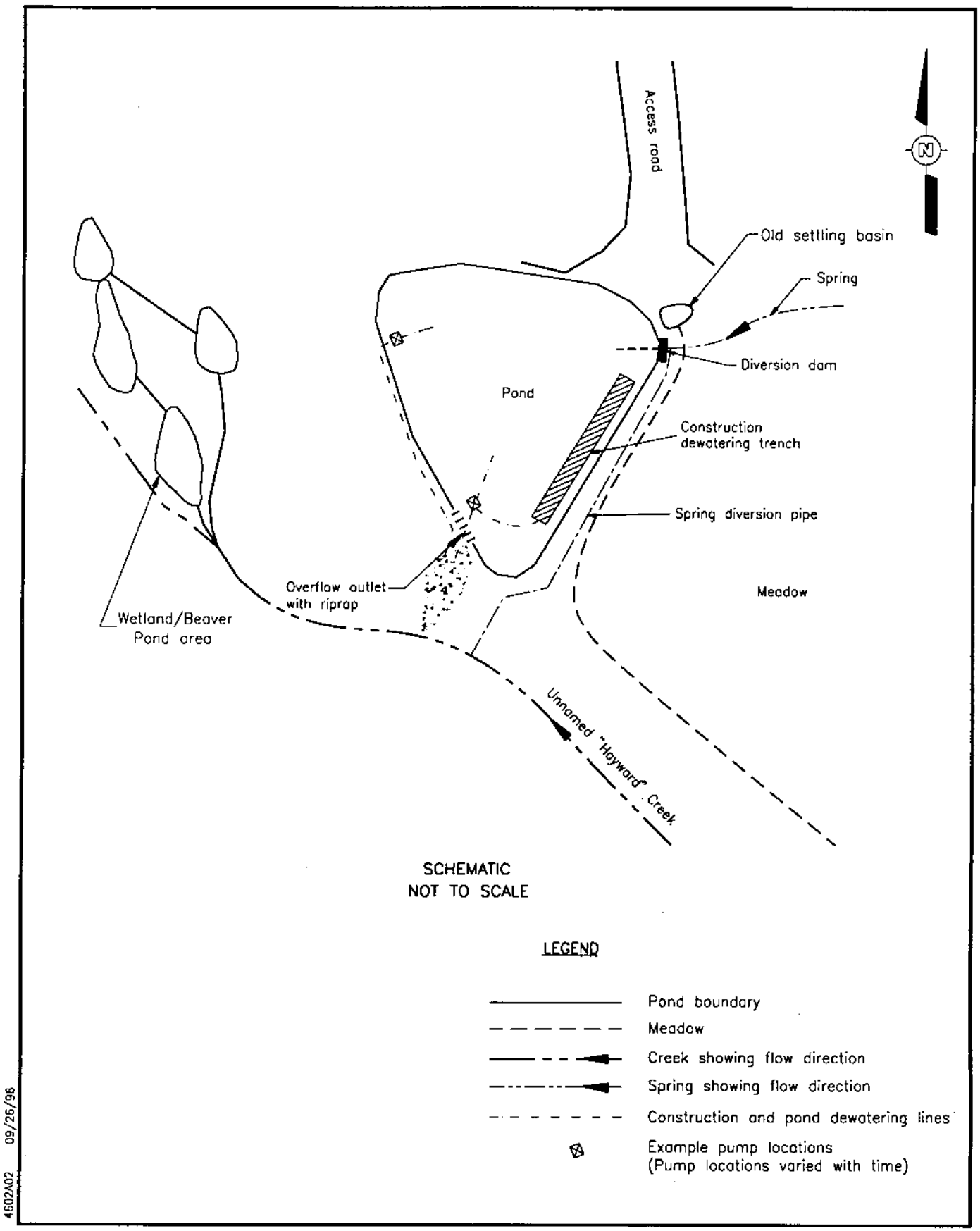

Figure 3-1
Rulison General Site Layout Diagram
Pond Water Discharge System

specified the analytes and sampling frequency for discharge monitoring, which superseded what was specified in the Rulison CAP (DOE, 1995a) and VSAP (DOE, 1995b). The permit is included in Appendix B.

3.1.1 Pond Draining and Construction Dewatering Analytical Results

The pond water discharge was sampled three times as required by the water discharge permit: once at the beginning of the operation, once approximately five days after pumping started, and once after the two pumps were removed and the flow from the third pump was reduced. After the analytical results from the third sample were received, the laboratory was instructed to filter the remaining sample volume and reanalyze it for chromium and iron to determine whether those metals, which exceeded permit criteria in the original unfiltered sample, were present as dissolved species. Both dissolved chromium and dissolved iron were below their respective discharge criteria in the reanalyzed sample.

The groundwater that infiltrated into the pond during sediment stabilization was sampled four times: twice from the ponded water before the dewatering trench was excavated, once from the dewatering trench before pumping began to determine if treatment was required before discharge, and once from the dewatering pump discharge.

Pond water and construction dewatering discharge sampling was conducted in accordance with the Rulison VSAP (DOE, 1995b) and QAPP (DOE, 1995d). The analytical data from these samples are presented in Table 3-1 and Appendix C along with a list of the discharge criteria for the analytes specified under the permit. The analytical results were communicated to the CDPHE Water Quality Control Division (WQCD) in Discharge Monitoring Reports during the field work. Results of the samples indicated exceedances of several permit discharge criteria. These exceedances were discussed with the CDPHE WQCD by the DOE, with the result that no enforcement action is pending or forthcoming, as documented in the correspondence included in Appendix C.

The sample digestion procedure used by the laboratory for chromium, iron, and zinc analyses was not the procedure normally used for total recoverable metals analyses (SW-846 Method 3005A, "Acid Digestion of Waters for Total Recoverable or Dissolved Metals Analysis by FLAA or ICP Spectroscopy"). A microwave digestion procedure was used for total recoverable metals analyses (SW-846 Method 3015, "Microwave-Assisted Acid Digestion of Aqueous Samples and Extract"). The microwave digestion procedure uses a stronger acid than the standard total recoverable metals procedure, so the concentrations reported for chromium, iron, and zinc are at least as high as, if not higher than, the total recoverable concentrations of those analytes in the samples.

Table 3-1
Pond Draining and Construction Dewatering Analytical Results

		Pond Dewatering Samples							
IT Corp ID#	Permit Criterion	RU00100		RU00102		RU00115		RU00115	
Date Collected		8/2/95		8/7/95		8/11/95		8/11/95	
Sample Location		Pond Water		Pond Water		Pond Water		Reanalysis	
		Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS:	µg/L	µg/L		µg/L		µg/L		µg/L	
Chromium	50	3.3	U	4.4	B	***131***		35.9	
Iron	1000	201		113		***1660***		84.1	
Dissolved Lead [a]	31	2.0	U	2.0	U	7.6		na	
Mercury	2	0.20	U	0.20	U	0.20	U	na	
Zinc	10	6.8		4.0		***20.2***		na	
ORGANICS: [b]	µg/L	µg/L		µg/L		µg/L		µg/L	
Benzene	1	1	U	1	U	1	U	na	
Toluene	NS	5	U	5	U	5	U	na	
Ethylbenzene	NS	5	U	5	U	3	J	na	
Total Xylene	NS	5	U	5	U	6	J	na	
Organic Toxic Pollutants	NS					ND *		na	
TPH:	mg/L	mg/L		mg/L		mg/L		mg/L	
Nonspecific	10	5.0	UJ	0.5	UJ	6.46		na	
Diesel	10	na		na		na		na	
INORGANICS:	mg/L	mg/L		mg/L		mg/L		mg/L	
Total Dissolved Solids	NS	380		393		380		na	
Total Suspended Solids	30/45 [c]	4.0		3.0		49.0		na	
pH	6.5 - 9.0	8.2		8.1		7.8		na	

		Construction Dewatering Samples							
IT Corp ID#	Permit Criterion	RU-CDW-01		RU-CDW-03		RU-CDW-05		RU-CDW-06	
Date Collected		9/15/95		9/15/95		9/27/95		10/5/95	
Sample Location		Pond Water		Pond Water		Pond Water		Pond Water	
		Conc.	Q	Conc.		Conc.		Conc.	
METALS:	µg/L	µg/L		µg/L		µg/L		µg/L	
Chromium	50	na		na		10	U	13	
Iron	1000	na		na		660		***4100***	
Dissolved Lead [a]	31	na		na		31	U	31	U
Mercury	2	na		na		0.20	U	na	
Zinc	10	na		na		20	U	***28***	
ORGANICS: [b]	µg/L	µg/L		µg/L		µg/L		µg/L	
Benzene	1	5	U	2	U	1.0	U	5.0	U
Toluene	NS	na		na		0.40	J	0.18	J
Ethylbenzene	NS	na		na		0.14	J	0.18	J
Total Xylene	NS	na		na		0.80	J	25	U
Organic Toxic Pollutants	NS	na		na		ND *			
TPH:	mg/L	mg/L		mg/L		mg/L		mg/L	
Nonspecific	10	na		na		1.0	U	na	
Diesel	10	na		na		na		0.44	
INORGANICS:	mg/L	mg/L		mg/L		mg/L		mg/L	
Total Dissolved Solids	NS	na		na		380		570	
Total Suspended Solids	30/45 [c]	na		na		14		140	
pH	6.5 - 9.0	na		na		7.7		7.5	J

Q=Data qualifier: U = Compound was analyzed but not detected above the specified limit; J = Reported value is estimated.
mg/L = milligrams per liter; µg/L = micrograms per liter
na = not analyzed; ND * = not detected. See Table B-2 for analytical quantitation limits..
NS = not specified

[a] Dissolved Lead analysis required under the discharge permit.

[b] Permit criterion for Total BTEX (benzene, toluene, ethylbenzene, and xylenes) = 100 ug/L

[c] 30/45 mg/L refers to 30 day average/7 day average

3.2 Pond Sediment Stabilization and Removal

Stabilization and removal of the contaminated pond sediments began once the pond was drained. Before beginning the full-scale sediment excavation and stabilization operation, tests were conducted at the site to determine the type of stabilizer to be used. These tests consisted of mixing cement and kiln dust with samples of the pond sediment and then testing the stabilized sediment for free liquids (using the paint filter test) and for pH to determine which stabilizer would be the most effective in binding up excess water. The results of this testing showed that kiln dust was as effective in stabilizing the sediments as cement and was considerably less costly than cement, so kiln dust was selected as the stabilizer. Both the cement and kiln dust were quite effective in absorbing free liquid, so it was decided that sediment drying or dewatering, as specified in the Rulison CAP (DOE, 1995a), was not necessary. It also was determined that mixing the stabilizer and sediment within the pond was more efficient and more cost-effective than using a pug mill. A pug mill was specified in the Rulison CAP (DOE, 1995a).

The stabilization and removal process generally progressed from east to west across the pond. Large track hoes were used to mix and excavate the initial (uppermost) "lift" of pond sediment to a depth where firm soils were encountered (approximately 1.2 to 1.8 m [4 to 6 ft] deep). Firm soil was considered to represent the pre-disposal pond floor (i.e., "native" soil) and was thought to be uncontaminated. The excavated material was thoroughly mixed in place using kiln dust as a stabilizer, with a kiln-dust-to-sediment volumetric mixing ratio of approximately 1:9. Once the sediment and kiln dust were thoroughly mixed, samples of the stabilized sediment were collected and analyzed for TPH, Toxicity Characteristic Leaching Procedure (TCLP) chromium, and TCLP benzene, at the frequency specified in the Rulison VSAP (DOE, 1995b). At the direction of the DOE Site Manager, some stabilized sediment samples were also analyzed for radionuclides during the initial stages of the removal operation. The objectives of the radiological analyses were to verify that the drilling mud was not contaminated with radionuclides resulting from the nuclear test, and to address potential public concerns about the presence of radiological contamination at the site. Radionuclide analyses were discontinued after the results from the first samples collected indicated that there were no radionuclides present in the stabilized sediments above natural background levels. The analytical results for the stabilized sediment samples are included in Appendix D. After mixing, the stabilized sediments were left in the pond to set up for one or two days before being transferred to a stockpile located north of the pond. The stockpile was then sampled and the stabilized sediments stored pending return of the analytical results. After the analytical results were received, the stabilized sediments were loaded from the stockpile into dump trucks and transported to the South Canyon Landfill for disposal. As each dump truck was being loaded, a sample was collected and analyzed for free liquids (using the

paint filter test) and for pH to ensure that the load met landfill acceptance criteria (passing the paint filter test, and a pH of between 2 and 12) before the truck was released from the site. All TPH, TCLP chromium, TCLP benzene, paint filter, and pH results met landfill disposal criteria.

After the initial lift of stabilized sediment was removed from the pond, the verification sample grid was established as specified in the Rulison VSAP (DOE, 1995b), and cleanup verification samples were collected (see Section 3.2.1). Excavation, stabilization, and removal of additional lifts of contaminated soil was conducted in areas where cleanup verification sample data or field observation indicated that contamination above cleanup criteria remained in the soils. Each additional lift of sediment removed was approximately 2 feet in thickness. After removal of each additional lift of stabilized soil, the verification sample grid was reestablished and cleanup verification samples were collected. This process continued until the results of the verification samples showed that the cleanup criteria had been met. In total, 1,923 cubic meters (m^3) (2,384 cubic yards [yd^3]) of kiln dust were used to stabilize the sediment, and 18,656 m^3 (24,400 yd^3) of stabilized sediment and soil were hauled to the landfill. The total volume of stabilized sediment transported to the landfill significantly exceeded the volume estimated in the Rulison VSAP (DOE, 1995b) because the depth of contamination exceeding cleanup criteria was greater than estimated.

3.2.1 Cleanup Verification Analytical Results

At the direction of the CDPHE representative overseeing the cleanup, the 37 cleanup verification soil sample locations proposed in the Rulison VSAP (DOE, 1995b) were augmented by 18 additional soil sample points. In addition, test pits were excavated at six locations along the pond berm to assess whether contamination was present in the berm soils. One cleanup verification sample location could not be sampled (location 39) because it was covered by infiltrating groundwater after the contaminated sediment was removed. Because the verification samples collected from locations adjacent to Location 39 were all below cleanup criteria, it was decided in the field that a sample from Location 39 was not necessary to demonstrate that cleanup goals for the pond had been met. The verification sample locations are shown on Figure 3-2.

The initial cleanup criteria used for the contaminants of concern in the pond sediments, as described in Section 3.7 of the Rulison CAP (DOE, 1995a), were 250 milligrams per kilogram (mg/kg) for TPH, 100 mg/kg for chromium, 100 mg/kg for lead, and 2,000 mg/kg for barium. The DOE entered into a series of negotiations with the CDPHE representative to raise the cleanup criterion for TPH in order to limit the amount of sediment and native soil requiring

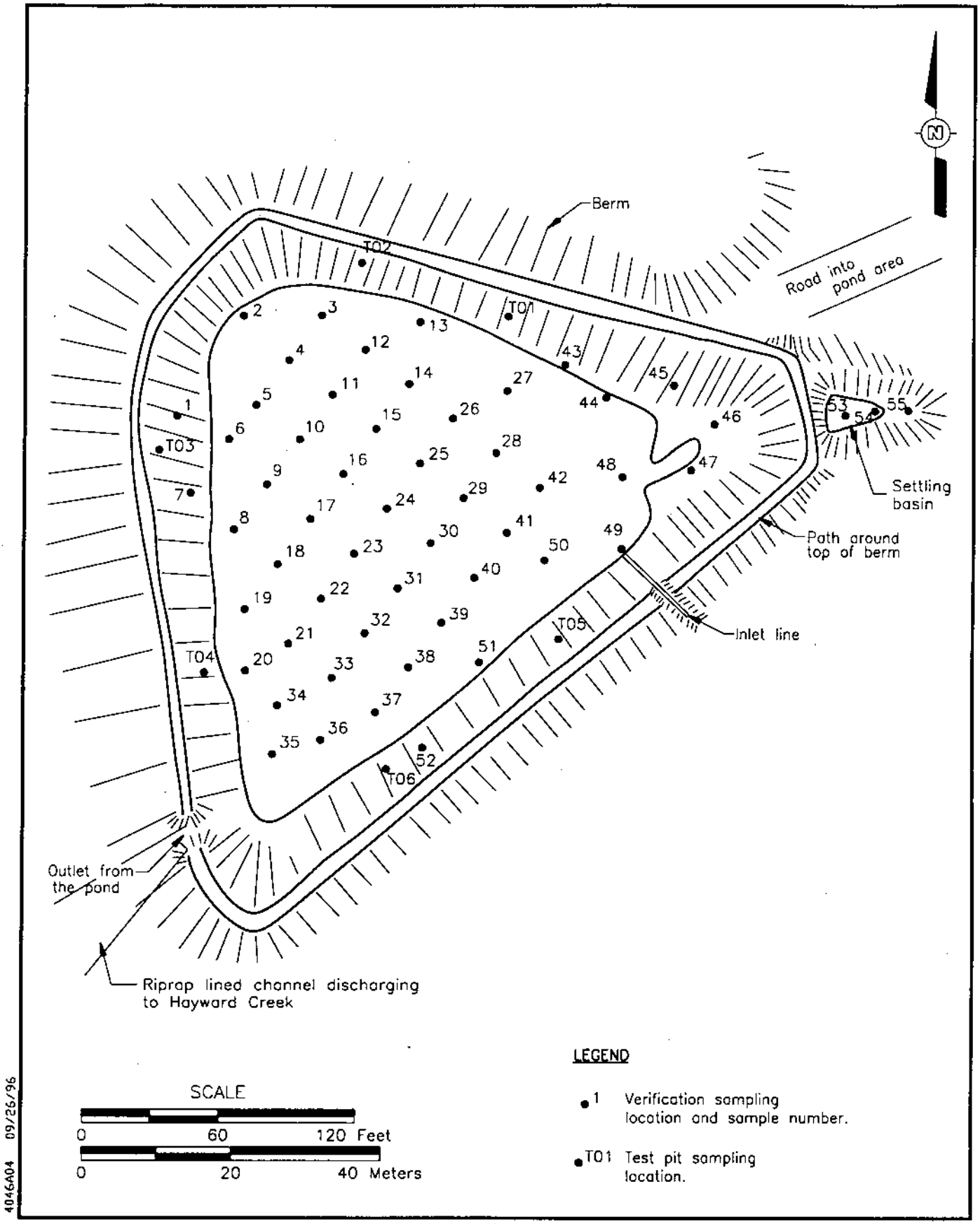

Figure 3-2
Rulison Drilling Effluent Pond
Verification Soil Sampling Locations

stabilization and removal, thus reducing the cost of the cleanup action. On October 17, 1995, the CDPHE representative overseeing the cleanup verbally authorized an increase in the TPH cleanup criterion to 1,000 mg/kg, to be supported by a risk assessment and an estimate of the area and volume of sediments remaining with TPH concentrations exceeding 250 mg/kg. A followup written notification from the CDPHE approving the 1,000 mg/kg TPH cleanup criterion variance was received by DOE on June 7, 1996. The written notification is included in Appendix E. This revised criterion was used to delineate the limits of excavation for the sediment and native soil removal.

All cleanup verification samples were analyzed for TPH, as specified in the Rulison VSAP (DOE, 1995b). The instructions used by field sampling personnel during verification sampling specified that samples were to be analyzed for TCLP benzene and TCLP metals, rather than for total concentrations of those contaminants as specified in the Rulison VSAP (DOE, 1995b). As a result, there are no cleanup verification analytical data available for total chromium, lead, and barium to compare against the cleanup criteria identified in the Rulison CAP (DOE, 1995a), although there are data for TCLP chromium, lead, and barium. However, pond sediment analytical data from the 1994 and 1995 sampling events suggest that TPH contamination and chromium contamination are correlated, in that there were no pond sediment samples that showed exceedence of the chromium cleanup criterion without a corresponding exceedence of the 1,000 mg/kg TPH criterion. As a consequence, TPH concentrations are considered to be an adequate indicator of whether the soils remaining in the pond meet the cleanup criteria for the metals.

As described in Section 3.2, cleanup verification samples were collected after each lift of stabilized sediment or native soil was removed. The TPH and TCLP chromium results for all cleanup verification samples are presented in Table 3-2, and all cleanup verification sample results, including TCLP metals and TCLP benzene data, are included in Appendix E. In these tables, the verification samples collected after removal of the original lift of contaminated sediment are numbered RU-VSS-xx, where xx is the sample location (see Figure 3-2). Locations where contamination above cleanup criteria remained after removal of the original lift were resampled after removal of each additional lift. These samples are numbered RU-VSS-xx-y, where y is the additional lift number. Samples numbered RU-VSS-xx-12 are duplicates of the samples collected at location(s) xx, and samples numbered RU-VSS-2xx are split samples collected at location(s) xx at the request of the CDPHE representative. The test pit samples are numbered RU-Txx-yy, where xx is the test pit number (see Figure 3-2) and yy is the depth (in inches) at which the samples were collected (several samples were collected from each test pit).

Table 3-2
Pond Cleanup Verification Analytical Results Total Petroleum Hydrocarbons, Toxicity Characteristic Leaching Procedure Chromium
(Page 1 of 2)

Sample ID#	RU-VSS-01	RU-VSS-01-1[1]	RU-VSS-01-2[1]	RU-VSS-02	RU-VSS-02-1[1]	RU-VSS-03-1[1]	RU-VSS-04-1[1]
Date Collected	9/7/95	9/9/95	10/13/95	9/7/95	9/9/95	9/9/95	9/9/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	1021J	na	na	700J	70J	685J
TPH-Diesel	1,600	na	22	1,700	na	na	na
TPH-Waste Oil	na	na	na	na	na	na	na
TCLP Cr (mg/L)	na	na	na	na	na	na	na

Sample ID#	RU-VSS-04-2[1]	RU-VSS-05-1[1]	RU-VSS-05-2[1]	RU-VSS-06-1[1]	RU-VSS-07-1[1]	RU-VSS-08	RU-VSS-08-1[1]
Date Collected	10/13/95	9/9/95	10/13/95	9/9/95	9/9/95	9/7/95	9/9/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	590J	na	138J	310J	na	10UJ
TPH-Diesel	160	na	33	na	na	260	na
TPH-Waste Oil	na	na	na	na	na	na	na
TCLP Cr (mg/L)	na	0.0033U	0.10U	na	na	0.0033U	na

Sample ID#	RU-VSS-09	RU-VSS-10-1[1]	RU-VSS-11-1[1]	RU-VSS-12[1]	RU-VSS-13	RU-VSS-13-1	RU-VSS-14[1]
Date Collected	9/7/95	9/9/95	9/9/95	10/13/95	10/14/95	10/19/95	10/13/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	176J	177J	na	na	na	na
TPH-Diesel	49	na	na	320	2600D	840	7.1
TPH-Waste Oil	na	na	na	na	25U	na	na
TCLP Cr (mg/L)	na	na	na	na	na	na	na

Sample ID#	RU-VSS-15[1]	RU-VSS-16[1]	RU-VSS-17[1]	RU-VSS-18	RU-VSS-19	RU-VSS-19-1	RU-VSS-20
Date Collected	10/13/95	10/12/95	10/12/95	10/12/95	10/12/95	10/18/95	10/12/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	180	25U	210	29	16,000	370	2,500
TPH-Waste Oil	na	25U	25U	na	na	na	na
TCLP Cr (mg/L)	0.10U	na	na	na	na	na	0.10U

Sample ID#	RU-VSS-20-1	RU-VSS-20-2	RU-VSS-21	RU-VSS-22	RU-VSS-23[1]	RU-VSS-24[1]	RU-VSS-25[1]
Date Collected	10/18/95	10/21/95	10/12/95	10/12/95	10/12/95	10/12/95	10/13/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	1,500	150	2.4U	370	25U	170	680
TPH-Waste Oil	na	na	na	na	25U	25U	na
TCLP Cr (mg/L)	na	na	na	na	na	na	0.10U

Sample ID#	RU-VSS-26[1]	RU-VSS-26-1	RU-VSS-27	RU-VSS-27-12	RU-VSS-28[1]	RU-VSS-29[1]	RU-VSS-29-1
Date Collected	10/13/95	10/18/95	10/14/95	10/14/95	10/13/95	10/13/95	10/18/95
Sample Location	pond floor	pond floor	pond floor	pond floor	pond floor	pond floor	pond floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	1,400	31	160	740	77	2000[2]	77
TPH-Waste Oil	na	na	25U	na	na	na	na
TCLP Cr (mg/L)	na	na	0.0037U	0.10U	na	na	na

Sample ID#	RU-VSS-30[1]	RU-VSS-31	RU-VSS-32	RU-VSS-33	RU-VSS-34	RU-VSS-34-1	RU-VSS-34-2
Date Collected	10/12/95	10/12/95	10/12/95	10/12/95	10/12/95	10/18/95	10/21/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	36	30[2]	170	340	1,400	1,700	140
TPH-Waste Oil	25U	na	na	na	na	na	na
TCLP Cr (mg/L)	0.0037U	na	na	na	na	na	na

Table 3-2
Pond Cleanup Verification Analytical Results Total Petroleum Hydrocarbons, Toxicity Characteristic Leaching Procedure Chromium
(Page 2 of 2)

Sample ID#	RU-VSS-34-12	RU-VSS-35[1]	RU-VSS-36	RU-VSS-37	RU-VSS-38	RU-VSS-40[1]	RU-VSS-41[1]
Date Collected	10/14/95	10/13/95	10/12/95	10/12/95	10/12/95	10/12/95	10/13/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	310	600	590	72	540	25U	240
TPH-Waste Oil	na	na	na	na	na	25U	na
TCLP Cr (mg/L)	0.10U	0.10U	na	na	na	0.0058U	0.10U

Sample ID#	RU-VSS-42[1]	RU-VSS-43	RU-VSS-44	RU-VSS-45	RU-VSS-46	RU-VSS-47	RU-VSS-48
Date Collected	10/13/95	10/19/95	10/19/95	11/01/95	11/01/95	11/01/95	10/19/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	49	170	470	45	21	67	790
TPH-Waste Oil	na	na	na	na	na	na	na
TCLP Cr (mg/L)	na	na	na	na	na	0.10U	na

Sample ID#	RU-VSS-49[1]	RU-VSS-49-12	RU-VSS-49-12S	RU-VSS-50[1]	RU-VSS-51[1]	RU-VSS-52	RU-VSS-53
Date Collected	10/13/95	10/14/95	10/14/95	10/13/95	10/12/95	10/12/95	11/6/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	110	350	120	1,000	60	2.4U	27
TPH-Waste Oil	na	na	25U	na	25U	na	na
TCLP Cr (mg/L)	na	0.10U	0.0048 B	0.10U	na	na	na

Sample ID#	RU-VSS-54	RU-VSS-55	RU-VSS-T01	RU-VSS-T01-07	RU-VSS-T01-19	RU-VSS-T02-15.5	RU-VSS-T02-23
Date Collected	11/6/95	11/6/95	9/21/95	9/21/95	9/21/95	9/20/95	9/20/95
Sample Location	pond floor	pond floor	Test Pit 01	Test Pit 01	Test Pit 01	Test Pit 02	Test Pit 02
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	60	38	na	300	330	20	40
TPH-Waste Oil	na	na	na	na	na	na	na
TCLP Cr (mg/L)	na	na	0.10U	na	na	na	na

Sample ID#	RU-VSS-T02-31.5	RU-VSS-T03-26	RU-VSS-T03-39	RU-VSS-T04	RU-VSS-T04-14	RU-VSS-T04-23	RU-VSS-T05-14
Date Collected	9/20/95	9/20/95	9/20/95	9/21/95	9/21/95	9/21/95	9/26/95
Sample Location	Test Pit 02	Test Pit 03	Test Pit 03	Test Pit 04	Test Pit 04	Test Pit 04	Test Pit 05
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	4.4	56	41	na	3,500	3,100	200
TPH-Waste Oil	na	na	na	na	na	na	na
TCLP Cr (mg/L)	na	na	na	0.10U	na	na	na

Sample ID#	RU-VSS-T05-24	RU-VSS-T05-30	RU-VSS-T06-7	RU-VSS-T06-15	RU-VSS-T06-22	RU-VSS-205	RU-VSS-215
Date Collected	9/26/95	9/26/95	9/26/95	9/26/95	9/26/95	10/13/95	10/13/95
Sample Location	Test Pit 05	Test Pit 05	Test Pit 06	Test Pit 06	Test Pit 06	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	14	2.5U	23	45	2.1U	30	240
TPH-Waste Oil	na	na	na	na	na	25U	25U
TCLP Cr (mg/L)	na	na	na	na	na	0.020U	0.0020U

Sample ID#	RU-VSS-225	RU-VSS-227	RU-VSS-235	RU-VSS-241	RU-VSS-247	RU-VSS-253	RU-VSS-255
Date Collected	10/13/95	10/14/95	10/13/95	10/13/95	11/1/95	11/6/95	11/6/95
Sample Location	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor	Pond Floor
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TPH-Nonspecific	na	na	na	na	na	na	na
TPH-Diesel	500	170	440	380	45	25U	25U
TPH-Waste Oil	24U	na	25U	24U	24U	25U	25U
TCLP Cr (mg/L)	0.0218	0.10U	0.020U	0.020U	0.020U	na	na

U = Compound was analyzed for but not detected above the specified limit
J = Reported value is estimated
D = TPH Diesel concentration for RU-VSS-13 is from a 1:5 dilution.
B = Concentration is greater than the instrument detection limit but less than the contract required detection limit
mg/kg = milligrams per kilogram; mg/L = milligrams per liter
[1]Validated sample
[2]Matrix interference experienced with this analysis
na = not analyzed

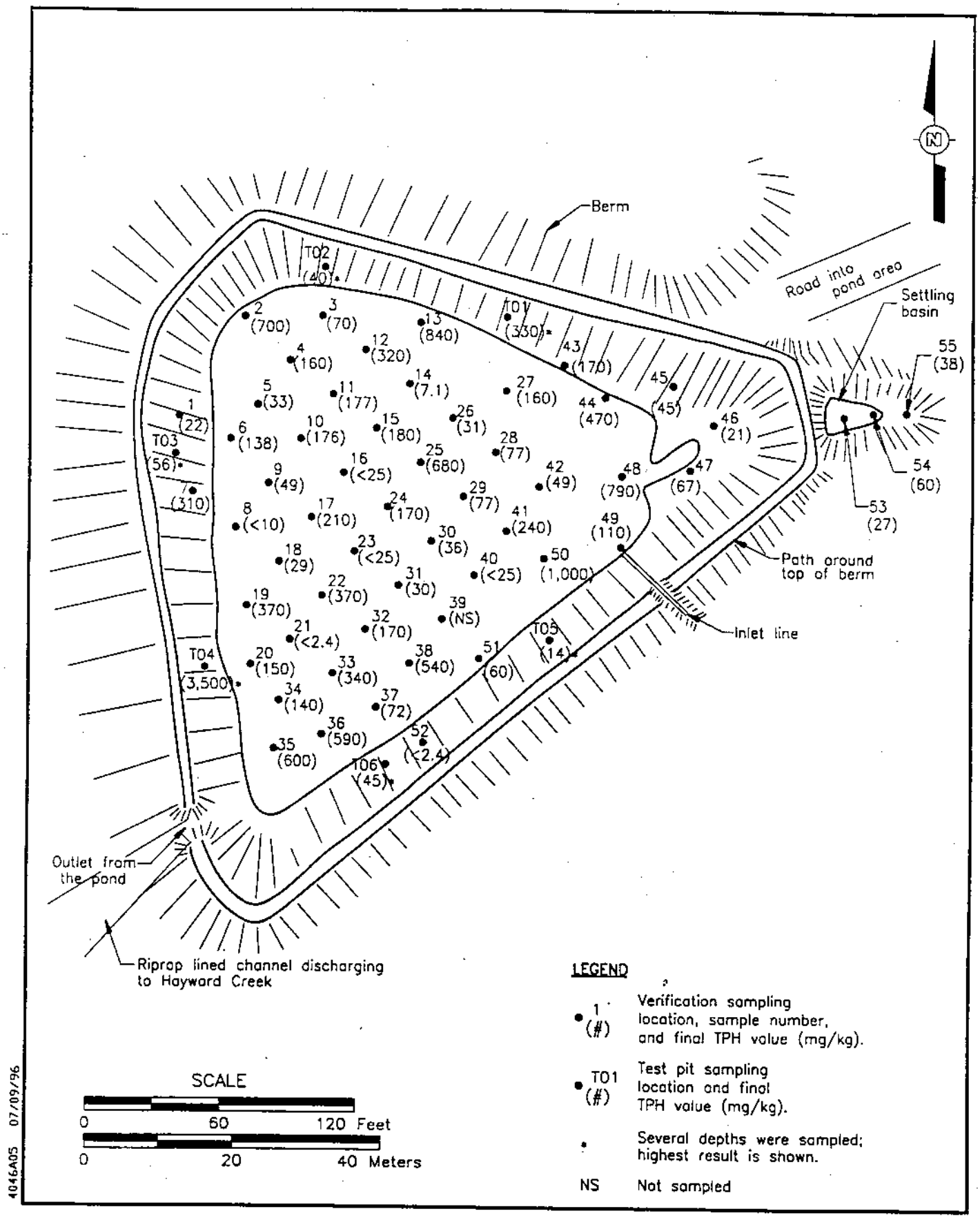

Figure 3-3
Verification Soil Sampling Locations and Total Petroleum Hydrocarbon Values

The TPH analytical results for the final (i.e., deepest) cleanup verification samples collected at each location are shown on Figure 3-3. With the exception of the samples from Test Pit T04, all final cleanup verification samples showed TPH concentrations equal to or less than the TPH cleanup criterion of 1,000 mg/kg, thus demonstrating the pond cleanup goals were met.

Visual observation and field screening data from Test Pit T04 indicated that the TPH contamination appeared to be confined to a thin layer of drilling mud. The mud layer was removed through additional excavation, but an additional verification sample was not collected from that location. However, based on the visual observations and field screening data, it is thought that any TPH contamination remaining at the Test Pit T04 location is well below 1,000 mg/kg.

3.3 Pond Restoration

Following verification that all soils remaining in the bottom and sides of the pond met the soil quality criteria specified for the site, the pond was restored in general accordance with Section 3.8 of the Rulison CAP (DOE, 1995a). The overall height of the berm was reduced, and material excavated from the top of the berm was used to backfill the pond. The pond was backfilled so the final depth was approximately 6 m (20 ft) below the top of the berm, and the pond sidewalls were graded to a 3:1 slope. A spillway was constructed at the southwest corner of the pond, approximately 4.3 m (14 ft) above the pond floor, to provide drainage from the pond. The elevation of the spillway was set at 3 m (10 ft) above the elevation of the ground surface at the toe of the outside slope of the berm to comply with Colorado Water Resources Division requirements for uncertified water retention structures. To ensure that the reconstructed pond is capable of retaining water, a Bentomat® geosynthetic clay liner was installed over the pond floor and sidewalls up to the elevation of the spillway. The Bentomat® liner consists of granulated bentonite sandwiched between two geosynthetic fabrics, and has a manufacturer's estimated permeability of less than 10^{-8} centimeters per second (cm/sec). To protect the Bentomat® liner from erosion and UV exposure, three-to-five-inch thick Kentucky Bluegrass sod was laid on the pond sidewalls, floor, and spillway. An as-built drawing of the pond is included as Plate 1.

As described in Section 3.8 of the Rulison CAP (DOE, 1995a), pond restoration was to include restoring water flow into the pond from the adjacent spring, reintroduction of aquatic vegetation, and restocking with trout. However, at the time the pond restoration activities were implemented, the property owner did not possess surface water rights to the spring to be used to

fill the pond, so flow from the spring into the pond was not restored. However, subsequent to completion of the cleanup operations, the landowner was granted temporary use of the spring to refill the pond, and as of February 1996 the pond has been filled. Restocking of the pond with trout currently is scheduled for the summer of 1997.

4.0 Surface Ground Zero Area Investigation

The SGZ area soil investigation described in this report consisted of three activities:

- Drill and sample soil borings in the vicinity of the R-EX well to determine if non-radioactive contamination exists in the mud pits adjacent to the well, and to confirm the findings of the extensive radiological surveys conducted during site deactivation and abandonment.

- Collect stream sediment, stream bank soil, and stream water samples from the reach of the stream adjacent to and downgradient of the R-EX well to determine if any contaminants present in the mud pits are migrating to the stream.

- Collect shallow soil samples for radiological analyses from the gas flare and R-EX well areas to confirm the findings of the radiological surveys conducted during site deactivation and abandonment, and to alleviate any public concerns regarding potential exposure to radiation.

All sample collection activities were performed in accordance with DOE-approved, IT Standard Operating Procedures. Sample handling, transport, and analyses were performed in accordance with the Rulison QAPP (DOE, 1995d).

4.1 Soil Borings

A total of eight soil borings were drilled in the R-EX well mud pit area (Figure 4-1). Soil borings SB01 through SB05 were drilled to a depth where native soils were encountered, which was considered to represent the bottom of the mud pits and was thought to be uncontaminated. Soil boring SB06 originally was intended to be drilled to a depth where native soils were encountered. However, when relatively high photoionization detector (PID) readings were obtained from sampling intervals in SB06, it was decided in the field to continue drilling to the water table to assess whether the apparent contamination had migrated to the groundwater. In addition, it was decided in the field to drill two additional soil borings (SB07 and SB08) to the water table in the vicinity of SB06 to assess the potential horizontal and vertical extent of the apparent contamination encountered in SB06.

4.1.1 Soil Boring Drilling and Sampling

The soil borings were drilled with an Ingersoll Rand TH 60 drill rig using air rotary drilling techniques with a 4.5-in. bit or a 5-in. Odex® hammer. Soil samples were collected from the

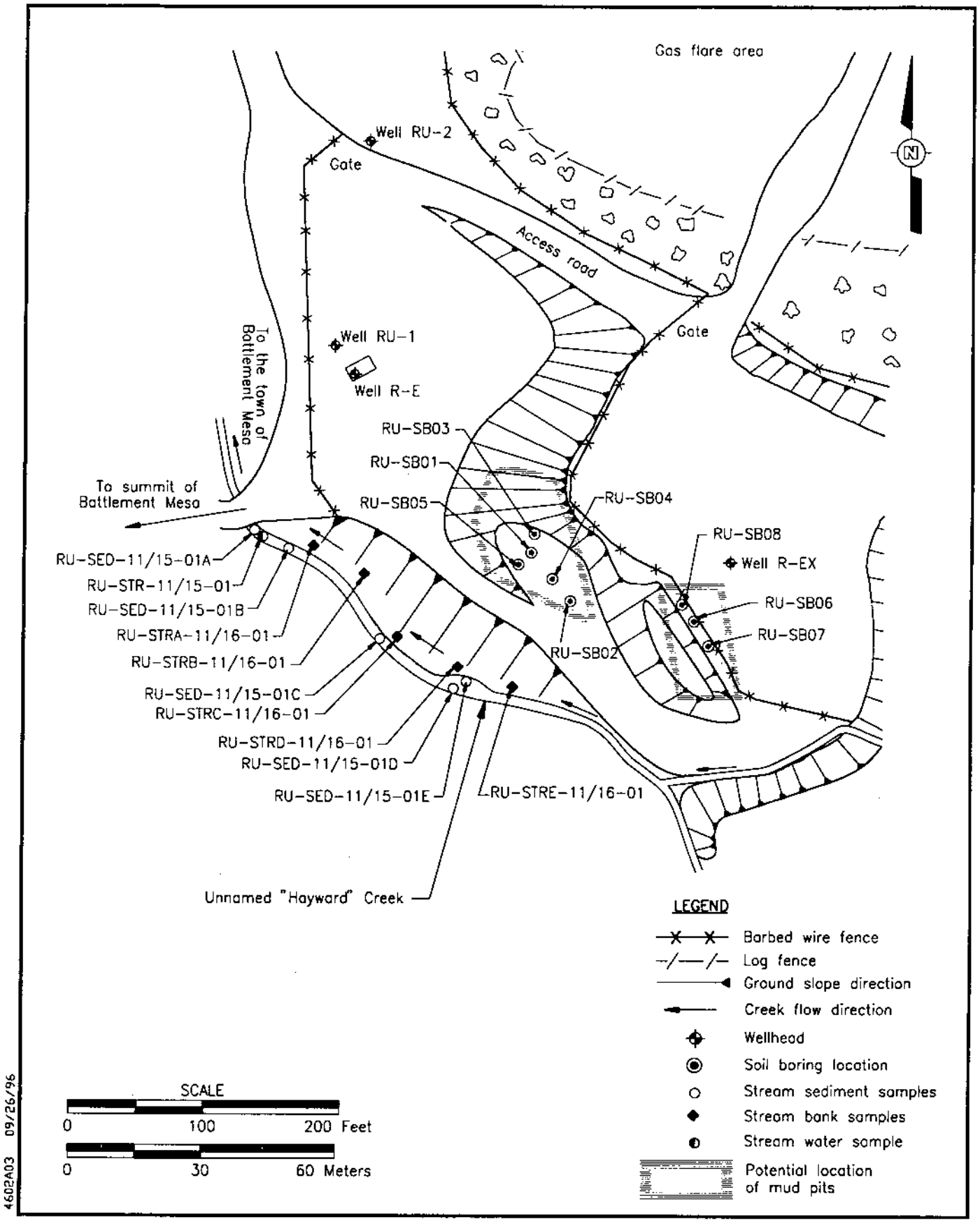

Figure 4-1
Surface Ground Zero Area Soil Boring and Stream Sample Locations

borings using 2-in. and 3-in. diameter stainless steel split-spoon sample barrels. The split-spoon sample barrels were driven into the soil with a 140-pound hammer or pushed into the soil by the drill rig. The first soil boring drilled was soil boring SB03. The soil samples from this boring were collected with a 2-in. diameter, 18-in. long stainless steel split spoon lined with three 6-in. long brass sleeves. However, the recovery from the sample barrel was not adequate to provide enough soil for the entire analytical suite. In order to improve recovery, the remaining seven borings were sampled using 3-in. diameter, 18-in. long stainless steel split spoon sample barrels. Brass sleeve inserts were not available for the three-inch split spoon sample barrels.

Soil samples were collected at five-foot intervals in each boring. An aliquot of soil from each sample was placed in a clean plastic bag for head-space analysis using a field-portable PID. Two samples from each boring were submitted to the laboratory for chemical analysis: a sample from the interval that showed the highest head-space PID reading, and a sample from the bottom of the soil boring. Pending results of the head-space analysis comparison, sample aliquots for benzene, toluene, ethylbenzene, and xylenes (BTEX) analyses were stored in the appropriate volatile sample bottles, and the remaining soil, collected for non-volatile analyses, was placed temporarily in decontaminated Mason®-type glass jars or clean plastic bags until the sample interval with the highest headspace reading was identified. All soil sample containers were immediately stored on ice in coolers until the sample interval with the highest PID reading was identified. The soil stored for non-volatile analyses from this interval was then placed into sample containers for shipment to the laboratory. In the cases where there was not enough soil available from the interval to provide the required volume for the specified non-volatile analyses, soil from the interval with the next highest head space reading was thoroughly mixed with the soil from the highest PID reading interval to provide the necessary soil sample volume. Soil boring logs are included in Appendix F of this report.

4.1.2 Soil Boring Abandonment

The soil borings were abandoned by backfilling them with a grout mixture of Portland cement with 5 percent bentonite to within two feet of the surface. The remaining two feet were then backfilled to the ground surface with native soil. Soil borings that penetrated the water table were backfilled with #20 Colorado Silica Sand from the bottom of the boring to above the water table before the grout was added. In two of the borings, RU-SB05 and RU-SB06, material had sloughed in to approximately eight feet below surface. Grout was placed on top of the sloughed material to within two feet of the ground surface, followed by native soil backfill to the ground surface.

4.1.3 Soil Boring Analytical Results

The soil boring samples were analyzed for BTEX, TPH, Resource Conservation and Recovery Action (RCRA) metals (both total and TCLP-extractable), gross alpha/gross beta, and tritium. The shallow sample from each boring also was analyzed using gamma spectroscopy. The analytical results for the soil boring samples are presented in Table 4-1. The depth interval from which each sample was collected is reflected in the sample numbering system, where the third number or set of numbers in the sample code is the depth or depths (in feet) from which the soil sample was collected. For example, the third set of numbers for sample number RU-B03-5/10/15 indicates that the sample was a composite consisting of soil collected from the 5-, 10- and 15-foot depth intervals.

TPH was detected in the shallow samples from all eight soil borings, and in deep samples from four of the eight borings. Detected concentrations in the shallow samples ranged from 66 mg/kg in sample SB03-05/10/15 to 4,700 mg/kg in SB07-18/22-1. Detected concentrations in the deep samples ranged from 66 mg/kg in SB01-15 to 150 mg/kg in SB-02-20.

BTEX compounds were detected in shallow samples from four of the eight soil borings. With the exception of ethylbenzene and xylene concentrations in sample SB08-05/10 (1,400 micrograms per kilogram [μg/kg] and 23,000 μg/kg, respectively), all detected concentrations for the BTEX compounds were below 1,000 μg/kg. Ethylbenzene and/or xylenes also were detected in deep samples from three of the eight soil borings. All detected concentrations in the deep samples were below 1,000 μg/kg.

The concentrations of barium, chromium, and lead appeared to be elevated above background in shallow samples from three of the eight soil borings. The maximum detected concentration of these metals were 3,990 mg/kg barium in SB05-02, 112 mg/kg chromium in SB06-21/13, and 119 mg/kg lead in SB07-18/22-1. None of the RCRA metals exceeded RCRA maximum concentration of contaminants (MCC) for the Toxicity Characteristic in the TCLP leachates from the samples.

No nuclear test-derived man-made radionuclides were detected, and all radiological measurements were within natural background levels.

Sample #	RU-SB01-10		RU-SB01-10/06		RU-SB01-15		RU-SB02-15/12		RU-SB02-15		RU-SB02-20		RU-SB03-05		RU-SB03-05/10/15		RU-SB03-23		RU-SB04-05	
Date Collected	10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/6/95	
		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
ORGANICS:	µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg	
Benzene	5	U	na		5	U	na		5	U	5	U	5	U	na		5	U	5	U
Toluene	5	U	na		5	U	na		5	U	5	U	5	U	na		5	U	5	U
Ethylbenzene	5	U	na		5	U	na		5	U	5	U	5	U	na		5	U	5	U
Total Xylene	5	U	na		5	U	na		5	U	5	U	5	U	na		5	U	5	U
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Diesel (EPA 8015)	na		140		66		110		na		150		na		66		68		na	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		9.28±4.93	J	9.39±4.62	J	8.6±4.3	J	na		6.47	UJ	na		7.01	UJ	16.4±5.6	J	na	
Gross Beta	na		36.6±5.5		24.5±3.9		26.8±4.1		na		26.4±3.8		na		26.1±4.0		24.8±3.7		na	
Bismuth-214	na		nd		na		nd		na		na		na		0.79±0.4		na		na	
Cesium-137	na		0.33	U	na		0.15	U	na		na		na		0.18	U	na		na	
Potassium-40	na		19.3±5.3		na		22.7±4.5		na		na		na		22.6±4.6		na		na	
Lead-210	na		nd		na		nd		na		na		na		1.49±1.39		na		na	
Lead-212	na		1.34±0.46		na		1±0.41		na		na		na		1.14±0.2		na		na	
Lead-214	na		1.13±0.54		na		1.23±0.31		na		na		na		0.99±0.25		na		na	
Radium-224	na		nd		na		nd		na		na		na		nd		na		na	
Radium-226	na		nd		na		1.02±0.21		na		na		na		0.98±0.21		na		na	
Radium-228	na		nd		na		1.08±0.47		na		na		na		1.52±0.44		na		na	
Thorium-234	na		nd		na		nd		na		na		na		1.28±1.19		na		na	
Thallium-208	na		0.43±0.29		na		0.34±0.17		na		na		na		0.4±0.17		na		na	
Tritium	na		0.042	U	0.037	U	0.035	U	na		0.042	U	na		0.039	U	0.034	U	na	
RCRA METALS (TOTAL)	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Arsenic	na		18.4		22.1		15.6		na		17.5		na		20.2		19		na	
Barium	na		246		247		197		na		194		na		214		186		na	
Cadmium	na		0.2	U	0.26	U	0.2	U	na		0.14	U	na		0.07	U	0.18	U	na	
Chromium	na		31.4		29.6		34.7		na		25.4		na		30		27.4		na	
Lead	na		17.9		14.1		10.9		na		12		na		14.1		12.1		na	
Mercury	na		0.05	U	0.05	U	0.05	U	na		0.05	U	na		0.05	U	0.05	U	na	
Selenium	na		0.53		0.48		0.5		na		0.28	U	na		0.84		0.53		na	
Silver	na		0.05	U	0.05	U	0.05	U	na		0.05	U	na		0.05	U	0.05	U	na	
RCRA METALS (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Arsenic	na		0.0377	UJ	0.0377	UJ	0.0377	UJ	na		0.0377	UJ	na		0.0377	UJ	0.0377	UJ	na	
Barium	na		1.02		1.4		1.4		na		1.28		na		1.23		1.37		na	
Cadmium	na		0.0034	U	0.0031	U	0.0038	U	na		0.0036	U	na		0.0034	U	0.0054	U	na	
Chromium	na		0.0037	U	0.0037	U	0.0037	U	na		0.0037	U	na		0.0037	U	0.0037	U	na	
Lead	na		0.0382	U	0.0382	U	0.0382	U	na		0.0382	U	na		0.0382	U	0.0382	U	na	
Mercury	na		0.0001	U	0.0001	U	0.0001	U	na		0.0001	U	na		0.0001	U	0.0001	U	na	
Selenium	na		0.0426	UJ	0.0426	UJ	0.0426	UJ	na		0.0426	UJ	na		0.0426	UJ	0.0426	UJ	na	
Silver	na		0.006	U	0.006	U	0.006	U	na		0.006	U	na		0.006	U	0.006	U	na	

Table 4-1
Surface Ground Zero Area Soil Boring Sample Analytical Results
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Sample #	RU-SB04-5/20		RU-SB04-23		RU-SB05-02		RU-SB05-17		RU-SB06-21/13		RU-SB06-21		RU-SB06-33		RU-SB07-16-1		RU-SB07-18-2		RU-SB07-18/22-01	
Date Collected	10/6/95		10/6/95		10/6/95		10/6/95		10/7/95		10/7/95		10/7/95		10/8/95		10/8/95		10/8/95	
		Q		Q		Q		Q		Q		Q		Q		Q		Q		Q
ORGANICS:	µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg	
Benzene	na		5	U	5	U	5	U	na		20		5	U	5	U	5	U	na	
Toluene	na		5	U	5	U	5	U	na		64		5	U	8.7		5.6		na	
Ethylbenzene	na		5	U	5	U	5.8		na		46		5	U	15		13		na	
Total Xylene	na		5	U	8.1		14		na		270		8.5		67		52		na	
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Diesel (EPA 8015)	120		120		2400	D	100		2200	D	na		25	U	na		na		4700	D
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	9.02±4.44	J	9.56±4.33	J	12±5.5	J	11.4±4.9	J	6.36	UJ	na		6.71±3.71	J	na		na		6.64	UJ
Gross Beta	23.8±3.8		27±4.1		22.4±4.1		24.5±3.7		27.5±4.4		na		16.5±2.9		na		na		26.3±4.6	
Bismuth-214	nd		na		0.82±0.35		na		nd		na		1.4±0.4		na		na		1.48±0.40	
Cesium-137	0.24	U	na		0.2	U	na		0.36	U	na		0.15	U	na		na		0.19	U
Potassium-40	21.3±4.4		na		18.4±4.1		na		24.6±6.0		na		11.6±2.9		na		na		21±4.3	
Lead-210	nd		na		nd		na		nd		na		nd		na		na		nd	
Lead-212	0.93±0.25		na		1.18±0.23		na		nd		na		0.99±0.20		na		na		1.06±0.19	
Lead-214	1.32±0.29		na		0.86±0.34		na		0.77±0.49		na		0.12±0.26		na		na		0.89±0.27	
Radium-224	nd		na		nd		na		nd		na		nd		na		na		2.04±1.61	
Radium-226	1.01±0.25		na		0.85±0.25		na		1.06±0.39		na		1.28±0.22		na		na		1.12±0.23	
Radium-228	nd		na		1.66±0.45		na		nd		na		nd		na		na		1.02±0.56	
Thorium-234	2.27±1.43		na		2.15±1.28		na		nd		na		nd		na		na		nd	
Thallium-208	0.37±0.21		na		0.34±0.19		na		nd		na		0.34±0.16		na		na		0.43±0.18	
Tritium	0.030	U	0.034	U	0.06	U	0.038	U	0.96±0.11		na		0.034	U	na		na		0.41±0.05	
RCRA METALS (TOTAL)	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Arsenic	16.2		19.8		9		18.7		9.8		na		6.1		na		na		8.9	
Barium	245		244		3990		255		375		na		205		na		na		1450	
Cadmium	0.23	U	0.27	U	0.29	U	0.19	U	0.05	U	na		0.03	U	na		na		0.12	U
Chromium	30.5		29		79.3		25.6		112		na		14.4		na		na		61.5	
Lead	12		13.9		52.8		13.2		89.5		na		9.1		na		na		119	
Mercury	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	na		0.05	U	na		na		0.05	U
Selenium	0.26	U	0.55		0.43		0.37	U	1.1		na		0.52	U	na		na		0.71	U
Silver	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	na		0.05	U	na		na		0.05	U
RCRA METALS (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Arsenic	0.0377	UJ	0.0377	UJ	0.0377	UJ	0.0377	UJ	0.0377	UJ	na		0.0377	UJ	na		na		0.0377	UJ
Barium	1.44		1.41		1.04		1.54		1.49		na		0.743		na		na		1.43	
Cadmium	0.004	U	0.0041	U	0.0032	U	0.0032	U	0.0037	U	na		0.0053	U	na		na		0.0068	U
Chromium	0.0037	U	0.0037	U	0.0135		0.0037	U	0.0797		na		0.0037	U	na		na		0.0146	
Lead	0.0382	U	0.0382	U	0.0382	U	0.0382	U	0.0382	U	na		0.0382	U	na		na		0.0813	
Mercury	0.0001	U	0.0001	U	0.0001	U	0.0001	U	0.0001	U	na		0.0001	U	na		na		0.0001	U
Selenium	0.0426	UJ	0.0426	UJ	0.0426	UJ	0.0426	UJ	0.0426	UJ	na		0.0426	UJ	na		na		0.0426	UJ
Silver	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	na		0.006	U	na		na		0.006	U

Table 4-1
Surface Ground Zero Area Soil Boring Sample Analytical Results
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Sample #	RU-SB07-18/22-02		RU-SB07-23		RU-SB07-30		RU-SB08-05		RU-SB08-05/10		RU-SB08-31	
Date Collected	10/8/95		10/8/95		10/8/95		10/8/95		10/8/95		10/8/95	
		Q		Q		Q		Q		Q		Q
ORGANICS:	µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg	
Benzene	na		5	U	5	U	290		na		5	U
Toluene	na		27		5	U	120	U	na		5	U
Ethylbenzene	na		41		5	U	1400		na		15	
Total Xylene	na		210		5	U	23000		na		220	
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Diesel (EPA 8015)	3500	D	na		24	U	na		2100	D	24	U
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	11.5±5.4	J	na		9.72±4.44	J	na		7.68	UJ	10.4±5.1	J
Gross Beta	23.3±4.0		na		21.7±3.5		na		29.8±4.7		18.3±3.4	
Bismuth-214	1.01±0.30		na		na		na		1.33±0.39		na	
Cesium-137	0.21	U	na		na		na		0.2	U	na	
Potassium-40	16.6±3.6		na		na		na		23.1±4.7		na	
Lead-210	nd		na		na		na		2.17±1.82		na	
Lead-212	1.03±0.26		na		na		na		1.39±0.26		na	
Lead-214	0.79±0.27		na		na		na		0.68±0.32		na	
Radium-224	3.6±2.3		na		na		na		3.14±2.53		na	
Radium-226	0.9±0.2		na		na		na		1.07±0.25		na	
Radium-228	nd		na		na		na		1.55±0.52		na	
Thorium-234	nd		na		na		na		nd		na	
Thallium-208	0.37±0.13		na		na		na		0.56±0.27		na	
Tritium	0.38±0.05		na		0.038	U	na		0.024±0.014		0.062±0.015	
RCRA METALS (TOTAL)	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Arsenic	7.5		na		11.7		na		13.4		5.9	
Barium	670		na		339		na		298		113	
Cadmium	0.37		na		0.03	U	na		0.03	U	0.03	U
Chromium	44		na		17.8		na		35.1		13.2	
Lead	89		na		12		na		17.5		6.7	
Mercury	0.05	U	na		0.05	U	na		0.05	U	0.05	U
Selenium	0.52	U	na		0.98	U	na		0.53	U	0.47	U
Silver	0.05	U	na		0.05	U	na		0.05	U	0.05	U
RCRA METALS (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Arsenic	0.0377	UJ	na		0.0377	UJ	na		0.0377	UJ	0.0377	UJ
Barium	1.51		na		0.889		na		1.75		0.757	
Cadmium	0.0056	U	na		0.0049	U	na		0.0035	U	0.0046	U
Chromium	0.0155		na		0.0037	U	na		0.0037	U	0.0037	U
Lead	0.056		na		0.0382	U	na		0.0382	U	0.0382	U
Mercury	0.0001	U	na		0.0001	U	na		0.0001	U	0.0001	U
Selenium	0.0426	UJ	na		0.0426	UJ	na		0.0426	UJ	0.0426	UJ
Silver	0.006	U	na		0.006	U	na		0.006	U	0.006	U

Q = Data qualifier
U = Compound was analyzed for, but not detected above the specified limit
J = Reported value is estimated
D = Sample was diluted for analysis
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
mg/L = milligrams per liter
pCi/g = picoCuries per gram
na = not analyzed
nd = not detected

Table 4-1
Surface Ground Zero Area Soil Boring Sample Analytical Results
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4.2 Stream Investigation

One composite stream sediment sample, one composite stream bank soil sample, and one discrete stream water sample were collected to assess whether contaminants from the R-EX mud pit area are migrating to the stream. The stream sediment sample and the stream bank soil sample each consisted of a composite sample made up of material collected from five separate sampling locations (sediment sampling locations RU-SED-11/15-01A through -01E and stream bank soil sampling locations RU-STRA-11/16-01 through -STRE-11/16-01 on Figure 4-1).

The stream bank soil samples were collected by using a shovel to remove the soil to the frost line at each of the five sample locations. Soil samples were collected at each location with decontaminated polyethylene scoops. The soil collected from the five sample locations was placed in a stainless steel bowl, thoroughly homogenized into one composite sample, and then placed in sample containers for shipment to the laboratory.

Stream sediment samples were collected with a polyethylene plastic scoop. Two scoops of sediment were collected from each sampling location, beginning with the downstream sample location (RU-SED-11/15-01A) and working upstream in an easterly direction. The sediment collected from the five sample locations was placed in a stainless steel bowl, thoroughly homogenized into one composite sample, and then placed in sample containers for shipment to the laboratory.

The stream water sample was collected by using a polyethylene scoop to collect the stream water and pour it directly into the sample containers for shipment to the laboratory.

4.2.1 Stream Analytical Results

The stream sediment, stream bank soil, and stream water samples were analyzed for TPH and total RCRA metals. The analytical results for the samples are presented in Table 4-2. In Table 4-2, the stream sediment composite sample is numbered RU-SED-11/15-01; the stream bank soil composite sample is numbered RU-STRB-11/16-01; and the stream water sample is numbered RU-STR-11/15-01. TPH was not detected in any of the stream samples, and metals concentrations do not appear to be elevated, which suggests that contamination has not migrated via saturated and unsaturated transport to the stream from the R-EX mud pits. Hayward Creek, a local groundwater discharge zone, is upgradient, cross-gradient, and downgradient from the R-EX mud pits.

Table 4-2
Surface Ground Zero Area Stream Sample Analytical Results

Sample #	RU-SED-11/15-01		RU-STR-11/15-01		RU-STRB-11/16-01	
Date Collected	11/15/95		11/15/95		11/16/95	
Sample Location	Stream Bed		Stream water		Stream Bank	
		Q		Q		Q
TPH (Method 8015)	**mg/kg**		**mg/L**		**mg/kg**	
Diesel	25	U	0.5	U	24	U
Waste Oil	25	U	0.5	U	24	U
Total RCRA Metals	**mg/kg**		**ug/L**		**mg/kg**	
Arsenic	15.7		3.9	B	13.9	
Barium	164		43.6	B	217	
Cadmium	0.33	B	2.3	U	0.44	B
Chromium	22.4		3.7	U	27.8	
Lead	10.5		0.80	U	12.5	
Selenium	0.26	U	2.6	U	0.26	U
Silver	0.60	U	6.0	U	0.60	U
Mercury	0.05	U	0.10	U	0.05	U

Notes:
Q = Laboratory assigned data qualifier
U = Compound was analyzed but not detected above the specified limit.
B = Result is above the Instrument Detection Limit but below the Contract Required Detection Limit.
mg/L = milligrams per liter; ug/L = micrograms per liter; mg/kg = milligrams per kilogram

4.3 Radiological Investigation

A total of nine locations were sampled for the radiological investigation: one in the vicinity of the R-EX well and eight downwind of the flare stack area (Figure 4-2). Sample holes for the radiological soil samples were excavated by hand with shovels, a post-hole digger, and a pry bar. Soil was removed to expose the interface between the E and B soil horizons (USDA, 1992). This depth ranged between approximately 0.6 and 2 m (2 and 4 ft) below the ground surface. This interface represents the depth at which the organic mineral soil horizon transitions into the soil horizon dominated by alterations that form silicate clays of granular, blocky, or prismatic structure. This transition also represents a zone of contact between two contrasting soil textures resulting in a capillary barrier. Percolating water tends to pond at this interface; therefore, if tritium was present, this would be the most logical place to sample. In addition, since radionuclides readily adsorb to clay particles, this interface was considered to be the most likely depth to find radiological contamination, if any existed. At each sampling location, equal amounts of soil were collected from above and below, but not at, the interface with a precleaned

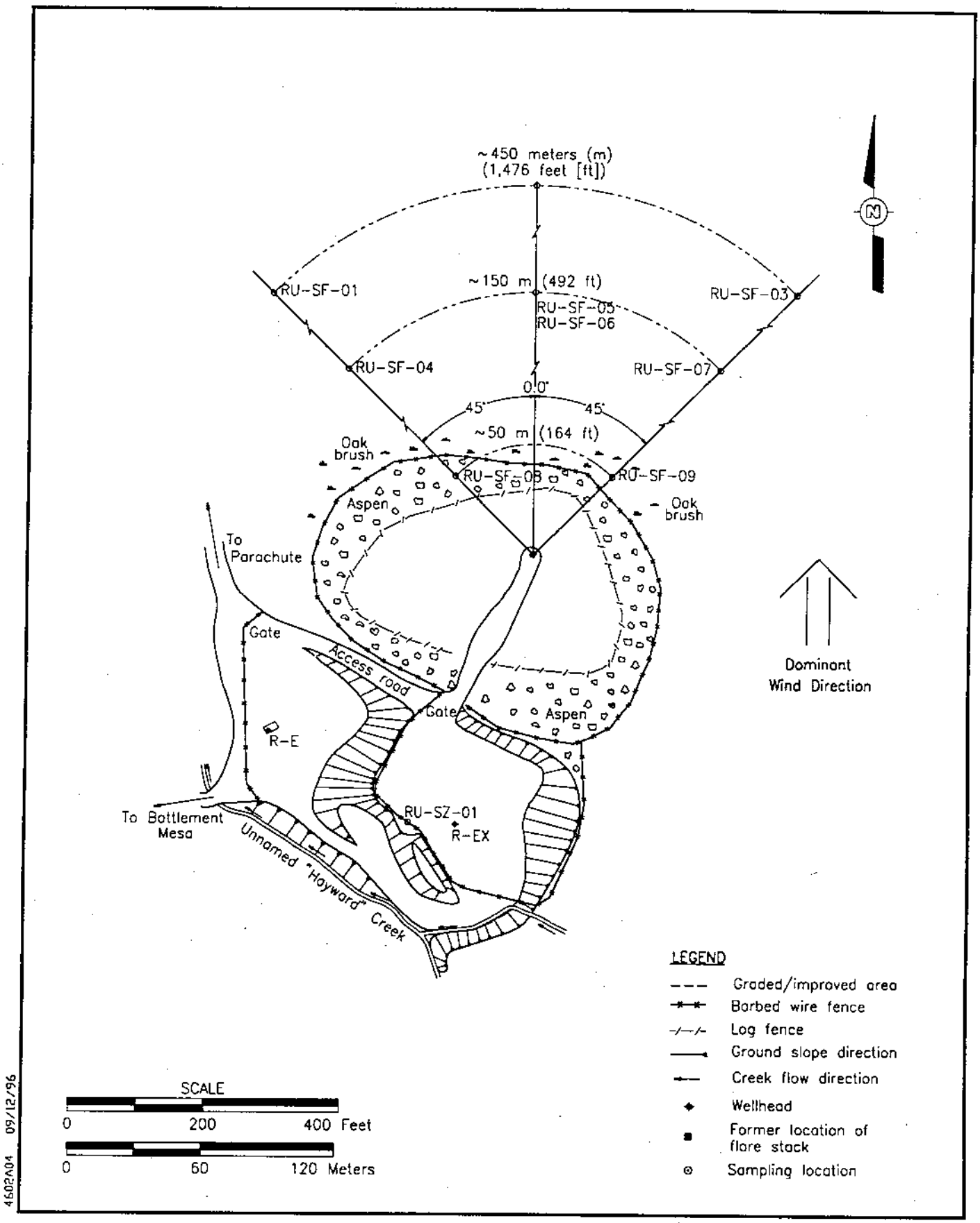

Figure 4-2
Radiological Sampling Locations

polyethylene scoop or a stainless steel spoon and placed in a stainless steel bowl. The soil was thoroughly homogenized in the bowl and then transferred to analytical sample containers for shipment to the laboratory. After the sample was collected from each excavation, the excavation was backfilled with native soil.

4.3.1 Radiological Analytical Results

The radiological investigation soil samples were analyzed for gross alpha/gross beta, tritium, carbon-14, and by gamma spectroscopy. The analytical results for the samples are presented in Table 4-3. All radionuclides detected in the samples using gamma spectroscopy are naturally occurring, and detected concentrations were not elevated above natural background levels.

Sample #	RU-SZ-01	RU-SF-01	RU-SF-03	RU-SF-04	RU-SF-05	RU-SF-06	RU-SF-07	RU-SF-08	RU-SF-09
Date Collected	11/4/95	11/4/95	11/4/95	11/4/95	11/8/95	11/8/95	11/4/95	11/4/95	11/4/95
RADIATION:	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
Gross Alpha	12.5	15.2	6.40	13.3	6.74	9.91	17.2	8.22	10.8
Gross Beta	28.4	31.0	24.8	31.2	31.0	29.4	43.4	36.3	34.5
Cesium-137	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium-40	23.2	28.2	17.9	27.5	27.2	23.8	41.1	28.7	27.8
Thallium-208	0.34	0.52	0.37	0.43	0.51	0.44	0.51	0.52	0.75
Bismuth-212	NA	NA	NA	NA	NA	NA	NA	1.30	NA
Lead-212	1.14	1.58	0.96	1.39	1.43	1.37	1.64	1.41	1.80
Bismuth-214	NA	NA	NA	1.18	1.27	1.26	1.56	1.27	1.20
Lead-214	1.24	1.22	0.97	0.93	1.42	1.19	1.39	1.35	1.23
Radium-226	1.01	1.05	0.98	0.97	1.36	1.24	1.45	1.36	1.22
Radium-228	NA	1.38	NA	1.06	NA	1.66	1.43	1.26	NA
Tritium	-0.006	-0.008	0.0007	-0.020	-0.006	-0.017	-0.010	-0.002	-0.002
Carbon-14	-0.0112	0.0728	-0.0186	0.0442	0.00269	0.0273	0.0105	0.0749	-0.00539

Notes:

NA = Sample not analyzed for indicated compound.

ND = Analyte not detected above method detection limit.

pCi/g = picoCuries per gram

Table 4-3
Surface Ground Zero Area Radiological Sample Analytical Results

5.0 Monitoring Well Installation and Sampling

A total of seven groundwater monitoring wells were installed at the site as part of the pond cleanup operation and SGZ area investigation. The monitoring well locations are shown on Figure 5-1. Two of these wells, RU-01 and RU-02, were installed hydraulically downgradient of well R-E to monitor for potential contaminant migration from the SGZ area. Monitoring well RU-03 was installed upgradient from the drilling effluent pond and monitoring wells RU-05, RU-06A, RU-07, and RU-08 were installed downgradient from the pond to monitor for potential contaminant migration from the pond.

Monitoring wells RU-01 through RU-03 and monitoring well RU-6A were installed using air rotary drilling techniques. Monitoring wells RU-05, RU-07, and RU-08 were installed in hand-dug excavations. Well RU-06 was originally hand-dug; however, it was determined in the field that a deeper monitoring well downgradient of the pond was desirable to allow aquifer testing to be conducted, and the best place to install a deeper well was in the vicinity of RU-06. As a result, RU-06 was abandoned, and monitoring well RU-06A was installed in its place. Monitoring Well RU-04, proposed in the Rulison CAP (DOE, 1995a) as an upgradient well for the pond, was primarily intended to be used to obtain aquifer data to support design and installation of construction dewatering wells. Since construction dewatering was accomplished by using an interceptor trench (see Section 3.1) rather than wells, it was decided in the field that installation of RU-04 was not necessary, as monitoring well RU-03 would provide adequate upgradient background water quality information for groundwater monitoring purposes. Monitoring well development and the handling of drilling cuttings, decontamination fluids, and water generated during well development were conducted in accordance with the Rulison CAP (DOE, 1995a). Soil boring logs and monitoring well completion diagrams for the wells are included in Appendix G.

5.1 Groundwater Analytical Results

One round of groundwater samples was collected during the pond cleanup operation and SGZ area investigation. This round of samples was collected after all monitoring wells had been installed and developed. Monitoring wells RU-05 and RU-07 were dry during the sampling event. Analytical results for the sampling round are presented in Table 5-1. The analytical results indicate that all of the targeted analytes were below their respective maximum contaminant levels. In addition, with the exception of barium which may be of local natural origin, none of the potential contaminants identified in the SGZ area soil boring samples were

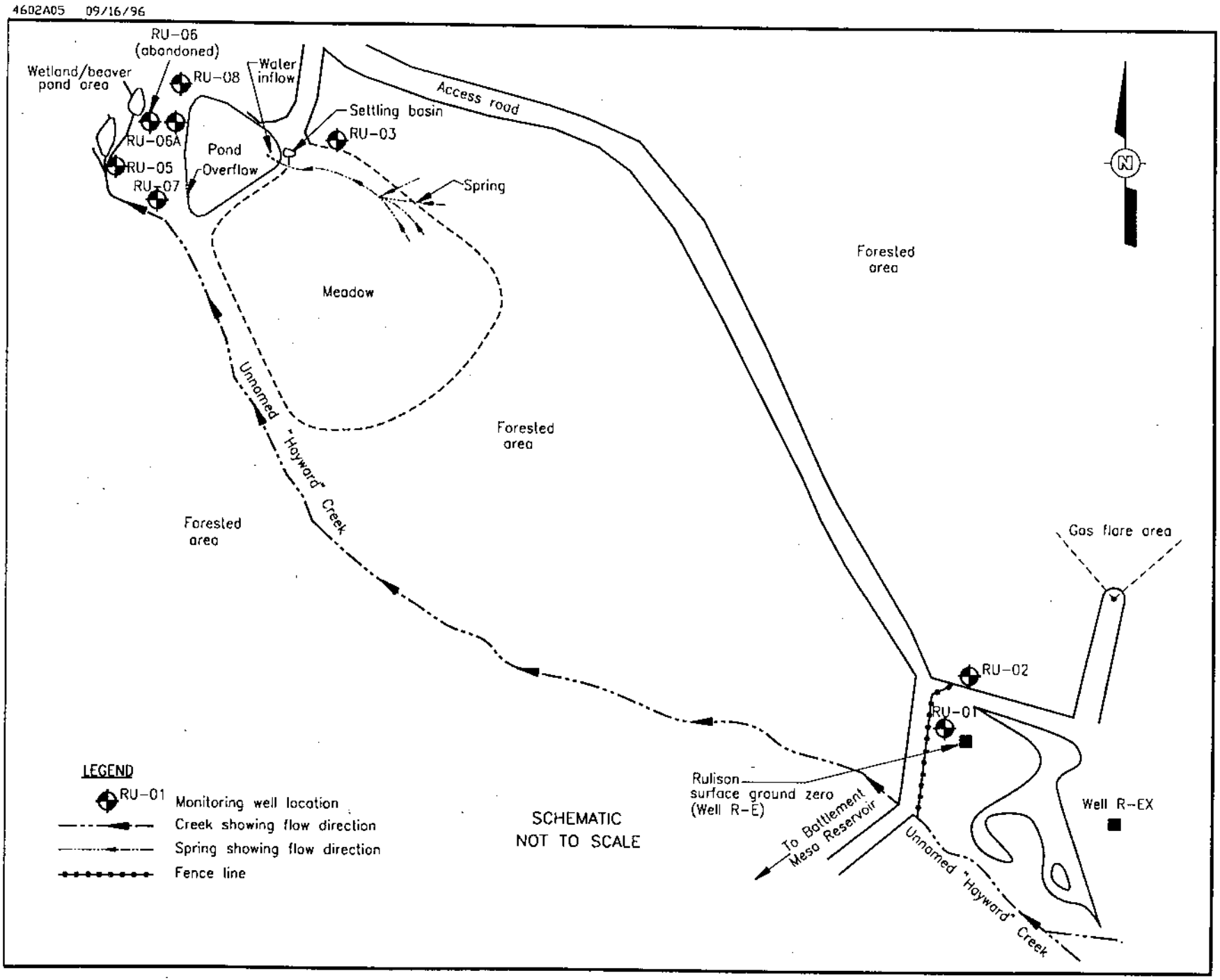

Figure 5-1
Monitoring Well Locations

Table 5-1

Groundwater Analytical Results, October 1995 Samples

Well	RU-01		RU-02		RU-03		RU-06A		RU-08	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS:	µg/L		µg/L		µg/L		µg/L		µg/L	
Arsenic	3.1	U	5.3	B	3.1	U	3.1	U	4.4	B
Barium	68.2		77.2	B	85.9		134		258	
Cadmium	0.3	U	5	U	0.3	U	0.3	U	5	U
Calcium	na		66200		64200		77300		73600	
Chromium	2.7	U	20	U	2.7	U	2.7	U	20	U
Iron	na		2390		1410	J	1140	J	1820	
Lead	1.8	U	3	U	1.7	U	0.8	U	5.1	
Magnesium	na		31800		28500		31600		28800	
Mercury	0.13	U	0.13	B	0.13	U	0.12	U	0.14	B
Potassium	na		5000	U	1390	U	2670		2490	B
Selenium	4.9		5	U	7.2	U	5.1	U	4.5	B
Silver	0.5	U	10	U	0.5	U	0.5	U	10	U
Sodium	na		52800		51400		39300		36100	
ANIONS	mg/L		mg/L		mg/L		mg/L		mg/L	
Bromide	na		0.25	U	0.25	U	0.25	U	na	
Chloride	na		1.88		1.83		4.86		na	
Fluoride	na		0.34		0.48		0.33		na	
Sulfate	na		70.5		61.1		111		na	
ORGANIC	µg/L		µg/L		µg/L		µg/L		µg/L	
Benzene	1	U	1	U	1	U	1	U	1	U
Toluene	1	U	1	U	1	U	1	U	1	U
Ethylbenzene	1	U	1	U	1	U	1	U	1	U
Total Xylenes	1	U	1.5		1	U	1	U	1	U
TPH:	mg/L		mg/L		mg/L		mg/L		mg/L	
Diesel (EPA 8015)	0.5	UJ	0.5	U	0.5	UJ	0.5	UJ	0.5	U
Motor Oil (EPA 8015)	0.5	UJ	0.5	U	0.5	UJ	0.5	UJ	0.5	U
INORGANICS:	mg/L		mg/L		mg/L		mg/L		mg/L	
Total Dissolved Solids	na		435		406		466		431	
Total Suspended Solids	na		13		19		46		626	
pH	na		7.5		7.35	J	7.13	J	7.17	
Alkalinity	na		321		326		278		na	
RADIATION:	pCi/L		pCi/L		pCi/L		pCi/L		pCi/L	
Gross Alpha	7.31	U	4.78		na		na		na	
Gross Beta	5.46	U	0.77		na		na		na	
Cesium-137	10	U	ND		na		na		na	
Radium-226	0.65±0.32		-0.1		na		na		na	
Strontium-89	1.04	UJ	0.78		na		na		na	
Strontium-90	0.94±0.47		0.09		na		na		na	
Tritium	254	U	-93		na		na		na	

Q=Data qualifier:
U = Compound was analyzed but not detected above the specified limit;
J = Reported value is estimated.
B = The result > IDL but < CRDL.
mg/L = milligrams per liter;
µg/L = micrograms per liter;
pCi = picocuries per liter
ND = parameter was analyzed for but not detected.
na = not analyzed

detected in the groundwater samples. This suggests that if the groundwater gradient is toward the northwest, contaminants have not migrated from the R-EX mud pits into the groundwater. The monitoring wells at the site will continue to be monitored as specified in the Rulison LTGMP (DOE, 1995c).

5.2 Aquifer Testing

Slug tests were conducted on monitoring wells RU-03 and RU-06A, and a pumping test was conducted on monitoring well RU-02 to provide data on aquifer characteristics. The computer model Aquifer Test Solver software program (AQTESOLV) was used to calculate aquifer hydraulic conductivities based on the slug test and pump test data. Results from the modeling indicate that the hydraulic conductivity of the aquifer in the vicinity of the pond ranges from $2x10^{-3}$ to $4x10^{-4}$ cm/sec, and the hydraulic conductivity of the aquifer in the vicinity of surface-ground-zero ranges from $4x10^{-3}$ cm/sec to $5x10^{-3}$ cm/sec. The slug test and pump test data and modeling results are included in Appendix H.

6.0 Summary and Conclusions

6.1 Drilling Effluent Pond

The cleanup goals as modified herein for the drilling effluent pond sediment have been met. Approximately 14,025,000 liters (3,705,000 gallons) of water were pumped from the pond prior to and during the sediment stabilization and removal operation, and approximately 18,656 m^3 (24,400 yd^3) of stabilized sediment was hauled to the landfill for disposal. Following completion of the sediment stabilization and removal operation, a Bentomat® geosynthetic clay liner was installed in the pond and covered with Kentucky Bluegrass sod to protect it from UV exposure and erosion. At the end of the operation the pond was left unfilled.

As discussed in Section 3.2.1 and documented in the correspondence from the CDPHE included in Appendix E, the CDPHE representative overseeing the drilling effluent pond cleanup work authorized an increase of the TPH cleanup criterion from 250 mg/kg to 1,000 mg/kg. In conjunction with the higher TPH cleanup criterion, the CDPHE representative requested an estimate of the approximate areas and volumes of sediment with TPH concentrations greater than 250 mg/kg being left in place. The following assumptions were used to make the requested estimate:

- At each sample location where the final TPH concentration was greater than 250 mg/kg, the TPH contamination extends one-half of the way to the closest adjacent sample locations with TPH concentrations less than or equal to 250 mg/kg. The areas resulting from this assumption are shown on Figure 6-1.

- Within each area where TPH concentrations are greater than 250 mg/kg, the TPH contamination extends to a depth of 2 feet.

Based on these assumptions, it is estimated that approximately 520 m^3 (620 yd^3) of sediment remaining in the pond contain concentrations of TPH greater than 250 mg/kg, but less than or equal to 1,000 mg/kg. It should be noted that this volume is not continuous, but is spread across ten separate areas in the pond bottom.

6.2 Surface Ground Zero Area

Some of the subsurface soil samples collected from the mud pits adjacent to well R-EX contained TPH and elevated levels of barium, chromium, and lead. The analytical data from the mud pit soils have been used to develop a human health risk assessment for the SGZ area soils. The risk assessment is included as Appendix I. Because the subsurface contamination found in

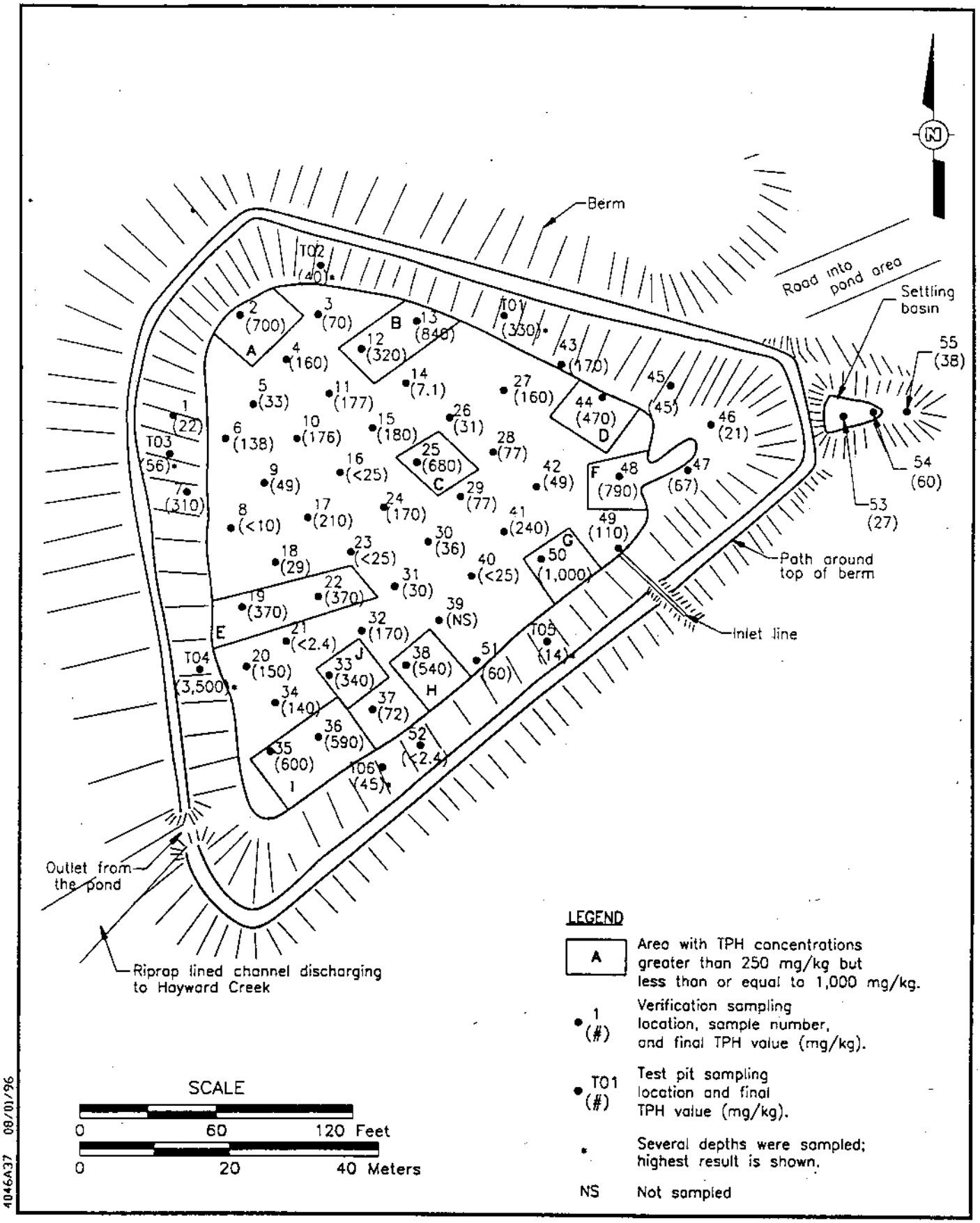

Figure 6-1
Areas of Sediment With TPH Concentrations Between 250 mg/kg and 1,000 mg/kg

the R-EX mud pit subsurface soils would not pose an undue risk to human health even if the soils were excavated and spread on the ground surface, and because there is no evidence that contaminants have migrated from the soils to groundwater or to the adjacent stream, no further action is proposed for the SGZ area soils.

6.3 Groundwater

The groundwater sample data for the five monitoring wells sampled in October 1995 have been used to develop a human health risk assessment for the site groundwater (Appendix I). The risk assessment shows that the groundwater currently does not pose an undue risk to human health. The monitoring wells at the site will continue to be monitored as specified in the Rulison LTGMP (DOE, 1995c) and the correspondence from the CDPHE included in Appendix E.

The risk assessment in Appendix I also includes development of groundwater trigger levels for the constituents of potential concern for use during implementation of the long-term groundwater monitoring program for the site. As described in Appendix I, the trigger levels are risk-based concentrations that, if exceeded, would indicate a need to further evaluate site monitoring data. Trigger levels will be incorporated into the Rulison LTGMP (DOE, 1995c).

7.0 Drilling Effluent Pond Closure Certification

7.1 U.S. Department of Energy

I, G. Leah Dever, Environmental Management, U.S. Department of Energy, hereby certify that, to the best of my knowledge and belief, the Rulison Drilling Effluent Pond at the Rulison Site, approximately 8 miles south of Parachute, Garfield County, Colorado, has been restored in accordance with the U.S. Department of Energy, Nevada Operations Office, May 1995, draft Corrective Action Plan and associated documents, including modifications approved by the Colorado Department of Public Health and Environment, and as discussed in the Corrective Action Report.

U.S. DEPARTMENT OF ENERGY

G. Leah Dever, Assistant Manager
Environmental Management

Date: 9-18-96

7.2 Independent Professional Engineer

I, Lloyd R. Hendry, III, a registered Colorado Professional Engineer, having reviewed the removal action requirements and the resulting documentation, hereby certify that, to the best of my knowledge and belief, the Rulison Drilling Effluent Pond at the Rulison Site, approximately 8 miles south of Parachute, Garfield County, Colorado, has been restored in accordance with the U.S. Department of Energy, Nevada Operations Office, May 1995, draft Corrective Action Plan and associated documents, including modifications approved by the Colorado Department of Public Health and Environment, and as discussed in the Corrective Action Report.

COLORADO REGISTERED
LLOYD R. HENDRY III
25574
PROFESSIONAL ENGINEER

IT CORPORATION

L. Raymond Hendry, III, P.E.

Date: 9/26/96

8.0 References

AEC, see U.S. Atomic Energy Commission.

DOE, see U.S. Department of Energy.

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Appendix A

Variances from the Approved Work Plans

Table A-1
Corrective Action Plan Variances
(Page 1 of 3)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
1	CAP, 3.2 Para. 1	Use of open area adjacent to the pond for staging...	The open area was not utilized for stabilizing of sediment.	Sediment was stabilized and stored in the pond then stockpiled on a 20 mil thick polyethylene plastic sheet over the settling basin at the east corner of the pond prior to transportation off location.
2	CAP, 3.2 Para. 2	Stored materials include stabilizer, 3/4-in. stone...	The staging area was not used for storage of a water treatment system because it was not utilized during the remediation activity. Kiln dust, used to stabilize the sediment, was stored in the pond prior to mixing.	Groundwater infiltrating into the dewatering trench during sediment stabilization and removal was below permitted discharge limits and did not require treatment. It was more efficient to store kiln dust in the pond.
3	CAP, 3.2 Para. 4	Preliminary drying of the sediments will occur...	No drying of the sediment or capturing of excess water from the sediment was required.	Excess water was absorbed by the kiln dust used to stabilize the sediment.
4	CAP, 3.3 Para. 1	Fish and salamanders will be removed from the pond...	Twenty-five fish were removed by capturing them with barbless hooks and then transporting them to a nearby beaver pond. No salamanders were observed.	No effective method was found to stun the fish using either ichthycides or electricity without stirring up contaminated sediments from the pond bottom, resulting in water disposal problems.
5	CAP, 3.4 Para. 1	Drainage of the pond will be required for sediment removal...	Gasoline powered pumps were used. Discharge hoses were placed in the riprap-lined pond spillway that discharged into the nearby stream ("Hayward Creek").	Gasoline powered pumps were more readily available than diesel powered pumps. Water was discharged to the vegetated riprap to minimize stream erosion and remove suspended material.
6	CAP, 3.4 Para. 2	Prior to pond drainage, the inlet to the pond will be blocked...	The spring flow was diverted from flowing into the pond by damming the inlet channel to the pond and draining collected water into the nearby stream through a 4-inch flexible pipe.	This engineering solution was deemed in the field to be simpler and more cost effective than the original plan.
7	CAP, 3.4 Para. 5	After removing the majority of the pond water...	Water remaining in the pond after initial pond dewatering was stabilized with kiln dust.	Stabilizing the water with the sediment was cheaper and more practical than moving in Baker tanks and installing a water treatment system.
8	CAP, 3.4 Para. 5	After removing the majority of the pond water...	No produced water was pumped to Baker tanks for treatment or disposal.	See above rationale.

Table A-1
Corrective Action Plan Variances
(Page 2 of 3)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
9	CAP, 3.4 Para. 6	If the water in the Baker tanks does not pass...	No water treatment system was utilized.	See above rationale.
10	CAP, 3.4 Para. 8	During pond drainage activities...	The groundwater levels were not monitored.	The sump excavated into the pond bottom adequately handled infiltrating groundwater, so the well points proposed in the CAP were not needed.
11	CAP, 3.4 Para. 8	The hydraulic characteristics of soils...	The hydraulic characteristics were not determined prior to draining the pond.	The sump excavated into the pond bottom adequately handled infiltrating groundwater, so the well points proposed in the CAP were not needed.
12	CAP, 3.4 Para. 8	If construction dewatering is determined to be...	A dewatering trench was installed along the southwest (upgradient) pond wall after the sediment was stabilized. The trench was installed to intercept groundwater infiltrating into the pond from upgradient.	Because it became necessary to remove soil from below the water table, the dewatering trench was deemed the best and most cost-effective engineering solution to control groundwater infiltration.
13	CAP, 3.5 Para. 3	Sediment drying would best be accomplished...	Sediment drying activity with associated water handling and treatment was not performed. The sediment was stabilized in the pond, using kiln dust.	Stabilizing all of the material was better and did not require much more stabilizer than would be needed to stabilize the "dewatered" sediment, and it would require less time.
14	CAP, 3.5 Para. 4	The pond will be covered...	The pond was not covered during precipitation events.	Covering the pond with plastic sheeting was impractical and would have resulted in the generation of large quantities of contaminated plastic.
15	CAP, 3.6 Para. 3	The sediment will be blended with a pug mill...	A pug mill was not used to blend the sediments. The sediments were mixed in place using two excavators.	This engineering solution was deemed in the field to be simpler, faster, and more cost-effective than the original plan.
16	CAP, 3.6 Para. 3	Following sampling, the resulting stabilized mixture...	The stabilized sediment was stored in the pond itself or stockpiled over the settling basin adjacent to the east corner of the pond for approximately 48 hours prior to transport off site for disposal. This time period was based on receiving laboratory analyses confirming stabilization of the contaminants of concern.	This change in plan was by State of Colorado Waste Management Division as acceptance criteria for classification of the stabilized sediment as solid waste. It was put into place after the CAP was written.
17	CAP, 3.6 Para. 4	Vendors who market proprietary stabilizers...	No bench top studies were conducted. Cement and kiln dust were tested in the field. Kiln dust was selected for use in stabilizing the sediment.	The kiln dust was as effective as cement in stabilizing the sediment and less costly than cement.
18	CAP, 3.6 Para. 5	The bench test will also determine how chromium...	A bench top partition test was not performed on the sediment and water.	The kiln dust bound the water in the sediment. There was no partition of the sediment and water.

Table A-1
Corrective Action Plan Variances
(Page 3 of 3)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
19	CAP, 3.7 Para. 1	Following removal of the sediment, confirmatory...	The TPH cleanup standard was increased from 250 milligrams per kilogram to 1,000 milligrams per kilogram.	Verbal authorization was received from the State of Colorado on October 12, 1995 to raise the cleanup level to 1,000 milligrams per kilogram in the pond sediments. State of Colorado correspondence documenting the verbal authorization was received by DOE on June 7, 1996 (see Appendix E).
20	CAP, 3.8 Para. 2	Following the installation of the pond liner...	Spring flow into the pond was not restored at the conclusion of remediation activities in November 1995.	The land owner did not have ownership of the water rights to the spring.
21	CAP, 3.8 Para. 3	A critical aspect of pond restoration...	The pond liner was covered with Kentucky bluegrass sod. The pond was not restocked with trout.	Natural vegetation could not be reestablished, nor could the trout be restocked because the pond was not refilled with water.
22	CAP, 3.9 Para. 3	Eight groundwater monitoring wells are planned...	Seven groundwater monitoring wells were installed at the Rulison site.	One of two planned hydraulically upgradient monitoring wells was eliminated. One well was enough to provide the necessary background groundwater quality information.
23	CAP, 3.9 Para. 4	Two methods of monitoring well installation...	The wells were not installed by a State of Colorado-licensed well driller.	It is not necessary for environmental monitoring wells to be installed in the State of Colorado by a licensed well driller per Colorado 2CCR-402-2, Paragraph 7.1.
24	CAP, 3.9 Para. 4	The wells downgradient of the pond...	The wells were dug using shovels and a pry bar.	The soil was too rocky to hand auger or to use a portable motorized auger.
25	CAP, 3.9 Para. 5	The upgradient wells will be constructed...	Three of the wells located down-gradient of the drilling effluent pond and one well located down-gradient of emplacement hole R-E were constructed of 4-inch Schedule 40 PVC. The well located upgradient of the drilling effluent pond, one well located downgradient of the drilling effluent pond and one well down- gradient of emplacement hole R-E were constructed of 5-inch Schedule 40 PVC.	The well designs were changed to reflect revised objectives for the well and to accommodate available testing equipment.
26	CAP, 3.9 Para. 7	The filter pack will consist of washed and graded...	A 16/32-sized filter pack instead of 20/40 was installed in the groundwater monitoring wells.	The slot size opening for the PVC well screens was 0.02 inch. The filter pack was changed to be compatible with this slot size opening.

PVC = Polyvinyl chloride

Table A-2
Verification Sampling and Analysis Plan Variances
(Page 1 of 2)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
1	VSAP, 1.3 Para. 1 Sen. 5	Third, it is anticipated that as water drainage from the pond...	Water remaining in the pond after pond drainage was mixed with kiln dust stabilizer and taken to the landfill for disposal with the other stabilized sediment.	This engineering solution was deemed in the field to be simpler and more cost-effective than the original plan.
2	VSAP, 1.3 Para. 2 Bullet 6	Water samples will be analyzed for whole effluent toxicity...	This analyses performed on water drained from the pond were organic toxic pollutants (OTP), total suspended solids (TSS), total dissolved solids (TDS), pH, total petroleum hydrocarbons (TPH), benzene, toluene ethyl benzene xylene (BTEX), potentially dissolved lead (Pb), total mercury (Hg), & total recoverable chromium (Cr), iron (Fe) & zinc (Zn).	All the analyses except for whole effluent toxicity (WET) were specified in the State of Colorado discharge permit. Because there were trout living in the pond, the State determined that WET analysis was not needed.
3	VSAP, 1.3 Para. 3 Bullet 1	The sediment will be mixed with a pug mill...	A pug mill was not used to mix the sediments. The sediments were mixed in place in the pond using two excavators.	This engineering solution was deemed in the field to be simpler and more cost-effective than the original plan.
4	VSAP, 1.3 Para. 3 Bullet 3	Stabilized sediment will be analyzed for...	The laboratory analyses performed on the stabilized sediment were Toxicity Characteristic Leaching Procedure (TCLP) Chromium, TPH, and TCLP Benzene. Paint filter and pH tests were performed on the stabilized sediment in the field.	The paint filter test was required by the State of Colorado for disposal purposes. The pH tests were performed to insure that the pH of the stabilized sediment was high enough to render metals immobile and to meet landfill requirements.
5	VSAP, 1.3 Para. 5 Bullet 4	Soil samples will be analyzed for total TCLP RCRA Metals...	Soil samples were analyzed for TCLP RCRA metals, TPH and TCLP benzene.	The instructions used by field sampling personnel during verification sampling specified that samples were to be analyzed for TCLP benzene and TCLP metals.
6	VSAP, 1.3 Para. 4	The proposed approach for sampling water that may...	Potentially contaminated water was not pumped to Baker tanks; therefore, no sampling of this water occurred. All potentially contaminated water was mixed with kiln dust stabilizer and analyzed as stabilized sediment.	This engineering solution was deemed in the field to be simpler and more cost-effective than the original plan.
7	VSAP, 5.2 Para. 1 Bullet 1	Sample will be collected from the pond prior to initiating discharge...	No samples were collected and analyzed for Whole Effluent Toxicity.	See Technical Change number 2 above.

Table A-2
Verification Sampling and Analysis Plan Variances
(Page 2 of 2)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
8	VSAP, 5.2 Para. 1 Bullet 2	One sample will be collected at the beginning...	The analyses performed on the water sample collected at the beginning of pond drainage activities were TSS, TDS, pH, TPH, BTEX, Potentially Dissolved Lead, Total Hg, and Total Recoverable Cr, Fe and Zn.	These analyses were stipulated by the State of Colorado as part of the site water discharge permit, except for OTC. The permit was not available when the VSAP was prepared.
9	VSAP, 5.2 Para. 1 Bullet 3	At midpoint of draining the pond, one sample will be ...	The analyses performed on the water sample collected at the midpoint of pond drainage activities were OTC, TSS, TDS, pH, TPH, BTEX, Potentially Dissolved Lead, Total Hg, and Total Recoverable Cr, Fe and Zn.	See above rationale.
10	VSAP, 5.2 Para. 1 Bullet 4	At the endpoint of pond drainage activity...	The analyses performed on the water sample collected at the end of pond drainage activities were TSS, TDS, pH, TPH, BTEX, Potentially Dissolved Lead, Total Hg, and Total Recoverable Cr, Fe and Zn.	See above rationale.
11	VSAP, 5.3 Para. 1 Sen. 3	Approximately 3,000 cubic yards (yd^3)....	The actual volume of stabilized sediment removed from the pond was 24,443 yd^3.	Hydrocarbons migrated into the wall of the dam and further than expected beneath the drilling mud into the floor of the pond.
12	VSAP, 5.3 Para. 1 Sen.	Ten samples of the stabilized sediment...	The actual number of stabilized sediment samples collected was 82, corresponding to 1 sample for every 300 yd^3 of stabilized sediment.	See above rationale.
13	VSAP, 5.4 Para. 1	The goal of this sampling task is to verify...	No treated pond water samples were analyzed.	All excess pond water was mixed with kiln dust stabilizer and transported to the landfill. No analyses were necessary.
14	VSAP, 5.5 Para. 7	The sample grid is calculated from the following...	The number of verification soil samples collected from the floor of the pond was increased from 37 to 55. Six test holes were dug on the walls of the pond, with three samples collected from each pit.	The number of samples was increased, in response to a request from a representative of the Colorado Department of Health, Solid Waste Management Division. The test pits were added when it was discovered that hydrocarbons had migrated into the walls of the pond.
15	VSAP, 5.10 Para. 1	The analytical laboratory will supply sample containers...	The sample containers were purchased separately.	The DOE-specified analytical laboratory, Rust GeoTech, did not supply sample containers for this project.

Table A-3
Long Term Groundwater Monitoring Plan Variances
(Page 1 of 2)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
1	LTGMP 1.0 Para. 1 Sec. 1.4 Para. 1 Sen. 4 Sec. 2.1.1 Para. 1 Sac. 5.0 Para. 1	The purpose of this groundwater...	A total of seven monitoring wells were installed during the remediation of the Rulison Drilling Effluent Pond Site.	Two wells upgradient of the drilling effluent were to be incorporated into a well point system. Because of the low permeability of the aquifer material, the well point system was subsequently deemed not feasible.
2	LTGMP 1.4 Para. 1 Sen. 2	Based on the current knowledge...	Sediment was stabilized, in-place, in the floor of the pond	This engineering solution was deemed in the field to be simpler and more cost-effective than the original plan.
3	LTGMP, 2.2 Para. 1	The downgradient wells, because of their location...	Four borings downgradient of the drilling effluent pond were dug by hand, and three were sampled. Monitoring wells were installed in three of the hand-dug wells. One hand-dug well was replaced by a drilled well.	Only one of the well locations was readily accessible to the drill rig.
4	LTGMP, 2.2 Para. 3	The upgradient wells will be constructed of 4-inch PVC...	Three downgradient wells were constructed of 4-inch, Schedule 40 PVC. One upgradient well and one downgradient well were constructed of 5-inch, Schedule 40 PVC.	The well designs were changed to reflect revised objectives for the well and to accommodate available testing equipment.
5	LTGMP, 2.2 Para. 4	Depending on the depth to water encountered...	Centralizers were not installed in two monitoring wells	Centralizers are not required for wells with an annular space less than 2.5 inches (State of Colorado, Water Well Construction Rules, 2-CCR 402-2, Section 10.4.2)
6	LTGMP, 2.2 Para. 5	Because of their location, the 2-inch wells will use...	The 2-inch wells were replaced with 4 and 5-inch wells.	The well designs were changed to reflect revised objectives for the well and to accommodate available testing equipment.
7	LTGMP, 2.2 Para. 5	A filter pack size of 20/40 is expected to be appropriate...	A 16/32-sized filter pack instead of 20/40 was installed in the groundwater monitoring wells.	This change was made based on information regarding the grain-size distribution of the aquifer matrix that was not available when the CAP was prepared.

Table A-3
Long Term Groundwater Monitoring Plan Variances
(Page 2 of 2)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
8	LTGMP, 2.4 Para. 1	Drill cuttings, waste materials from soil samples...	Uncontaminated drill cuttings from wells drilled adjacent to the drilling effluent pond were placed onto plastic sheeting instead of into 55-gallon barrels.	This change was proposed by DOE and approved by the State of Colorado regulators after the LTGMP was prepared. Following completion of each drill hole, the cuttings were placed into drums.
9	LTGMP, 3.0 Para. 3.3	Groundwater Monitoring Methodology	Prior to discharging groundwater during the pumping test, a quick turnaround groundwater sample was analyzed for the discharge parameters specified in the State of Colorado groundwater discharge permit.	Although the permit did not address this activity, the groundwater sample was collected and analyzed to verify that no contaminated water was discharged to the nearby stream during the pumping test. Because of low production rates, one to less than three gallons per minute, all water produced during pumping was applied to the land surface.
10	LGTMP, 7.1.2 Para. 1	Additional sample volume will be collected...	An MS/MSD sample was not collected during the first round groundwater sampling event in August 1995.	The plan stipulates that the MS/MSD sample be collected from an hydraulically upgradient well. The upgradient well had not been installed at the time of this sampling event.
11	LTGMP, 7.1.3 Para. 1	To assess the effectiveness of the purging...	Distilled water was used to collect equipment rinsate samples.	Deionized water was not available at this site.
12	LTGMP, 7.1.4 Para. 1	Trip blank samples will be used during...	Trip blanks were prepared in the field laboratory.	The analytical laboratory, Rust GeoTech, did not supply trip blank samples for this project.

Table A-4
Quality Assurance Project Plan Variances
(Page 1 of 1)

Variance Number	Document Section	Original Technical Approach	Actual Technical Activity	Rationale for Change
1	QAPP C 5.3 Table 5-2	BTEX by method 8020A TPH by method 8015A	BTEX by method 8260 TPH by method 418.1	The analytical laboratory Rust GeoTech did not have the capability to perform methods 8020A or 8015A, as prescribed in the QAPP.
2	QAPP C 5.5.2.1 Para. 1	Tier I review is essentially a completeness review...	A partial Tier I review was conducted in the field.	It was deemed more cost-effective to have qualified personnel from the office review the data and notify field personnel of any discrepancies.
3	QAPP C 5.5.2.2 Para. 1	Tier II review shall include a review...	A partial Tier II review was conducted in the field.	See above rationale.

Table A-5
Nonconformances
(Page 1 of 1)

Nonconformance Number	Document Section	Nonconformance	Cause
1	QAPP, 5.2.1 Para. 2	Chain of custody #42176 dated 8/7/95 was not signed over to Rust GeoTech laboratory by a sample team member. However, a sample team member was in continuous possession of the samples and was present during transfer of custody.	Oversight by the personnel delivering the samples. A sampling team member was present but the other person delivering the samples signed the form.
2&3	LTGMP, 2.2 Para. 4	Centralizers were not installed in monitoring wells RU-6A or RU-2.	The driller was having trouble installing the well casing with the centralizers because of the small annular space and since centralizers are not required for wells with an annular space less than 2.5 inches (State of Colorado, Water Well Construction Rules, 2-CCR 402-2, Section 10.4.2) the casing was installed without the centralizers.
4	VSAP, 5.5 Para. 7	One verification sample designated as sample location # 39 was not collected from the floor of the pond.	The location identified for this sample was under water so sampling personnel could not reach it.
5	VSAP, 5.7 Para. 1	Total metals analyses were not performed on verification soil samples collected in the pond as prescribed in the work plan.	TCLP metals analyses were performed instead because that is what the State of Colorado uses to determine if soils need to be cleaned up.
6	QAPP, 1.0 Table 1-2	Duplicate samples were not collected every day that samples were collected as prescribed in the work plan.	Duplicate samples were not collected every day of sampling because only a small number of samples were collected on most days and this would have resulted in an inordinately large number of duplicate samples and analytical costs.

Appendix B

Permits

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80222-1530
Phone (303) 692-2000

Laboratory Building
4210 E. 11th Avenue
Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department
of Public Health
and Environment

August 14, 1995

U.S. Department of Energy
Roxanne Danz
P.O. Box 98518
Las Vegas, Nevada 89193-8518

CERTIFIED MAIL NO: Z 416 968 879

RE: Amended Certification, Colorado Wastewater Discharge Permit System: Permit Number: COG-310084, U.S. Department of Energy

Dear Ms. Danz:

Enclosed please find a copy of your amended certification which was issued under the Colorado Water Quality Control Act. This permit requires that specific actions be performed at designated times. You are legally obligated to comply with all terms and conditions of the permit and certifications. It is especially important to note the effective date which can be found on page one of the Certification. It is illegal to discharge per the conditions of this permit until that date.

Please read the permit and if you have any questions contact this office at 692-3590.

Sincerely,

Robert J. Shukla

Robert J. Shukla, Chief
Permits and Enforcement Section
Water Quality Control Division

xc: Permits Section, Environmental Protection Agency
Regional Council of Government
Local County Health Department
District Engineer, Field Support Section, WQCD
Derald Lang, Field Support Section, WQCD
Permit Drafter, Permits and Enforcement Section, WQCD

Enclosure

COLORADO DISCHARGE PERMIT SYSTEM
AMENDMENT TO THE CERTIFICATION
GROUNDWATER CLEANUP OF GASOLINE

Category 07, Sub-category 8, General Permits. Gasoline cleanup Current fee $850/year per CRS 25-8-502
SIC code 1629

This amendment specifically authorizes. U.S. Department of Energy
Roxanne Danz
P.O. Box 98518
Las Vegas, Nevada 89193-8518
(702)+295-7723

with the facility contact of, Same as above

to discharge from facility identified as **Drilling Effluent Pond** project, located in the SW 1/4, Section 25, T7S, R95W; Garfield County as shown in Figure 1 of the permit from discharge points identified as 001-002, as shown in Figure 2 of the Permit and further described in this table.

Discharge Point	Description	Estimated Flow Rate
001	Discharge from the drilling effluent pond following treatment prior to entering Hayward Creek.	Avg. = 25 gpm Max. = 500 gpm
002	Discharge from the wellpoints following treatment prior to entering Hayward Creek.	Max. = 150 gpm Avg. = 75 gpm

The discharge goes to Hayward Creek, which is within Segment 7, Lower Colorado River Sub-basin, Lower Colorado River Basin, found in 3.7.0 Classifications and Numeric Standards for the Lower Colorado River Basin (5 CCR 1002-8). Segment 7 is classified for the following uses: Recreation, Class 2; Aquatic Life, Class 1 (cold); Agriculture; Water Supply. The Division reviewed this facility on 6/12/95 and determined that the antidegradation presumption was overcome because the discharge is temporary (1 week).

The activity involves cleanup of sediment contaminated with petroleum hydrocarbons and metals. Surface water showed very low or non-detectable levels of petroleum hydrocarbons and toxic metals. Discharge will be treated by on-site activated carbon filters.

The flow limitation of 0.05 MGD will be waived due to the short duration of this discharge.

Table V-1 - Effluent Limits for Discharge Point 001.

Parameter	Limitation		Rationale
Flow, MGD	Report	d/	
TSS, mg/ℓ	30/45	a/	State Effluent Regulations
pH, s.u.	6.5-9.0	b/	Water Quality Standards
Oil and Grease, mg/ℓ	10	c/	State Effluent Regulations
Potentially Dissolved Lead, mg/ℓ *	0.031	c/	Water Quality Standards
Benzene, mg/ℓ	0.001	d/	Best Professional Judgment
BETX, mg/ℓ	0.1	c/	Basic Water Quality Standards
Total Dissolved Solids, mg/l **	Report		Colorado River Basin Salinity Standards
Total Phosphorus, mg/l ***	Report		Control Regulations For Basins Listed In I.C.4.b

a/ 30-Day Average/7-Day Average c/ Daily Maximum
b/ Minimum-Maximum d/ 30-Day Average

* See Permit Rationale discussion, page 6
** Applicable to waters of the Colorado River basin only. See I.D.8. of the Permit
*** Applicable to waters listed in I.C.4.b) of the Permit

Additional Monitoring: *The Division reserves the right to request further monitoring of any pollutants outside the requirements of this permit to insure that the conditions of the general permit are met and/or to ensure that the antidegradation presumption is overcome by site specific reasons specified in Section 3.1.8(1)(c)(i)(ii)(iii) of The Basic Standards and Methodologies for Surface Water. If any of the additional monitoring indicates pollutants of concern that may be of an impact to the receiving waters, or may need limitations set, then the Division shall determine that an individual permit is required and reserves the right to require that the discharges cease until an individual permit is in effect. Additional monitoring shall be included with the Discharge Monitoring Report (DMR) and shall be subject to the permit's monitoring and reporting requirements.*

Additional monitoring for discharge point 001-002.

Parameter	Trigger Level	Frequency	Rationale
Total Mercury, ug/l	2	Once at beginning of draining pond, once halfway through, and once near end of pond draining.	Metals concentration in the sediments of the pond. Concern that metal concentrations in surface water will rise as sediments are disturbed.
Total Recoverable Iron, ug/l	1000		
Total Recoverable Zinc, ug/l	10		
Total Recoverable Chromium, ug/l	50		

Results for additional monitoring parameters must be obtained as soon as possible after sampling. If trigger levels are reached or exceeded, permittee shall cease discharge and notify the Division immediately.

The permittee is encouraged to read the general rationale for an understanding of how this permit was developed and to read the permit to see what requirements exist. Within the body of the permit itself, effluent limitations and monitoring requirements are specified in Parts I.B and I.C. Best Management Practices are addressed in Part I.F.5., and special notification requirements for effluent violations are addressed in Part II.A.2. and II.A.3. Organic Toxic Pollutants in the volatile fraction (VOC) shall be monitored and the data submitted in the manner described in I.C.4. of the permit. The first instance of VOC monitoring for this facility shall be within 90 days of the effective date of this certification.

Salinity (TDS) monitoring of the discharge will be required.
Total Phosphorus monitoring of the discharge will not be required.

Aquatic life Whole Effluent Toxicity (WET) testing will not be required, because of the short duration of the discharge.

Although there is fuel storage in the project area, a Materials Containment Plan will not be required. However, diking should be performed as discussed in Best Management Practices Part I.F.5. of the permit.

Certification: Based on the above information, the gasoline cleanup facility is certified to discharge under the general permit for groundwater cleanup of gasoline, identified as permit number COG-310000. All correspondence relative to this facility should reference the specific facility number, COG-310084.

The purpose of this amendment is to ; (1) change the mercury trigger level from 0.01 to 2 ug/l and (2) change the zinc trigger level from 2 to 10 ug/l. The original numbers were mistakenly inserted and the new numbers are the intended values. Also the permittee has requested that TPH analyses, which are routinely being done, be substituted for the Oil & Grease analyses required by the permit. Since the TPH analysis is more inclusive of petroleum hydrocarbons likely to be found, and the permittee recognizes the limit will remain 10 mg/l, the Division grants this request. The permittee has also requested that the methods used to analyze the samples are need only to provide detection levels that equal or are less than the permit limitations (or trigger levels as the case may be). This is satisfactory with the Division providing the method is EPA approved.

Tom Boyce
August 1, 1995

Effective 08/14/95 *Certified Letter No.* Z 416 968 879

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
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Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department
of Public Health
and Environment

Jon K[illegible]
[illegible]-692-[illegible]

June 30, 1995

U. S. Department of Energy
Roxanne Danz
P.O. Box 98518
Las Vegas, Nevada 89193-8518

CERTIFIED MAIL NO: Z 416 968 756

RE: Certification, Colorado Wastewater Discharge Permit System:
Permit Number: COG-310084, U.S. Department of Energy

Dear Ms. Danz:

Enclosed please find a copy of your certification which was issued under the Colorado Water Quality Control Act. This permit requires that specific actions be performed at designated times. You are legally obligated to comply with all terms and conditions of the permit and certifications. It is especially important to note the effective date which can be found on page one of the Certification. It is illegal to discharge per the conditions of this permit until that date.

Please read the permit and if you have any questions contact this office at 692-3590.

Sincerely,

Robert J. Shukle

Robert J. Shukle, Chief
Permits and Enforcement Section
Water Quality Control Division

xc: Permits Section, Environmental Protection Agency
Regional Council of Government
Local County Health Department
District Engineer, Field Support Section, WQCD
Derald Lang, Field Support Section, WQCD
Permit Drafter, Permits and Enforcement Section, WQCD

Enclosure
RJS: mlb

ACTION
INFO EAD
MGR
AMA
AMESSH
AMO

COLORADO DISCHARGE PERMIT SYSTEM
CERTIFICATION
GROUNDWATER CLEANUP OF GASOLINE

Category 07, Sub-category 8, General Permits, Gasoline cleanup Current fee $850/year per CRS 25-8-502
SIC code 1629

This permit specifically authorizes, U.S. Department of Energy
Roxanne Danz
P.O. Box 98518
Las Vegas, Nevada 89193-8518
(702)+295-1113

with the facility contact of, Same as above

to discharge from facility identified as **Drilling Effluent Pond** project, located in the SW 1/4, Section 25, T7S, R95W; Garfield County as shown in Figure 1 of the permit from discharge points identified as 001-002, as shown in Figure 2 of the Permit and further described in this table.

Discharge Point	Description	Estimated Flow Rate
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The discharge goes to Hayward Creek, which is within Segment 7, Lower Colorado River Sub-basin, Lower Colorado River Basin, found in 3.7.0 Classifications and Numeric Standards for the Lower Colorado River Basin (5 CCR 1002-8). Segment 7 is classified for the following uses: Recreation, Class 2; Aquatic Life, Class 1 (cold); Agriculture; Water Supply. The Division reviewed this facility on 6/12/95 and determined that the antidegradation presumption was overcome because the discharge is temporary (1 week).

The activity involves cleanup of sediment contaminated with petroleum hydrocarbons and metals. Surface water showed very low or non-detectable levels of petroleum hydrocarbons and toxic metals. Discharge will be treated by on-site activated carbon filters.

The flow limitation of 0.05 MGD will be waived due to the short duration of this discharge.

Table V-1 - Effluent Limits for Discharge Point 001.

Parameter	Limitation		Rationale
Flow, MGD	Report	d/	
TSS, mg/ℓ	30/45	a/	State Effluent Regulations
pH, s.u.	6.5-9.0	b/	Water Quality Standards
Oil and Grease, mg/ℓ	10	c/	State Effluent Regulations
Potentially Dissolved Lead, mg/ℓ *	0.031	c/	Water Quality Standards
Benzene, mg/ℓ	0.001	d/	Best Professional Judgment
BETX, mg/ℓ	0.1	c/	Basic Water Quality Standards
Total Dissolved Solids, mg/l **	Report		Colorado River Basin Salinity Standards
Total Phosphorus, mg/l ***	Report		Control Regulations For Basins Listed In I.C.4.b

a/ 30-Day Average/7-Day Average c/ Daily Maximum
b/ Minimum-Maximum d/ 30-Day Average

* See Permit Rationale discussion, page 6
** Applicable to waters of the Colorado River basin only. See I.D.8. of the Permit
*** Applicable to waters listed in I.C.4.b) of the Permit

Additional Monitoring: The Division reserves the right to request further monitoring of any pollutants outside the requirements of this permit to insure that the conditions of the general permit are met and/or to ensure that the antidegradation presumption is overcome by site specific reasons specified in Section 3.1.8(1)(c)(i)(ii)(iii) of The Basic Standards and Methodologies for Surface Water. If any of the additional monitoring indicates pollutants of concern that may be of an impact to the receiving waters, or may need limitations set, then the Division shall determine that an individual permit is required and reserves the right to require that the discharges cease until an individual permit is in effect. Additional monitoring shall be included with the Discharge Monitoring Report (DMR) and shall be subject to the permit's monitoring and reporting requirements.

Additional monitoring for discharge point 001-002.

Parameter	Trigger Level	Frequency	Rationale
Total Mercury, ug/l	~~0.01~~ 2	Once at beginning of draining pond, once halfway through, and once near end of pond draining.	Metals concentration in the sediments of the pond. Concern that metal concentrations in surface water will rise as sediments are disturbed.
Total Recoverable Iron, ug/l	1000		
Total Recoverable Zinc, ug/l	~~2~~ 10		
Total Recoverable Chromium, ug/l	50		

Results for additional monitoring parameters must be obtained as soon as possible after sampling. If trigger levels are reached or exceeded, permittee shall cease discharge and notify the Division immediately.

The permittee is encouraged to read the general rationale for an understanding of how this permit was developed and to read the permit to see what requirements exist. Within the body of the permit itself, effluent limitations and monitoring requirements are specified in Parts I.B and I.C, Best Management Practices are addressed in Part I.F.5., and special notification requirements for effluent violations are addressed in Part II.A.2. and II.A.3. ***Organic Toxic Pollutants in the volatile fraction (VOC) shall be monitored and the data submitted in the manner described in I.C.4. of the permit. The first instance of VOC monitoring for this facility shall be within 90 days of the effective date of this certification.***

Salinity (TDS) monitoring of the discharge will be required.
Total Phosphorus monitoring of the discharge will not be required.

Aquatic life Whole Effluent Toxicity (WET) testing will not be required, *because of the short duration of the discharge.*

Although there is fuel storage in the project area, a Materials Containment Plan will not be required. However, diking should be performed as discussed in Best Management Practices Part I.F.5. of the permit.

Certification: Based on the above information, the gasoline cleanup facility is certified to discharge under the general permit for groundwater cleanup of gasoline, identified as permit number COG-310000. ***All correspondence relative to this facility should reference the specific facility number, COG-310084.***

Tom Boyce
June 12, 1995

Effective 06/30/95 . Certified Letter No. Z 416 968 756 .

CDPS GENERAL PERMIT

GROUNDWATER CLEANUP OF GASOLINE

AUTHORIZATION TO DISCHARGE UNDER THE

COLORADO DISCHARGE PERMIT SYSTEM

In compliance with the provisions of the Colorado Water Quality Control Act, (25-8-101 et seq., CRS, 1973 as amended) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.; the "Act") facilities performing groundwater cleanup from gasoline contamination are authorized to discharge cleanup water from approved locations throughout the State of Colorado to specified waters of the State. Such discharges shall be in accordance with the conditions of this permit.

This permit specifically authorizes the facility listed on page 1 of this permit to discharge process generated wastewaters, as of this date, in accordance with the permit requirements and conditions set forth in Parts I and II hereof. All discharges authorized herein shall be consistent with the terms and conditions of this permit.

This permit and the authorization to discharge shall expire at midnight,

March 31, 2000.

Issued and Signed this 13 day of January Effective April 1, 1995

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Robt J. Shukle for

J. David Holm, Director
Water Quality Control Division

CERTIFIED LETTER NO.
DATE SIGNED 01/13/95
EFFECTIVE DATE
PERMIT 04/01/95

Permit No. COG-310000

RENEWAL OF

CDPS GENERAL PERMIT RATIONALE

GROUNDWATER CLEANUP OF GASOLINE

AUTHORIZATION TO DISCHARGE UNDER THE

COLORADO DISCHARGE PERMIT SYSTEM

Update

The most significant changes in this renewal are as follows:

A. *Total phosphorus monitoring is required for certain Waters of the State. Nutrient loading can lead to algal blooms, which can cause low oxygen situations that degrade the aquatic life habitat and affect the quality of the water for water supply and recreational purposes. The Water Quality Control Division has established control regulations for these waterbodies and requires monitoring of discharges for these nutrients. The permit is being modified to include monitoring for Total Phosphorus where required. Paragraph (I.C.4.b.) lists these waters and describes sampling frequency and type.*

B. *New language has been added to the WET testing section to allow flexibility to the permit in dealing with toxicity. These changes bring this permit into agreement with the "Colorado WQCD Biomonitoring Guidance Document July 1, 1993" and are as follows:*

   1 *Language allowing greater flexibility in the determination of frequency or applicability of WET testing for certain facilities has been added. These decisions will be made on the basis of analytical data, duration of discharge, flow rates or other factors that the Division deems relevant. WET testing requirements and limits are included in Part I.B.2.c) of the permit.*

   2 *The imposition of an acute toxicity limit is included. This defines the conditions that must be met in order to comply with the WET limit.*

   3 *In cases that the Division determines that WET testing is required, Acute tests rather than Chronic tests will be required due to the low flow rates normally associated with this type of discharge.*

   4 *Language describing the Accelerated testing, Preliminary Toxicity Incident, and Toxicity Identification Evaluation procedures are included in the permit for cases where permittees have failed the WET tests.*

C. *Review of the EPA RREL 4 data and data from permitted gasoline remediation sites collected over the past five years in Colorado, demonstrates that a limit of 1 ug/l for benzene can and has been achieved by treating benzene contaminated ground water with air stripping and/or granular activated carbon (GAC) systems.*

C. cont.

When air stripping plus GAC is used as treatment for ground water containing a benzene concentration between 0 and 100 ug/l, the reported treated effluent benzene concentration is less than 1.0 ug/l. Typical removal efficiencies appear to be in excess of 90% and frequently are in excess of 99%, when influent concentrations of benzene 100 ug/l.

Over 90% (11 out of 12) of the facilities that submitted data for benzene in Colorado for the past two years demonstrated that they could routinely meet a 1 ug/l benzene limit.

D. *Comments during public notice*

No written comments were received during the public notice period. No changes were made to the permit or rationale from the public notice permit.

References

I. *U.S. Environmental Protection Agency. RREL 4 Treatability Database. Cincinnati, Ohio.*

II. *State of California Regional Water Quality Control Board, Central Valley Region. A Compilation of Water Quality Goals. Sacramento, California.*

Reauthorization

Authorization to discharge under this general permit will expire on March 31, 2000; thus facilities wishing continual coverage under this permit must reapply by September 30, 1999.

Tom Boyce
December 14, 1994

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PART II

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PART I

A. COVERAGE UNDER THIS PERMIT

1. Types of Wastewater

Under this general permit, facilities engaged in cleanup of gasoline from contaminated groundwater may be granted authorization to discharge treated process generated wastewaters into waters of the state of Colorado. For purposes of this permit, process generated wastewaters include:

Wastewater produced from cleanup of groundwater contaminated by gasoline and aviation gasoline. Cleanup of other petroleum products, such as aviation turbine fuel, kerosene, and diesel fuel, may not be covered under this permit.

2. Stream Dredging or Filling

This permit does not constitute authorization under 33 U.S.C. 1344 (Section 404 of the Clean Water Act) of any stream dredging or filling operations.

3. Criteria

The following is a list of the criteria which will be used in evaluating whether or not an individual permit may be required instead of a general permit:

a) proximity of the operation to a landfill or mine and mill tailings;

b) evidence of significant noncompliance under a previous permit for the operation;

c) an effluent flow greater than 0.05 MGD (50,000 gpd), except for flow exemption under Part I.A.4;

d) presence of downstream drinking water intakes or a fishery;

e) the need to preserve high quality water;

f) addition of flocculants (settling agents or chemical additives) to water prior to discharge;

g) use of chemicals (such as chlorine) within the system;

h) failure of the effluent to pass a Whole Effluent Toxicity (WET) test;

i) lead or organics levels in the effluent which could lead to a violation of the receiving waters instream water quality standard for lead or organics, respectively;

j) an anti-degradation review by the Division showing that the discharge would cause unallowable degradation to the receiving waters.

A. COVERAGE UNDER THIS PERMIT

4. Flow Volume Exemption

The Flow Volume Exemption may be applied under two separate circumstances, as follows:

a) The flow volume limit of 0.05 MGD may be temporarily waived for 30 days, for temporary dewatering sites. This provision will be approved by the Division on a case by case basis. The temporary dewatering projects which use the Flow Volume Exemption have the option of remaining under the general permit beyond the initial period, provided that the 0.05 MGD flow limit is met after the initial 30 days.

b) The flow volume limit of 0.05 MGD may be temporarily deleted for groundwater remediation sites with a discharge of greater than 0.05 MGD, if approved by the Division, provided that the permittee has applied for an individual discharge permit for the site. During this interim period, the Division reserves the right to impose additional monitoring and/or other requirements in order to verify compliance with the general permit. These requirements will be covered outside of the permit by letter. Noncompliance with the additional requirements could result in revocation of the permittee's certification under the general permit.

Any request for a Flow Volume Exemption must be included with the permittee's permit application. See the individual Certification Rationale to determine whether or not the exemption is allowed. In any event, no temporary flow increase is allowed without prior Division approval.

The Division reserves the right to refuse a facility coverage under the exemption. The flow volume, level of organics in the effluent, quality of receiving waters, and/or lack of information on the treatment system capability will be evaluated. The Division will use best professional judgment in determining whether or not the exemption will provide adequate coverage for the discharge.

5. Application

In order to be considered eligible for authorization to discharge under the terms and conditions of this permit, the owner, operator, and/or authorized agent of any facility desiring to discharge must submit, by certified mail or hand delivery, three copies of a completed discharge application form (available from the Division). The form requires, at a minimum, the following information:

a) Name, address, and descriptive location of the facility;

b) Name of principal in charge of operation of the facility;

c) Name of potential receiving waters;

d) Description of the type of activity resulting in the discharge, including the anticipated duration of activity and/or the discharge, anticipated volume and rate of discharge, and the source of water which is to be discharged;

e) Description of any wastewater treatment system and recycle/reuse utilized;

A. COVERAGE UNDER THIS PERMIT

5. Application cont.

f) A topographic map showing the general geographical location of the facility and any nearby landfills or mine or mill tailings;

g) A sketch of the facility showing all structures, outfalls and receiving waters, as well as storage locations of any petroleum or chemicals on site; and

h) A chemical analysis of the water to be discharged.

i) If the discharge is to a storm sewer system, ditch, or other man made conveyance, approval from the owner of the system must be obtained prior to certification under this permit. Documentation of this approval must be submitted with the discharge application.

At least thirty days prior to the anticipated date of discharge, three copies of the application shall be submitted to:

Colorado Department of Public Health and Environment
WQCD-PE-B2
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530

The Division shall have up to thirty days after receipt of the above information to request additional data and/or deny the authorization for any particular discharge. Upon receipt of additional information, the Division shall have an additional thirty days to issue or deny authorization for the particular discharge.

If the applicant does not receive a request for additional information or a notification of denial from the Division within 30 days, authorization to discharge in accordance with the conditions of the permit shall be deemed granted.

If the Division determines that the operation does not fall under the authority of the general permit, then the information received will be treated as an individual permit. In this case, discharge is not allowed until a permit is issued, which may take 180 days.

6. Expiration

Authorization to discharge under this general permit shall expire on March 31, 2000. The Division must evaluate and may reissue this general permit once every five years, and must also recertify the applicant's authority to discharge under the general permit at such time. Therefore, a permittee desiring continued coverage under the general permit must reapply by September 30, 1999. The Division will determine if the applicant may continue to operate under the terms of the general permit. An individual permit will be required for any facility not reauthorized to discharge under the reissued general permit. For facilities wishing to terminate authorization under the new permit, provisions of Part II.B.5.d will be applicable.

B. TERMS AND CONDITIONS

1. General Limitations

a) Discharge is allowed of treated process-generated wastewater from the cleanup of gasoline from contaminated groundwater. There shall be no discharge of groundwater from the cleanup of any other petroleum products, such as aviation turbine fuel, kerosene, or diesel fuel without prior approval.

b) There shall be no discharge of sanitary wastewater from toilets or related facilities into the treatment facilities covered under this permit.

c) There shall be no discharge of floating solids or visible foam in other than trace amounts.

d) No chemicals are to be added to the discharge unless permission for the use of a specific chemical is granted by the Division. In granting the use of such chemicals, additional limitations and monitoring requirements may be imposed.

e) Bulk storage structures for gasoline and other chemicals shall have adequate protection so as to contain all spills and prevent any spilled material from entering the effluent stream or waters of the State.

2. Effluent Limitations

In accordance with the Regulations for Water Quality Control Commission for Effluent Limitations, Section 10.1.3, and Regulations for the State Discharge Permit System, Section 6.9.2, 5 C.C.R. 1002-2, the permitted discharge shall not contain effluent parameter concentrations which exceed the following limitations or exceed the specified flow limitation:

Effluent Parameter	Discharge Limitations		
	30-Day Avg	7-Day Avg	Daily Max
Flow, MGD	See B.2.a)	NA	Report
Total Suspended Solids, mg/l	30	45	NA
Potentially Dissolved Lead, mg/l *	NA	NA	0.031
Benzene, mg/l	0.001	NA	NA
Total BETX, mg/l **	NA	NA	0.1
Total Dissolved Solids, mg/l ***	NA	NA	Report
Whole Effluent Toxicity, Acute	NA	NA	See B.2.c)
Total Phosphorus, mg/l ****	NA	NA	Report

* The lead limit is applicable only to those facilities which discharge to streams which have an instream lead limit, or which could impact such a stream. See the individual Certification Rationale to determine if the limit is applicable.
** Total BTEX includes Benzene, Ethylbenzene, Toluene, and Total Xylenes.
*** Applicable to waters of the Colorado River basin only. See I.D.8.
**** Applicable to waters listed in I.C.4.b)

pH - standard units shall remain between 6.5 and 9.0.
Oil and Grease shall not exceed 10 mg/l.

B. TERMS AND CONDITIONS

2. Effluent Limitations (Cont.)

a) The flow limit used will be the 30 day average flow (design) from the facility. See the individual Certification Rationale for the flow limit applicable to the individual facility.

b) Benzene Best Professional Judgment is the basis for the benzene limitation in this permit. The Division has established the permit limit for benzene as 0.001 mg/, because this effluent concentration has been proven achievable using present technology, i.e. air stripping and/or granular activated carbon systems.

c) **WET Testing:** The Division will examine each discharge application on a case by case basis. In cases where the data and circumstances justify, the Division may determine that WET testing not be required under the general permit for certain facilities. Similarly, the Division may determine that the frequency of WET testing be either increased or decreased from the normal quarterly monitoring depending on the analytical data, duration of discharge, flow rates or other factors that the Division deems relative. Unless specifically exempted in the rationale, the following the following WET testing requirements shall be preformed.

As a condition of the permit, the permittee will be required to conduct routine monitoring for acute toxicity using Ceriodaphnia sp. (water flea) and fathead minnows. An acute WET test is failed whenever the LC_{50}, which represents an estimate of the effluent concentration which is lethal to 50% of the test organisms in the time period prescribed, is found to be less than or equal to 100% effluent.

The monitoring frequency for acute WET tests shall be quarterly, commencing with the first full calendar quarter following the permit effective date. Quarterly test results shall be reported on a Quarterly DMR along with the Discharge Monitoring Reports (DMRs) submitted for the end of the reporting calendar quarter (i.e., WET testing results for the calendar quarter ending March 31 shall be reported with the DMR due April 28, with the remaining WET testing reports submitted with DMRs due each July 28, October 28 and January 28).

In addition to the WET test reporting DMR, the permittee shall submit CDPS WET Test Report Forms (generally completed by the laboratory for each species). Copies of these reports are to be submitted to both the Division and EPA.

The permittee shall conduct each acute WET test in general accordance with methods described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms,EPA/600/4-90/027 or the most current edition, except as modified by the most current Division guidance document entitled Guidelines for Conducting Whole Effluent Toxicity Tests. The permittee shall conduct an acute 48-hour WET test using Ceriodaphnia sp., and an acute 96-hour WET test using fathead minnows. Acute tests will be replacement static tests of a single grab sample.

Should acute toxicity be detected, the permittee must provide written notification of the failure of a WET test to the Division, along with a statement as to whether the Preliminary Toxicity Incident ("PTI")/Toxicity Identification Evaluation ("TIE") investigation or accelerated testing is being performed . Notification must be received by the Division within 14 calendar days of the demonstration of acute WET in the routine required test. "Demonstration" means no later than the last day of the laboratory test.

B. TERMS AND CONDITIONS

2. Effluent Limitations

c) WET Testing cont.

If a routine acute WET test is failed, the permittee shall either:

(i) proceed to conduct the PTI/TIE investigation as described below or

(ii) conduct accelerated testing using the single species found to be more sensitive.

If accelerated testing is being performed, the permittee shall provide written notification of the results within 14 calendar days of completion of the "Pattern of Toxicity"/"No Toxicity" demonstration. Testing will be at least once every two weeks for up to five tests until 1) two consecutive tests fail or three of five tests fail, in which case a pattern of toxicity has been demonstrated or, 2) two consecutive tests pass or three of five tests pass, in which case no pattern of toxicity has been found. If no pattern of toxicity is found, the toxicity episode is considered to be ended and routine testing is to resume. If a pattern of toxicity is found, a PTI/TIE investigation is to be performed. If a pattern of toxicity is not demonstrated but a significant level of erratic toxicity is found, the Division may require an increased frequency of routine monitoring or some other modified approach.

The results of the PTI/TIE investigation are to be received by the Division within 120 days of the demonstration of acute WET in the routine test, as defined above, or if accelerated testing is performed, the date the pattern of toxicity is demonstrated. A status report is to be provided to the Division at the 30, 60 and 90 day points of the PTI/TIE investigation. The Division may extend the time frame for investigation where reasonable justification exists. A request for an extension must be made in writing and received prior to the 120 day deadline. Such request must include a justification and supporting data for such an extension.

The permittee may use the time for investigation to conduct a PTI or move directly into the TIE. A PTI consists of a brief search for possible sources of WET, which might reveal causes of such toxicity and appropriate corrective actions more simply and cost effectively than a formal TIE. If the PTI allows resolution of the WET incident, the TIE need not necessarily be conducted. If, however, WET is not identified or resolved during the PTI, the TIE must be conducted within the 120 days.

Any permittee that is required to conduct a PTI/TIE investigation shall do so in conformance with procedures identified in the following documents, or as subsequently updated: 1) Methods for Aquatic Toxicity Identification Evaluations, Phase I Toxicity Characterization Procedures, EPA/600/6-91/003 Feb. 1991 and 2) Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures, EPA/600/3-88/035 Feb. 1989. A third document in this series is Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures, EPA/600/3-88/036 Feb. 1989. As indicated by the title, this procedure is intended to confirm that the suspected toxicant is truly the toxicant. The Phase III investigation is optional.

B. TERMS AND CONDITIONS

2. Effluent Limitations

c) WET Testing cont.
If toxicity spontaneously disappears at any time after a test failure, the permittee shall notify the Division in writing within 14 days of a demonstration of disappearance of the toxicity. If a pattern of toxicity or recurring toxicity is not identified, the toxicity incident response is considered closed and normal WET testing shall resume.

C. MONITORING REQUIREMENTS

1. Frequency and Sample Type

In order to obtain an indication of the probable compliance or noncompliance with the effluent limitations specified in Section B, the permittee shall monitor all effluent parameters at the following frequencies.

Effluent Parameter	Measurement Frequency	Sample Type
Flow, MGD	Weekly	Instantaneous or Continuous
Total Suspended Solids, mg/l	Monthly	Grab
pH, s.u.	Weekly	Grab
Oil and Grease, mg/l	Weekly	Visual See I.D.12.
Potentially Dissolved Lead, mg/l	Monthly	Grab
Benzene, mg/l	Monthly	Grab
Total BETX, mg/l	Monthly	Grab
Whole Effluent Toxicity, Acute (See Part I.B.2.c)	Quarterly ***	Grab
Total Dissolved Solids, mg/l *	Quarterly	Grab
Total Phosphorus, mg/l **	Monthly	Grab

* Applicable to waters of the Colorado River basin only. See I.D.8.
** Applicable to waters listed in I.C.4.b)
*** Quarterly monitoring unless modified by the Division.

If the permittee, using the approved analytical methods, monitors any parameter more frequently than required by this permit, then the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form or other forms as required by the Division. Such increased frequency shall also be indicated.

C. MONITORING REQUIREMENTS cont.

2. Detection Limits

When the most sensitive analytical method which complies with Part I.F.2. of the permit has a detection limit greater than or equal to the permit limit, the permittee shall report "less than the detectable limit," as appropriate. Such reports shall not be considered as violations of the permit limit.

3. Reporting of Data

Reporting of the data gathered in compliance with Part I.C.1 shall be on a quarterly basis. Monitoring results shall be summarized for each month and reported on Division approved discharge monitoring report forms received by the Division no later than the 28th day of the last month of the quarter. If no discharge occurs during the reporting period, "No Discharge" shall be reported.

Duplicate signed copies of the above report forms shall be submitted to the following addresses:

Submit the top copy (original) of each set of forms to:

Colorado Department of Public Health and Environment
WQCD-PE-B2
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530

Submit the second duplicate of each set of forms to:

U.S. Environmental Protection Agency
Water Management Division
NPDES Branch 8WM-C
Denver Place
999 18th Street, Suite 500
Denver, CO 80202-2405

4. Special Monitoring

Pursuant to CRS 1973, 25-8-304, and to maintain a current data base for proper evaluation of the water quality impact of the discharge, the permittee shall monitor and submit data for Organic Toxic Pollutants in the volatile fraction listed in I.C.4.a) on an annual basis. The analysis shall be done from a grab sample by GC/MS and each parameter shall be reported individually. The first instance of monitoring shall be performed within three months of the certification effective date, and the results submitted to the Division with the next DMR.

If the new data indicate the presence of any organics at levels which might violate the organic pollutant standards contained in tables A, B or C of "The Basic Standards and Methodologies for Surface Water," 3.1.0, the Division reserves the right to require the facility to obtain an individual permit.

C. MONITORING REQUIREMENTS

4. Special Monitoring (Cont.)

a) Organic Toxic Pollutants - Volatiles Fraction
(all units are ug/l)

Parameter	Maximum Acceptable Detection Level	Parameter	Maximum Acceptable Detection Level
Acrolein	25	1,2-Dichloropropane	5
Acrylonitrile	25	1,3-Dichloropropylene	5
Benzene	5	Ethylbenzene	5
Bromoform	5	Methyl Bromide	10
Carbon Tetrachloride	5	Methyl Chloride	10
Chlorobenzene	5	Methylene Chloride	10
Chlorodibromomethane	5	1,1,2,2-Tetrachloroethane	5
Chloroethane	10	Tetrachloroethylene	5
2-Chloroethylvinyl Ether	10	Toluene	5
Chloroform	5	1,2-Trans-dichloroethylene	5
Dichlorobromomethane	5	1,1,1-Trichloroethane	5
1,1-Dichloroethane	5	1,1,2-Trichloroethane	5
1,2-Dichloroethane	5	Trichloroethylene	5
1,1-Dichloroethylene	5	Vinyl Chloride	2

b) Total phosphorus (as P) monitoring is required for facilities which discharge into the following drainage basins: Cherry Creek basin, Chatfield Reservoir upstream of the USGS gage at Waterton and on Plum Creek, Dillon Reservoir basin (i.e. Ten Mile Creek, Snake River, Blue River, all tributaries to the Dillon Reservoir), and Bear Creek basin. The Division also reserves the right to include phosphorus monitoring for any receiving waters that may later enter into phosphorus monitoring requirements. If phosphorus monitoring is a requirement of the permit than it shall be included within the terms and conditions of the individual Certification Rationale of the permit. Additional monitoring for phosphorus shall be included on the (DMR) and shall be subject to the permit's monitoring and reporting requirements. Phosphorus sampling shall be on a quarterly basis, taken as a grab sample.

D. DEFINITIONS

1. "BETX" shall be measured as the sum of benzene, ethylbenzene, toluene and xylenes. EPA methods 502, 602, 624, 1624, 8020, 8240, or 8260 shall be used for the measurement of benzene, ethylbenzene, toluene, and xylenes including ortho-, meta-, and para-xylene.

2. A "composite" sample, for monitoring requirements, is a minimum of four (4) grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow.

3. A "continuous" measurement, for flow monitoring requirements, is a measurement obtained from an automatic recording device which continually measures flow.

4. A "grab" sample, for monitoring requirements, is a single "dip and take" sample.

5. An "instantaneous" measurement, for monitoring requirements, is a single reading, observation, or measurement performed on site.

6. The "potentially dissolved metal" fraction is defined in "The Basic Standards and Methodologies for Surface Water," 3.1.0, as that portion of a constituent measured from the filtrate of a water and suspended sediment sample, that was first treated with nitric acid to a pH of 2 or less and let stand for 8 to 96 hours prior to sample filtration using a 0.4 or 0.45-um membrane filter. Note the "potentially dissolved" method cannot be used where nitric acid will interfere with the analytical procedure used for the constituent measured.

7. A "quarterly sample" shall be collected during March, June, September and December, if a continual discharge occurs. If the discharge is intermittent, then samples shall be collected during the period that discharge occurs.

8. "Salinity" is measured as Total Dissolved Solids (TDS). Where based on a minimum of 5 samples, the permittee demonstrates, to the satisfaction of the Water Quality Control Division, that the level of TDS in the effluent can be calculated based upon the level of electrical conductivity, the permittee may measure and report salinity in terms of electrical conductivity.

9. The "seven (7) day average" shall be determined by the arithmetic mean of all samples taken in a seven (7) day period. Samples may not be used for more than one (1) reporting period.

10. A "24 hour composite" sample is a combination of at least eight (8) sample aliquots of at least 100 milliliters, collected at equally spaced intervals during the operating hours of a facility over a twenty-four (24) hour period. For volatile pollutants, aliquots must be combined in the laboratory immediately before analysis. The composite must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the wastewater or effluent flow at the time of sampling or the total wastewater or effluent flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically.

D. DEFINITIONS cont.

11. "The thirty (30) day average" shall be determined by the arithmetic mean of all samples collected during a thirty (30) consecutive-day period or calendar month.

12. A "visual" observation, for oil and grease monitoring requirements, is defined as observing the discharge to check for the presence of a visible sheen or floating oil. If either of these is present, a grab sample shall be taken, analyzed, and reported on the appropriate DMR. In addition, corrective action shall be taken immediately to mitigate the discharge of oil and grease. A description of the corrective action taken should be included with the DMR.

13. "Water Quality Control Division" or "Division" means the state Water Quality Control Division as established in 25-8-101 et al.)

E. REPORTING

1. Signatory Requirements

All reports and other information required by the Division shall be signed in ink and certified for accuracy by the permittee in accord with the following criteria:

a) In the case of corporations, by a principal executive officer of at least the level of vice-president or his or her duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge described in the form originates;

b) In the case of a partnership, by a general partner;

c) In the case of a sole proprietorship, by the proprietor;

d) In the case of a municipal, state, or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

e) The permittee shall make the following certification on all such documents;

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

F. GENERAL REQUIREMENTS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and approval by the Division.

F. GENERAL REQUIREMENTS cont.

2. Analytical and Sampling Methods for Monitoring

Analytical and sampling methods utilized by the discharger shall conform to Colorado Regulations for Effluent Limitations (10.1.5), and to regulations published pursuant to Section 304 (h) of the Clean Water Act.

The analytical method selected for a parameter shall be the one that can measure the lowest detected limit for that parameter unless the permit limitation or stream standard for those parameters is within the testing range of another approved method.

3. Records

The permittee shall establish and maintain records. Those records shall include the following:

a) The date, type, exact location, and time of sampling or measurements;

b) The individual(s) who performed the sampling or measurements;

c) The date(s) the analyses were performed;

d) The individual(s) who performed the analyses;

e) The analytical techniques or methods used;

f) The results of such analyses; and

g) Any other observations which may result in an impact on the quality or quantity of the discharge as indicated in 40 CFR 122.44 (i)(1)(iii).

The permittee shall retain for a minimum of three (3) years records of all monitoring information, including all original strip chart recordings for continuous monitoring instrumentation, all calibration and maintenance records, copies of all reports required by this permit and records of all data used to complete the application for coverage under this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the permittee or when requested by the Division or Regional Administrator of EPA.

4. Flow Measuring Device

If not already a part of the permitted facility, within ninety (90) days after the effective date of the certification, a flow measuring device shall be installed to give representative values of effluent quantities at the respective discharge points. A flow measuring device will be applicable at all designated discharge points. Pump capacity may be used for flow measurement if corrected for elevation head, pipe size and length, and pipe friction loss.

At the request of the Water Quality Control Division, or the Environmental Protection Agency, the permittee shall show proof of the accuracy of any flow measuring device used in obtaining data submitted in the monitoring report. The flow-measuring device must indicate values within ten (10) percent of the actual flow being discharged from the facility.

F. GENERAL REQUIREMENTS cont.

5. Best Management Practices

The permittee shall implement and maintain Best Management Practices for the control of surface runoff and prevention of erosion due to the discharge. Best Management Practices can include various options, such as: modification of the pipe discharge structure to disperse flows; containment of water by hay bales or other comparable structures; the use of geocloth, filter fabric, or plastic sheeting for protection of containment structures; rip-rap; and/or any other approved methods which might be used.

There shall be no sludge banks or deposition of solids downstream from the discharge(s). Control of excessive suspended solids shall be undertaken as necessary to prevent reaching surface receiving waters and causing any receiving water deterioration. Any hazardous materials or chemicals stored or used on site shall be adequately handled and contained to prevent any spills from occurring. Earthen dikes or concrete basins with capacity to hold contents of storage tanks or containers shall be used to prevent spills of these materials into State Waters in the event of failure of the storage containers.

PART II

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

The permittee shall inform the Division (Permits and Enforcement Section) in writing of any intent to construct, install, or alter any process, facility, or activity that is likely to result in a new or altered discharge, in and shall furnish the Division such plans and specifications which the Division deems reasonably necessary to evaluate the effect on the discharge and receiving stream.

The permittee shall submit this notice within two (2) weeks after making a determination to perform the type of activity referred to in the preceding paragraph. Process modifications include, but are not limited to, the introduction of any new pollutant not previously identified in the permit, or any other modifications which may result in a discharge of a quantity or quality different from that which was evaluated in the drafting of the permit including subsequent amendments. Following such notice, the permittee shall be required to submit a new CDPS application, and may be required to be covered under an individual permit to specify and limit any pollutants not previously limited, if the new or altered discharge might be inconsistent with the conditions of the general permit. In no case shall the permittee implement such change without first notifying the Division.

2. Special Notifications - Definitions

a) Bypass: The intentional diversion of waste streams from any portion of a treatment facility.

b) Severe Property Damage: Substantial physical damage to property at the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. It does not mean economic loss caused by delays in production.

c) Spill: An unintentional release of solid or liquid material which may cause pollution of state waters.

d) Upset: An exceptional incident in which there is unintentional and temporary noncompliance with permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

3. Noncompliance Notification

a) If, for any reason, the permittee does not comply with or will be unable to comply with any discharge limitations or standards specified in this permit, the permittee shall, at a minimum, provide the Water Quality Control Division and EPA with the following information:

(i) A description of the discharge and cause of noncompliance;

A. MANAGEMENT REQUIREMENTS

3. Noncompliance Notification cont.

(ii) The period of noncompliance, including exact dates and times and/or the anticipated time when the discharge will return to compliance; and

(iii) Steps being taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

b) The permittee shall report the following instances of noncompliance orally within twenty-four (24) hours from the time the permittee becomes aware of the noncompliance, and shall mail to the Division a written report containing the information requested in Part II.A.3.(a) within five (5) days after becoming aware of the noncompliance:

(i) Any instance of noncompliance which may endanger health or the environment;

(ii) Any unanticipated bypass which exceeds effluent limitations;

(iii) Any upset which causes an exceedance of any effluent limitation in the permit;

(iv) Any spill which causes any effluent limitation to be violated;

(v) Daily maximum violations for any toxic pollutants or hazardous substances limited by Part I-A of this permit and specified as requiring 24 hour notification. This includes any toxic pollutant or hazardous substance or any pollutant specifically identified as the method to control any toxic pollutant or hazardous substance.

c) The permittee shall report all other instances of non-compliance not requiring 24-hour notification at the time Discharge Monitoring Reports are submitted. The reports shall contain the information listed in sub-paragraph (a) of this section.

4. Submission of Incorrect or Incomplete Information

Where the permittee failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or report to the Division, the permittee shall promptly submit the relevant application information which was not submitted or any additional information needed to correct any erroneous information previously submitted.

5. Bypass

The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but if and only if it is for essential maintenance to assure optimal operation. These bypasses are not subject to the provisions noted in item b.) below. Division notification is not required.

Bypass is prohibited, and the Division may take enforcement action against a permittee for bypass, unless:

a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

A. MANAGEMENT REQUIREMENTS

5. Bypass cont.

b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance;

c) The permittee submitted notices as required in "Bypass Notification", Part II.A.6.

6. Bypass Notification

If the permittee knows in advance of the need for a bypass, a notice shall be submitted, at least ten days before the date of the bypass, to the Division and the Environmental Protection Agency (EPA). The bypass shall be subject to Division approval and limitations imposed by the Division and EPA.

7. Upsets

a) Effect of an Upset

An upset constitutes an affirmative defense to an action brought for noncompliance with permit effluent limitations if the requirements of paragraph b of this section are met. (No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.)

b) Conditions Necessary for a Demonstration of Upset

A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed contemporaneous operating logs, or other relevant evidence that:

(i) An upset occurred and that the permittee can identify the specific cause(s) of the upset; and

(ii) The permitted facility was at the time being properly operated and maintained; and

(iii) The permittee submitted notice of the upset as required in Part II.A.3. of this permit (24-hour notice); and

(iv) The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(v) In addition to the demonstration required above, a permittee who wishes to establish the affirmative defence of upset for a violation of effluent limitations based on water quality standards shall also demonstrate through monitoring, modeling, or other methods that the relevant standards were achieved in the receiving water.

A. MANAGEMENT REQUIREMENTS

7. Upsets cont.

c) Burden of Proof

In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

8. Removed Substances

Solids, sludges, or other pollutants removed in the course of treatment or control of wastewaters shall be properly disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State.

9. Minimization of Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to waters of the State resulting from any discharge. As necessary, accelerated or additional monitoring to determine the nature and impact of the noncomplying discharge is required.

10. Discharge Point

Any discharge to the waters of the State from a point source other than specifically authorized by this permit is prohibited.

11. Reduction, Loss, or Failure of Treatment Facility

The permittee has the duty to halt or reduce any activity if necessary to maintain compliance with the effluent limitations of the permit. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production, or all discharges, or both until the facility is restored or an alternative method of treatment is provided. This provision for example, applies to power failures, unless an alternative power source sufficient to operate the wastewater control facilities is provided.

It shall not be a defense for a permittee in an enforcement action that it would be necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

12. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee as necessary to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by the permittee only when necessary to achieve compliance with the conditions of the permit.

B. RESPONSIBILITIES

1. Inspections and Right to Entry

The permittee shall allow access to the Director of the Division, the EPA Regional Administrator, and/or their authorized representative, upon the presentation of credentials. In the making of such inspections, investigations, and determinations, the Division, in sofar as practicable, may designate as its authorized representatives any qualified personnel of the Department of Agriculture. The Division may also request assistance from any other state or local agency or institution.

a) To enter upon the permittee's premises where a regulated facility or activity is located or in which any records are required to be kept under the terms and conditions of this permit;

b) At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit and to inspect any monitoring equipment or monitoring method required in the permit; and

c) To enter upon the permittee's premises to investigate, within reason, any actual, suspected, or potential source of water pollution, or any violation of the Colorado Water Quality Control Act. The investigation may include, but is not limited to, the following: sampling of any discharge and/or process waters, the taking of photographs, interviewing permittee staff on alleged violations, and access to any and all facilities or areas within the permittee's premises that may have any effect on the discharge, permit, or alleged violation. Such entry is also authorized for the purpose of inspecting and copying records required to be kept concerning any effluent source.

d) The Division shall split any sample taken with the permittee if requested to do so by the permittee.

2. Duty to Provide Information

The permittee shall furnish to the Division, within a reasonable time, any information which the Division may request to determine whether cause exists for modifying, revoking and reissuing, or terminating coverage under this permit, or to determine compliance with this permit. The permittee shall also furnish to the Division, upon request, copies of records required to be kept by this permit.

3. Transfer of Ownership or Control

Certification under this permit may be transferred to a new permittee if:

a) The current permittee notifies the Division in writing 30 days in advance of the proposed transfer date; and

b) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage and liability between them; and

c) The Division does not notify the existing permittee and the proposed new permittee of its intent to modify, or revoke and reissue the permit; and

d) The current permittee has met all fee requirements of the Regulations for the State Discharge Permit System, Section 6.16.0.

B. RESPONSIBILITIES cont.

4. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Clean Water Act and Regulations for the State Discharge Permit System 6.6.4 (2), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Division and the Environmental Protection Agency.

5. Modification, Suspension, or Revocation of Permits By the Division

All permit modification, termination or revocation and reissuance actions shall be subject to the requirements of the Regulations for the State Discharge Permit System, Sections 6.6.2, 6.6.3, 6.8.0 and 6.16.0, 5 C.C.R. 1002-2, except for minor modifications. Minor modifications may only correct typographical errors, require a change in the frequency of monitoring or reporting by the permittee, change an interim date in a schedule of compliance or allow for a change in ownership or operational control of a facility including addition, deactivation or relocation of discharge points where the Division determines that no other change in the permit is necessary.

a) This permit, and certification under this permit, may be modified, suspended, or revoked in whole or in part during its term for reasons determined by the Division including but not limited to, the following:

(i) Violation of any terms or conditions of the permit;

(ii) Obtaining a permit by misrepresentation or failing to disclose any fact which is material to the granting or denial of a permit or to the establishment of terms or conditions of the permit;

(iii) Materially false or inaccurate statements or information in the application for the permit, or;

(iv) A determination that the permitted activity endangers human health or the classified or existing uses of State Waters and can only be regulated to acceptable levels by permit modifications or termination.

b) This permit, or certification under this permit, may be modified in whole or in part due to a change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge, such as:

(i) There are material and substantial alterations or additions to the permitted facility or activity which occurred after permit issuance which justify the application of permit conditions that are different or absent in the existing permit;

B. RESPONSIBILITIES

5. Modification, Suspension, or Revocation of Permits By the Division cont.

b)

(ii) The Division has received new information which was not available at the time of permit issuance (other than revised regulations, guidance, or test methods) and which would have justified the application of different permit conditions at the time of issuance. For permits issued to new sources or new dischargers, this cause includes information derived from effluent testing required under Section 6.5.7(5) of the ***Regulations for the State Discharge Permit System***. This provision allows a modification of the permit to include conditions that are less stringent than the existing permit only to the extent allowed under Section 6.11.0 of the ***Regulations for the State Discharge Permit System***;

(iii) The standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision after the permit was issued. Permits may be modified during their terms for this cause only as follows:

(a) The permit condition requested to be modified was based on a promulgated effluent limitation guideline, EPA approved water quality standard, or an effluent limitation set forth in 5 CCR 1002-3, § 10.1.0 et seq.; and

(b) EPA has revised, withdrawn, or modified that portion of the regulation or effluent limitation guideline on which the permit condition was based, or has approved a Commission action with respect to the water quality standard or effluent limitation on which the permit condition was based; and

(c) The permittee requests modification after the notice of final action by which the EPA effluent limitation guideline, water quality standard, or effluent limitation is revised, withdrawn, or modified; or

(d) For judicial decisions, a court of competent jurisdiction has remanded and stayed EPA promulgated regulations or effluent limitation guidelines, if the remand and stay concern that portion of the regulations or guidelines on which the permit condition was based and a request is filed by the permittee in accordance with this Regulation, within ninety (90) days of judicial remand;

(iv) The Division determines that good cause exists to modify a permit condition because of events over which the permittee has no control and for which there is no reasonable available remedy;

(v) The permittee has received a variance;

(vi) When required to incorporate applicable toxic effluent limitation or standards adopted pursuant to § 307(a) of the Federal act;

(vii) When required by the reopener conditions in the permit;

B. RESPONSIBILITIES

5. Modification, Suspension, or Revocation of Permits By the Division cont.

b)

(viii) As necessary under 40 C.F.R. 403.8(e), to include a compliance schedule for the development of a pretreatment program;

(ix) When the level of discharge of any pollutant which is not limited in the permit exceeds the level which can be achieved by the technology-based treatment requirements appropriate to the permittee under Section 6.9.2(1) *of the Regulations for the State Discharge Permit System*;

(x) To establish a pollutant notification level required in Section 6.9.5 *of the Regulations for the State Discharge Permit System*;

(xi) To correct technical mistakes, such as errors in calculation, or mistaken interpretations of law made in determining permit conditions, to the extent allowed in Section 6.11.0 *of the Regulations for the State Discharge Permit System*, or;

(xii) When required by a permit condition to incorporate a land application plan for beneficial reuse of sewage sludge, to revise an existing land application plan, or to add a land application plan.

(xiii) For any other cause provided in Section 6.11.0 *of the Regulations for the State Discharge Permit System*.

c) At the request of a permittee, the Division may modify or terminate a permit and issue a new permit if the following conditions are met:

(i) The Regional Administrator has been notified of the proposed modification or termination and does not object in writing within thirty (30) days of receipt of notification;

(ii) The Division finds that the permittee has shown reasonable grounds consistent with the Federal and State statutes and regulations for such modifications or termination;

(iii) Requirements of Section 6.16.0 *of the Regulations for the State Discharge Permit System* have been met, and;

(iv) Requirements of public notice have been met.

d) Permit modification (except for minor modifications), termination or revocation and reissuance actions shall be subject to the requirements of Sections 6.6.2, 6.6.3, 6.7.0, 6.8.0 and 6.16.0 of the Regulations for the State Discharge Permit System. The Division shall act on a permit modification request, other than minor modifications requests, within 180 days of receipt thereof. Except for minor modifications, the terms of the existing permit govern and are enforceable until the newly issued permit is formally modified or revoked and reissued following public notice.

B. RESPONSIBILITIES

5. Modification, Suspension, or Revocation of Permits By the Division cont.

e) Upon consent by the permittee, the Division may make minor permit modifications without following the requirements of Sections 6.6.2, 6.6.3, 6.8.0, and 6.16.0 of the Regulations for the State Discharge Permit System. Minor modifications to permits are limited to:

(i) Correcting typographical errors; or

(ii) Increasing the frequency of monitoring or reporting by the permittee; or

(iii) Changing an interim date in a schedule of compliance, provided the new date of compliance is not more than 120 days after the date specific in the existing permit and does not interfere with attainment of the final compliance date requirement; or

(iv) Allowing for a transfer in ownership or operational control of a facility where the Division determines that no other change in the permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage and liability between the current and new permittees has been submitted to the Division; or

(v) Changing the construction schedule for a discharger which is a new source, but no such change shall affect a discharger's obligation to have all pollution control equipment installed and in operation prior to discharge; or

(vi) Deleting a point source outfall when the discharge from that outfall is terminated and does not result in discharge of pollutants from other outfalls except in accordance with permit limits; or

f) When a permit is modified, only the conditions subject to modification are reopened. If a permit is revoked and reissued, the entire permit is reopened and subject to revision and the permit is reissued for a new term.

g) The filing of a request by the permittee for a permit modification, revocation and reissuance or termination does not stay any permit condition.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject to under Section 311 (Oil and Hazardous Substance Liability) of the Clean Water Act.

7. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority granted by Section 510 of the Clean Water Act.

B. RESPONSIBILITIES cont.

8. Permit Violations

Failure to comply with any terms and/or conditions of this permit shall be a violation of this permit.

9. Property Rights

The issuance of this permit does not convey any property or water rights in either real or personal property, or stream flows, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. Severability

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

11. Renewal Application

If the permittee desires to continue to discharge, a permit renewal application shall be submitted at least one hundred eighty (180) days before this permit expires. If the permittee anticipates there will be no discharge after the expiration date of this permit, the Division should be promptly notified so that it can terminate the certification in accordance with Part II.B.5.

12. Confidentiality

Any information relating to any secret process, method of manufacture or production, or sales or marketing data which has been declared confidential by the permittee, and which may be acquired, ascertained, or discovered, whether in any sampling investigation, emergency investigation, or otherwise, shall not be publicly disclosed by any member, officer, or employee of the Commission or the Division, but shall be kept confidential. Any person seeking to invoke the protection of this Subsection (2) shall bear the burden of proving its applicability. This section shall never be interpreted as preventing full disclosure of effluent data.

13. Fees

The permittee is required to submit payment of an annual fee as set forth in the 1983 amendments to the Water Quality Control Act. Section 25-8-502 (1) (b), and State Discharge Permit Regulations 5CCR 1002-2, Section 6.16.0 as amended. Failure to submit the required fee when due and payable is a violation of the permit and will result in enforcement action pursuant to Section 25-8-601 et. seq., C.R.S. 1973 as amended.

B. RESPONSIBILITIES cont.

14. Requiring an Individual CDPS Permit

The Director may require any owner or operator covered under this permit to apply for and obtain an individual CDPS permit if:

a) The discharger is not in compliance with the conditions of this general permit;

b) Conditions or standards have changed so that the discharge no longer qualifies for a general permit; or

c) Data become available which indicate water quality standards may be violated.

The owner or operator must be notified in writing that an application for an individual CDPS permit is required. When an individual CDPS permit is issued to an owner or operator otherwise covered under this general permit, the applicability of the general permit to that owner or operator is automatically terminated upon the effective date of the individual CDPS permit.

15. Requesting an Individual CDPS Permit

Any owner or operator covered by this general permit may request to be excluded from the coverage by applying for an individual CDPS permit.

16. Requesting Coverage Under the General Permit

The owner or operator of a facility excluded from coverage by this general permit solely because that facility already has an individual permit may request that the individual permit be revoked and that the facility be covered by this general permit. Such request shall be evaluated by the Division as per the criteria specified in Part I of this permit.

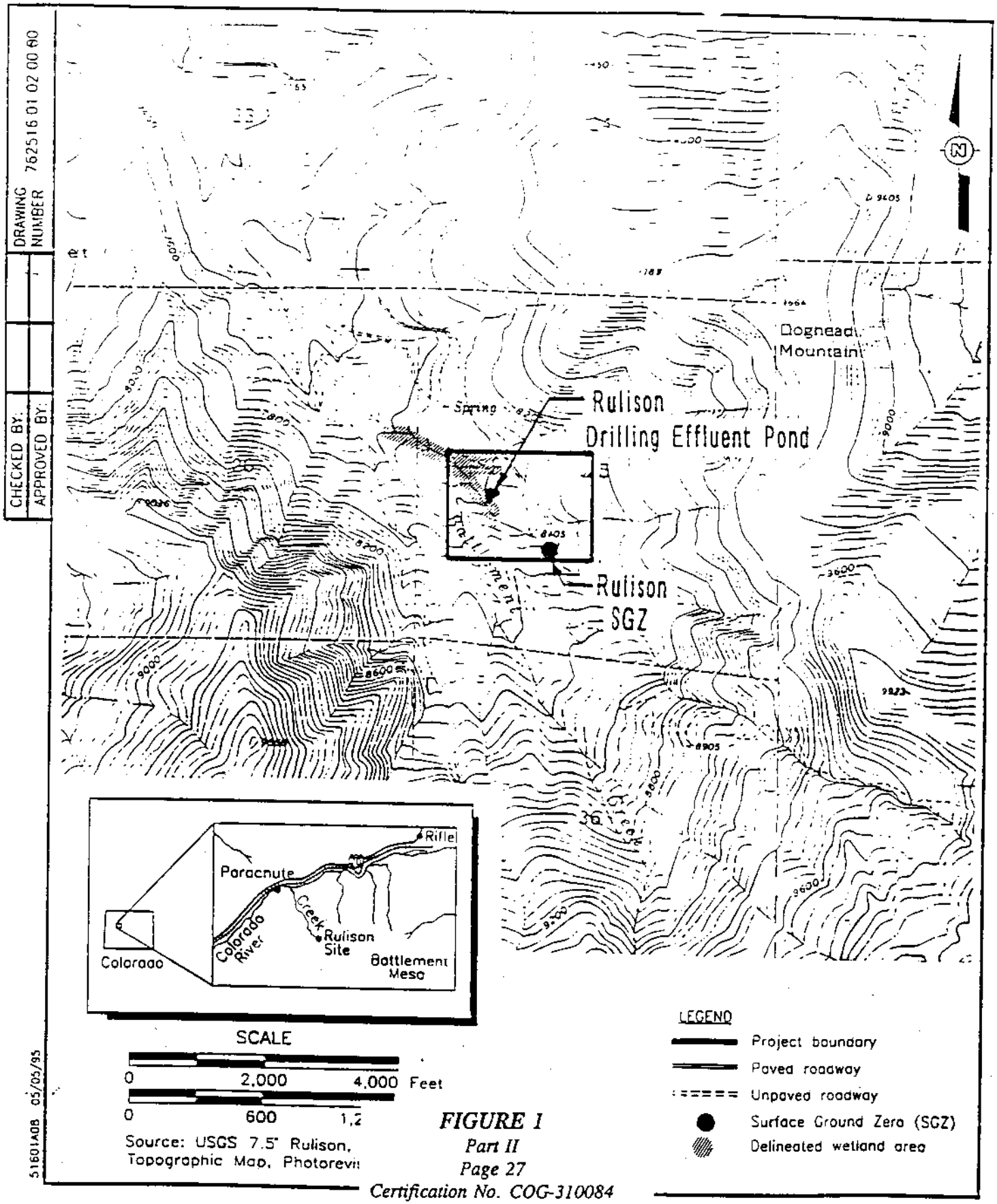

FIGURE 1
Part II
Page 27
Certification No. COG-310084

Project Rulison Location Map
Garfield County, Colorado

51601A23 05/18/95

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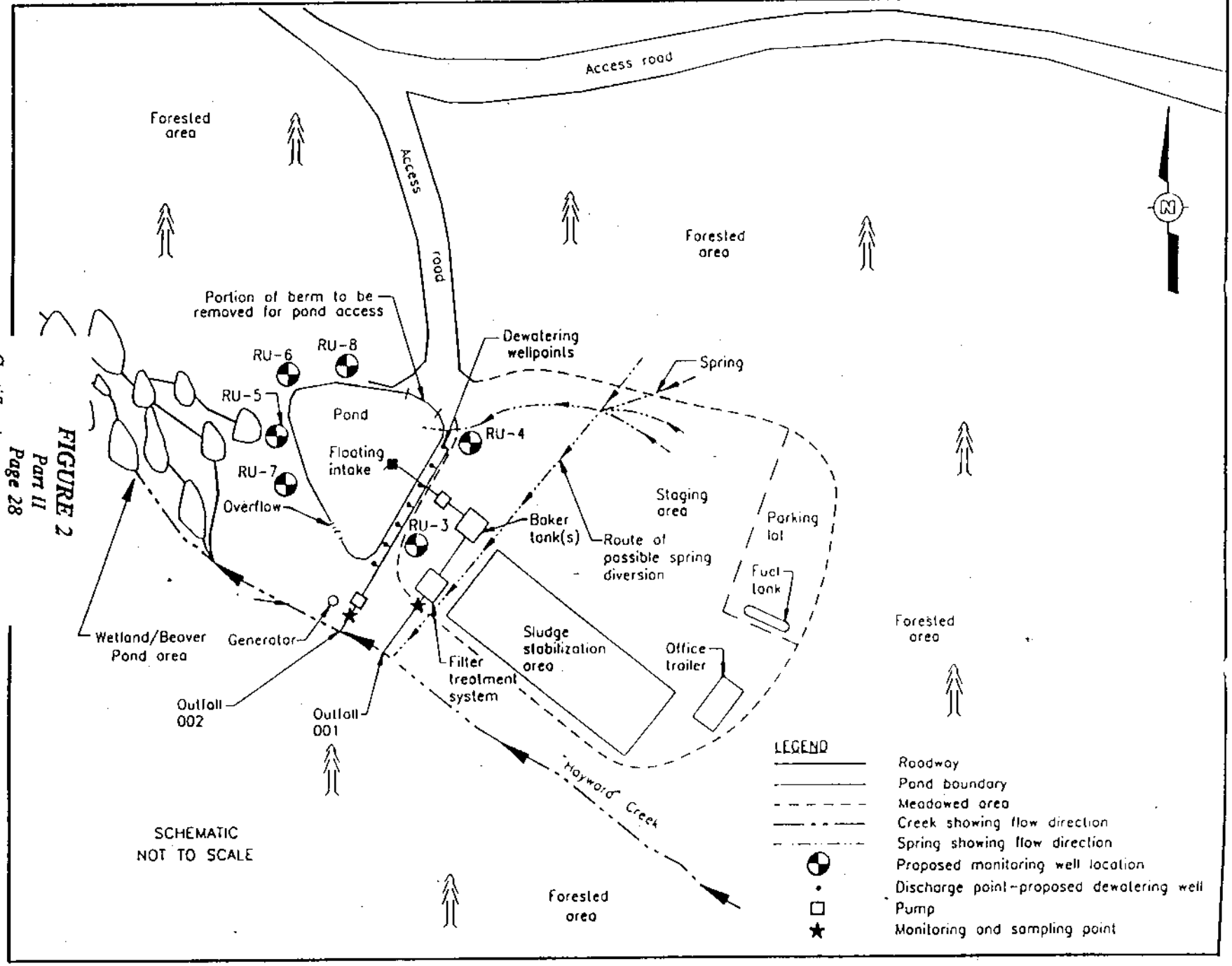

FIGURE 2
Part II
Page 28
Certification No. COG-310084
Project Rulison Site Sketch
Garfield County, Colorado

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Division
4210 East 11th Avenue
Denver, Colorado 80220

AMENDMENT #1

RATIONALE

GROUNDWATER CLEANUP OF GASOLINE

GENERAL PERMIT IN COLORADO

COLORADO DISCHARGE PERMIT NUMBER COG-310000

PURPOSE OF AMENDMENT:

The Division has initiated this amendment to the general permit to include a Flow Volume Exemption, as follows.

The permit is currently written to allow a maximum discharge of 0.05 MGD, or about 35 gpm. This excludes larger facilities from coverage under the general permit. The larger facilities then need to apply for an individual permit, which is desirable so that more frequent monitoring and/or other more stringent controls may be applied. This additional control is needed for on-going systems. However, this restriction has also resulted in a lack of flexibility in applying this permit. Therefore, the Flow Volume Exemption will be applied under two separate circumstances, as follow:

1) Several cases have arisen at sites contaminated or potentially contaminated by gasoline, where discharge is of a temporary nature for construction dewatering, and is expected to last for a matter of weeks. Such projects typically involve larger volumes of water, and may be on a tighter schedule which does not allow time for application for an individual permit. Therefore, the general permit will be amended so that the maximum flow limit of 0.05 MGD is deleted, for a period not to exceed 30 days, for temporary dewatering sites. This provision will be approved by the Division on a case-by-case basis.

2) Many operators of groundwater cleanup sites wish to begin groundwater remediation as quickly as possible to prevent further spread of the contamination, but larger facilities may not be able to because of the flow restriction. Therefore, if the flow from a groundwater remediation site as defined in this permit is greater than 0.05 MGD, and the Division determines that there is no other reason why cleanup should not begin immediately, then the permittee may be temporarily certified under this general permit (with no flow limit) while going through the application process for an individual permit. However, the permittee must agree to perform additional monitoring and/or any other requirements the Division may impose during this interim time. These requirements will be covered outside of the permit by letter. Noncompliance with the additional requirements could result in revokation of the permittee's certification under the general permit.

PURPOSE OF AMENDMENT:

Therefore, the general permit will be amended to remove the maximum discharge limit of 0.05 MGD, for the two situation described above.

The Division reserves the right to refuse a facility coverage under the exemption. The flow volume, level of organics in the effluent, quality of receiving waters, and/or lack of information on the treatment system capability will be evaluated. The Division will use best professional judgment in determining whether or not the exemption will provide adequate coverage for the discharge.

The temporary dewatering projects which use the Flow Volume Exemption have the option of remaining under the general permit beyond the initial period, provided that the 0.05 MGD flow limit is met after the initial 30 days. The 30 day time period will start with the first day of dewatering, and end 30 days after that, regardless of how many days dewatering actually took place in the interim. The permittee must notify the Division in writing if it intends to use the permit beyond 30 days.

Any request for a Flow Volume Exemption must be included with the permittee's permit application. See the individual Certification Rationale to determine whether or not the exemption is allowed. In any event, no temporary flow increase is allowed without prior Division approval.

Page 2 of the permit has been amended. Page 2a has been added. All other permit requirements shall remain the same.

Kathryn Dolan
July 16, 1991

PUBLIC NOTICE:

No changes were made to the permit as a result of public notice.

Kathryn Dolan
April 13, 1992

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Division
4210 East 11th Avenue
Denver, Colorado 80220

RATIONALE

GROUNDWATER CLEANUP OF GASOLINE

GENERAL PERMIT IN COLORADO

COLORADO DISCHARGE PERMIT NUMBER COG-310000

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I. INTRODUCTION

Facilities performing cleanup of gasoline from contaminated groundwater are located in many areas in Colorado. Waters discharged from these facilities to state waters are subject to the requirements of the State of Colorado "Water Quality Control Act," 1973 as amended. Section 6.10.2 of the "Colorado Discharge Permit System Regulations" provides for the issuance of general permits where covered facilities:

1. involve the same or substantially similar types of operations;
2. discharge the same types of wastes;
3. require the same effluent limitations or operating conditions;
4. require the same or similar monitoring; and
5. are more appropriately controlled under a general permit than under individual permits.

Administrative delays in the issuance of a permit to implement remediation might significantly impact the timing and cost of a project, as well as allow the contamination to spread farther. The Water Quality Control Division (the Division) has determined that facilities performing groundwater cleanup from gasoline contamination are, in many cases, suitable for coverage under a general permit.

II. INDUSTRY DESCRIPTION

It is estimated (by the Hazardous Materials and Waste Management Division) that there are approximately 25,000 underground storage tanks (USTs) in Colorado, the majority of which are used for storing petroleum products. Variables such as the tank size, age, construction and method used to install and operate the tank dictate the probability of the tank eventually leaking into the environment. The percentage of USTs in Colorado which are leaking into the surrounding environment is unknown at this time. However, past construction practices often did not take into account concerns about leakage, and so contamination of the groundwater has resulted at many sites.

Due to the increased attention (including national legislation) on this issue, many of these contaminated sites have been discovered and are undergoing remediation. Cleanup often consists of pumping contaminated groundwater, treating it, and then discharging the treated effluent to surface waters or a municipal sewer system, land applying it, or re-injecting it back into the ground. For discharges of this treated water to surface waters (including storm sewer systems), a Colorado Discharge Permit System permit is required.

Gasoline products are mixtures of hydrocarbon compounds with a broad range of physical, chemical and toxicological properties and chemical composition. Consequently, the concentration of pollutants in wastewaters generated from leaking USTs is highly variable. Of the types of hydrocarbons found in gasoline, the aromatics are generally considered to be the most toxic, and therefore pose the greatest potential for impact on human health and the environment. Some of the parameters known to be present in gasoline are benzene, toluene, ethylbenzene and xylene. Their concentrations in contaminated groundwater will vary depending on the fuel composition and the volatility and solubility of the compound. They will be limited in the permit based on water quality criteria and/or cleanup technology. Organic lead, added to some gasolines in the form of tetraethyllead, must also be addressed. Tetraethyllead is toxic to fish larvae at low levels (Ref. H). This may lead to problems with the effluent passing WET testing.

A. Treatment Technologies

The cleanup operation usually involves two phases. The first phase includes actions designed to immediately contain and control a release. The second phase involves assessing and developing long term measures designed to rectify and mitigate contamination to a level which will protect human health and the environment.

An UST cleanup typically begins with an effort to recover free product (i.e., gasoline). This recovery is usually accomplished through the use of a trench (where the fuel collects and is skimmed off), or a pumping well system. A dual pump system uses separate pumps to collect fuel and water, while a single pump system sends the fuel/water mix to an above-ground oil/water separator. In each case,

II. INDUSTRY DESCRIPTION

the recovered fuel is sent off-site for disposal or re-processing. The wastewater from the oil/water separator may still contain some of the fuel; this is the main source of the contaminants of concern in the discharge.

This wastewater may then be discharged directly from the oil/water separator when there are no contaminants, or treated in a variety of ways. One common and relatively economical method of treatment is air stripping. This involves providing contact between air and water to allow the volatile substances to diffuse from the liquid to the gaseous phase. There are several methods of air stripping, including diffused aeration, tray aerators, spray basins, and packed towers. The packed tower type is the most efficient, and consists of wastewater sprayed down over media as air is blown up through the tower.

There are several factors which affect the ability of air stripping to remove organic pollutants. Air stripping is most amenable to organic compounds with a Henry's Constant value greater than 0.1. (Henry's Constant is a coefficient which describes the tendency for a substance to partition between the liquid and gas phases.) The efficiency of air stripping is also controlled by the temperature of the wastewater and the intensity or duration of the aeration. It may be necessary to heat the wastewater prior to air stripping, and/or to recycle the wastewater or add more treatment units to achieve the necessary removal efficiencies. Because of the limited area required for these facilities, and the lack of a need to change the media, this method is economical in many situations. It should be noted that there may be air pollution considerations with this type of treatment (Ref. F).

Another common treatment method is granular activated carbon adsorption, used either separately or in combination with air stripping. Activated carbon is more expensive than airstripping. Use of activated carbon systems is most effective on influent with low levels of organics present. The wastewater is brought into contact with the activated carbon, which then selectively adsorbs organic constituents into the internal pores of the carbon granules. As solubility of the compound decreases, the compound is more likely to be adsorbed. Thus, factors which will affect the solubility of the compound, such as pH and temperature, will affect how well a substance is removed via carbon adsorption. It is suggested (Ref. D) that organic lead may be removed by activated carbon. Laboratory tests put this removal at 58-96%.

The carbon in such systems needs to be regenerated or replaced on a routine basis, which adds to the cost of the treatment. In addition, use of activated carbon may be impractical if the wastewater contains high levels of iron and manganese, which can use up the adsorptive capacity of the carbon and thus not allow it to fully remove the organics (Ref. F).

II. INDUSTRY DESCRIPTION

Other methods for treatment of organics include bioremediation, reverse osmosis, ozonation and ultraviolet irradiation. These methods are still being developed. As they are refined and become more cost effective, their use will become more widespread. This permit does not specify the type of treatment to be used, and so does not require that any of these methods be used. It should be noted that no one treatment method is applicable to all organics. Treatment systems, if needed, must be chosen which work best given the specific site and wastewater characteristics.

III. COVERAGE UNDER THIS PERMIT

Under this general permit, owners and operators of groundwater cleanup operations for gasoline or aviation gasoline may be granted authorization to discharge treated groundwater into waters of the State of Colorado. Other petroleum products, such as aviation turbine fuel, kerosene, and diesel fuel are not covered under this permit.

Authorization under the permit shall require prior submittal of certain facility information. Upon receipt of all required information, the permit issuing authority may allow or disallow coverage under the general permit.

The following list shows the criteria which will be used in evaluating whether or not an individual permit may be required instead of a general permit:

1. proximity of the operation to a landfill or mine and mill tailings;
2. evidence of significant noncompliance under a previous permit for the operation;
3. an effluent flow greater than 0.05 MGD (50,000 gpd);
4. the need to preserve high quality water;
5. addition of flocculants (settling agents or chemical additives) to water prior to discharge;
6. use of chemicals (such as chlorine) within the treatment system;
7. failure of the effluent to pass a Whole Effluent Toxicity (WET) test;
8. lead or organics levels in the effluent which could lead to a violation of the receiving waters instream water quality standard for lead or organics, respectively;
9. presence of downstream drinking water intakes or a fishery;
10. an anti-degradation review by the Division showing that the discharge would cause unallowable degradation to the receiving waters.

IV. APPLICATION AND CERTIFICATION

At least thirty days prior to the anticipated date of discharge, the owner, operator and/or authorized agent for a facility shall submit an application as provided by the Division. This application will be evaluated utilizing the criteria outlined previously. If the general permit is applicable to the applicant's operation, then a rationale will

IV. APPLICATION AND CERTIFICATION

be developed and the applicant will be certified under this general permit. The rationale shall include, at a minimum, the name and address of the contact person, the person responsible for the operation, a description of the facility, the receiving water, the number of outfalls, and the calculations to determine ~~the Instream Waste Concentration (IWC) and~~ the benzene limit. A determination on the need for salinity monitoring and a lead limit shall also be included.

The Division shall have up to thirty days after receipt of the above information to request additional data and/or deny the authorization for any particular discharge. Upon receipt of additional information, the Division shall have an additional 30 days to issue or deny authorization to discharge.

If the applicant does not receive a request for additional information or a notification of denial from the Division within 30 days, authorization to discharge in accordance with the conditions of the permit shall be deemed granted.

If, after evaluation of the application, it is found that the general permit is not applicable to the operation, then the application will be processed as one for an individual permit. The applicant will be notified of the Division's decision to deny certification under this general permit. For an individual permit, 180 days will be required to process the application and issue the permit. In this case, a discharge cannot take place until the permit is issued and becomes effective.

An existing source may request coverage under the general permit. If, after evaluation of the application for an existing source which is already covered under an individual permit, it is found that the general permit is not applicable to the operation, then the applicant will continue operation under the existing individual permit.

If facility conditions change such that coverage under the general permit is no longer applicable, the permittee will be required by the Division to apply for an individual permit. Determination of toxicity of the effluent alone is grounds for the Division to convert the facility to coverage under an individual permit. Coverage will continue under the general permit until issuance of the individual permit.

V. TERMS AND CONDITIONS OF PERMIT

A. Effluent Limitations

In developing suitable effluent limitations, the Division must review all applicable standards and regulations and apply that which is more stringent. This review includes, but is not limited to, the water quality standard-based effluent limitations, federal guidelines and standards (40 CFR Subchapter N) and "Regulations for Effluent Limitations" (Ref. B). Such a review has been done for this permit. The following limits will apply and are discussed in Table V-1.

V. TERMS AND CONDITIONS OF PERMIT

Table V-1 — Effluent Limits

Parameter	Limit	Rationale
Flow, MGD	See Certification	Design
TSS, mg/l	30/45 a/	State Effluent Regulations
pH, s.u.	6.5-9.0 b/	Water Quality Standards
Oil and Grease, mg/l	10 c/	State Effluent Regulations
Potentially Dissolved Lead, mg/l (only if required)	0.031 c/d/	Water Quality Standards
Benzene, mg/l	See Certification	Basic Water Quality Standards
BETX, mg/l	0.1 c/	Best Professional Judgment
Whole Effluent Toxicity, Acute	See Discussion	Discharge Permit Regulations
T. Dissolved Solids, mg/l (Colo. River Basin only)	Monitor Only	Salinity Regulations

a/ 30-Day Average/7-Day Average
b/ Minimum-Maximum
c/ Daily Maximum
d/ The lead limit is applicable only to those facilities which discharge to streams which have an instream lead limit, or which could impact such a stream.

1. Water Quality Standard-Based Effluent Limitations:

a) Lead: For individual permits, a mass balance equation is used to determine the effluent concentrations for lead, the limits for which are based on the water quality standards. However, due to the complexity of the calculations for this parameter and the time constraints involved in issuing a general permit certification, it is not feasible to include such a calculation-based limit in a general permit. Therefore, a limit for potentially dissolved lead of 0.031 mg/l (daily maximum) will be imposed. This is based on an assumption of worst-case conditions: minimal dilution provided by the receiving stream, and an instream hardness value of 50 mg/l, applying the table value for lead as outlined in the "Basic Standards and Methodologies for Surface Water" (Ref. A). Although this may be a stricter limit for some facilities than a calculation-based one would be, the permittee still has the option of applying for an individual permit in order to come under the calculation-based limit.

V. TERMS AND CONDITIONS OF PERMIT

The lead limit will only be applicable to those facilities which discharge to streams which have an instream lead limit, or which could impact such a stream. Monitoring for lead will be required at all facilities.

See the individual Certification Rationale for the receiving stream, and a discussion on whether a lead limit is applicable to the individual facility.

b) Benzene: Benzene is a commonly found contaminant in fuel cleanups. Benzene is limited in the "Basic Standards and Methodologies for Surface Water," 3.1.11. A mass balance equation is used to determine the effluent concentration for this parameter. The mass balance equation is:

$$M_2 = \frac{M_3Q_3 - M_1Q_1}{Q_2}$$

Where:
Q_1 = Upstream low flow
Q_2 = Effluent flow (chronic)
Q_3 = Combined downstream flow ($Q_1 + Q_2$)
M_1 = Upstream background pollutant concentration
M_2 = Unknown; effluent pollutant concentration
M_3 = Basic Water Quality Standard

The Division does not have instream data available for benzene. Therefore, the background level (M_1) is assumed to be zero. The value for M_3 varies depending on the receiving water classification. For a water supply, the instream chronic limit is 0.005 mg/l. For an aquatic life classification, the instream acute limit is 5.3 mg/l. The effluent flow used (Q_2) is the 30 day average flow from the facility, since the acute limit will not be applied. The upstream low flow (Q_1) is calculated by the Division using a set protocol.

If the calculated benzene limit is greater than 0.1 mg/l, then the BETX limit of 0.1 mg/l (as discussed below) will dictate the maximum benzene level allowed, and so a separate benzene limit will not be included. (This is why, for receiving waters which are classified for aquatic life, the benzene calculation is not appropriate, since the instream limit is already greater than the BETX limit.) Monitoring for benzene will still be required for all facilities, however. If the calculated benzene limit is equal to or less than 0.1 mg/l, it will be applied to the facility.

V. TERMS AND CONDITIONS OF PERMIT

See the individual Certification Rationale for the actual calculation, and a discussion on which limit the individual facility will be required to meet.

2. Applicable Federal Effluent Guidelines and Standards: Although no federal guidelines have been promulgated for this type of facility, EPA has come out with guidance on such permits (Ref. E). This guidance was used in developing a technology-based limit for BETX.

BETX means the combined total of benzene, ethylbenzene, toluene and xylenes in the effluent. It is a common petroleum industry practice to determine the quality of fuels by measuring BETX.

Monitoring and limitation of BETX in discharges from this type of facility is prudent for several reasons. First, the composition of gasoline is highly variable and for some gasoline products, any one of the four BETX constituents can be the predominant constituent. Second, EPA has promulgated or proposed water quality criteria for benzene, ethylbenzene, toluene and the xylenes. Except for napthalene, criteria have not been proposed for the other constituents of gasoline. Also, the constituents of BETX have low Henry's Law Constants, which means they are not as easily air stripped as other gasoline constituents, and so are a good indicator of treatment effectiveness.

The BETX limit is derived using Best Professional Judgment of what the Best Available Technology is for treating the wastewater. According to EPA, the potential removal efficiency of BETX using a commercially available air stripper unit is 99.5 percent. If air stripping is applied to influent BETX levels of 15 mg/l (the estimated maximum influent level of BETX after the product recovery phase), the stripped effluent would contain 0.075 mg/l total BETX. Since product recovery and air stripping technologies may not always occur under optimal conditions, the total BETX discharge limit will be slightly increased to 0.1 mg/l (daily maximum).

3. Regulations for Effluent Limitations: The "Regulations for Effluent Limitations" (Ref. B), apply to the conventional pollutants. For this permit, the limitations for TSS and Oil and Grease are based on this regulation.

4. Discussion of Limitations:

a) Flow: A flow limit is included in the permit, due to the benzene limit being flow-based for some facilities. The flow limit used will be the 30 day average flow (design) from the facility, since the limits imposed are chronic (30 day average). See the individual Certification Rationale for the flow limit applicable to the individual facility.

V. TERMS AND CONDITIONS OF PERMIT

b). Salinity: Salinity, or total dissolved solids (TDS) is an issue in the Colorado River Basin. Regulation 3.10.0, "Regulations for Implementation of the Colorado River Salinity Standards Through the Colorado Discharge Permit Program," addresses the discharge of TDS to the Colorado River Basin. It is a requirement of the regulation that the salinity of each discharge in the Colorado River Basin be evaluated for impact on the system. Generally, the net impact on salinity to the basin from groundwater cleanup activities is expected to be negligible, because the waters are typically shallow groundwaters which will eventually reach the river, and because the discharge volume is usually low. Nonetheless, the State reserves the right to refuse the applicability under the general permit of any groundwater cleanup operation, if it appears that the discharge will not be consistent with the regulation.

Additionally, quarterly monitoring for TDS will be a permit requirement for all facilities located in the Colorado River Basin. Should the data identify a problem, the State will have the right to require the facility to obtain an individual permit, whereby a study addressing the economic feasibility of salt removal can be required. See the individual Certification Rationale that accompanies the permit for the Division's determination of whether or not salinity monitoring is required.

5. Whole Effluent Toxicity (WET) Testing: For this facility, acute WET testing is required. (See Parts I.B and I.C of the permit, as well as the individual Certification Rationale.) Monitoring shall be performed commencing with the first full calendar quarter following the certification effective date.

a) Purpose of WET Testing: Section 6.9.7 of the "Regulations for the State Discharge Permit System" (Ref. C), passed by the Water Quality Control Commission, has established the use of WET testing as a method for identifying and controlling toxic discharges from wastewater treatment facilities. WET testing is being utilized as a means to ensure that there are no discharges "in amounts, concentrations or combinations which are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life" as required by Section 3.1.11 (1)(d) of the Basic Standards and Methodologies.

Chemical analysis of effluent has provided only a partial evaluation of the potential impact a discharge could have on the receiving stream. Also, chemical analysis cannot evaluate the synergistic or antagonistic effect of compounds. There are also

V. TERMS AND CONDITIONS OF PERMIT

compounds for which an accurate or reproducable method of chemical analysis has not yet been developed, as well as compounds which are just beginning to be evaluated for toxic effects. WET testing will provide a more comprehensive means of evaluating the toxicity of a discharge than could otherwise currently be accomplished.

b) Species Toxicity: As a condition of the permit, the permittee will be required to conduct routine monitoring for acute toxicity using two species, *Ceriodaphnia* sp. (water flea) and fathead minnows. Acute toxicity occurs when a species mortality in any dilution of effluent (including 100% effluent) exceeds 50% for either species, or there is a statistically significant difference in the mortality observed for either species between the control and any effluent concentration.

Should acute toxicity be detected, discharge must be halted immediately. The permittee must submit a report to the Division within 5 days of the toxicity being detected, outlining the steps proposed to determine the cause of the toxicity. In most cases, this will involve conducting a series of accelerated tests to show whether the toxicity was continuous or an isolated incident. (Effluent from this type of facility is expected to be relatively consistent.) In those cases where a real or potential WET problem has been established, the permittee must apply for coverage under an individual permit, which will include imposition of WET limits. (Steps must also be taken to identify the source of toxicity, and propose suitable treatment, before an individual permit can be issued.)

The permittee should read the WET testing sections of Part I.B and I.C of the permit carefully, and should note that the test methods for the toxicity tests are described in detail in the Division guidance document, Guidelines for Conducting Whole Effluent Toxicity Tests. This document should be read thoroughly prior to commencing the required WET testing, to ensure that the permittee is aware of the various test conditions that could affect the test results (e.g., sample holding time).

The permittee should be aware that eligibility for coverage under the general permit may change if the facility experiences a change in discharge, as outlined in Part II.A.1 of the permit. Such changes shall be reported to the Division immediately.

V. TERMS AND CONDITIONS OF PERMIT

B. Monitoring and Reporting

1. Monitoring: Table V-2 lists the monitoring requirements for this permit, including sample type and frequency.

Table V-2 — Monitoring Requirements

Parameter	Measurement Frequency	Sample Type
Flow, MGD	Weekly	Instantaneous or Continuous
Total Suspended Solids, mg/l	Monthly	Grab
pH, s.u.	Weekly	Grab
Oil and Grease	Weekly	Visual
Oil and Grease, mg/l	Monthly	Grab
Potentially Dissolved Lead, mg/l	Monthly	Grab
Benzene, mg/l	Monthly	Grab
BETX, mg/l	Monthly	Grab
Whole Effluent Toxicity, Acute	Quarterly	Grab
T. Dissolved Solids, mg/l (Colo. River Basin only)	Quarterly	Grab

2. Reporting: The permittee must submit a Discharge Monitoring Report (DMR) on a monthly basis to the Division. This report should contain the required summarization of the test results for parameters shown in Table V-2 and Part I.C.1 of the permit. See the permit, Part I.C.2 for details on such submission.

3. Additional Monitoring and Reporting: In addition to the routine monitoring discussed above, the permittee will be required to monitor for the entire volatile fraction of the organic toxic pollutants, once per year, beginning within three months of the effective date of the certification. If the new data indicate the presence of any organics at levels which might violate the organic pollutant standards contained in tables A, B and C of "The Basic Standards and Methodologies for Surface Water" (Ref. A), the Division reserves the right to require the facility to obtain an individual permit.

C. Additional Terms and Conditions

1. Spill Containment: As most facilities provide bulk storage of some volume of gasolines or other chemicals, the permit will require

V. TERMS AND CONDITIONS OF PERMIT

1. Spill Containment: (Cont.) adequate protection from spills for such facilities so as to prevent loss of these materials into discharged waters. Such protection can take various forms; however, diking in most cases will prove to be the most cost effective. This provision is required as the Division interprets proper operation as properly addressing potential pollutant sources before problems occur.

   Spill reports will only be required in cases of noncompliance with permit conditions. The permittee will, however, be required to maintain its records for a period of three years. Such records will be subject to inspection by EPA and/or the Division.

2. Duration of Permit: The permit shall not exceed five years in duration. The permittee's authority to discharge under this permit is approved until the expiration date of the general permit. The permittee must apply for recertification under the general permit at least 180 days prior to its expiration date.

Kathryn Dolan
November 15, 1989

D. Changes Following Public Notice

The following changes were made in the permit after review of comments received during the public notice period:

1. Coverage of diesel fuel contamination was deleted, due to the constituents of diesel fuel, which are best determined by analyses for acid and base-neutral organics, not volatiles.

2. Coverage for facilities with effluent volumes over 0.05 MGD was deleted, so that more frequent monitoring could be applied to larger facilities. However, such operations could still apply for temporary coverage under the general permit, if they met the 0.05 MGD flow limit while an individual permit is processed.

3. The requirement that discharge be immediately terminated if toxicity is identified is clarified.

4. A requirement has been added stating that if discharge is to a storm sewer system, approval from the owner of the system must be obtained prior to certification.

Kathryn Dolan
May 9, 1990

VI. REFERENCES

A. Colorado Dept. of Health, Water Quality Control Commission. Basic Standards and Methodologies for Surface Water (3.1.0). Denver: CDH, as revised 8/7/89.

B. Colorado Dept. of Health, Water Quality Control Commission. Regulations for Effluent Limitations (10.1.0). Denver: CDH, as revised 1/6/86.

C. Colorado Dept. of Health, Water Quality Control Commission. Regulations for the State Discharge Permit System (6.1.0). Denver: CDH, as revised 8/31/89.

D. Patterson, James W. Industrial Wastewater Treatment Technology, Second Edition. Boston: Butterworths, 1985.

E. U.S. Environmental Protection Agency. Model NPDES Permit for Discharges Resulting from the Cleanup of Gasoline Released from Underground Storage Tanks. Wash., D.C.: U.S. Gov't Printing Office, 6/89.

F. U.S. Environmental Protection Agency. Cleanup of Releases from Petroleum USTs: Selected Technologies (EPA/530/UST-88/001). Wash., D.C.: U.S. Gov't Printing Office, 4/88.

G. State of Utah, Division of Environmental Health. General Permit for Treated Groundwater Contaminated with Petroleum Products (draft). State of Utah, 2/89.

H. Verschueren, Karel. Handbook of Environmental Data on Organic Chemicals, Second Edition. New York: Van Nostrand Reinhold Company, 1983.

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WELL PERMIT NUMBER 188864

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NE 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P

DISTANCES FROM SECTION LINES

1700 Ft. from South Section Line
3500 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of t permit does not assure the applicant that no injury will occur to another vested water right or preclude anot owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unls approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pur Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this wel limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner a submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water W Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resourc within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropria and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individ according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct t well. For non-standard construction the report must include an as-built drawing showing details such as dep casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-1.

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347A DATE ISSUED JUL 27 1995 EXPIRATION DATE JUL 27 199

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188865 - ____ - __

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NE 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
1820 Ft. from South Section Line
3450 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-2.

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347B DATE ISSUED JUL 27 1995 EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188866 - ____ - __

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2150 Ft. from South Section Line
4100 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-3.

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

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APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347C

DATE ISSUED JUL 27 1995

EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188867 - ____ - __

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot. Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2300 Ft. from South Section Line
4010 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. **This well is known as RU-4.**

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

Receipt No. 0386347D

DATE ISSUED JUL 27 1995

EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188868 - ____ - ____

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2200 Ft. from South Section Line
4310 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.
5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve those markings.
8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-5.
10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347E

DATE ISSUED JUL 27 1995

EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188869 - ____ - ____

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot. Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2390 Ft. from South Section Line
4280 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-6.

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347F DATE ISSUED JUL 27 1995 EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188870 - ____ - ____

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2130 Ft. from South Section Line
4310 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-7.

10) This well shall be constructed not more than 200 feet from the location specified on this permit.

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

By

Receipt No. 0386347G

DATE ISSUED JUL 27 1995

EXPIRATION DATE JUL 27 1997

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 188871 - ___ - ___

DIV. 5 CNTY. 23 WD 45 DES. BASIN MD

Lot: Block: Filing: Subdiv:

APPLICANT

US DEPT OF ENERGY
%ROXANNE DANZ
BOX 98518
LAS VEGAS NV 89193-8518

(702)295-7723

APPROVED WELL LOCATION
GARFIELD COUNTY

NW 1/4 SW 1/4 Section 25
Twp 7 S RANGE 95 W 6th P.M.

DISTANCES FROM SECTION LINES
2440 Ft. from South Section Line
4180 Ft. from East Section Line

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of the permit does not assure the applicant that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.

2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.

3) Approved pursuant to CRS 37-92-602(3)(b)(1) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.

4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept locked at all times except during sampling or measuring.

5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.

6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with the Water Well Construction Rules. A well plugging report must be completed and submitted to the Division of Water Resources within 60 days of plugging.

7) The owner shall mark the well in a conspicuous place with well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.

8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.

9) A well completion report including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval. This well is known as RU-8.

10) This well shall be constructed not more than 200 feet from the location specified on this permit. GD 7-26-95

DIVISION COPY

APPROVED
SGA

Hal D. Simpson
State Engineer

Receipt No. 0386347H

DATE ISSUED JUL 27 1995

EXPIRATION DATE JUL 27 1997

5.2.32 "**Watertight**" means a condition which does not allow the entrance, passage or flow of water under normal operating conditions.

5.2.33 "**Well Owner**" means any person or his agent who holds the title or other rights of property in a well.

5.2.34 "**Well Pit**" means a structure for the underground installation of equipment and piping. If the well terminates in the pit, the structure shall be deemed to be a vault.

5.2.35 "**Well Vault**" means an underground structure in which the well casing terminates below ground surface. A vault may include the installation of additional equipment and piping.

5.2.36 "**Well Yield Test**" means a test of a well conducted to determine a stabilized drawdown and production rate of a well.

5.3 **Other Definitions** - All other words used herein shall be given their usual customary and accepted meaning. Terms that were not defined in this Rule which are defined in the statutes or other rules of the State Engineer shall use the meaning given therein. All words of a technical nature specific to the water well industry shall be given the meaning which is generally accepted in the said water well industry.

RULE 6 GENERAL RULES

6.1 **Permit Requirement** - A permit issued by the State Engineer is required prior to constructing a new or replacement well, prior to changing the producing interval of an existing well or prior to installing the initial pumping system or a pumping system having a sustained production rate in excess of the permitted production rate.

6.1.1 It is the responsibility of all persons authorized to construct wells or install pumping equipment to ensure that a valid permit issued by the State Engineer exists prior to and during all work performed to construct or modify a well. A copy of the permit, verbal approval number or a copy of the notice provided to the State Engineer shall be available at the drilling site

6.1.2 All well construction, repair of an existing well, or installation or replacement of a pump shall comply with the conditions of approval on the valid well permit or the verbal approval. The work shall be completed prior to the expiration of the permit.

6.2 **Authorized Well Construction or Pump Installation Contractor** - Well construction, repair, modification or plugging and sealing or pump installation, repair, or modification shall be performed only by a contractor or a direct employee of the contractor or by a person who is under supervision of an individual having a valid license issued by the State Board of Examiners of Water Well and Pump Installation Contractors unless exempt under provisions of Rule 7 or Section 37-91-106(3), C.R.S.

6.3 **Notice of Intent to Construct** - Prior to beginning construction of a well, a monitoring and observation hole, or a test hole, the licensed water well contractor or the authorized individual shall notify the State Engineer of their intent to construct as shown below. Such notice is not

required for test holes which are not intended to be constructed through a confining layer between aquifers.

a. for wells where a permit has been issued by the State Engineer, such notice shall be submitted not less than three (3) nor more than ten (10) working days prior to the anticipated date of construction. This notice shall be submitted on a form provided by the State Engineer and shall be valid for a period of fourteen (14) calendar days from the anticipated construction date. In the event that a construction contractor has entered into an agreement to construct a well less than this minimum three (3) day notice requirement, such notice may be given by facsimile transmission. After six (6) months from the effective date of these rules, the Board may evaluate and reconsider the impacts and effectiveness of this notice requirement and shall have the authority to suspend this rule by taking formal action at an official Board meeting; or

b. for test holes which will penetrate though a confining layer between aquifers and for monitoring and observation holes the notice shall be submitted in writing at least three (3) days prior to construction, and the construction of the excavation must be completed within 90 days from the date of notice to the State Engineer. This monitoring or test hole notice shall contain the following information as a minimum (Table 1 summarizes when notice to the State Engineer is required):

Landowner's name; structure owner's name; name of the water well contractor or authorized individual; approximate date of construction; location by 1/4-1/4, section, township and range; number and type of holes to be constructed; estimated total depths; and purpose or intended use of the holes.

6.4 **Compliance with Regulations** - Construction of all wells shall, as a minimum, comply with the standards in these Rules. In the case where federal, state, county, municipal or local government laws, regulations or codes are more stringent than these Rules or contain standards not covered by these Rules, then the contractor shall comply with those standards.

6.5 **Products Containing Toxic Materials** - Products such as solder and fluxes containing more than two tenths (0.2) per cent lead, and materials, such as pipes and fittings containing more than eight (8.0) per cent lead and all mercury are prohibited from being used in wells and holes.

6.6 **Disposal of Fluids Resulting from Well Construction, Development and Disinfection** - Fluids resulting from well construction, development or disinfection shall not be discharged into the waters of the state without first obtaining a permit pursuant to the Colorado Discharge Permit System (CDPS). Fluid disposal by land application must not flow into or have the potential to flow into surface waters and must not impact aquatic life or ground water. Fluid wastes may be disposed of by other proper means such as off site transport for treatment and final disposal, evaporation ponds, or pumping to a sanitary sewer system with permission.

6.7 **Directional Drilling** - Prior approval from the State Engineer is required if the proposed well will be deflected more than 200 feet horizontally from its surface location.

6.8 **Water Used for Well Construction and Stimulation** - All water used during the construction, development and stimulation of a well shall be obtained from an approved public supply. If water is not readily available from such a public supply, the water may be obtained

Appendix C

Pond Draining and Construction Dewatering Analytical Results

facsimile
TRANSMITTAL

to: Ray Henry, IT
fax #: 793-5222
re: CDPS Permit COG-310084 Reported Violations
date: September 24, 1996
pages: 1, including this cover sheet.

Kevin Leary, at USDOE, requested I send you this fax regarding reported violations for the above-referenced permit. At this time, the Division does not intend to pursue formal enforcement action against the permittee for the violations reported on Discharge Monitoring Reports submitted to the Division relative to this permit.

If you have any questions, you may contact me at the number listed below.

From the desk of...

Kathleen L. Sullivan
Industrial Enforcement Engineer
Colorado Department of Public Health and Environment
WQCD-PE-B2, 4300 Cherry Creek Dr. S.
Denver, CO 80222-1530

(303)692-3503
Fax (303)782-0390

Table C-1
Pond Draining and Construction Dewatering Analytical Results

		Pond Dewatering Samples							
IT Corp ID#	Permit Criterion	RU00100		RU00102		RU00115		RU00115	
Date Collected		8/2/95		8/7/95		8/11/95		8/11/95	
Sample Location		Pond Water		Pond Water		Pond Water		Reanalysis	
		Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS:	µg/L	µg/L		µg/L		µg/L		µg/L	
Chromium	50	3.3	U	4.4	B	131		35.9	
Iron	1000	201		113		1660		84.1	
Dissolved Lead [a]	31	2.0	U	2.0	U	7.6		na	
Mercury	2	0.20	U	0.20	U	0.20	U	na	
Zinc	10	6.8		4.0		20.2		na	
ORGANICS: [b]	µg/L	µg/L		µg/L		µg/L		µg/L	
Benzene	1	1	U	1	U	1	U	na	
Toluene	NS	5	U	5	U	5	U	na	
Ethylbenzene	NS	5	U	5	U	3	J	na	
Total Xylene *	NS	5	U	5	U	6	J	na	
Organic Toxic Pollutants	NS					ND *		na	
TPH:	mg/L	mg/L		mg/L		mg/L		mg/L	
Nonspecific	10	5.0	UJ	0.5	UJ	6.46		na	
Diesel	10	na		na		na		na	
INORGANICS:	mg/L	mg/L		mg/L		mg/L		mg/L	
Total Dissolved Solids	NS	380		393		380		na	
Total Suspended Solids	30/45 [c]	4.0		3.0		49.0		na	
pH	6.5 - 9.0	8.2		8.1		7.8		na	

		Construction Dewatering Samples							
IT Corp ID#	Permit Criterion	RU-CDW-01		RU-CDW-03		RU-CDW-05		RU-CDW-06	
Date Collected		9/15/95		9/15/95		9/27/95		10/5/95	
Sample Location		Pond Water		Pond Water		Pond Water		Pond Water	
		Conc.	Q	Conc.		Conc.		Conc.	
METALS:	µg/L	µg/L		µg/L		µg/L		µg/L	
Chromium	50	na		na		10	U	13	
Iron	1000	na		na		660		4100	
Dissolved Lead [a]	31	na		na		31	U	31	U
Mercury	2	na		na		0.20	U	na	
Zinc	10	na		na		20	U	28	
ORGANICS: [b]	µg/L	µg/L		µg/L		µg/L		µg/L	
Benzene	1	5	U	2	U	1.0	U	5.0	U
Toluene	NS	na		na		0.40	J	0.18	J
Ethylbenzene	NS	na		na		0.14	J	0.18	J
Total Xylene	NS	na		na		0.80	J	25	U
Organic Toxic Pollutants	NS	na		na		ND *			
TPH:	mg/L	mg/L		mg/L		mg/L		mg/L	
Nonspecific	10	na		na		1.0	U	na	
Diesel	10	na		na		na		0.44	
INORGANICS:	mg/L	mg/L		mg/L		mg/L		mg/L	
Total Dissolved Solids	NS	na		na		380		570	
Total Suspended Solids	30/45 [c]	na		na		14		140	
pH	6.5 - 9.0	na		na		7.7		7.5	J

Q=Data qualifier: U = Compound was analyzed but not detected above the specified limit; J = Reported value is e
mg/L = milligrams per liter; µg/L = micrograms per liter
na = not analyzed; ND * = not detected. See Table C-2 for analytical quantitation limits..
NS = not specified

[a] Dissolved Lead analysis required under the discharge permit.

[b] Permit criterion for Total BTEX (benzene, toluene, ethylbenzene, and xylenes) = 100 ug/L

[c] 30/45 mg/L refers to 30 day average/7 day average

Table C-2
Pond Draining and Construction Dewatering Analytical Results - Organic Toxic Pollutants

IT Corp ID#	Permit Criterion *	RU00115		RU-CDW-05	
Date Collected		8/11/95		9/27/95	
Sample Location		Pond Water		Pond Water	
		Conc.	Q	Conc.	
ORGANICS:	µg/L	µg/L		µg/L	
Chloromethane	10	10	U	NR	
Vinyl Chloride	2	2	U	2.0	U
Bromomethane	10	10	U	NR	
Chloroethane	10	10	U	10	U
Acrolein	25	20	U	25	U
Acrylonitrile	25	20	U	25	U
Methylene Chloride	10	10	U	10	U
1,1-Dichloroethene	5	5	U	5.0	U
trans-1,2-Dichloroethene	5	5	U	5.0	U
1,1-Dichloroethane	5	5	U	5.0	U
Chloroform	5	5	U	5.0	U
1,2-Dichloroethane	5	5	U	5.0	U
1,1,1-Trichloroethane	5	5	U	5.0	U
Carbon Tetrachloride	5	5	U	5.0	U
Trichloroethene	5	5	U	5.0	U
1,2-Dichloropropane	5	5	U	5.0	U
Benzene	5	1	U	1.0	U
Bromodichloromethane	5	5	U	5.0	U
2-Chloroethylvinyl ether	10	20	UJ	10	U
trans-1,3-Dichloropropene	5	5	U	5.0	U
cis-1,3-Dichloropropene	5	5	U	5.0	U
1,1,2-Trichloroethane	5	5	U	5.0	U
Chlorodibromomethane	5	5	U	5.0	U
Toluene	5	5	U	0.40	J
Tetrachloroethene	5	5	U	5.0	U
Chlorobenzene	5	5	U	5.0	U
Ethylbenzene	5	3	J	0.14	J
Total Xylene	NS	6	J	0.80	J
Bromoform	5	5	UJ	5.0	U
1,1,2,2-Tetrachloroethane	5	5	U	5.0	U

Q=Data qualifier: U = Compound was analyzed but not detected above the specified limit; J = Reported value is estimated.
µg/L = micrograms per liter
NR = not reported; NS = not specified
* Permit Criterion is a maximum acceptable detection limit.

Appendix D

Stabilized Sediment Analytical Results

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

IT Corp ID#	STSD-01		STSD-02		STSD-04		STSD-05		STSD-06		STSD-07		STSD-08		STSD-09		STSD-10		STSD-12		STSD-15		STSD-18		STSD-19		STSD-20		STSD-21		STSD-22	
Date Collected	8/20/95		8/20/95		8/21/95		8/23/95		8/23/95		8/23/95		8/23/95		8/23/95		8/23/95		8/23/95		8/25/95		8/25/95		8/25/95		8/25/95		8/28/95		8/28/95	
Sample Location	Soil Pile		Soil Pile		Soil Pile		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	20.0	B	24.4	B	na		183	B	36.7	B	20.0	B	14.4	B	15.6	B	15.6	B	na		15.6	B	7.8	B	25.6	B	na		16.7	B	14.4	B
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	50	U	50	U	na		50	U	50	U	50	U	50	U	50	U	50	U	na		15	BJ	50	U	10	BJ	na		50	U	50	U
Vinyl Chloride	10	U	5	J	na		10	U	10	U	10	U	10	U	10	U	10	U	na		10	U	10	U	10	U	na		10	U	10	U
Bromomethane	50	U	50	U	na		50	U	50	U	50	U	50	U	50	U	50	U	na		50	U	50	U	50	U	na		50	U	50	U
Chloroethane	50	U	50	U	na		50	U	50	U	50	U	50	U	50	U	50	U	na		50	U	50	U	50	U	na		50	U	50	U
Acrolein	120	U	120	U	na		120	U	120	U	120	U	120	U	120	U	120	U	na		120	U	120	U	120	U	na		120	U	120	U
Acrylonitrile	120	U	120	U	na		120	U	120	U	120	U	120	U	120	U	120	U	na		120	U	120	U	120	U	na		120	U	120	U
Methylene Chloride	50	U	50	U	na		50	U	50	U	50	U	50	U	50	U	50	U	na		5	J	50	U	50	U	na		50	U	50	U
1,1-Dichloroethene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
trans-1,2-Dichloroethene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
1,1-Dichloroethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Chloroform	25	U	10	J	na		25		10	J	10	J	25	U	10	J	25	U	na		120		25	U	5	J	na		10	J	25	U
1,2-Dichloroethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
1,1,1-Trichloroethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Carbon Tetrachloride	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Trichloroethene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
1,2-Dichloropropane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25		na		25	U	25	U	25	U	na		25	U	25	U
Benzene	10		10		na		5	U	5	U	10		5	U	5		5		na		5		5		5	U	na		5	U	5	U
Bromodichloromethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
2-Chloroethylvinyl ether	50	U	50	U	na		50	U	50	U	50	U	50	U	50	U	50	U	na		50	U	50	U	50	U	na		50	U	50	U
trans-1,3-Dichloropropene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
cis-1,3-Dichloropropene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
1,1,2-Trichloroethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Chlorodibromomethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Toluene	25	U	25		na		25	U	30		30		20	J	20	J	20	J	na		25	U	30		15	J	na		5	J	10	J
Tetrachloroethene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		5	J	25	U	25	U	na		25	U	25	U
Chlorobenzene	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
Ethylbenzene	20	J	20	J	na		10	J	20	J	20	J	20	J	20	J	20	J	na		20	J	20	J	15	J	na		10	J	15	J
Total Xylene	65		60		na		30		70		75		55		65		55		na		40		70		55		na		25		45	
Bromoform	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
1,1,2,2-Tetrachloroethane	25	U	25	U	na		25	U	25	U	25	U	25	U	25	U	25	U	na		25	U	25	U	25	U	na		25	U	25	U
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	12141		12791		na		11378		22519		25551		19039		21031		18376		na		39275		31185		20957		na		15371		6549	
Diesel	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		19.3		na		na		na		na		na		na		22.1		na		na		na		31		na		na	
Gross Beta	na		na		26.6		na		na		na		na		na		na		28.1		na		na		na		31		na		na	
Actinium-228	na		na		0.59	U	na		na		na		na		na		na		2.54	#	na		na		na		2.76		na		na	
Americium-241	na		na		0.50	U	na		na		na		na		na		na		1.30	U	na		na		na		0.62	U	na		na	
Bismuth-211	na		na		1.15	U	na		na		na		na		na		na		1.54	U	na		na		na		0.62	U	na		na	
Bismuth-212	na		na		1.67	U	na		na		na		na		na		na		1.43	U	na		na		na		0.75	U	na		na	
Bismuth-214	na		na		1.10	U	na		na		na		na		na		na		1.45	U	na		na		na		1.02	U	na		na	
Cobalt-57	na		na		0.08	U	na		na		na		na		na		na		0.10	U	na		na		na		0.07	U	na		na	
Cobalt-60	na		na		0.10	U	na		na		na		na		na		na		0.16	U	na		na		na		0.12	U	na		na	
Cesium-134	na		na		0.15	U	na		na		na		na		na		na		0.15	U	na		na		na		0.12	U	na		na	
Cesium-137	na		na		0.15	U	na		na		na		na		na		na		0.25	U	na		na		na		0.21	U	na		na	
Potassium-40	na		na		19.53		na		na		na		na		na		na		32.81		na		na		na		44.15		na		na	
Manganese-54	na		na		0.04	U	na		na		na		na		na		na		0.44	#	na		na		na		0.09	U	na		na	
Sodium-22	na		na		0.04	U	na		na		na		na		na		na		0.08	U	na		na		na		0.02	U	na		na	
Protactinium-231	na		na		5.16	U	na		na		na		na		na		na		7.13	U	na		na		na		4.71	U	na		na	
Protactinium-234	na		na		0.96	U	na		na		na		na		na		na		1.09	U	na		na		na		0.86	U	na		na	
Protactinium-234 (meta)	na		na		18.60	U	na		na		na		na		na		na		34.10	U	na		na		na		16.20	U	na		na	
Lead-210	na		na		3.07	U	na		na		na		na		na		na		22.80	U	na		na		na		14.80	U	na		na	
Lead-211	na		na		0.16	U	na		na		na		na		na		na		0.62	U	na		na		na		0.24	U	na		na	
Lead-212	na		na		1.36		na		na		na		na		na		na		1.12		na		na		na		1.31		na		na	
Lead-214	na		na		1.05		na		na		na		na		na		na		0.53	U	na		na		na		1.83		na		na	
Radium-223	na		na		0.90	U	na		na		na		na		na		na		1.27	U	na		na		na		0.81	U	na		na	
Radium-224	na		na		4.31	U	na		na		na		na		na		na		5.22	U	na		na		na		3.77	U	na		na	
Radium-226	na		na		0.42	U	na		na		na		na		na		na		1.61		na		na		na		2.35		na		na	
Radon-219	na		na		1.09	U	na		na		na		na		na		na		1.53	U	na		na		na		1.04	U	na		na	
Ruthenium-106	na		na		1.17	U	na		na		na		na		na		na		0.63	U	na		na		na		0.71	U	na		na	
Thorium-227	na		na		2.06	U	na		na		na		na		na		na		2.79	U	na		na		na		2.01	U	na		na	
Thorium-234	na		na		3.83	U	na		na		na		na		na		na		7.58	U	na		na		na		7.42	U	na		na	
Thallium-208	na		na		0.40		na		na		na		na		na		na		0.23	U	na		na		na		0.15	U	na		na	
Uranium-235	na		na		0.25	U	na		na		na		na		na		na		0.35	U	na		na		na		0.24	U	na		na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

IT Corp ID#	STSD-23		STSD-24		STSD-25		STSD-27		STSD-28		STSD-29		STSD-30		STSD-31		STSD-33		STSD-34		STSD-35		STSD-36		STSD-37		STSD-38		STSD-39		STSD-41	
Date Collected	8/28/95		8/28/95		8/28/95		9/6/95		9/6/95		9/6/95		9/6/95		9/6/95		9/6/95		9/11/95		9/11/95		9/11/95		9/11/95		9/11/95		9/11/95		9/15/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	6.7	B	13.3	B	na		14.4		14.4		8.9	B	8.9	B	11.1		na		3.3	B	21.1	B	12.2	B	20.0	B	34.4	B	na		136	B
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	50	U	50	U	na		na		na		na		na		na		na		50	U	50	U	50	U	50	U	50	U	na		na	
Vinyl Chloride	10	U	10	U	na		na		na		na		na		na		na		10	U	10	U	10	U	10	U	10	U	na		na	
Bromomethane	50	U	50	U	na		na		na		na		na		na		na		50	U	50	U	50	U	50	U	50	U	na		na	
Chloroethane	50	U	50	U	na		na		na		na		na		na		na		50	U	50	U	50	U	50	U	50	U	na		na	
Acrolein	120	U	120	U	na		na		na		na		na		na		na		120	U	120	U	120	U	120	U	120	U	na		na	
Acrylonitrile	120	U	120	U	na		na		na		na		na		na		na		120	U	120	U	120	U	120	U	120	U	na		na	
Methylene Chloride	50	U	50	U	na		na		na		na		na		na		na		50	U	50	U	50	U	50	U	50	U	na		na	
1,1-Dichloroethene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
trans-1,2-Dichloroethene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
1,1-Dichloroethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Chloroform	10	J	15	J	na		na		na		na		na		na		na		10	U	10	U	25	U	25	U	5	U	na		na	
1,2-Dichloroethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
1,1,1-Trichloroethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Carbon Tetrachloride	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Trichloroethene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
1,2-Dichloropropane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Benzene	5	U	5	U	na		5	U	5	U	5	U	5	U	5	U	na		5	U	5	U	5	U	5	U	5	U	na		5	U
Bromodichloromethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
2-Chloroethylvinyl ether	50	U	50	U	na		na		na		na		na		na		na		50	U	50	U	50	U	50	U	50	U	na		na	
trans-1,3-Dichloropropene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
cis-1,3-Dichloropropene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
1,1,2-Trichloroethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Chlorodibromomethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Toluene	10	J	10	J	na		na		na		na		na		na		na		25	U	25	U	10	U	25	U	25	U	na		na	
Tetrachloroethene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Chlorobenzene	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
Ethylbenzene	15	J	15	J	na		na		na		na		na		na		na		25	U	5	U	10	U	25	U	25	U	na		na	
Total Xylene	50		40		na		na		na		na		na		na		na		10	U	20	U	25	U	25	U	25	U	na		na	
Bromoform	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
1,1,2,2-Tetrachloroethane	25	U	25	U	na		na		na		na		na		na		na		25	U	25	U	25	U	25	U	25	U	na		na	
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	22899		7721		na		14909		12981		7984		8703		5330		na		1230	J	2835	J	1724	J	1110	J	4755	J	na		1745	
Diesel	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		18		na		na		na		na		na		30		na		na		na		na		na		35		na	
Gross Beta	na		na		32		na		na		na		na		na		29		na		na		na		na		na		26		na	
Actinium-228	na		na		1.88		na		na		na		na		na		2.22		na		na		na		na		na		1.4		na	
Americium-241	na		na		0.81	U	na		na		na		na		na		0.41	U	na		na		na		na		na		0.33	U	na	
Bismuth-211	na		na		1.46	U	na		na		na		na		na		1.52	U	na		na		na		na		na		0.57	U	na	
Bismuth-212	na		na		0.97	U	na		na		na		na		na		1.31	U	na		na		na		na		na		0.85	U	na	
Bismuth-214	na		na		3.13		na		na		na		na		na		1.21	U	na		na		na		na		na		0.93	U	na	
Cobalt-57	na		na		0.12	U	na		na		na		na		na		0.07	U	na		na		na		na		na		0.06	U	na	
Cobalt-60	na		na		0.10	U	na		na		na		na		na		0.18	U	na		na		na		na		na		0.08	U	na	
Cesium-134	na		na		0.15	U	na		na		na		na		na		0.14	U	na		na		na		na		na		0.06	U	na	
Cesium-137	na		na		0.19	U	na		na		na		na		na		0.20	U	na		na		na		na		na		0.08	U	na	
Potassium-40	na		na		41.10		na		na		na		na		na		20.45		na		na		na		na		na		18.77		na	
Manganese-54	na		na		0.11	U	na		na		na		na		na		0.09	U	na		na		na		na		na		0.06	U	na	
Sodium-22	na		na		0.07	U	na		na		na		na		na		0.06	U	na		na		na		na		na		0.08	U	na	
Protactinium-231	na		na		4.71	U	na		na		na		na		na		5.31	U	na		na		na		na		na		4.49	U	na	
Protactinium-234	na		na		0.81	U	na		na		na		na		na		0.88	U	na		na		na		na		na		0.69	U	na	
Protactinium-234 (meta)	na		na		22.90	U	na		na		na		na		na		29.60	U	na		na		na		na		na		17.50	U	na	
Lead-210	na		na		17.50	U	na		na		na		na		na		22.50	U	na		na		na		na		na		2.36	U	na	
Lead-211	na		na		0.24	U	na		na		na		na		na		0.52	U	na		na		na		na		na		0.19	U	na	
Lead-212	na		na		1.16		na		na		na		na		na		1.32		na		na		na		na		na		1.10		na	
Lead-214	na		na		1.31		na		na		na		na		na		1.34		na		na		na		na		na		1.35		na	
Radium-223	na		na		0.93	U	na		na		na		na		na		1.16	U	na		na		na		na		na		0.67	U	na	
Radium-224	na		na		3.60	U	na		na		na		na		na		4.17	U	na		na		na		na		na		3.67	U	na	
Radium-226	na		na		2.19	#	na		na		na		na		na		1.98		na		na		na		na		na		1.26		na	
Radon-219	na		na		1.11	U	na		na		na		na		na		1.25	U	na		na		na		na		na		0.81	U	na	
Ruthenium-106	na		na		0.60	U	na		na		na		na		na		0.46	U	na		na		na		na		na		0.79	U	na	
Thorium-227	na		na		1.91	U	na		na		na		na		na		2.12	U	na		na		na		na		na		1.54	U	na	
Thorium-234	na		na		7.64	U	na		na		na		na		na		9.13	U	na		na		na		na		na		2.29	U	na	
Thallium-208	na		na		0.20	U	na		na		na		na		na		0.54	#	na		na		na		na		na		0.37		na	
Uranium-235	na		na		0.24	U	na		na		na		na		na		0.21	U	na		na		na		na		na		0.19	U	na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

JT Corp ID#	STSD-42		STSD-43		STSD-44		STSD-45		STSD-46		STSD-50		STSD-52		STSD-53		STSD-54		STSD-55		STSD-58		STSD-59		STSD-60		STSD-61		STSD-62	
Date Collected	9/15/95		9/15/95		9/15/95		9/15/95		9/15/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95		9/26/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	16.7	B	12.2	B	8.9	B	11.1	B	na		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Benzene	5	U	5	U	5	U	5	U	na		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Bromodichloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	9030		21583		8990		3026		na		na		na		na		na		na		na		na		na		na		na	
Diesel	na		na		na		na		na		2.5		0.076		0.38		1.6		0.12		2.9		0.063		0.58		0.60		2.5	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		na		na		25		na		na		na		na		na		na		na		na		na		na	
Gross Beta	na		na		na		na		28		na		na		na		na		na		na		na		na		na		na	
Actinium-228	na		na		na		na		0.52	U	na		na		na		na		na		na		na		na		na		na	
Americium-241	na		na		na		na		0.36	U	na		na		na		na		na		na		na		na		na		na	
Bismuth-211	na		na		na		na		0.41	U	na		na		na		na		na		na		na		na		na		na	
Bismuth-212	na		na		na		na		0.71	U	na		na		na		na		na		na		na		na		na		na	
Bismuth-214	na		na		na		na		0.87	U	na		na		na		na		na		na		na		na		na		na	
Cobalt-57	na		na		na		na		0.04	U	na		na		na		na		na		na		na		na		na		na	
Cobalt-60	na		na		na		na		0.11	U	na		na		na		na		na		na		na		na		na		na	
Cesium-134	na		na		na		na		0.15	U	na		na		na		na		na		na		na		na		na		na	
Cesium-137	na		na		na		na		0.18	U	na		na		na		na		na		na		na		na		na		na	
Potassium-40	na		na		na		na		17.53		na		na		na		na		na		na		na		na		na		na	
Manganese-54	na		na		na		na		0.04	U	na		na		na		na		na		na		na		na		na		na	
Sodium-22	na		na		na		na		0.05	U	na		na		na		na		na		na		na		na		na		na	
Protactinium-231	na		na		na		na		5.00	U	na		na		na		na		na		na		na		na		na		na	
Protactinium-234	na		na		na		na		0.66	U	na		na		na		na		na		na		na		na		na		na	
Protactinium-234 (meta)	na		na		na		na		19.30	U	na		na		na		na		na		na		na		na		na		na	
Lead-210	na		na		na		na		16.30	U	na		na		na		na		na		na		na		na		na		na	
Lead-211	na		na		na		na		0.39	U	na		na		na		na		na		na		na		na		na		na	
Lead-212	na		na		na		na		0.99		na		na		na		na		na		na		na		na		na		na	
Lead-214	na		na		na		na		1.36		na		na		na		na		na		na		na		na		na		na	
Radium-223	na		na		na		na		0.90	U	na		na		na		na		na		na		na		na		na		na	
Radium-224	na		na		na		na		3.23	U	na		na		na		na		na		na		na		na		na		na	
Radium-226	na		na		na		na		1.28		na		na		na		na		na		na		na		na		na		na	
Radon-219	na		na		na		na		0.81	U	na		na		na		na		na		na		na		na		na		na	
Ruthenium-106	na		na		na		na		0.96	U	na		na		na		na		na		na		na		na		na		na	
Thorium-227	na		na		na		na		1.73	U	na		na		na		na		na		na		na		na		na		na	
Thorium-234	na		na		na		na		6.59	U	na		na		na		na		na		na		na		na		na		na	
Thallium-208	na		na		na		na		0.48		na		na		na		na		na		na		na		na		na		na	
Uranium-235	na		na		na		na		0.19	U	na		na		na		na		na		na		na		na		na		na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

IT Corp ID#	STSD-63		STSD-64		STSD-65		STSD-66		STSD-67		STSD-68		STSD-69		STSD-70		STSD-71		STSD-73		STSD-74		STSD-75		STSD-76		STSD-77		STSD-78	
Date Collected	10/6/95		10/6/95		10/6/95		10/6/95		10/6/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/10/95	
Sample Location	Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Benzene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Bromodichloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Diesel	5.2		2.9		4.2		3.0		4.9		570		1300		1100		970		1100		2000		1100		1100		1700		1500	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Gross Beta	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Actinium-228	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Americium-241	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-211	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-212	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-214	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cobalt-57	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cobalt-60	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cesium-134	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cesium-137	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Potassium-40	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Manganese-54	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Sodium-22	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-231	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234 (meta)	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-210	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-211	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-212	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-214	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-223	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-224	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-226	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radon-219	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Ruthenium-106	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thorium-227	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thorium-234	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thallium-208	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Uranium-235	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

IT Corp ID#	STSD-79		STSD-80		STSD-81		STSD-82		STSD-83		STSD-84		STSD-85		STSD-86		STSD-87		STSD-88		STSD-89		STSD-90		STSD-92		STSD-93		STSD-95	
Date Collected	10/10/95		10/10/95		10/10/95		10/10/95		10/10/95		10/19/95		10/19/95		10/19/95		10/19/95		10/30/95		10/30/95		10/30/95		10/30/95		10/30/95		10/30/95	
Sample Location	Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		Soil Pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	ND		ND		ND		ND		ND		0.020	U	0.020	U	0.010	B	0.020	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Benzene	ND		ND		ND		ND		ND		10	U	10	U	10	U	10	U	25	U	25	U	25	U	25	U	25	U	25	U
Bromodichloromethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Diesel	3100		1500		2400		2000		1400		1300		980	U	1300	U	2100	U	5800		8400		5400		3700		6300		7400	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Gross Beta	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Actinium-228	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Americium-241	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-211	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-212	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Bismuth-214	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cobalt-57	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cobalt-60	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cesium-134	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Cesium-137	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Potassium-40	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Manganese-54	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Sodium-22	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-231	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234 (meta)	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-210	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-211	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-212	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Lead-214	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-223	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-224	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radium-226	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Radon-219	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Ruthenium-106	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thorium-227	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thorium-234	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Thallium-208	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
Uranium-235	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na		na		na		na		na	

APPENDIX D
STABILIZED SEDIMENT ANALYTICAL RESULTS

IT Corp ID#	STSD-96		STSD-97		STSD-98		STSD-99		STSD-101		STSD-102		STSD-103		STSD-104		STSD-105		STSD-106		STSD-107	
Date Collected	11/1/95		11/1/95		11/1/95		11/1/95		11/1/95		11/1/95		11/1/95		11/7/95		11/7/95		11/7/95		11/7/95	
Sample Location	spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile		spoil pile	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chromium	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
ORGANICS (TCLP):	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane	na		na		na		na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na		na		na		na	
Benzene	25	U	25	U	25	U	25	U	25	U	25	U	25	U	25	U	25	U	25	U	25	U
Bromodichloromethane	na		na		na		na		na		na		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na		na		na		na	
TPH	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na		na		na		na	
Diesel	2600		1500		590		740		160		4600		340		1800		3100		1300		550	
RADIATION:	pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		na		na		na		na		na		na		na		na		na	
Gross Beta	na		na		na		na		na		na		na		na		na		na		na	
Actinium-228	na		na		na		na		na		na		na		na		na		na		na	
Americium-241	na		na		na		na		na		na		na		na		na		na		na	
Bismuth-211	na		na		na		na		na		na		na		na		na		na		na	
Bismuth-212	na		na		na		na		na		na		na		na		na		na		na	
Bismuth-214	na		na		na		na		na		na		na		na		na		na		na	
Cobalt-57	na		na		na		na		na		na		na		na		na		na		na	
Cobalt-60	na		na		na		na		na		na		na		na		na		na		na	
Cesium-134	na		na		na		na		na		na		na		na		na		na		na	
Cesium-137	na		na		na		na		na		na		na		na		na		na		na	
Potassium-40	na		na		na		na		na		na		na		na		na		na		na	
Manganese-54	na		na		na		na		na		na		na		na		na		na		na	
Sodium-22	na		na		na		na		na		na		na		na		na		na		na	
Protactinium-231	na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234	na		na		na		na		na		na		na		na		na		na		na	
Protactinium-234 (meta)	na		na		na		na		na		na		na		na		na		na		na	
Lead-210	na		na		na		na		na		na		na		na		na		na		na	
Lead-211	na		na		na		na		na		na		na		na		na		na		na	
Lead-212	na		na		na		na		na		na		na		na		na		na		na	
Lead-214	na		na		na		na		na		na		na		na		na		na		na	
Radium-223	na		na		na		na		na		na		na		na		na		na		na	
Radium-224	na		na		na		na		na		na		na		na		na		na		na	
Radium-226	na		na		na		na		na		na		na		na		na		na		na	
Radon-219	na		na		na		na		na		na		na		na		na		na		na	
Ruthenium-106	na		na		na		na		na		na		na		na		na		na		na	
Thorium-227	na		na		na		na		na		na		na		na		na		na		na	
Thorium-234	na		na		na		na		na		na		na		na		na		na		na	
Thallium-208	na		na		na		na		na		na		na		na		na		na		na	
Uranium-235	na		na		na		na		na		na		na		na		na		na		na	
TRITIUM	na		na		na		na		na		na		na		na		na		na		na	

Appendix D
Stabilized Sediment Analytical Results

IT Corp ID#	STSD-105		STSD-106		STSD-107	
Date Collected	11/7/95		11/7/95		11/7/95	
Sample Location	spoil pile		spoil pile		spoil pile	
	Conc.	Q	Conc.	Q	Conc.	Q
METALS (TCLP):	mg/L		mg/L		mg/L	
Chromium	0.10	U	0.10	U	0.10	U
ORGANICS (TCLP):	µg/kg		µg/kg		µg/kg	
Chloromethane	na		na		na	
Vinyl Chloride	na		na		na	
Bromomethane	na		na		na	
Chloroethane	na		na		na	
Acrolein	na		na		na	
Acrylonitrile	na		na		na	
Methylene Chloride	na		na		na	
1,1-Dichloroethene	na		na		na	
trans-1,2-Dichloroethene	na		na		na	
1,1-Dichloroethane	na		na		na	
Chloroform	na		na		na	
1,2-Dichloroethane	na		na		na	
1,1,1-Trichloroethane	na		na		na	
Carbon Tetrachloride	na		na		na	
Trichloroethene	na		na		na	
1,2-Dichloropropane	na		na		na	
Benzene	25	U	25	U	25	U
Bromodichloromethane	na		na		na	
2-Chloroethylvinyl ether	na		na		na	
trans-1,3-Dichloropropene	na		na		na	
cis-1,3-Dichloropropene	na		na		na	
1,1,2-Trichloroethane	na		na		na	
Chlorodibromomethane	na		na		na	
Toluene	na		na		na	
Tetrachloroethene	na		na		na	
Chlorobenzene	na		na		na	
Ethylbenzene	na		na		na	
Total Xylene	na		na		na	
Bromoform	na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na	
TPH	mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na	
Diesel	3100		1300		550	
RADIATION:	pCi/g		pCi/g		pCi/g	
Gross Alpha	na		na		na	
Gross Beta	na		na		na	
Actinium-228	na		na		na	
Americium-241	na		na		na	
Bismuth-211	na		na		na	
Bismuth-212	na		na		na	
Bismuth-214	na		na		na	
Cobalt-57	na		na		na	
Cobalt-60	na		na		na	
Cesium-134	na		na		na	
Cesium-137	na		na		na	
Potassium-40	na		na		na	
Manganese-54	na		na		na	
Sodium-22	na		na		na	
Protactinium-231	na		na		na	
Protactinium-234	na		na		na	
Protactinium-234 (meta)	na		na		na	
Lead-210	na		na		na	
Lead-211	na		na		na	
Lead-212	na		na		na	
Lead-214	na		na		na	
Radium-223	na		na		na	
Radium-224	na		na		na	
Radium-226	na		na		na	
Radon-219	na		na		na	
Ruthenium-106	na		na		na	
Thorium-227	na		na		na	
Thorium-234	na		na		na	
Thallium-208	na		na		na	
Uranium-235	na		na		na	
Tritium	na		na		na	

Appendix D
Stablized Sediment Analytical Results

Q = Data qualifier
U = Compound was analyzed but not detected above the specified limit
J = Reported value is estimated
B = For organics, the analyte was found in the blank. For inorganics, the result is above the Instrument Detection Limit but below the Contract Required Detection Limit
N = Presumptive identification of a tentatively identified compound based on a mass spectral library search
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

ug/kg = micrograms per kilogram
ug/L = micrograms per liter
pCi/g = picocuries per gram
na = not analyzed
ND = parameter was analyzed for but not detected
# = Peaks used to calculate value were poorly shaped.

Appendix E

Pond Cleanup Verification Analytical Results

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

Grand Junction Regional Office
222 S. 6th Street, Room 232
Grand Junction, Colorado 81501-2768
Fax (970) 248-7198

Colorado Department of Public Health and Environment

June 7, 1996

Mr. Stephen A. Millington, Director
Environmental Restoration Division
Department of Energy Nevada Operations Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

Re: Rulison Pond Site

Dear Mr. Millington:

Mr. Kevin Leary of your office has asked me to write a letter confirming our variance agreement for soil TPH levels at the Rulison Pond Site in Rulison, Colorado. The Remediation Plan proposed attainment levels of 250 mg/kg TPH in soil in the excavated area. This target level was established by review of the Storage Tank Facility Owner/Operator Guidance Document (April 15, 1994) published by the Colorado Department of Public Health and Environment.

During the remediation, it became necessary to leave in place isolated areas with TPH concentrations in excess of the proposed attainment level. A variance of up to 1000 mg/kg TPH was agreed to by the Colorado Department of Public Health and Environment on October 17, 1995. This variance was to be supported by the Department of Energy with a risk assessment that would evaluate and document the areas and estimated volumes being left in place. Additionally, groundwater monitoring being conducted quarterly for a minimum of two years will be utilized to demonstrate the effectiveness of the remediation.

The risk assessment and documentation has not yet been received by our office. This information will be reviewed upon receipt.

If you require further information regarding the TPH variance please contact me at 970-248-7168.

Sincerely,

Donna Stoner

Donna Stoner, Environmental Specialist
Solid Waste Program
Hazardous Materials and
Waste Management Division

:ds

cc: Mr. Kevin Leary, DOE Nevada Operations Office
SW GAR RUL 1A
File

ACTION
INFO ERD
MGR
OBFS
AMTS
AMNS
AMEM

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-01		RU-VSS-01-1		RU-VSS-01-2		RU-VSS-02		RU-VSS-02-1		RU-VSS-03		RU-VSS-03-1		RU-VSS-04	
Date Collected	9/7/95		9/9/95		10/13/95		9/7/95		9/9/95		8/31/95		9/9/95		8/31/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**	
Nonspecific	na		1,021	J	na		na		700	J	na		70	J	na	
Diesel	1,600		na		22		1,700		na		na		na		na	
Waste Oil	na		na		na		na		na		na		na		na	
METALS: (TCLP)	**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**	
Silver	na		na		na		na		na		na		na		na	
Arsenic	na		na		na		na		na		na		na		na	
Barium	na		na		na		na		na		na		na		na	
Cadmium	na		na		na		na		na		na		na		na	
Chromium	na		na		na		na		na		na		na		na	
Lead	na		na		na		na		na		na		na		na	
Selenium	na		na		na		na		na		na		na		na	
Mercury	na		na		na		na		na		na		na		na	
ORGANICS: (TCLP)	**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**	
Chloromethane	50	U	na		na		50	U	na		50	U	na		50	U
Vinyl Chloride	10	U	na		na		10	U	na		10	U	na		10	U
Bromomethane	50	U	na		na		50	U	na		50	U	na		50	U
Chloroethane	50	U	na		na		50	U	na		50	U	na		50	U
Acrolein	120	U	na		na		120	U	na		120	U	na		120	U
Acrylonitrile	120	U	na		na		120	U	na		120	U	na		120	U
Methylene Chloride	50	U	na		na		50	U	na		50	U	na		50	U
1,1-Dichloroethene	25	U	na		na		25	U	na		25	U	na		25	U
trans-1,2-Dichloroethene	25	U	na		na		25	U	na		25	U	na		25	U
1,1-Dichloroethane	25	U	na		na		25	U	na		25	U	na		25	U
Chloroform	5	J	na		na		10	J	na		10	J	na		10	J
1,2-Dichloroethane	25	U	na		na		25	U	na		25	U	na		25	U
1,1,1-Trichloroethane	25	U	na		na		25	U	na		25	U	na		25	U
Carbon Tetrachloride	25	U	na		na		25	U	na		25	U	na		25	U
Trichloroethene	25	U	na		na		25	U	na		25	U	na		25	U
1,2-Dichloropropane	25	U	na		na		25	U	na		25	U	na		25	U
Benzene	5	U	na		25	U	5	U	na		5	U	na		5	U
2-Chloroethylvinyl ether	50	U	na		na		50	U	na		50	U	na		50	U
Bromodichloromethane	25	U	na		na		25	U	na		25	U	na		25	U
trans-1,3-Dichloropropene	25	U	na		na		25	U	na		25	U	na		25	U
cis-1,3-Dichloropropene	25	U	na		na		25	U	na		25	U	na		25	U
1,1,2-Trichloroethane	25	U	na		na		25	U	na		25	U	na		25	U
Chlorodibromomethane	25	U	na		na		25	U	na		25	U	na		25	U
Toluene	25	U	na		na		25	U	na		25	U	na		25	U
Tetrachloroethene	25	U	na		na		25	U	na		25	U	na		25	U
Chlorobenzene	25	U	na		na		25	U	na		25	U	na		25	U
Ethylbenzene	25	U	na		na		25	U	na		25	U	na		25	U
Total Xylene	25	U	na		na		25	U	na		25	U	na		25	U
Bromoform	25	U	na		na		25	U	na		25	U	na		25	U
1,1,2,2-Tetrachloroethane	25	U	na		na		25	U	na		25	U	na		25	U

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-04-1		RU-VSS-04-2		RU-VSS-05		RU-VSS-05-1		RU-VSS-05-2		RU-VSS-06		RU-VSS-06-1		RU-VSS-07-1	
Date Collected	9/9/95		10/13/95		8/31/95		9/9/95		10/13/95		8/31/95		9/9/95		9/9/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	685	J	na		na		590	J	na		na		138	J	310	J
Diesel	na		160		na		na		33		na		na		na	
Waste Oil	na		na		na		na		na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	na		na		na		0.0044	U	0.50	UJ	na		na		na	
Arsenic	na		na		na		0.127	U	0.50	U	na		na		na	
Barium	na		na		na		1.92	B	10.0	U	na		na		na	
Cadmium	na		na		na		0.0022	U	0.10	U	na		na		na	
Chromium	na		na		na		0.0033	U	0.10	U	na		na		na	
Lead	na		na		na		0.0422	U	0.50	U	na		na		na	
Selenium	na		na		na		0.147	U	0.10	U	na		na		na	
Mercury	na		na		na		0.0	U	0.02	U	na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		50	U	na		na		50	U	na		50	U
Vinyl Chloride	na		na		10	U	na		na		10	U	na		10	U
Bromomethane	na		na		50	U	na		na		50	U	na		50	U
Chloroethane	na		na		50	U	na		na		50	U	na		50	U
Acrolein	na		na		120	U	na		na		120	U	na		120	U
Acrylonitrile	na		na		120	U	na		na		120	U	na		120	U
Methylene Chloride	na		na		50	U	na		na		50	U	na		50	U
1,1-Dichloroethene	na		na		25	U	na		na		25	U	na		25	U
trans-1,2-Dichloroethene	na		na		25	U	na		na		25	U	na		25	U
1,1-Dichloroethane	na		na		25	U	na		na		25	U	na		25	U
Chloroform	na		na		25	U	na		na		10	J	na		15	J
1,2-Dichloroethane	na		na		25	U	na		na		25	U	na		25	U
1,1,1-Trichloroethane	na		na		25	U	na		na		25	U	na		25	U
Carbon Tetrachloride	na		na		25	U	na		na		25	U	na		25	U
Trichloroethene	na		na		25	U	na		na		25	U	na		25	U
1,2-Dichloropropane	na		na		25	U	na		na		25	U	na		25	U
Benzene	na		25	U	5	U	na		25	U	5	U	na		5	U
2-Chloroethylvinyl ether	na		na		50	U	na		na		50	U	na		50	U
Bromodichloromethane	na		na		25	U	na		na		25	U	na		25	U
trans-1,3-Dichloropropene	na		na		25	U	na		na		25	U	na		25	U
cis-1,3-Dichloropropene	na		na		25	U	na		na		25	U	na		25	U
1,1,2-Trichloroethane	na		na		25	U	na		na		25	U	na		25	U
Chlorodibromomethane	na		na		25	U	na		na		25	U	na		25	U
Toluene	na		na		25	U	na		na		25	U	na		25	U
Tetrachloroethene	na		na		25	U	na		na		25	U	na		25	U
Chlorobenzene	na		na		25	U	na		na		25	U	na		25	U
Ethylbenzene	na		na		25	U	na		na		25	U	na		25	U
Total Xylene	na		na		25	U	na		na		25	U	na		25	U
Bromoform	na		na		25	U	na		na		25	U	na		25	U
1,1,2,2-Tetrachloroethane	na		na		25	U	na		na		25	U	na		25	U

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-08		RU-VSS-08-1		RU-VSS-09		RU-VSS-09-1		RU-VSS-10-1		RU-VSS-11-1		RU-VSS-12		RU-VSS-13	
Date Collected	9/7/95		9/9/95		9/7/95		9/9/95		9/9/95		9/9/95		10/13/95		10/14/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		10	UJ	na		na		176	J	177	J	na		na	
Diesel	260		na		49		na		na		na		320		2,600	D
Waste Oil	na		na		na		na		na		na		na		25	U
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.0044	U	na		na		na		na		na		na		na	
Arsenic	0.127	U	na		na		na		na		na		na		na	
Barium	1.37		na		na		na		na		na		na		na	
Cadmium	0.0133		na		na		na		na		na		na		na	
Chromium	0.0033	U	na		na		na		na		na		na		na	
Lead	0.0422	U	na		na		na		na		na		na		na	
Selenium	0.147	U	na		na		na		na		na		na		na	
Mercury	0.002	U	na		na		na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	50	U	na		50	U	na		50	U	50	U	na		na	
Vinyl Chloride	10	U	na		10	U	na		10	U	10	U	na		na	
Bromomethane	50	U	na		50	U	na		50	U	50	U	na		na	
Chloroethane	50	U	na		50	U	na		50	U	50	U	na		na	
Acrolein	120	U	na		120	U	na		120	U	120	U	na		na	
Acrylonitrile	120	U	na		120	U	na		120	U	120	U	na		na	
Methylene Chloride	50	U	na		50	U	na		50	U	50	U	na		na	
1,1-Dichloroethene	25	U	na		25	U	na		25	U	25	U	na		na	
trans-1,2-Dichloroethene	25	U	na		25	U	na		25	U	25	U	na		na	
1,1-Dichloroethane	25	U	na		25	U	na		25	U	25	U	na		na	
Chloroform	10	J	na		25	U	na		15	J	15	J	na		na	
1,2-Dichloroethane	25	U	na		25	U	na		25	U	25	U	na		na	
1,1,1-Trichloroethane	25	U	na		25	U	na		25	U	25	U	na		na	
Carbon Tetrachloride	25	U	na		25	U	na		25	U	25	U	na		na	
Trichloroethene	25	U	na		25	U	na		25	U	25	U	na		na	
1,2-Dichloropropane	25	U	na		25	U	na		25	U	25	U	na		na	
Benzene	5	U	na		5	U	na		5	U	5	U	25	U	10	U
2-Chloroethylvinyl ether	50	U	na		50	U	na		50	U	50	U	na		na	
Bromodichloromethane	25	U	na		25	U	na		25	U	25	U	na		na	
trans-1,3-Dichloropropene	25	U	na		25	U	na		25	U	25	U	na		na	
cis-1,3-Dichloropropene	25	U	na		25	U	na		25	U	25	U	na		na	
1,1,2-Trichloroethane	25	U	na		25	U	na		25	U	25	U	na		na	
Chlorodibromomethane	25	U	na		25	U	na		25	U	25	U	na		na	
Toluene	25	U	na		25	U	na		25	U	25	U	na		na	
Tetrachloroethene	25	U	na		25	U	na		25	U	25	U	na		na	
Chlorobenzene	25	U	na		25	U	na		25	U	25	U	na		na	
Ethylbenzene	25	U	na		25	U	na		25	U	25	U	na		na	
Total Xylene	25	U	na		25	U	na		25	U	25	U	na		na	
Bromoform	25	U	na		25	U	na		25	U	25	U	na		na	
1,1,2,2-Tetrachloroethane	25	U	na		25	U	na		25	U	25	U	na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-13-1		RU-VSS-14		RU-VSS-15		RU-VSS-16		RU-VSS-17		RU-VSS-18		RU-VSS-19		RU-VSS-19-1	
Date Collected	10/19/95		10/13/95		10/13/95		10/12/95		10/12/95		10/12/95		10/12/95		10/18/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	840		7.1		180		25	U	210		29		16,000		370	
Waste Oil	na		na		na		25	U	25	U	na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	na		na		0.50	UJ	na		na		na		na		na	
Arsenic	na		na		0.50	U	na		na		na		na		na	
Barium	na		na		10.0	U	na		na		na		na		na	
Cadmium	na		na		0.10	U	na		na		na		na		na	
Chromium	na		na		0.10	U	na		na		na		na		na	
Lead	na		na		0.50	U	na		na		na		na		na	
Selenium	na		na		0.10	U	na		na		na		na		na	
Mercury	na		na		0.02	U	na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	25	U	25	U	25	U	10	U	10	U	25	U	25	U	na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-20		RU-VSS-20-1		RU-VSS-20-2		RU-VSS-120		RU-VSS-21		RU-VSS-22		RU-VSS-23		RU-VSS-24	
Date Collected	10/12/95		10/18/95		10/21/95		10/12/95		10/12/95		10/12/95		10/12/95		10/12/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	2,500		1,500		150		na		2.4	U	370		25	U	170	
Waste Oil	na		na		na		na		na		na		25	U	25	U
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.50	U	na		na		na		na		na		na		na	
Arsenic	0.50	U	na		na		na		na		na		na		na	
Barium	10.0	U	na		na		na		na		na		na		na	
Cadmium	0.10	U	na		na		na		na		na		na		na	
Chromium	0.10	U	na		na		na		na		na		na		na	
Lead	0.50	U	na		na		na		na		na		na		na	
Selenium	0.10	U	na		na		na		na		na		na		na	
Mercury	0.020	U	na		na		na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	25	U	na		na		na		25	U	25	U	10	U	10	U
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-25		RU-VSS-26		RU-VSS-26-1		RU-VSS-27		RU-VSS-27-12		RU-VSS-28		RU-VSS-29		RU-VSS-29-1	
Date Collected	10/13/95		10/13/95		10/18/95		10/14/95		10/14/95		10/13/95		10/13/95		10/18/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	680		1,400		31		160		740		77		2,000		77	
Waste Oil	na		na		na		25	U	na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.50	UJ	na		na		0.006	U	0.50	U	na		na		na	
Arsenic	0.50	U	na		na		0.0377	U	0.50	U	na		na		na	
Barium	10.0	U	na		na		2.42		10.0	U	na		na		na	
Cadmium	0.10	U	na		na		0.0058		0.10	U	na		na		na	
Chromium	0.10	U	na		na		0.0037	U	0.10	U	na		na		na	
Lead	0.50	U	na		na		0.0382	U	0.50	U	na		na		na	
Selenium	0.10	U	na		na		0.055	B	0.10	U	na		na		na	
Mercury	0.02	U	na		na		0.0001	U	0.020	U	na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	25	U	25	U	na		10	U	25	U	25	U	25	U	na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-30		RU-VSS-31		RU-VSS-131		RU-VSS-32		RU-VSS-33		RU-VSS-34		RU-VSS-34-1		RU-VSS-34-2	
Date Collected	10/12/95		10/12/95		10/12/95		10/12/95		10/12/95		10/12/95		10/18/95		10/21/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	36		30	*	na		170		340		1,400		1,700		140	
Waste Oil	25	U	na		na		na		na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.006	U	na		na		na		na		na		na		na	
Arsenic	0.0377	UJ	na		na		na		na		na		na		na	
Barium	1.32		na		na		na		na		na		na		na	
Cadmium	0.0045	U	na		na		na		na		na		na		na	
Chromium	0.0037	U	na		na		na		na		na		na		na	
Lead	0.0382	U	na		na		na		na		na		na		na	
Selenium	0.0426	U	na		na		na		na		na		na		na	
Mercury	0.0001	U	na		na		na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	10	U	25	U	na		25	U	25	U	25	U	na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-34-12		RU-VSS-35		RU-VSS-36		RU-VSS-37		RU-VSS-38		RU-VSS-40		RU-VSS-41		RU-VSS-42	
Date Collected	10/14/95		10/13/95		10/12/95		10/12/95		10/12/95		10/12/95		10/13/95		10/13/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	310		600		590		72		540		25	U	240		49	
Waste Oil	na		na		na		na		na		25	U	na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.50	U	0.50	UJ	na		na		na		0.006	U	0.50	UJ	na	
Arsenic	0.50	U	0.50	U	na		na		na		0.0377	UJ	0.50	U	na	
Barium	10.0	U	10.0	U	na		na		na		1.16		10.0	U	na	
Cadmium	0.10	U	0.10	U	na		na		na		0.0023	U	0.10	U	na	
Chromium	0.10	U	0.10	U	na		na		na		0.0058	U	0.10	U	na	
Lead	0.50	U	0.50	U	na		na		na		0.0382	U	0.50	U	na	
Selenium	0.10	U	0.10	U	na		na		na		0.0426	U	0.10	U	na	
Mercury	0.020	U	0.020	U	na		na		na		0.0001	U	0.020	U	na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	25	U	25	U	25	U	25	U	25	U	10	U	25	U	25	U
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-43		RU-VSS-44		RU-VSS-45		RU-VSS-46		RU-VSS-47		RU-VSS-48		RU-VSS-49		RU-VSS-49-12	
Date Collected	10/19/95		10/19/95		11/01/95		11/01/95		11/01/95		10/19/95		10/13/95		10/14/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	170		470		45		21		67		790		110		350	
Waste Oil	na		na		na		na		na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	na		na		na		na		0.50	U	na		na		0.50	U
Arsenic	na		na		na		na		0.50	U	na		na		0.50	U
Barium	na		na		na		na		10.0	U	na		na		10.0	U
Cadmium	na		na		na		na		0.10	U	na		na		0.10	U
Chromium	na		na		na		na		0.10	U	na		na		0.10	U
Lead	na		na		na		na		0.50	U	na		na		0.50	U
Selenium	na		na		na		na		0.10	U	na		na		0.10	U
Mercury	na		na		na		na		0.020	U	na		na		0.020	U
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	0.025	U	0.025	U	25	U	25	U	25	U	0.025	U	25	U	25	U
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-49-12S		RU-VSS-50		RU-VSS-51		RU-VSS-52		RU-VSS-53		RU-VSS-54		RU-VSS-55	
Date Collected	10/14/95		10/13/95		10/12/95		10/12/95		11/6/95		11/6/95		11/6/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na	
Diesel	120		1,000		60		2.4	U	27		60		38	
Waste Oil	25	U	na		25	U	na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	6.0	U	0.50	UJ	na		na		na		na		na	
Arsenic	37.7	U	0.50	U	na		na		na		na		na	
Barium	1480		10.0	U	na		na		na		na		na	
Cadmium	2.3	U	0.10	U	na		na		na		na		na	
Chromium	4.8	B	0.10	U	na		na		na		na		na	
Lead	38.2	U	0.50	U	na		na		na		na		na	
Selenium	58.8	B	0.10	U	na		na		na		na		na	
Mercury	0.10	U	0.020	U	na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na	
Benzene	10	U	25	U	10	U	25	U	25	U	25	U	25	U
2-Chloroethylvinyl ether	na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-T01		RU-VSS-T01-07		RU-VSS-T01-19		RU-VSS-T02-15.5		RU-VSS-T02-23		RU-VSS-T02-31.5		RU-VSS-T03-26	
Date Collected	9/21/95		9/21/95		9/21/95		9/20/95		9/20/95		9/20/95		9/20/95	
Sample Location	Test Pit 01		Test Pit 01		Test Pit 01		Test Pit 02		Test Pit 02		Test Pit 02		Test Pit 03	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na	
Diesel	na		300		330		20		40		4.4		56	
Waste Oil	na		na		na		na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	0.50	U	na		na		na		na		na		na	
Arsenic	0.50	U	na		na		na		na		na		na	
Barium	10.0	U	na		na		na		na		na		na	
Cadmium	0.10	U	na		na		na		na		na		na	
Chromium	0.10	U	na		na		na		na		na		na	
Lead	0.50	U	na		na		na		na		na		na	
Selenium	0.10	U	na		na		na		na		na		na	
Mercury	0.020	U	na		na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na	
Benzene	ND		na		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-T03-39		RU-VSS-T04		RU-VSS-T04-14		RU-VSS-T04-23		RU-VSS-T05-14		RU-VSS-T05-24		RU-VSS-T05-30	
Date Collected	9/20/95		9/21/95		9/21/95		9/21/95		9/26/95		9/26/95		9/26/95	
Sample Location	Test Pit 03		Test Pit 04		Test Pit 04		Test Pit 04		Test Pit 05		Test Pit 05		Test Pit 05	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na	
Diesel	41		na		3,500		3,100		200		14		2.5	U
Waste Oil	na		na		na		na		na		na		na	
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	na		0.50	U	na		na		na		na		na	
Arsenic	na		0.50	U	na		na		na		na		na	
Barium	na		10.0	U	na		na		na		na		na	
Cadmium	na		0.10	U	na		na		na		na		na	
Chromium	na		0.10	U	na		na		na		na		na	
Lead	na		0.50	U	na		na		na		na		na	
Selenium	na		0.10	U	na		na		na		na		na	
Mercury	na		0.020	U	na		na		na		na		na	
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na	
Benzene	na		ND		na		na		na		na		na	
2-Chloroethylvinyl ether	na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-T06-7		RU-VSS-T06-15		RU-VSS-T06-22		RU-VSS-205		RU-VSS-215		RU-VSS-225		RU-VSS-227		RU-VSS-235	
Date Collected	9/26/95		9/26/95		9/26/95		10/13/95		10/13/95		10/13/95		10/14/95		10/13/95	
Sample Location	Test Pit 06		Test Pit 06		Test Pit 06		Pond Floor		Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Nonspecific	na		na		na		na		na		na		na		na	
Diesel	23		45		2.1	U	30		240		500		170		440	
Waste Oil	na		na		na		25	U	25	U	24	U	na		25	U
METALS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Silver	na		na		na		0.01	U	0.01	U	0.01	U	0.50	U	0.01	U
Arsenic	na		na		na		0.5	U	0.5	U	0.5	U	0.50	U	0.5	U
Barium	na		na		na		1.28		1.04		1.81		10.0	U	2.07	
Cadmium	na		na		na		0.05	U	0.0063		0.0105		0.10	U	0.007	
Chromium	na		na		na		0.02	U	0.02	U	0.0218		0.10	U	0.02	U
Lead	na		na		na		0.1	U	0.1	U	0.1	U	0.50	U	0.1	U
Selenium	na		na		na		0.25	U	0.25	U	0.25	U	0.10	U	0.25	U
Mercury	na		na		na		0.0002	U	0.0002	U	0.0002	U	0.020	U	0.0002	U
ORGANICS: (TCLP)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Chloromethane	na		na		na		na		na		na		na		na	
Vinyl Chloride	na		na		na		na		na		na		na		na	
Bromomethane	na		na		na		na		na		na		na		na	
Chloroethane	na		na		na		na		na		na		na		na	
Acrolein	na		na		na		na		na		na		na		na	
Acrylonitrile	na		na		na		na		na		na		na		na	
Methylene Chloride	na		na		na		na		na		na		na		na	
1,1-Dichloroethene	na		na		na		na		na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na		na		na		na		na	
1,1-Dichloroethane	na		na		na		na		na		na		na		na	
Chloroform	na		na		na		na		na		na		na		na	
1,2-Dichloroethane	na		na		na		na		na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na		na		na		na		na	
Carbon Tetrachloride	na		na		na		na		na		na		na		na	
Trichloroethene	na		na		na		na		na		na		na		na	
1,2-Dichloropropane	na		na		na		na		na		na		na		na	
Benzene	na		na		na		10	U	10	U	10	U	25	U	10	U
2-Chloroethylvinyl ether	na		na		na		na		na		na		na		na	
Bromodichloromethane	na		na		na		na		na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na		na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na		na		na		na		na	
Chlorodibromomethane	na		na		na		na		na		na		na		na	
Toluene	na		na		na		na		na		na		na		na	
Tetrachloroethene	na		na		na		na		na		na		na		na	
Chlorobenzene	na		na		na		na		na		na		na		na	
Ethylbenzene	na		na		na		na		na		na		na		na	
Total Xylene	na		na		na		na		na		na		na		na	
Bromoform	na		na		na		na		na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na		na		na		na		na	

Appendix E
Pond Cleanup Verification Analytical Results

IT Corp ID#	RU-VSS-241		RU-VSS-247		RU-VSS-253		RU-VSS-255	
Date Collected	10/13/95		11/1/95		11/6/95		11/6/95	
Sample Location	Pond Floor		Pond Floor		Pond Floor		Pond Floor	
	Conc.	Q	Conc.	Q	Conc.	Q	Conc.	Q
TPH:	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**	
Nonspecific	na		na		na		na	
Diesel	380		45		25	U	25	U
Waste Oil	24	U	24	U	25	U	25	U
METALS: (TCLP)	**mg/L**		**mg/L**		**mg/L**		**mg/L**	
Silver	0.01	U	0.01	U	na		na	
Arsenic	0.5	U	0.50	U	na		na	
Barium	1.67		0.94		na		na	
Cadmium	0.0054		0.0030	B	na		na	
Chromium	0.02	U	0.020	U	na		na	
Lead	0.1	U	0.10	U	na		na	
Selenium	0.25	U	0.25	U	na		na	
Mercury	0.0002	U	0.00010	B	na		na	
ORGANICS: (TCLP)	**mg/L**		**mg/L**		**mg/L**		**mg/L**	
Chloromethane	na		na		na		na	
Vinyl Chloride	na		na		na		na	
Bromomethane	na		na		na		na	
Chloroethane	na		na		na		na	
Acrolein	na		na		na		na	
Acrylonitrile	na		na		na		na	
Methylene Chloride	na		na		na		na	
1,1-Dichloroethene	na		na		na		na	
trans-1,2-Dichloroethene	na		na		na		na	
1,1-Dichloroethane	na		na		na		na	
Chloroform	na		na		na		na	
1,2-Dichloroethane	na		na		na		na	
1,1,1-Trichloroethane	na		na		na		na	
Carbon Tetrachloride	na		na		na		na	
Trichloroethene	na		na		na		na	
1,2-Dichloropropane	na		na		na		na	
Benzene	10	U	10	U	10	U	10	U
2-Chloroethylvinyl ether	na		na		na		na	
Bromodichloromethane	na		na		na		na	
trans-1,3-Dichloropropene	na		na		na		na	
cis-1,3-Dichloropropene	na		na		na		na	
1,1,2-Trichloroethane	na		na		na		na	
Chlorodibromomethane	na		na		na		na	
Toluene	na		na		na		na	
Tetrachloroethene	na		na		na		na	
Chlorobenzene	na		na		na		na	
Ethylbenzene	na		na		na		na	
Total Xylene	na		na		na		na	
Bromoform	na		na		na		na	
1,1,2,2-Tetrachloroethane	na		na		na		na	

Q = Data qualifier.
U = Compound was analyzed but not detected above the specified limit.
J = Reported value is estimated.
B = In organics, the analyte was found in the blank. In inorganics, the result is above the Instrument Detection Limit but below the Contract Required Detection Limit
N = Presumptive identification of a tentatively identified compound based on a mass spectral library search.
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
ug/L = micrograms per liter
* Matrix interference experienced with this analysis
D = TPH Diesel concentration for RU-VSS-13 is from a 1:5 dilution.
na = not analyzed
ND = parameter was analyzed for but not detected.

Appendix F

Surface Ground Zero Area Soil Boring Logs

BORING NO. RU-SB01

PROJECT NAME: Rulison	COORDINATES: N 581,667 E 1,308,481	DATE STARTED: 10/06/95
BORING NUMBER: RU-SB01		DATE COMPLETED: 10/06/95
ELEVATION: 2,490.94m (8,172.36')		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0				0.61m (2')			
1 (3.3)	NA	12 23 14	16/18	Soft to firm, brown with some grey sandy silty clay, some rocks, moist. 1.07m (3.5')	CL		0.2
				1.83m (6')			
2 (6.6)	RU-SB01 06	5 10 10	10/18	Soft to firm, brown to reddish-brown clayey silt to silty clay, some fine sand, (some brown-grey silty clay), moist. 2.29m (7.5')	CL-ML		0.2
3 (9.8)				3.05m (10')			
	RU-SB01 10	2 9 49	16/18	Soft to firm brown to light brown silty clay with some rocks (siltstone, fine sandstone), moist. 3.51m (11.5')	CL		
4 (13.1)				4.57m (15')			
5 (16.4)	RU-SB01 15	50 50 50	16/18	Soft to firm, brown silty clay with sand to sandy silt, rock and rock fragments, sandstone, siltstone, possibly basalt cobble, moist. 5.03m (16.5')	CL		
				BOTTOM OF BORING - 5.18m (17')			
				[Drilled to 4.57m (15'), split-spoon sampled from 4.57-5.18m (15-17')]			
6 (19.7)							
7 (23.0)							
8 (26.2)							
9 (29.5)							

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: Split spoons and a 63.50kg (140 lb) hammer

4602A07 09/16/96

BORING NO. RU-SB02

PROJECT NAME: Rulison	COORDINATES: N 581,643 E 1,308,498	DATE STARTED: 10/06/95
BORING NUMBER: RU-SB02		DATE COMPLETED: 10/06/95
ELEVATION: 2,490.94m (8,172.17')		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0							0
1 (3.3)							1 (3.3)
2 (6.6)	NA	28 50/4	NA	Loose, brown to reddish-brown silt with clay and fine sand, abundant rock fragments (40%) – shale, siltstone, dry-moist.	ML		0.0
3 (9.8)	NA	50/1	NA	No sample recovery. 3.66m (12')			3 (9.8)
4 (13.1)	RU-SB02 12	13 16 18	18/18	Soft to firm, brown, clayey silt with fine sand, rock fragments (30% rock fragments) – siltstone, shale, basalt, moist. 4.11m (13.5')	ML		0.0
				4.57m (15')			
5 (16.4)	RU-SB02 15	18 21 19	18/18	Soft to firm, brown clayey silt with some fine sand, rock fragments and pebbles (shale, siltstone, basalt), moist. 5.03m (16.5')	ML		0.3
6 (19.7)				@ 5.49m (18') – grey powder (cuttings) but hard drilling, looks like possible cement.			
	RU-SB02 20	46 41 36	18/18	Soft to firm, brown clayey silt with rock fragments (approximately 30-40%), – siltstone, shale, some sandstone; sand, some cobbles/pebbles, wet, – entire spoon was saturated. 6.55m (21.5')	ML		0.1
7 (23.0)				**BOTTOM OF BORING – 6.55m (21.5')** **[Drilled to 6.10m (20'), split-spoon sampled from 6.10-6.55m (20-21.5')]**			
8 (26.2)							
9 (29.5)							

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A08 09/16/96

BORING NO. RU-SB03

PROJECT NAME: Rulison	COORDINATES: N 581,684 E 1,308,483	DATE STARTED: 10/06/95
BORING NUMBER: RU-SB03		DATE COMPLETED: 10/06/95
ELEVATION: 2,491.04m (8,172.69')		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0							
1 (3.3)							
2 (6.6)	RU-SB03 05	5 9 8 8	9/24	Soft to firm, dark brown clayey silt, moist; large rock in end of spoon.	ML		1.7
3 (9.8)	RU-SB03 10	9 11 8 7	19/24	Soft to firm brown silty clay with shale/siltstone rock fragments, some coarse sand and pebbles, moist.	CL		0.0
4 (13.1)							
5 (16.4)	RU-SB03 15	17 26 31 27	8/24	Soft to firm, brown clayey silt with fine sand and rock fragments – shale and sandstone, moist.	ML		0.0
6 (19.7)	NA	50/5	5/24	Soft to firm brown silty clay, lots of rocks – basalt; very moist. No sample collected.	CL		3.8
7 (23.0)	RU-SB03 23	8 8 8 9	NA	Soft to firm brown clayey silt with sand, some rock fragments, very moist to wet at approximately 7.16m (23.5'). 7.62m (25')	ML		0.3
8 (26.2)				BOTTOM OF BORING – 7.62m (25') [Drilled to 7m (23'), split-spoon sampled from 7-7.62m (23-25')]			
9 (29.5)							

DRILLING METHODS: Odex – Air rotary with 12.7cm (5") casing and bit
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 5.08cm (2") ø, 60.96cm (24") long split spoons with 15.24cm (6") brass liners and a 63.50 kg (140 lb) hammer using winch line.

4046A24 02/10/96

BORING NO. RU-SB04

PROJECT NAME: Rulison	COORDINATES: N 581,659 E 1,308,493	DATE STARTED: 10/06/95
BORING NUMBER: RU-SB04		DATE COMPLETED: 10/06/95
ELEVATION: 2,491.03m (8,172.66')		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0							0
1 (3.3)							1 (3.3)
2 (6.6)	RU-SB04 05	26 20 50/6	18/18	Loose to dense brown sandy/clayey silt with rock fragments, dry to moist. (Rock in end of spoon)	ML		0.4
				from 1.98-3.0m (6.5-10') - on basalt boulder			2 (6.6)
3 (9.8)				from 3.05-3.96m (10-13') - using downhole hammer to drill through rock			3 (9.8)
4 (13.1)	NA	17 50/3	6/18	Soft to firm brown silt with clay, some fine sand, moist, several large basalt pebbles.	ML		0.0
							4 (13.1)
5 (16.4)				from 4.19-6.10m (13.75-20') - in rock			5 (16.4)
6 (19.7)	RU-SB04 20	31 37 50/5	12/18	Soft to firm brown clayey silt with some sand, rock fragments.	ML		0.0
							6 (19.7)
7 (23.0)	RU-SB04 23	34 41 50/4	12/18	Soft to firm clayey silt with some sand, rock fragments (30-40%) - shale, sandstone, siltstone, basalt; moist to very moist.	ML		0.1
							7 (23.0)
				BOTTOM OF BORING - 7.47m (24.5')			
8 (26.2)				[Drilled to 7m (23'), split-spoon sampled from 7-7.47m (23-24.5')]			8 (26.2)
9 (29.5)							9 (29.5)

DRILLING METHODS: Odex - Air rotary with 12.7cm (5") casing and bit
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4046A25 02/10/96

BORING NO. RU-SB05

PROJECT NAME: Rulison	COORDINATES: N 581,661 E 1,308,470	DATE STARTED: 10/06/95
BORING NUMBER: RU-SB05		DATE COMPLETED: 10/06/95
ELEVATION: 2,490.74m (8,171.71')		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0				0.61m (2')			
1 (3.3)	RU-SB04 02	NA	18/18	Soft; top 15.2cm (6") dark brown silt with some clay, some fine sand, a few rootlets, few pieces of wood, moist. Mid 15.2cm (6") soft to firm light grey clay/fine sand/silt – could be bentonite, dry to moist. 1.23m (4') Bottom 15.2cm (6") soft to firm brown to dark brown clayey silt with fine sand, a few pebbles, lots of "mica", moist. 1.83m (6')	ML		0.6
2 (6.6)	NA	NA	18/18	Soft to firm brown and grey silty clay/clayey silt, some mica, looks like some bentonite, piece of wire and twig, a few rocks, moist. 2.43m (8')	CL-ML		0.3
3 (9.8)	NA	50/2	4/18	Soft to firm brown to reddish-brown silt with clay and sand, some pebbles and rock fragments, moist.	ML		0.5
4 (13.1)				from 3.81-4.11m (12.5-13.5') – rock			
5 (16.4)				from 4.57-5.18m (15-17') – rock/cobbles, no sample taken 5.18m (17')			
	RU-SB05 17	28 37 43	16/18	Soft to firm brown to reddish-brown silty clay with sand and rock fragments (siltstone, shale, some basalt peabbles). 5.64m (18.5')	CL		0.0
6 (19.7)				from cuttings – Soft reddish-brown clayey silt, rock fragments, moist. 6.1m (20')	ML		
7 (23.0)				**BOTTOM OF BORING – 6.1m (20')** **[Drilled to 6.1m (20'), split-spoon sampled from 5.18-5.64m (17-18.5')]**			
8 (26.2)							
9 (29.5)							

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A09 09/16/96

BORING NO. RU-SB06

PROJECT NAME: Rulison	COORDINATES: N 581,653 E 1,308,618	DATE STARTED: 10/07/95
BORING NUMBER: RU-SB06		DATE COMPLETED: 10/07/95
ELEVATION: 2,499.40m (8,200.12')		PAGE 1 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0				0.61m (2')			
1 (3.3)	NA	32 38 41	16/18	Soft to dense brown clayey silt with some sand, rocks, and rock fragments (siltstone, shale), basalt cobble, dry to moist. 1.07m (3.5')	ML		0.0
				from 1.22–1.52m (4–5') – rock 1.83m (6')			
2 (6.6)	NA	4 7 12	16/18	Soft brown and dark grey silty clay with a little sand, very moist, some rocks (5–10%), and metal, wire, nail, metal shavings. 2.29m (7.5')	CL		3.3
3 (9.8)				3.05m (10')			
	NA	NA	16/18	Soft to very soft brown (top 7.62cm [3"]) to grey/blue-grey streaked with black. Top 7.62cm (3") – silty clay, some gravel and bentonite – grey bentonite with black streaks, petroleum odor, very moist. 3.51m (11.5') 3.96m (13')	CL		14.0
4 (13.1)	RU-SB06 13	NA	16/18	Top 7.62cm (3") – Very soft grey bentonite, moist. 7.62cm (3") soft grey-black-brown bentonite and silt/clay, moist. 30.5cm (12") grey-black clayey silt, trace sand, moist – looks like native material. 4.57m (15')	CL-ML		16.2
5 (16.4)				@ 4.87m (16') – hit rock			
6 (19.7)							
7 (23.0)	RU-SB06 21	50/4	4/18	Soft greyish brown silty clay, some bentonite (soft grey clay, very moist), moist. Red basalt cobble in spoon. Slight diesel/petroleum odor.	CL		35.5
	NA	NA	3/18	Soft to firm brown to dark brown clayey silt with gravel/rock fragments, moist; petroleum/diesel odor.	ML		9.0
8 (26.2)							
9 (29.5)	NA	5 8 9	16/18	Soft to firm brown silty clay with trace sand, some rock fragments, cobbles (basalt), sandstone, moist.	CL		3.4

(Continued on page 2)

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A10 09/16/96

BORING NO. RU-SB06

PROJECT NAME: Rulison	COORDINATES: N 581,653 E 1,308,618	DATE STARTED: 10/07/95
BORING NUMBER: RU-SB06		DATE COMPLETED: 10/07/95
ELEVATION: 2,499.40m (8,200.12')		PAGE 2 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
9 (29.5)							
10 (32.8)				10.1m (33')			
	RU-SB06 33	NA	NA	Soft to very soft silty clay. 10.7m (35')	CL		0.5
11 (36.1)				BOTTOM OF BORING – 10.7m (35') [Drilled to 101m (33'), split spoon sampled from 10.1–10.7m (33–35')]			
12 (39.4)							
13 (42.7)							
14 (45.9)							
15 (49.2)							
16 (52.5)							
17 (55.8)							
18 (59.1)							

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A26 09/16/96

BORING NO. RU-SB07

PROJECT NAME: Rulison	COORDINATES: N 581,638 E 1,308,628	DATE STARTED: 10/08/95
BORING NUMBER: RU-SB07		DATE COMPLETED: 10/08/95
ELEVATION: 2,499.39m (8,200.10')		PAGE 1 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0							0
1 (3.3)							1 (3.3)
2 (6.6)							2 (6.6)
	NA	7 8 7	8/18	Loose to dense silt and gravel [15.24cm (6")], brown, trace clay, moist. 5.08cm (2") (in end of spoon) grey, soft clayey material, moist.	GM		8.5
3 (9.8)				3.66m (12')			3 (9.8)
	NA	8 12 21	18/18	Loose brown gravelly silt (well rounded) with some clay, dry to moist. 3.86m (12.67')	ML		4.5
4 (13.1)				Dark brown to black silty clay to clay, firm, some rocks/ pebbles (well rounded), moist. 4.12m (31.5')	CL		4 (13.1)
5 (16.4)							5 (16.4)
6 (19.7)	RU-SB07 18	27 41 48	NA	Soft to firm, dark brown to black silty clay with abundant pebbles (well rounded), (25%), some black electrical tape, moist. Slight petroleum odor.	CL		4.1
							6 (19.7)
7 (23.0)	RU-SB07 22	37 50/5	8/18	Soft to firm, dark brown silty clay with gravel (5-10%), moist. Diesel/ petroleum odor.	CL		12.0
							7 (23.0)
8 (26.2)				Cuttings from 7.92-8.84m (26-29') - Soft grey sand and gravel, very moist to wet.			8 (26.2)
9 (29.5)							9 (29.5)

(Continued on page 2)

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A11 09/16/96

BORING NO. RU-SB07

PROJECT NAME: Rulison	COORDINATES: N 581,638 E 1,308,628	DATE STARTED: 10/08/95
BORING NUMBER: RU-SB07		DATE COMPLETED: 10/08/95
ELEVATION: 2,499.39m (8,200.10')		PAGE 2 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
9 (29.5)	RU-SB07 30	12 28 37	18/18	Firm to hard grey clay with some silt and sand, some red/maroon streaks [greenish-bluish grey in bottom 15.24cm (6")], a few rocks, moist.	CL		
10 (32.8)				BOTTOM OF BORING - 9.60m (31.5')			0.5
11 (36.1)							
12 (39.4)							
13 (42.7)							
14 (45.9)							
15 (49.2)							
16 (52.5)							
17 (55.8)							
18 (59.1)							

DRILLING METHODS: Air rotary
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A27 09/16/96

BORING NO. RU-SB08

PROJECT NAME: Rulison	COORDINATES: N 581,667 E 1,308,612	DATE STARTED: 10/08/95
BORING NUMBER: RU-SB08		DATE COMPLETED: 10/08/95
ELEVATION: 2,499.57m (8,200.69')		PAGE 1 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
0							0
1 (3.3)							1 (3.3)
	RU-SB08 05	4 7 8	18/18	Loose brown silt and sand with clay, gravel, dry to moist. 1.52m (5') 1.60m (5.25')	GC		110.0
2 (6.6)				Soft to firm grey to blue-grey silty clay with some sand [more sand in bottom 15.24cm (6"), more blue-grey also], moist. 1.98m (6.5')	CL-ML		2 (6.6)
3 (9.8)	RU-SB08 10	NA	12/18	Soft to firm grey to blue-grey silty clay with gravel/rock fragments (siltstone, shale), moist. 3.05m (10') 3.15m (10.33')	CL		85.0 3 (9.8)
				Firm brown clay with silt, some sand and a few pebbles, moist; petroleum odor. 3.25m (10.67')			
4 (13.1)							4 (13.1)
5 (16.4)				4.57–5.49m (15–18') – drilling through rock, grey fine-grained basalt.			5 (16.4)
6 (19.7)	NA	46 50/2	2/18	Mostly rock, large basalt piece/cobble stuck in shoe of spoon – remainder is soft to firm grey silty clay, moist. 6.25m (20.5')	CL		2.3 6 (19.7)
7 (23.0)				Approximately 6.25–9.45m (20.5–31') – drilling through boulders/cobbles, (black and red basalt cuttings).			7 (23.0)
8 (26.2)							8 (26.2)
9 (29.5)							9 (29.5)

(Continued on page 2)

DRILLING METHODS: Odex – Air rotary 12.7cm (5") casing and bit
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A12 09/16/96

BORING NO. RU-SB08

PROJECT NAME: Rulison	COORDINATES: N 581,677 E 1,308,612	DATE STARTED: 10/08/95
BORING NUMBER: RU-SB08		DATE COMPLETED: 10/08/95
ELEVATION: 2,499.57m (8,200.69')		PAGE 2 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)
9 (29.5)				Approximately 6.25-9.45m (20.5-31') - drilling through boulders/cobbles, (black and red basalt cuttings). 9.45m (31')			
	RU-SB08 31	8 8 12	18/18	Soft brown gravelly silt with sand and some clay, wet. 9.60m (31.5')	ML		0.4
				Soft to firm brown silty clay with gravel/rock fragments, wet. 9.86m (32.3')	CL-ML		
10 (32.8)				Soft to firm grey to grey-brown clay with some silt, moist. 9.91m (32.5')	CL		
				BOTTOM OF BORING - 9.91m (32.5')			
11 (36.1)							
12 (39.4)							
13 (42.7)							
14 (45.9)							
15 (49.2)							
16 (52.5)							
17 (55.8)							
18 (59.1)							

DRILLING METHODS: Odex - Air rotary with 12.70cm (5") casing and bit
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 7.62cm (3") ø, 45.72cm (18") long split spoons and a 63.50kg (140 lb) hammer, using winch line.

4602A28 09/17/96

Appendix G

Monitoring Well Boring Logs and Construction Diagrams

BORING NO. RU-01

PROJECT NAME: Rulison	COORDINATES: N 581,869 E 1,308,383	DATE STARTED: 09/20/95
BORING NUMBER: RU-01	GROUNDWATER LEVEL: 12.15m (39.87 ft) BGS	DATE COMPLETED: 09/28/95
ELEVATION: 2,486.07m (8,156.40 ft)	DATE/TIME: 09/27/95 07:00	PAGE 1 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
0				Soft to firm brown to dark brown clayey silt with trace fine sand, some organics, some gravel, moist. 1.07m (3.5')	a-ML			
1 (3.3)				Firm brown silt and sand with some clay, gravel, moist. 1.52m (5')				
2 (6.6)	RU-1 05	12 12 9 11	8/24	Firm brown and white/grey silty clay with some sand, gravel (20%), well rounded – 2.54cm to 3.81cm (1" to 1.5") ø, moist. 3.05m (10')	CL		1.5	0.69
3 (9.8)	RU-1 10	14 40/4	8/24	Firm brown with red-brown silty clay, some (5-10%) fine sand and gravel (2%), moist. 3.66m (12')	CL		0.5	0.37
4 (13.1)				Soft to firm brown clayey silt and silty clay with some fine and medium grained sand, moist. 4.57m (15')	CL-ML			
5 (16.4)	RU-1 15	9 13 21 23	20/24	[bottom 15.24cm (6")] Soft to firm brown to red-brown with some green mottling, silty clay with some light green/grey fine sand/silt, moist. (Some clay sticking to outside of spoon.) 5.18m (17')			0.6	0.0
6 (19.7)				Brown clayey silt with some sand, some pebbles, moist. 6.10m (20')	CL			
7 (23.0)				From cuttings: Soft to firm brown silt with sand and some clay, moist. 7.62m (25')	ML			
8 (26.2)	RU-1 25	6 7 8 24	NA	Soft to firm brown silt with some clay and sand, very moist to wet. Possibly water at approximately 8.23m (27'). 8.23m (27')			0.6	0.08
				Soft brown silt with clay, some sand, very moist to wet. 8.53m (28')	ML			
9 (29.5)				Rock, grey, fine-grained. 9.14m (30')				

(Continued on page 2)

DRILLING METHODS: Odex – Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 5.08cm (2") split spoons with brass liners and a 63.50 kg (140 lb) hammer

4046A07 07/22/96

BORING NO. RU-01

PROJECT NAME: Rulison	COORDINATES: N 581,869 E 1,308,383	DATE STARTED: 09/20/95
BORING NUMBER: RU-01	GROUNDWATER LEVEL: 12.15m (39.87 ft) BGS	DATE COMPLETED: 09/28/95
ELEVATION: 2,486.07m (8,156.40 ft)	DATE/TIME: 09/27/95 07:00	PAGE 2 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
9 (29.5)				Rock, grey, fine grained. 9.45m (31')				
				Cobbly sand – no sample. 10.36m (34')				
10 (32.8)				Firm to hard brown–grey clay with silt. 10.67m (35')				
11 (36.1)	RU-1 35	12 23 26 31	15/24	Hard (tough to tear/break) brown, grey, white, rust–red clay, very tight, some pebbles, slightly moderate plasticity, moist. 12.19m (40')	CL		0.3	0.03
12 (39.4)				Drilling through boulder/cobbles – cuttings are grey, fine–grained rock – basalt. 12.80m (42')				
13 (42.7)				Soft to firm brown silty clay, some sand, moist to very moist. 13.41m (44')			0.0	0.21
14 (45.9)								
15 (49.2)				15.24m (50')				
	RU-1 50	NA	22/24	Very soft brown sandy silt with clay, wet. 15.39m (50.5')				
				Soft to firm greyish green silt with some clay, some fine sand, very moist to wet. 15.70m (51.5')	ML		0.0	0.13
				Firm red–brown silty clay with some green silt and clay, very moist to wet. 15.80m (52')				
16 (52.5)				16.76m (55')				
17 (55.8)	RU-1 55	NA	NA	Soft brown sandy silt with clay (30% sand), wet. 17.37m (57')	ML		0.1	0.00
				(Continued on page 3)				
18 (59.1)								

DRILLING METHODS: Odex – Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll–Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 5.08cm (2") split spoons with brass liners and a 63.50kg (140 lb) hammer

4046A07a 07/22/96

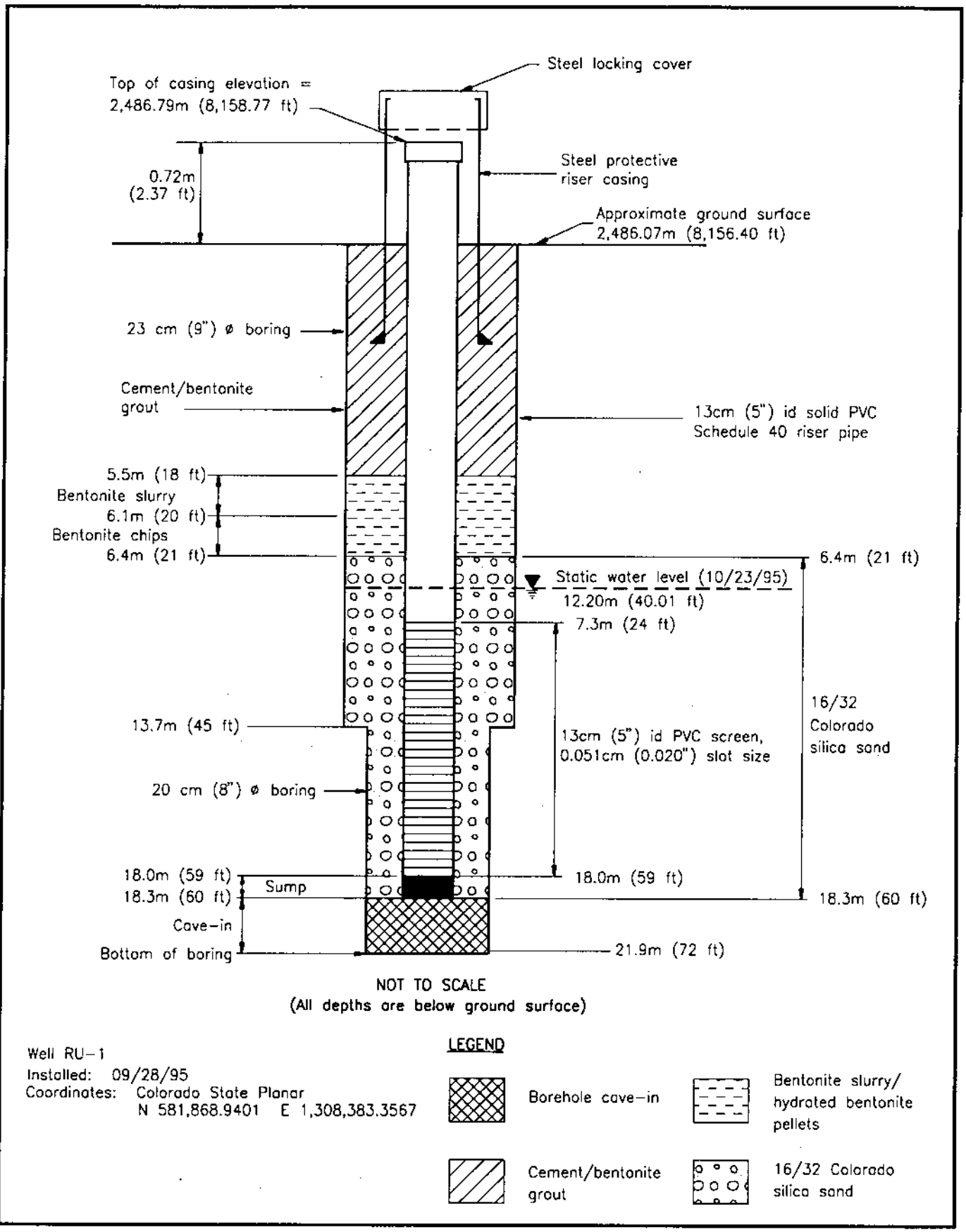
BORING NO. RU-01

PROJECT NAME: Rulison	COORDINATES: N 581,869 E 1,308,383	DATE STARTED: 09/20/95
BORING NUMBER: RU-01	GROUNDWATER LEVEL: 12.15m (39.87 ft) BGS	DATE COMPLETED: 09/28/95
ELEVATION: 2,486.07m (8,156.40 ft)	DATE/TIME: 09/27/95 07:00	PAGE 3 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
18 (59.1)				Drilling through rock – cuttings are dark grey to grey, fine-grained basalt.				
19 (62.3)								
				Rock – cuttings are grey and black, fine-grained basalt.				
20 (65.6)								
21 (68.9)				21.3m (70')				
				Drilling through rock – cuttings are black and red fine-grained basalt and green siltstone/shale fragments (weathered). 21.9m (72')				
				BOTTOM OF BORING – 21.9m (72')				
22 (72.2)								
23 (75.5)				**NOTES:** Bit for Odex drilling broke off downhole at approximately 11.58m (38'), could not recover it. Casing stuck in hole from 0.61m to 11.58m (2' to 38'), cannot recover without another Odex bit. Resumed drilling at 07:30 on September 21, 1995 on relocated hole, using 25.08cm (9 7/8") ø roller bit.				
24 (78.7)				Abandoned second borehole (for monitoring well) because two boulders would not allow casing [Odex 20.32cm (8") casing] to get post 3.66m (12').				
25 (82.0)								
26 (85.3)								
27 (88.6)								

DRILLING METHODS: Odex – Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: 5.08cm (2") split spoons with brass liners and a 63.50kg (140 lb) hammer

4602A13 09/16/96



Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-1

BORING NO. RU-02

PROJECT NAME: Rulison	COORDINATES: N 582,010 E 1,308,392	DATE STARTED: 10/03/95
BORING NUMBER: RU-02		DATE COMPLETED: 10/05/95
ELEVATION: 2,485.22m (8,153.60 ft)		PAGE 1 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
0				From cuttings – soft brown to dark brown silt with fine sand, trace clay, organic matter, a few pebbles, moist. 1.52m (5')	ML			
1 (3.3)								
2 (6.6)	RU-2 5	NA	20/24	Soft to firm brown clayey silt with some sand, some pebbles, moist. 2.13m (7')	ML		0.0	0.02
				3.05m (10')				
3 (9.8)	RU-2 10	NA	16/24	Soft to firm brown clayey silt with some fine sand, some pebbles, shale fragments, moist. 3.66m (12')	ML		0.0	0.12
4 (13.1)				Brown clayey silt with lots of shale fragments, some weathered (25–30% shale fragments), moist. 4.57m (15')				
5 (16.4)	RU-2 15	NA	18/24	Soft to firm brown clayey silt with fine sand, rock fragments (shale/siltstone), (25–30% rock fragments), moist. 5.18m (17')	ML		0.0	0.13
6 (19.7)				6.10m (20')				
	RU-2 20	NA	14/24	Soft to firm brown clayey silt with fine sand, rock fragments–predominantly siltstone (brown), (30–35% rock fragments), moist. 6.71m (22')	ML		0.4	0.23
7 (23.0)				7.62m (25')				
8 (26.2)	RU-2 25	NA	NA	Soft to firm brown clayey silt with sand and rock fragments (30–40% rock fragments, mostly shale and siltstone), wet. Water at approximately 7.77m (25.5 ft). 8.23m (27')	ML		0.0	0.06
9 (29.5)				(Continued on page 2)				

DRILLING METHODS: Odex – Air rotary with 17.78cm (7") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll–Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: Split spoons and a 63.50kg (140 lb) hammer

4046A08 07/22/96

BORING NO. RU-02

PROJECT NAME: Rulison	COORDINATES: N 582,010 E 1,308,392	DATE STARTED: 10/03/95
BORING NUMBER: RU-02		DATE COMPLETED: 10/05/95
ELEVATION: 2,485.22m (8,153.60 ft)		PAGE 2 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)	DEPTH, M (FT.)
9 (29.5)	RU-2 30	NA	12/24	Soft to firm brown sandy/clayey silt with rock fragments (30-40%), mostly shale and siltstone, some sandstone, wet. 9.75m (32')	ML		0.0	0.03	9 (29.5)
10 (32.8)				10.67m (35')					10 (32.8)
11 (36.1)	RU-2 35	NA	18/24	Soft to firm brown clayey silt with sand, and some rock fragments (25%), wet. 11.28m (37')	CL-ML		0.0	0.01	11 (36.1)
12 (39.4)				12.19m (40')					12 (39.4)
	RU-2 40	NA	3/24	Soft-loose brown silty fine sand with trace clay, and rock fragments and coarse angular sand (approx. 40% rock fragments), wet. 12.80m (42')	SM		0.4	0.01	
13 (42.7)				13.72m (45')					13 (42.7)
14 (45.9)	RU-2 45	NA	8/24	Soft brown silty/sandy clay with some rock fragments - siltstone and basalt (approx. 10%), wet. Large basalt pebble in end of spoon. 14.33m (47')	CL		0.2	0.01	14 (45.9)
15 (49.2)				15.24m (50')					15 (49.2)
	RU-2 50	NA	6/24	Soft to firm reddish brown silty clay with fine sand, wet, a few rock fragments - large basalt pebble in catcher. 15.85m (52')	CL		0.2	0.00	
16 (52.5)				16.76m (55')					16 (52.5)
17 (55.8)	RU-2 55	NA	6/24	Soft to firm brown to reddish brown silty clay with sand, some rock fragments (5-10%), wet. 17.37m (57')	CL		0.3	ND	17 (55.8)
				(Continued on page 3)					
18 (59.1)									18 (59.1)

DRILLING METHODS: Odex - Air rotary with 17.78cm (7") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: Split spoons and a 63.50 kg (140 lb.) hammer

4046A08a 07/22/96

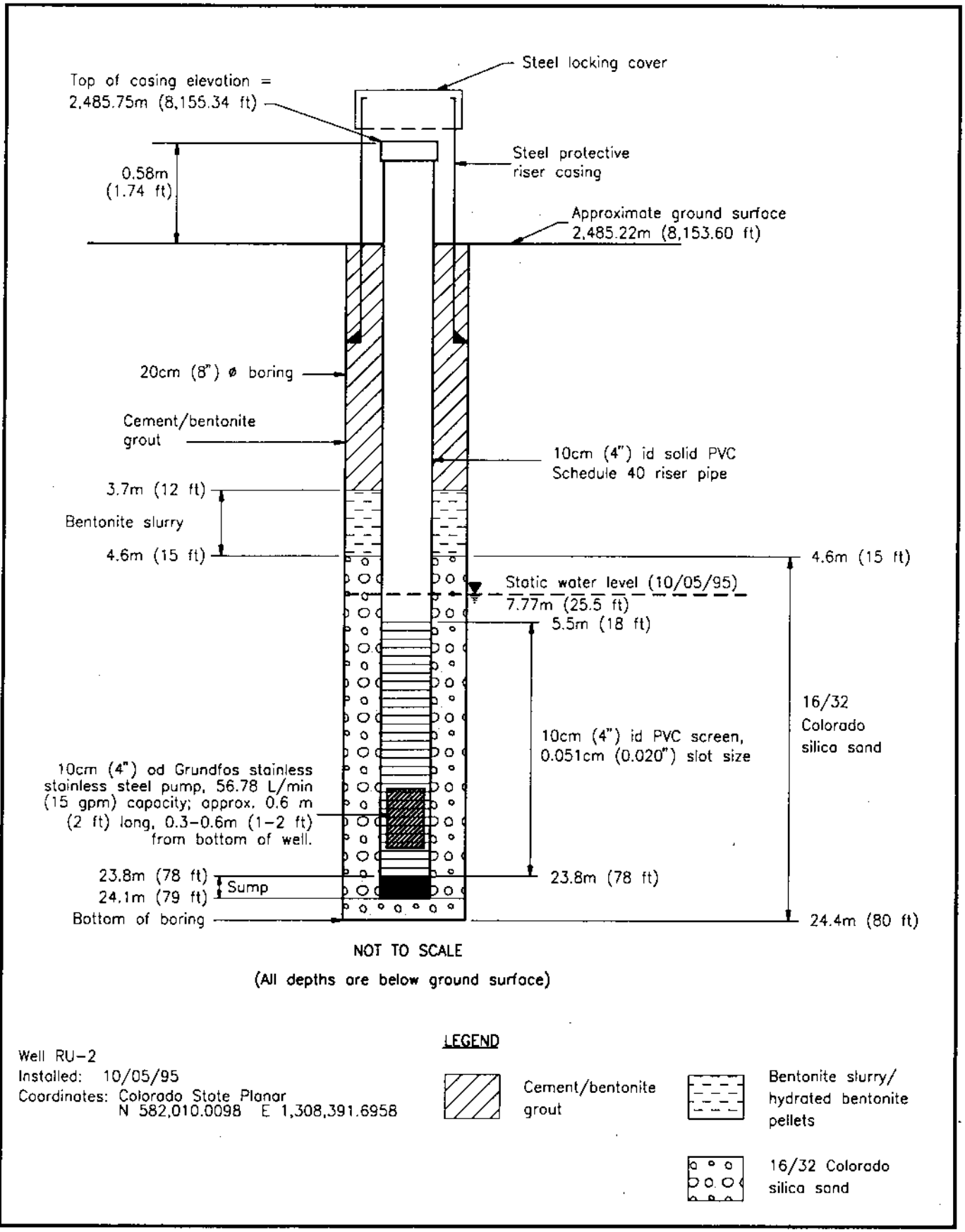
BORING NO. RU-02

PROJECT NAME: Rulison	COORDINATES: N 582,010 E 1,308,392	DATE STARTED: 10/03/95
BORING NUMBER: RU-02		DATE COMPLETED: 10/05/95
ELEVATION: 2,485.22m (8,153.60 ft)		PAGE 3 OF 3
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
18 (59.1)	RU-2 60	NA	5/24	Soft to firm brown with some red-brown silty/sandy clay, a few rock fragments (5-10%), wet. 18.90m (62')	CL		0.0	0.01
19 (62.3)								
				From cuttings - gravelly silt and clay, brown, wet.				
20 (65.6)								
21 (68.9)				From cuttings - brown, gravelly/silty clay, wet.	CL-ML			
22 (72.2)								
23 (75.5)								
24 (78.7)				24.38m (80')				
	RU-2 80	NA	NA	Soft brown clayey silt with fine grained sand and rock fragments-sandstone/siltstone, and some shale (20-30% rock fragments), wet. 24.99m (82')	MH		0.0	0.00
25 (82.0)				**BOTTOM OF BORING - 24.99m (82')** **[Drilled to 24.38m (80'),** **split-spoon sampled from 24.38m to 24.99m (80'-82')]**				
26 (85.3)								
27 (88.6)								

DRILLING METHODS: Odex - Air rotary with 17.78cm (7") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLERS: Steve Mott
John Montgomery
SAMPLING METHOD: Split spoons and a 63.50 kg (140 lb) hammer

4602A15 09/16/96



Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-2

BORING NO. RU-3

PROJECT NAME: Rulison	COORDINATES: N 582,563 E 1,307,805	DATE STARTED: 09/13/95
BORING NUMBER: RU-3	GROUNDWATER LEVEL: 10.06m (33 ft) BGS	DATE COMPLETED: 09/14/95
ELEVATION: 2,454.25m (8,052.10 ft)	DATE/TIME: 09/13/95 16:45	PAGE 1 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
0	RU-3 0	NA	NA	From cuttings – brown silt with some fine sand, some clay, moist. 0.91m (3')	ML		0.1	0.736
1 (3.3)				Rock – hard, fine grained, slightly vessicular, grey, unbroken surfaces weathered. 1.52m (5')				
2 (6.6)	RU-3 5	NA	NA	Brown silty clay with fine sand, rock fragments, moist. From 1.52 to 1.98m (5 to 6.5'), rock/boulder, grey, fine-grained. 3.05m (10')	CL		0.0	0.233
3 (9.8)	RU-3 10	5 5 / 5 8	18/24	Soft to firm brown to grey silty fine sandy clay; bottom of spoon was mottled grey and rusty-brown. 3.66m (12')	CL		0.0	0.118
4 (13.1)				From cuttings – soft to firm brown silty clay with some fine sand, moist. Siltier/sandier (fine sand) near 4.57m (15'). 4.57m (15')				
5 (16.4)	RU-3 15	4 5 / 11	17/18	Firm brown to reddish-brown with white/grey mottling, clayey silt to silty clay with some fine sand, moist. 5.03m (16.5')	MH to CL		0.1	0.205
6 (19.7)				Soft brown clayey silt to silty clay, some sand, moist to wet. 6.10m (20')				
	RU-3 20	3 3 / 4 6	20/24	Soft brown clayey silt with fine sand, some medium sand sized rock fragments, moist to wet. 6.71m (22')	ML		0.0	0.215
7 (23.0)				Soft brown clayey silt with fine sand, some medium sand, moist to wet. 7.62m (25')				
8 (26.2)	RU-3 25	5 17 / 20	22/18	Soft brown clayey silt with some sand with some zones of purplish-red fine sand, wet. 8.23m (27')	ML		0.0	0.226
9 (29.5)				Soft, brown sandy silt (fine sand) with clay and 0.64 to 1.91cm (1/4 to 3/4") ø gravel (20% gravel), moist wet. 9.14m (30')				

(Continued on page 2)

DRILLING METHODS: Odex – Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLER: Steve Mott
SAMPLING METHOD: Split spoons with a 63.50kg (140 lb) hammer

4602A17 09/17/96

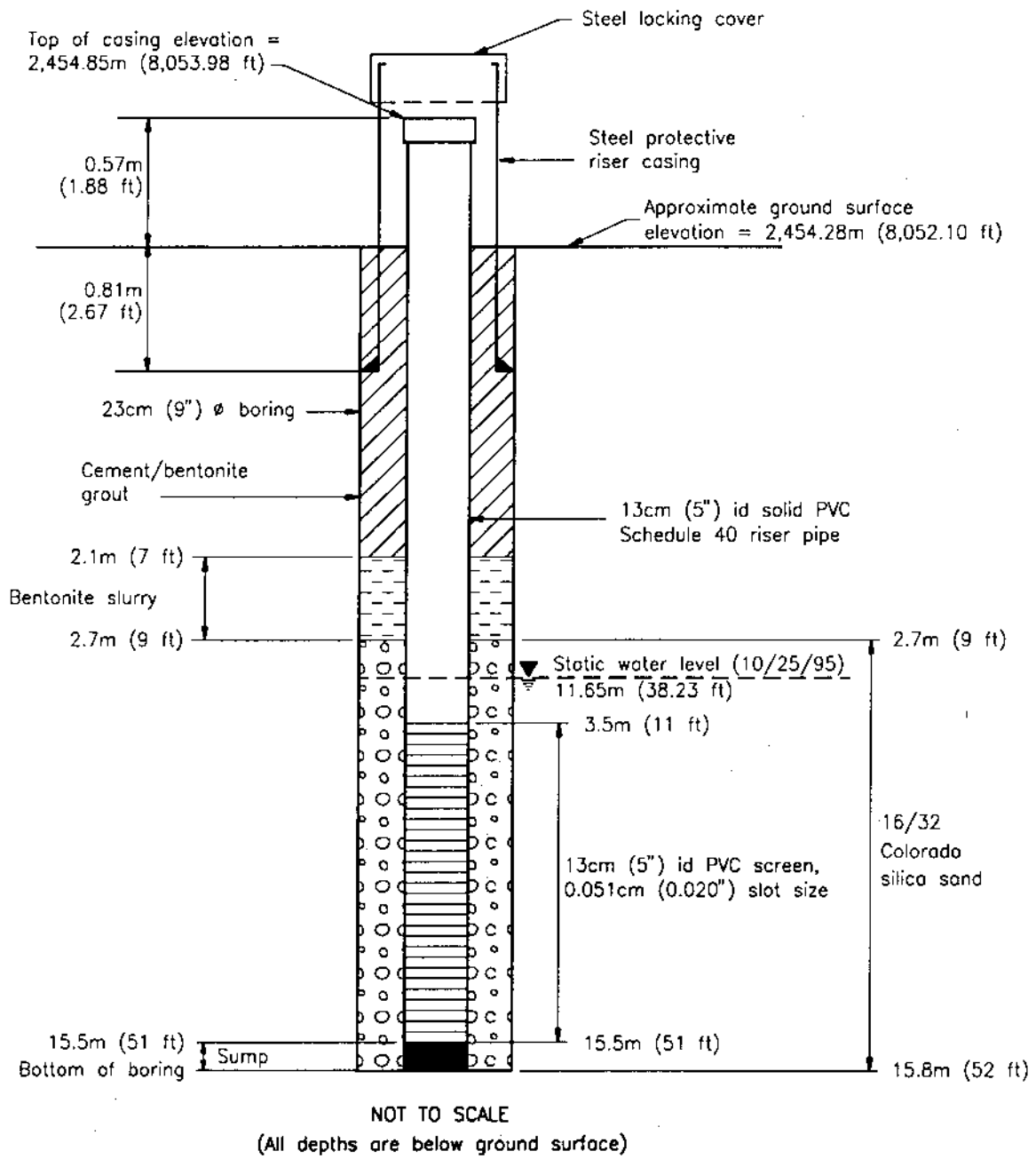
BORING NO. RU-3

PROJECT NAME: Rulison	COORDINATES: N 582,563 E 1,307,805	DATE STARTED: 09/13/95
BORING NUMBER: RU-3	GROUNDWATER LEVEL: 10.06m (33') BGS	DATE COMPLETED: 09/14/95
ELEVATION: 2,454.28m (8,052.10 ft)	DATE/TIME: 09/13/95 16:45	PAGE 2 OF 2
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
9 (29.5)	RU-3 30	5 7 / 6 9	7/24	Soft brown sandy silt with some clay, some gravel, cobble in end of spoon, wet. 9.75m (32')	ML		0.0	0.195
10 (32.8)				Soft to very soft brown fine sandy silt with clay, some pebbles (5%), wet. 10.67m (35')				
11 (36.1)	RU-3 35	4 6 / 7 9	16/24	Soft brown sandy silt with clay and gravel (approx. 10-15% gravel), wet. 11.13m (36.5')	ML		2.1	ND
				Very soft brown sandy/clayey silt (20-30% sand), some pebbles, wet. 12.19m(40')				
12 (39.4)	RU-3 40	4 3 / 5 7	10/24	Soft to firm, brown with with light grey/maroon silty clay with some sand (5% sand), some gravel, wet. 13.72m (45')	CL		8.5	0.108
13 (42.7)								
14 (45.9)	RU-3 45	3 4 / 4 6	18/24	Soft to firm, brown sandy silt (15-20% sand) with clay, some pebbles, wet. 14.33m (47')	ML		1.7	0.125
15 (49.2)				From cuttings - soft brown sandy silt with clay and gravel, wet. 15.85m (52')				
16 (52.5)				BOTTOM OF BORING - 15.85m (52')				
17 (55.8)								
18 (59.1)								

DRILLING METHODS: Odex - Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLER: Steve Mott
SAMPLING METHOD: Split spoons and a 63.50kg (140 lb) hammer

4046A09a 07/22/96



Well RU-3
Installed: 09/14/95
Coordinates: Colorado State Planar
N 582563.2770 E 1307804.6005

LEGEND

Cement/bentonite grout

Bentonite slurry/ hydrated bentonite pellets

16/32 Colorado silica sand

4602A18 09/17/96

Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-3

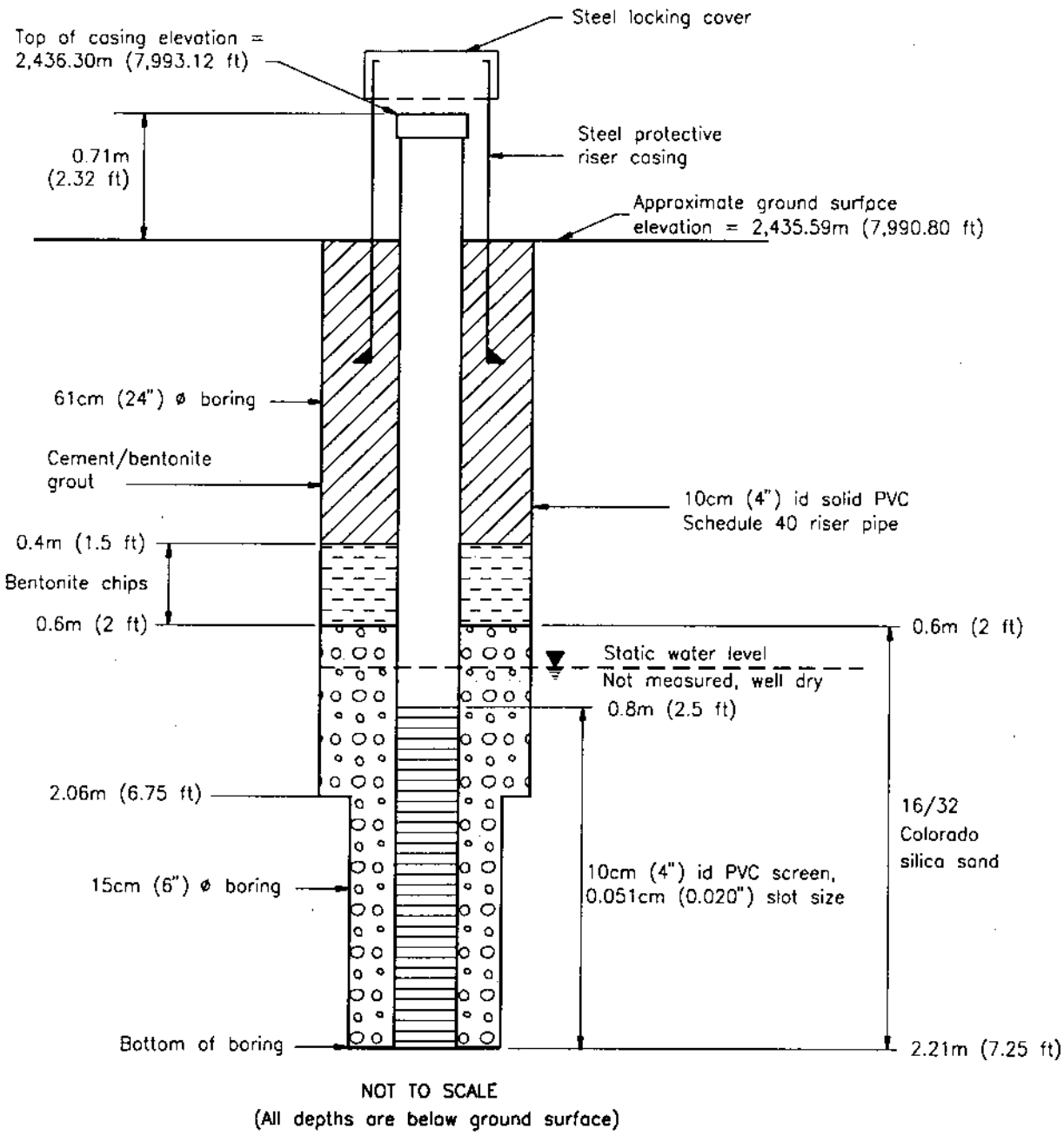
BORING NO. RU-5

PROJECT NAME: Rulison	COORDINATES: N 582,543 E 1,307,117	DATE STARTED: 09/19/95
BORING NUMBER: RU-5	GROUNDWATER LEVEL: 6.375'	DATE COMPLETED: 09/19/95
ELEVATION: 2,435.59m (7,990.80 ft)	DATE/TIME: 09/19/95 15:40	PAGE 1 OF 1
ENGINEER/GEOLOGIST: Kevin Leary		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
0	NA	NA	NA	Organic silt, dark brown, dry, medium stiff, slightly sticky/plastic, very fine/fine sub-angular blocky structure. Common very fine, few fine, and few medium fine roots, many very fine interstitial pores. 20% gravel, mostly 2-5 mm (0.008-0.02"). Minerology, mixed alluvial deposits primarily shale and sandstone, few scattered cobbles of vesicular basalt. 0.34m (1.1')	OL			
0.5 (1.64)	NA	NA	NA	Clayey gravel with sand, brown, dry, dense, slightly sticky/plastic, weak medium sub-angular blocky structure, few very fine/medium roots. Common fine interstitial pores. Mixed alluvial deposits consisting of primarily shale and sandstone with a few scattered cobbles of vesicular basalt. 0.67m (2.2')	GC			
1 (3.3)	NA	NA	NA	Clayey gravel with sand, yellowish brown, highly mottled and streaked; very common yellow, red, and orange mottles; moist to wet; stiff, slightly sticky/plastic. Massive, very few very fine and medium roots stopping at a depth of 104 cm (41"). Common very fine interstitial pores, approximately 70% coarse fragment content consisting of 40% gravel, 25% cobble, 5% stone.	GC			
1.5 (4.9)								
2 (6.6)				2.26m (7.42')				
				BOTTOM OF BORING - 2.26m (7.42')				

DRILLING METHODS: Hand-dug boring
DRILLING CONTRACTOR: IT Corporation
DRILLING EQUIPMENT: Post hole digger/hand auger
DRILLER:
SAMPLING METHOD:

4602A19 09/16/96



Well RU-5
Installed: 09/26/95
Coordinates: Colorado State Planar
N 582543.2696 E 1307116.7871

LEGEND

Cement/bentonite grout

Hydrated bentonite chips

16/32 Colorado silica sand

4602A20 09/17/96

Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-5

BORING NO. RU-6

PROJECT NAME: Rulison	COORDINATES: N 582,719	DATE STARTED: 09/28/95
BORING NUMBER: RU-6 (Abandoned)	E 1,307,194	DATE COMPLETED: 09/28/95
ELEVATION: Top of PVC = 2,432.46m (7,980.50 ft)		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Kevin Leary		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
0	NA	NA	NA	Organic silt, dark brown, dry, medium stiff, slightly sticky and slightly plastic. Moderate-medium sub-angular blocky structure. Mixed minerology of colluvial origin; common very fine interstitial pores; few, fine tubular pores; common very fine, few fine, medium, and coarse roots. 0.15m (5')	OL			
	NA	NA	NA	10% gravel, mostly 2-5mm (0.008-0.02") ø range. Inorganic clay, dark brown, dry, stiff, sticky and plastic; weak-coarse and very coarse sub-angular blocky structure; mixed minerology of colluvial origin; common very fine and fine interstitial pores; few, fine, tubular pores; few very fine and fine roots; 20% gravel, mostly 2-5mm (0.008-0.02") ø range. 0.43m (1.4')	CL			
0.5 (1.64)	NA	NA	NA	Organic silt, very dark brown, slightly moist, slightly sticky and slightly plastic; moderate, medium sub-angular blocky structure; mixed minerology of colluvial origin; many very fine and fine interstitial pores; very few, very fine, and fine roots. 1.10m (3.6')	OL			
1 (3.3)	NA	NA	NA	Water bearing zone (dry); clayey sand with gravel, light brown, moist, slightly sticky and slightly plastic; massive; mixed minerology of colluvial origin; reddish and orange mottles, common; common very fine interstitial pores; few very fine and fine roots; 50% gravel, 10% cobble. 1.30m (4.25')	SC			
				BOTTOM OF BORING - 1.30m (4.25')				
1.5 (4.9)								
2 (6.6)								

DRILLING METHODS: Hand-dug boring
DRILLING CONTRACTOR: IT Corporation
DRILLING EQUIPMENT: Post hole digger/hand auger
DRILLER:
SAMPLING METHOD:

4046A11a 08/02/96

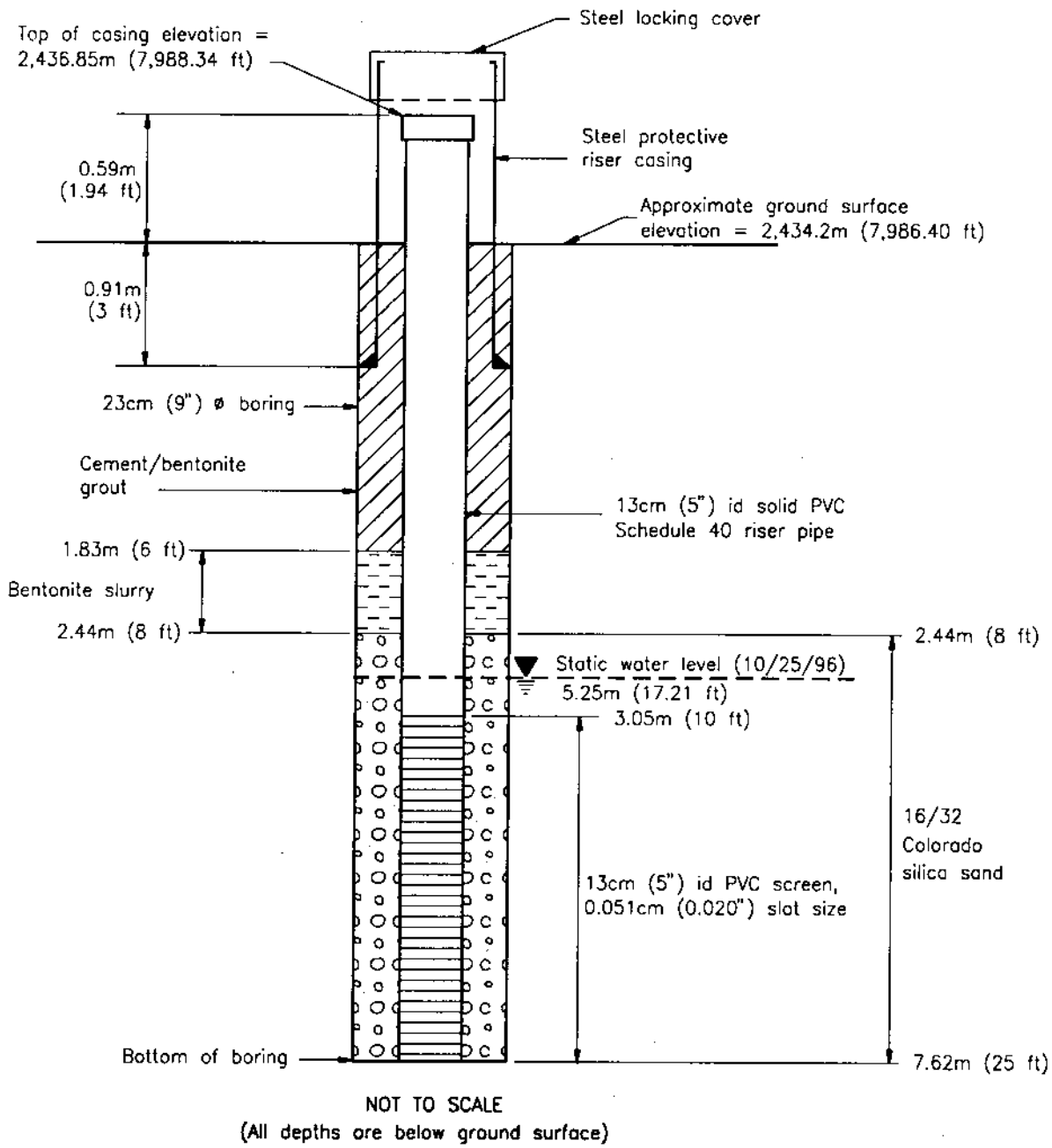
BORING NO. RU-6A

PROJECT NAME: Rulison	COORDINATES: N 582,764 E 1,370,238	DATE STARTED: 09/14/95
BORING NUMBER: RU-6A		DATE COMPLETED: 09/15/95
ELEVATION: 2,434.25m (7,986.40 ft)		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Sam Hannah		

DEPTH, M (FT)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	TPH (ppm)
0				Brown to black loam – surface soil. 0.46m (1.5')	ML			
1 (3.3)				On rock/boulder, from cuttings – grey, fine grained with vessicles. 1.52m (5')				
				Soft to firm brown clayey silt with some sand, moist. 1.83m (6')	MH			
2 (6.6)				Drilling through rock – grey, fine-grained. 3.81m (12.5')				
3 (9.8)								
4 (13.1)				4.57m (15')				
5 (16.4)	RU-6A 15	15	6/24	Soft to firm, brown to red-brown with some white and light green mottling (slight), silty clay with some sand and pebbles. Rock fragment in shoe (end of spoon), hard, grey, fine-grained. 4.72m (15.5')	CL		0.0	
6 (19.7)				6.10m (20')				
	RU-6A 20	5 7 / 9 6	8/24	Soft to firm, brown clayey silt with fine sand, some pebbles (5%), wet. 6.71m (22')	MH		0.0	
7 (23.0)	RU-6A 22	4 5 / 5 8	18/24	0.30m (1') of soft brown silty clay with sand, pebbles, wet. 15.24cm (6") of firm to hard blue to blue-green clay with some sand (2%), plastic, wet. 7.32m (24')	CL		0.0	
				7.62m (25')				
8 (26.2)	RU-6A 25	6 8 / 8 10	24/24	Firm to hard greyish-blue to blue-green clay with some blue-green silty sandy zones 1.27 to 2.54cm (1/2 to 1"), wet. 8.23m (27')	CL		0.0	
				BOTTOM OF BORING – 8.23m (27')				
9 (29.5)								

DRILLING METHODS: Odex – Air rotary with 20.32cm (8") casing
DRILLING CONTRACTOR: PC Exploration
DRILLING EQUIPMENT: Ingersoll-Rand TH60
DRILLER: Steve Mott
SAMPLING METHOD: 5.08cm (2") split spoons and a 63.50kg (140 lb) hammer

4602A21 09/16/96



Well RU-6A
Installed: 09/15/95
Coordinates: Colorado State Planar
N 582,764.2546 E 1,307,237.8146

LEGEND

Cement/bentonite grout

Bentonite slurry

16/32 Colorado silica sand

4602A22 09/17/96

Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-6A

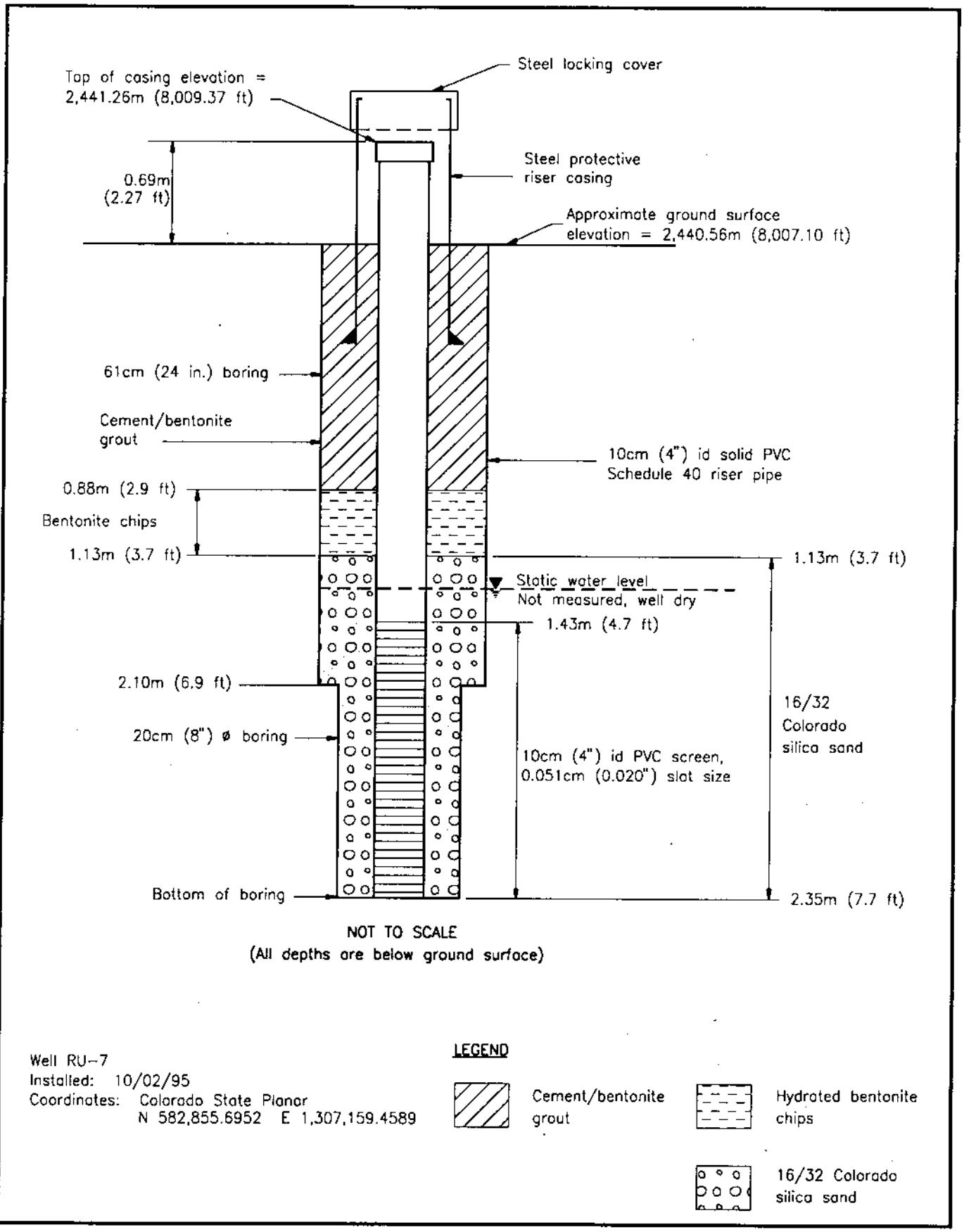
BORING NO. RU-7

PROJECT NAME: Rulison	COORDINATES: N 582,856 E 1,307,227	DATE STARTED: 09/19/95
BORING NUMBER: RU-7	GROUNDWATER LEVEL: DRY	DATE COMPLETED: 09/19/95
ELEVATION: 2,440.56m (8,007.10 ft)		PAGE 1 OF 1
ENGINEER/GEOLOGIST: Kevin Leary		

DEPTH, M (FT.)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
0	NA	NA	NA	Organic silt, dark brown, dry, medium stiff, slightly sticky/plastic; very fine/fine sub-angular blocky structure; common very fine, few fine, and few medium roots, many very fine interstitial pores; 25% gravel, all 2-5mm (0.008-0.02") ø. Minerology mixed alluvial deposits, primarily sandstone and shale. 0.38m (1.25')	OL			
0.5 (1.6)	NA	NA	NA	Organic silts, dark brown, dry, medium stiff, slightly sticky/plastic, medium sub-angular blocky structure, few fine common medium and few coarse roots, many very fine interstitial pores, 20% coarse fragments, mostly 2-5 mm (0.008-0.02") ø. Minerology same as above. 1.14m (3.75')	OL			
1.0 (3.3)								
1.5 (4.9)	NA	NA	NA	Clayey gravel with sand, yellowish-brown, highly mottled and streaked, very common red, yellow, and orange mottles; moist, stiff, slightly sticky/plastic; massive; few fine common medium roots; common very fine interstitial pores; approximately 60% coarse fragments consisting of 40% gravel, 10% cobble, and 10% stone. 2.3m (7.6')	GC			
2.0 (6.6)								
2.5 (8.2)				BOTTOM OF BORING - 2.3m (7.6')				

DRILLING METHODS: Hand-dug boring
DRILLING CONTRACTOR: IT Corporation
DRILLING EQUIPMENT: Post hole digger/hand auger
DRILLER:
SAMPLING METHOD:

4602A23 09/16/96



Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-7

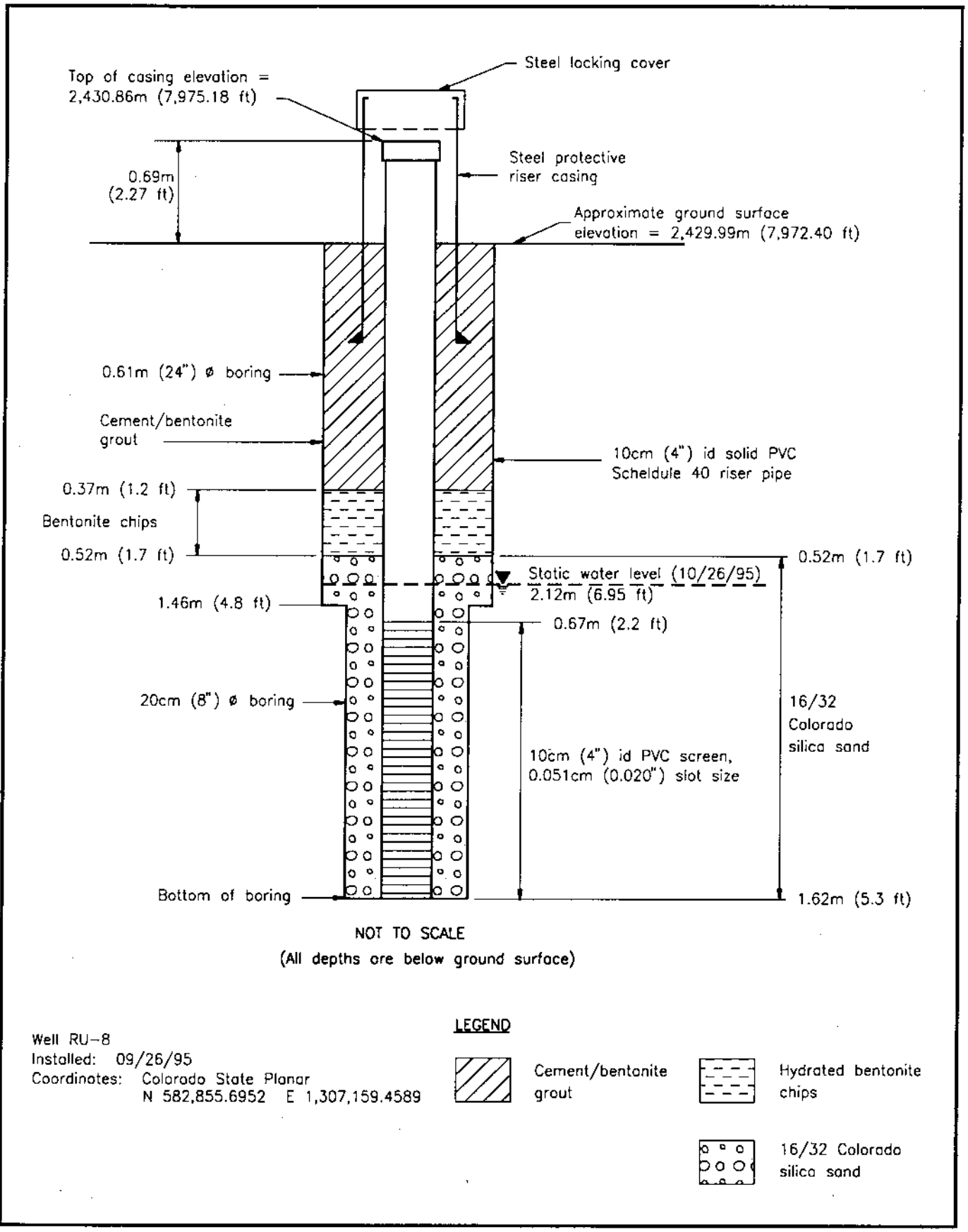
BORING NO. RU-8

PROJECT NAME: Rulison	COORDINATES: N 582,856 E 1,307,159	DATE STARTED: 09/19/95
BORING NUMBER: RU-8	GROUNDWATER LEVEL: 1.07m (3.50')	DATE COMPLETED: 09/19/95
ELEVATION: 2,429.99m (7,972.40 ft)	DATE/TIME: 09/19/95 13:45	PAGE 1 OF 1
ENGINEER/GEOLOGIST: Kevin Leary		

DEPTH, M (FT)	SAMPLE TYPE & NUMBER	BLOWS PER 6 INCHES	RECOVERY/DRIVE (in.)	DESCRIPTION	USCS	PROFILE	HEADSPACE (ppm)	PAH (ppm)
0	NA	NA	NA	Organic silt, dark brown, dry, medium stiff, slightly sticky/slightly plastic; medium sub-angular blocky structure; common very fine, few fine, few very fine coarse roots; common very fine interstitial pores; mixed colluvial and alluvial deposits. 0.41m (1.33')	OL			
0.5 (1.6)	NA	NA	NA	Organic clay, dark brown, dry, stiff, sticky and plastic; fine to medium sub-angular blocky structure; common very fine, few fine medium and coarse roots: common very fine interstitial pores; evidence of translocated clays; 15% coarse fragment content, most <5mm (<0.02") ø, most coarse fragments slightly decomposed. Minerology same as above. 0.66m (2.17')	OH			
	NA	NA	NA	Gravelly fat clay, brown, moist, very sticky/plastic; weak/medium sub-angular blocky structure. Minerology same as above; 30% boulders, evidence of charcoal, 10% gravel; common very fine, fine, and common medium, few coarse roots; evidence of translocated clays; few fine orange and red mottles; common fine interstital pores, few medium tubular pores; majority of gravel 2-5mm (0.008-0.02") ø range, slightly decomposed. 0.84m (2.75')	CH			
1.0 (3.3)	NA	NA	NA	Clayey gravel, varigated matrix consisting of yellowish brown, orange, and grey (gleyed soil); wet, soft, sticky and plastic; massive, general trend in texture coarsening downward; 30% cobble, 20% gravel. Minerology same as above; common very fine in upper 0.15m (6 inches). 1.60m (5.25')	GC			
1.5 (4.9)								
				BOTTOM OF BORING - 1.60m (5.25')				
2.0 (6.6)								
2.5 (8.2)								

DRILLING METHODS: Hand-dug boring
DRILLING CONTRACTOR: IT Corporation
DRILLING EQUIPMENT: Post hole digger/hand auger
DRILLER:
SAMPLING METHOD:

4046A14 07/22/96



Well RU-8
Installed: 09/26/95
Coordinates: Colorado State Planar
N 582,855.6952 E 1,307,159.4589

4602A25 09/17/96

Rulison Drilling Effluent Pond-Schematic Well Construction Diagram
Monitoring Well RU-8

Appendix H

Aquifer Test Data

Aquifer Test Data

To estimate the hydrologic properties of the unconsolidated material present at the Rulison site, two slugs tests and one eight-hour pumping test, with recovery, were performed. Analysis of the field data was conducted using AQTESOLV (Aquifer Test Solver), a software program written by Geraghty & Miller, Inc. (Revision 1, 1991).

To analyze the pumping test and recovery data, a Theis solution was calculated which assumed unconfined conditions, without a delayed yield from storage. The pumping rate was approximately 2 gallons per minute (gpm). These assumptions appeared to be valid because total drawdown in the pumping well was approximately 0.4 meters (1.3 feet), which had approximately 3 meters (10 feet) of saturated aquifer screened. A piezometer, located approximately 8 feet from the pumping well, had approximately 3 centimeters (0.1 feet) of drawdown during the test. Accurate aquifer parameters could not be calculated using the piezometer data. Hydraulic conductivities calculated from the pumping well pumping and recovery data were 5×10^{-3} centimeters per second (cm/sec), respectively.

Slug tests were performed on Wells RU-3 and RU-6. The rise in head in each test was approximately 1 foot while the saturated thickness of the aquifer screened was approximately 13 feet in Well RU-3 and 8 feet in Well RU-6. An unconfined aquifer was assumed and a Bouwer-Rice solution calculated. The hydraulic conductivity for Well RU-6 was calculated to be 8×10^{-4} cm/sec. A hydraulic conductivity for the RU-3 slug test could not be accurately calculated because the aquifer responded too quickly and in a nonlinear manner. This indicates that there was either not an adequate rise in head during the test or the hydraulic conductivity was much greater than anticipated.

Appendix H
Summary of Slug Test Relative Drawdown/Recovery
RU-3

Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)
0	0.154	0.1833	1.035	0.5	0.774	6	0.343	80	0.212
0.0033	0.198	0.1866	1.035	0.5166	0.769	6.2	0.343	82	0.212
0.0066	0.512	0.19	1.02	0.5333	0.764	6.4	0.338	84	0.208
0.01	1.011	0.1933	1.02	0.55	0.754	6.6	0.338	86	0.212
0.0133	1.132	0.1966	1.02	0.5666	0.745	6.8	0.333	88	0.212
0.0166	0.895	0.2	1.011	0.5833	0.74	7	0.329	90	0.208
0.02	0.648	0.2033	1.011	0.6	0.735	7.2	0.329	92	0.212
0.0233	0.696	0.2066	1.006	0.6166	0.73	7.4	0.324	94	0.212
0.0266	0.382	0.21	0.996	0.6333	0.73	7.6	0.319	96	0.212
0.03	0.256	0.2133	0.991	0.65	0.72	7.8	0.324	98	0.208
0.0333	1.615	0.2166	0.991	0.6666	0.716	8	0.314	100	0.212
0.0366	1.809	0.22	0.991	0.6833	0.711	8.2	0.319	120	0.212
0.04	1.315	0.2233	0.991	0.7	0.706	8.4	0.309	140	0.208
0.0433	1.233	0.2266	0.982	0.7166	0.696	8.6	0.309	160	0.208
0.0466	1.364	0.23	0.982	0.7333	0.691	8.8	0.304	180	0.208
0.05	1.335	0.2333	0.977	0.75	0.691	9	0.304	200	0.212
0.0533	1.282	0.2366	0.977	0.7666	0.682	9.2	0.3	220	0.208
0.0566	1.277	0.24	0.972	0.7833	0.677	9.4	0.304	240	0.212
0.06	1.286	0.2433	0.967	0.8	0.672	9.6	0.295	260	0.198
0.0633	1.267	0.2466	0.962	0.8166	0.672	9.8	0.295	280	0.198
0.0666	1.248	0.25	0.958	0.8333	0.667	10	0.29	300	0.203
0.07	1.253	0.2533	0.958	0.85	0.662	12	0.285	320	0.203
0.0733	1.233	0.2566	0.948	0.8666	0.662	14	0.275	340	0.203
0.0766	1.224	0.26	0.953	0.8833	0.658	16	0.261	360	0.198
0.08	1.224	0.2633	0.943	0.9	0.653	18	0.261	380	0.198
0.0833	1.214	0.2666	0.948	0.9166	0.648	20	0.246	400	0.203
0.0866	1.209	0.27	0.938	0.9333	0.643	22	0.246	420	0.193
0.09	1.199	0.2733	0.928	0.95	0.643	24	0.246	440	0.193
0.0933	1.19	0.2766	0.933	0.9666	0.638	26	0.242	460	0.193
0.0966	1.185	0.28	0.933	0.9833	0.638	28	0.232	480	0.188
0.1	1.17	0.2833	0.928	1	0.629	30	0.232	500	0.193
0.1033	1.17	0.2866	0.924	1.2	0.595	32	0.227	520	0.188
0.1066	1.166	0.29	0.919	1.4	0.566	34	0.237	540	0.188
0.11	1.166	0.2933	0.919	1.6	0.537	36	0.227	560	0.183
0.1133	1.151	0.2966	0.919	1.8	0.527	38	0.227	580	0.188
0.1166	1.146	0.3	0.919	2	0.503	40	0.227	600	0.193
0.12	1.141	0.3033	0.914	2.2	0.493	42	0.227	620	0.193
0.1233	1.132	0.3066	0.909	2.4	0.479	44	0.227	640	0.193
0.1266	1.132	0.31	0.904	2.6	0.469	46	0.227	660	0.188
0.13	1.117	0.3133	0.899	2.8	0.45	48	0.227	680	0.193
0.1333	1.117	0.3166	0.899	3	0.445	50	0.222	700	0.188
0.1366	1.107	0.32	0.899	3.2	0.43	52	0.227	720	0.183
0.14	1.103	0.3233	0.899	3.4	0.425	54	0.222	740	0.183
0.1433	1.098	0.3266	0.895	3.6	0.416	56	0.217	760	0.183
0.1466	1.088	0.33	0.885	3.8	0.401	58	0.217	780	0.188
0.15	1.088	0.3333	0.89	4	0.401	60	0.217		
0.1533	1.083	0.35	0.875	4.2	0.396	62	0.212		
0.1566	1.078	0.3666	0.856	4.4	0.387	64	0.217		
0.16	1.069	0.3833	0.846	4.6	0.382	66	0.222		
0.1633	1.064	0.4	0.837	4.8	0.377	68	0.217		
0.1666	1.064	0.4166	0.827	5	0.362	70	0.217		
0.17	1.054	0.4333	0.817	5.2	0.362	72	0.212		
0.1733	1.054	0.45	0.803	5.4	0.358	74	0.217		
0.1766	1.045	0.4666	0.793	5.6	0.353	76	0.212		
0.18	1.035	0.4833	0.783	5.8	0.353	78	0.212		

Appendix H
Summary of Slug Test Relative Drawdown/Recovery
RU-6

Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)	Time (minutes)	Recovery (feet)
0	-0.009	0.1733	1.09	0.4	1.237	4.2	0.108
0.0033	0.722	0.1766	1.071	0.4166	1.222	4.4	0.08
0.0066	1.142	0.18	1.048	0.4333	1.237	4.6	0.07
0.01	0.028	0.1833	1.057	0.45	1.213	4.8	0.061
0.0133	0.892	0.1866	1.034	0.4666	1.204	5	0.061
0.0166	1.043	0.19	1.057	0.4833	1.189	5.2	0.037
0.02	1.133	0.1933	1.086	0.5	1.185	5.4	0.047
0.0233	1.024	0.1966	1.086	0.5166	1.152	5.6	0.028
0.0266	1.227	0.2	1.062	0.5333	1.142	5.8	0.033
0.03	1.194	0.2033	1.076	0.55	1.142	6	0.004
0.0333	1.067	0.2066	1.062	0.5666	1.128	6.2	0.014
0.0366	1.109	0.21	1.052	0.5833	1.123	6.4	0.018
0.04	1.251	0.2133	1.029	0.6	1.109	6.6	0.009
0.0433	1.246	0.2166	1.052	0.6166	1.114	6.8	-0.014
0.0466	1.142	0.22	1.043	0.6333	1.123	7	-0.018
0.05	1.161	0.2233	1.043	0.65	1.086	7.2	-0.009
0.0533	1.147	0.2266	1.043	0.6666	1.071	7.4	-0.018
0.0566	1.133	0.23	1.038	0.6833	1.052	7.6	-0.018
0.06	1.09	0.2333	1.128	0.7	1.038	7.8	-0.033
0.0633	1.09	0.2366	1.142	0.7166	1.034	8	-0.023
0.0666	1.071	0.24	1.18	0.7333	1.029	8.2	-0.023
0.07	1.038	0.2433	1.156	0.75	1.015	8.4	-0.037
0.0733	1.029	0.2466	1.17	0.7666	1.005	8.6	-0.023
0.0766	1.015	0.25	1.142	0.7833	0.986	8.8	-0.033
0.08	1.043	0.2533	1.114	0.8	0.958	9	-0.033
0.0833	1.052	0.2566	1.133	0.8166	0.972	9.2	-0.033
0.0866	1.067	0.26	1.142	0.8333	0.953	9.4	-0.033
0.09	1.071	0.2633	1.119	0.85	0.949	9.6	-0.033
0.0933	1.052	0.2666	1.123	0.8666	0.958	9.8	-0.028
0.0966	1.019	0.27	1.1	0.8833	0.953	10	-0.033
0.1	1.015	0.2733	1.119	0.9	0.953	12	0.023
0.1033	0.991	0.2766	1.119	0.9166	0.953	14	0.028
0.1066	1.005	0.28	1.1	0.9333	0.925	16	0.042
0.11	1.043	0.2833	1.095	0.95	0.944	18	0.056
0.1133	1.048	0.2866	1.114	0.9666	0.911	20	0.08
0.1166	1.038	0.29	1.104	0.9833	0.897	22	0.118
0.12	1.019	0.2933	1.081	1	0.892	24	0.122
0.1233	1.029	0.2966	1.119	1.2	0.746	26	0.122
0.1266	0.996	0.3	1.119	1.4	0.67	28	0.16
0.13	1.015	0.3033	1.114	1.6	0.613	30	0.151
0.1333	1.043	0.3066	1.109	1.8	0.552	32	0.203
0.1366	1.057	0.31	1.119	2	0.472	34	0.198
0.14	1.052	0.3133	1.095	2.2	0.406	36	0.212
0.1433	1.067	0.3166	1.123	2.4	0.373	38	0.231
0.1466	1.09	0.32	1.119	2.6	0.344		
0.15	1.114	0.3233	1.123	2.8	0.311		
0.1533	1.133	0.3266	1.123	3	0.255		
0.1566	1.137	0.33	1.123	3.2	0.212		
0.16	1.052	0.3333	1.128	3.4	0.184		
0.1633	1.048	0.35	1.194	3.6	0.203		
0.1666	1.067	0.3666	1.232	3.8	0.16		
0.17	1.057	0.3833	1.237	4	0.118		

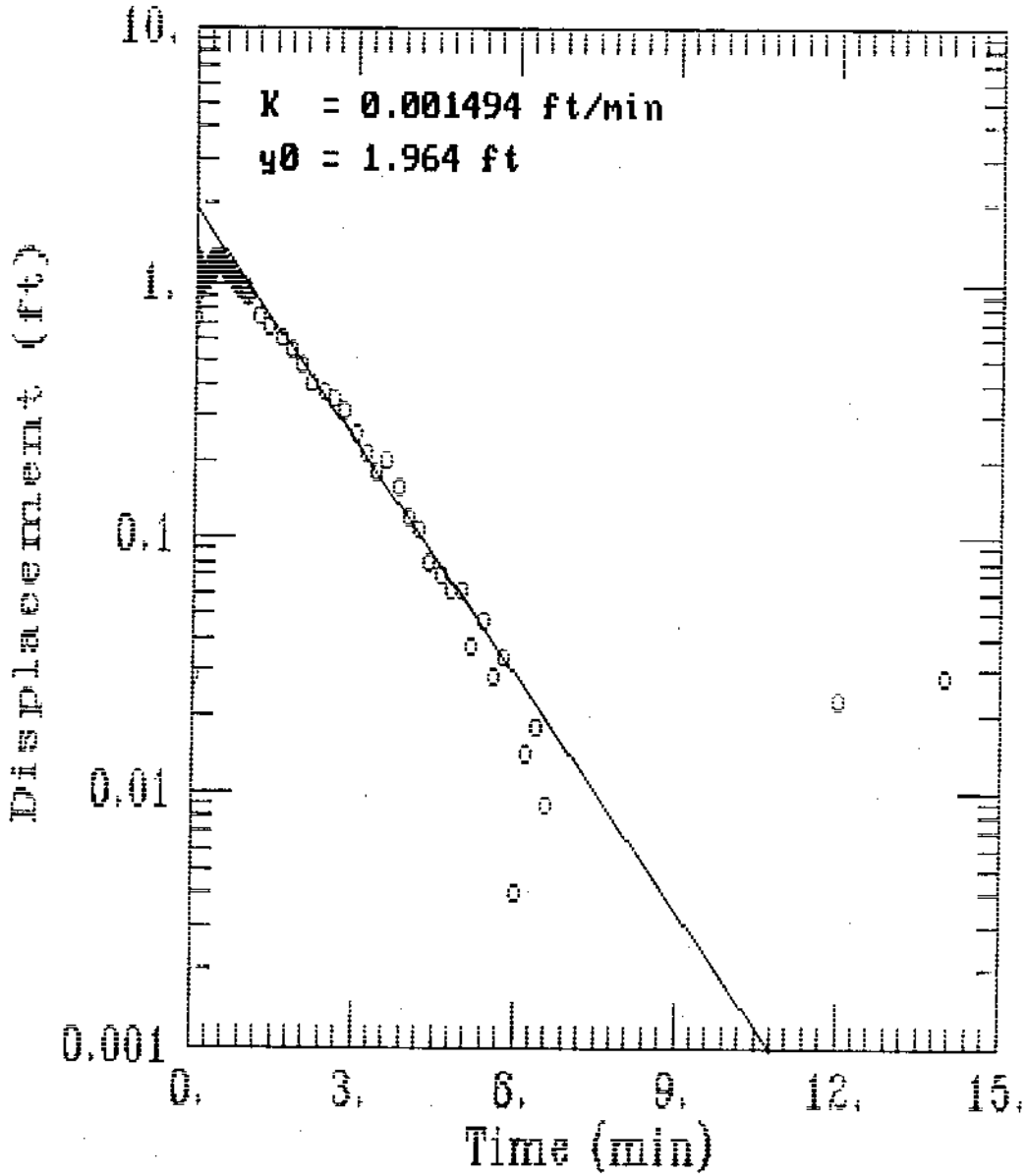
Appendix H
Summary of Relative Drawdown
RU-1 and Associated Piezometer

Time (minutes)	Piezometer Drawdown (feet)	RU-1 Drawdown (feet)	Time (minutes)	Piezometer Drawdown (feet)	RU-1 Drawdown (feet)	Time (minutes)	Piezometer Drawdown (feet)	RU-1 Drawdown (feet)	Time (minutes)	Piezometer Drawdown (feet)	RU-1 Drawdown (feet)
0.0000	0.0090	-0.0040	0.2166	-0.1980	0.1300	0.8333	-0.2730	0.3230	30.0000	-0.0610	1.0870
0.0033	-0.1980	-0.0040	0.2200	-0.2070	0.1350	0.8500	-0.2350	0.3230	32.0000	-0.1320	1.1020
0.0066	-0.4480	-0.0040	0.2233	-0.1980	0.1350	0.8666	-0.2400	0.3280	34.0000	-0.0800	1.1160
0.0100	-0.1360	0.0000	0.2266	-0.2500	0.1350	0.8833	-0.2120	0.3330	36.0000	-0.0750	1.1310
0.0133	-0.2540	-0.0040	0.2300	-0.1650	0.1400	0.9000	-0.2540	0.3380	38.0000	-0.1600	1.1400
0.0166	-0.4900	-0.0040	0.2333	-0.1840	0.1400	0.9166	-0.2120	0.3430	40.0000	-0.1130	1.1500
0.0200	-0.4240	0.0000	0.2366	-0.2170	0.1450	0.9333	-0.2970	0.3380	42.0000	-0.1550	1.1550
0.0233	-0.3160	-0.0040	0.2400	-0.2500	0.1450	0.9500	-0.2260	0.3480	44.0000	0.0000	1.1650
0.0266	-0.3160	-0.0040	0.2433	-0.2310	0.1490	0.9666	-0.3300	0.3480	46.0000	-0.0660	1.1690
0.0300	-0.3580	-0.0040	0.2466	-0.1460	0.1450	0.9833	-0.2170	0.3520	48.0000	-0.0140	1.1840
0.0333	-0.2870	-0.0040	0.2500	-0.2500	0.1490	1.0000	-0.2830	0.3480	50.0000	-0.0280	1.1890
0.0366	-0.2350	0.0000	0.2533	-0.2450	0.1490	1.2000	-0.2450	0.3810	52.0000	-0.0230	1.1940
0.0400	-0.1410	-0.0040	0.2566	-0.2310	0.1540	1.4000	-0.2450	0.4010	54.0000	-0.0610	1.2030
0.0433	-0.2260	0.0000	0.2600	-0.2260	0.1540	1.6000	-0.1840	0.4200	56.0000	-0.0230	1.2080
0.0466	-0.2540	0.0000	0.2633	-0.1980	0.1590	1.8000	-0.2590	0.4350	58.0000	-0.0280	1.2130
0.0500	-0.2260	0.0000	0.2666	-0.2450	0.1590	2.0000	-0.2350	0.4540	60.0000	-0.0370	1.2130
0.0533	-0.2870	0.0040	0.2700	-0.2070	0.1590	2.2000	-0.2070	0.4680	62.0000	-0.0660	1.2180
0.0566	-0.2920	0.0040	0.2733	-0.2540	0.1640	2.4000	-0.1930	0.4880	64.0000	-0.0510	1.2230
0.0600	-0.2970	0.0040	0.2766	-0.2830	0.1690	2.6000	-0.2170	0.5020	66.0000	-0.0230	1.2270
0.0633	-0.2590	0.0090	0.2800	-0.2070	0.1690	2.8000	-0.1790	0.5170	68.0000	0.0040	1.2270
0.0666	-0.1460	0.0140	0.2833	-0.2210	0.1640	3.0000	-0.2310	0.5310	70.0000	0.0000	1.2320
0.0700	-0.1930	0.0140	0.2866	-0.2170	0.1690	3.2000	-0.2540	0.5410	72.0000	-0.0230	1.2370
0.0733	-0.2640	0.0190	0.2900	-0.3160	0.1690	3.4000	-0.1740	0.5510	74.0000	-0.0610	1.2370
0.0766	-0.2120	0.0190	0.2933	-0.2590	0.1690	3.6000	-0.1650	0.5650	76.0000	0.0610	1.2420
0.0800	-0.1170	0.0240	0.2966	-0.1980	0.1740	3.8000	-0.1790	0.5700	78.0000	0.0560	1.2420
0.0833	-0.1740	0.0290	0.3000	-0.2210	0.1740	4.0000	-0.1510	0.5800	80.0000	-0.0610	1.2470
0.0866	-0.1460	0.0290	0.3033	-0.2400	0.1740	4.2000	-0.1930	0.5890	82.0000	-0.0140	1.2520
0.0900	-0.1790	0.0330	0.3066	-0.2640	0.1780	4.4000	-0.1790	0.5940	84.0000	-0.0180	1.2560
0.0933	-0.1510	0.0380	0.3100	-0.1840	0.1780	4.6000	-0.1740	0.6090	86.0000	0.0040	1.2520
0.0966	-0.1550	0.0380	0.3133	-0.2310	0.1780	4.8000	-0.1980	0.6180	88.0000	0.0090	1.2520
0.1000	-0.1980	0.0430	0.3166	-0.2020	0.1880	5.0000	-0.2350	0.6330	90.0000	-0.0330	1.2560
0.1033	-0.1360	0.0480	0.3200	-0.1880	0.1830	5.2000	-0.1980	0.6420	92.0000	0.0370	1.2560
0.1066	-0.2070	0.0480	0.3233	-0.1980	0.1830	5.4000	-0.1550	0.6520	94.0000	-0.0090	1.2560
0.1100	-0.2070	0.0530	0.3266	-0.2400	0.1930	5.6000	-0.1880	0.6670	96.0000	0.0230	1.2610
0.1133	-0.1740	0.0580	0.3300	-0.2450	0.1880	5.8000	-0.2120	0.6760	98.0000	0.0510	1.2560
0.1166	-0.1550	0.0620	0.3333	-0.1510	0.1930	6.0000	-0.1840	0.6760	100.0000	0.0230	1.2560
0.1200	-0.1550	0.0620	0.3500	-0.0140	0.1980	6.2000	-0.2070	0.6810	120.0000	0.0330	1.2710
0.1233	-0.2780	0.0670	0.3666	-0.1130	0.1980	6.4000	-0.2070	0.6860	140.0000	0.1510	1.2660
0.1266	-0.2350	0.0670	0.3833	-0.0840	0.2120	6.6000	-0.1650	0.6910	160.0000	0.1360	1.2850
0.1300	-0.2170	0.0720	0.4000	-0.1080	0.2170	6.8000	-0.1460	0.7000	180.0000	0.1170	1.3000
0.1333	-0.2500	0.0770	0.4166	-0.1320	0.2270	7.0000	-0.1220	0.7000	200.0000	0.1270	1.3000
0.1366	-0.2780	0.0720	0.4333	-0.0990	0.2270	7.2000	-0.1840	0.7050	220.0000	0.2210	1.3190
0.1400	-0.2970	0.0820	0.4500	-0.1220	0.2320	7.4000	-0.1220	0.7100	240.0000	0.2170	1.3190
0.1433	-0.2730	0.0820	0.4666	-0.1220	0.2410	7.6000	-0.2070	0.7150	260.0000	0.2350	1.3140
0.1466	-0.2310	0.0820	0.4833	-0.1550	0.2460	7.8000	-0.1650	0.7250	280.0000	0.3530	1.3050
0.1500	-0.2920	0.0870	0.5000	-0.2070	0.2510	8.0000	-0.1650	0.7250	300.0000	0.2780	1.3140
0.1533	-0.2780	0.0910	0.5166	-0.1980	0.2560	8.2000	-0.1840	0.7300	320.0000	0.2970	1.3240
0.1566	-0.2260	0.0870	0.5333	-0.1790	0.2610	8.4000	-0.1880	0.7340	340.0000	0.2920	1.3240
0.1600	-0.2690	0.0910	0.5500	-0.1980	0.2650	8.6000	-0.1790	0.7390	360.0000	0.2870	1.3340
0.1633	-0.2350	0.0910	0.5666	-0.1220	0.2700	8.8000	-0.1360	0.7490	380.0000	0.3630	1.3390
0.1666	-0.1980	0.1010	0.5833	-0.2120	0.2750	9.0000	-0.1930	0.7490	400.0000	0.3250	1.3340
0.1700	-0.2450	0.1010	0.6000	-0.1270	0.2800	9.2000	-0.2210	0.7540	420.0000	0.3630	1.3340
0.1733	-0.2310	0.1010	0.6166	-0.2310	0.2800	9.4000	-0.1840	0.7630	440.0000	0.2170	1.3340
0.1766	-0.2350	0.1010	0.6333	-0.1930	0.2850	9.6000	-0.1650	0.7680	460.0000	0.1880	1.3240
0.1800	-0.2020	0.1060	0.6500	-0.2310	0.2940	9.8000	-0.1550	0.7780	480.0000	0.2970	1.3050
0.1833	-0.1740	0.1110	0.6666	-0.2400	0.2900	10.0000	-0.1690	0.7780			
0.1866	-0.2730	0.1160	0.6833	-0.2120	0.2940	12.0000	-0.1690	0.8500			
0.1900	-0.2260	0.1160	0.7000	-0.2310	0.2990	14.0000	-0.1690	0.8940			
0.1933	-0.1840	0.1200	0.7166	-0.1880	0.3040	16.0000	-0.2310	0.9280			
0.1966	-0.1690	0.1200	0.7333	-0.2120	0.3040	18.0000	-0.1170	0.9620			
0.2000	-0.2070	0.1200	0.7500	-0.1930	0.3090	20.0000	-0.1650	0.9860			
0.2033	-0.2590	0.1250	0.7666	-0.2400	0.3090	22.0000	-0.0840	1.0150			
0.2066	-0.1930	0.1250	0.7833	-0.2640	0.3190	24.0000	-0.0280	1.0390			
0.2100	-0.2170	0.1250	0.8000	-0.2640	0.3190	26.0000	-0.1360	1.0530			
0.2133	-0.2170	0.1250	0.8166	-0.2780	0.3230	28.0000	-0.0560	1.0780			

Appendix H
Summary of Relative Recovery
RU-1 and Associated Piezometer

Time (minutes)	Piezometer Recovery (feet)	RU-1 Recovery (feet)	Time (minutes)	Piezometer Recovery (feet)	RU-1 Recovery (feet)	Time (minutes)	Piezometer Recovery (feet)	RU-1 Recovery (feet)	Time (minutes)	Piezometer Recovery (feet)	RU-1 Recovery (feet)
0.0000	0.2210	1.3290	0.2166	-0.1270	1.1650	0.8333	-0.0610	0.9710	30.0000	-0.1130	0.2700
0.0033	0.1360	1.3190	0.2200	-0.1080	1.1740	0.8500	-0.0660	0.9660	32.0000	-0.1320	0.2610
0.0066	0.0700	1.3240	0.2233	-0.1030	1.1650	0.8666	-0.0840	0.9710	34.0000	-0.1080	0.2410
0.0100	0.0000	1.3240	0.2266	-0.1510	1.1650	0.8833	-0.0890	0.9710	36.0000	-0.1360	0.2410
0.0133	0.0180	1.3190	0.2300	-0.1460	1.1550	0.9000	-0.0840	0.9620	38.0000	-0.1840	0.2270
0.0166	0.1170	1.3140	0.2333	-0.1320	1.1500	0.9166	-0.0750	0.9620	40.0000	-0.1740	0.2220
0.0200	0.0560	1.3100	0.2366	-0.1410	1.1550	0.9333	-0.0610	0.9570	42.0000	-0.1220	0.2070
0.0233	0.0660	1.3100	0.2400	-0.1690	1.1550	0.9500	-0.0660	0.9520	44.0000	-0.1360	0.2070
0.0266	0.0800	1.3140	0.2433	-0.1510	1.1550	0.9666	-0.0800	0.9470	46.0000	-0.1980	0.1980
0.0300	0.0420	1.3050	0.2466	-0.1270	1.1500	0.9833	-0.1220	0.9470	48.0000	-0.1650	0.1880
0.0333	0.0140	1.3050	0.2500	-0.1460	1.1450	1.0000	-0.1170	0.9470	50.0000	-0.1130	0.1880
0.0366	-0.0090	1.2950	0.2533	-0.1650	1.1450	1.2000	-0.1030	0.9080	52.0000	-0.1690	0.1830
0.0400	0.0000	1.2950	0.2566	-0.1460	1.1450	1.4000	-0.1170	0.8890	54.0000	-0.1410	0.1740
0.0433	-0.0180	1.2900	0.2600	-0.1410	1.1450	1.6000	-0.1030	0.8650	56.0000	-0.2070	0.1740
0.0466	-0.0370	1.2850	0.2633	-0.1650	1.1450	1.8000	-0.0510	0.8410	58.0000	-0.1930	0.1690
0.0500	0.0000	1.2850	0.2666	-0.1740	1.1400	2.0000	-0.0560	0.8210	60.0000	-0.1600	0.1690
0.0533	-0.0230	1.2760	0.2700	-0.1550	1.1450	2.2000	-0.0700	0.8070	62.0000	-0.1550	0.1640
0.0566	-0.0560	1.2760	0.2733	-0.1320	1.1400	2.4000	-0.0890	0.7870	64.0000	-0.1510	0.1540
0.0600	-0.0370	1.2760	0.2766	-0.1690	1.1310	2.6000	-0.1130	0.7680	66.0000	-0.1740	0.1450
0.0633	-0.0140	1.2710	0.2800	-0.1690	1.1360	2.8000	-0.1410	0.7630	68.0000	-0.2070	0.1490
0.0666	-0.0420	1.2710	0.2833	-0.1360	1.1310	3.0000	-0.1220	0.7390	70.0000	-0.1650	0.1450
0.0700	-0.0750	1.2610	0.2866	-0.1460	1.1360	3.2000	-0.1170	0.7340	72.0000	-0.1790	0.1350
0.0733	-0.0510	1.2610	0.2900	-0.1690	1.1310	3.4000	-0.0840	0.7200	74.0000	-0.1650	0.1450
0.0766	-0.0420	1.2560	0.2933	-0.1550	1.1260	3.6000	-0.0890	0.7100	76.0000	-0.1600	0.1300
0.0800	-0.0750	1.2560	0.2966	-0.1220	1.1310	3.8000	-0.1080	0.7000	78.0000	-0.1840	0.1400
0.0833	-0.0890	1.2610	0.3000	-0.1410	1.1210	4.0000	-0.1170	0.6910	80.0000	-0.1980	0.1250
0.0866	-0.0750	1.2560	0.3033	-0.1360	1.1310	4.2000	-0.1460	0.6810	82.0000	-0.1690	0.1300
0.0900	-0.0800	1.2470	0.3066	-0.1320	1.1210	4.4000	-0.1270	0.6710	84.0000	-0.1840	0.1250
0.0933	-0.1220	1.2420	0.3100	-0.1030	1.1160	4.6000	-0.1170	0.6570	86.0000	-0.2070	0.1200
0.0966	-0.1080	1.2420	0.3133	-0.1410	1.1160	4.8000	-0.1170	0.6520	88.0000	-0.1030	0.1250
0.1000	-0.0800	1.2420	0.3166	-0.1550	1.1210	5.0000	-0.1080	0.6470	90.0000	-0.1080	0.1160
0.1033	-0.1270	1.2370	0.3200	-0.1030	1.1210	5.2000	-0.1030	0.6420	92.0000	-0.0890	0.1110
0.1066	-0.1460	1.2420	0.3233	-0.1030	1.1160	5.4000	-0.1550	0.6330	94.0000	-0.1130	0.1160
0.1100	-0.1030	1.2320	0.3266	-0.1220	1.1110	5.6000	-0.1650	0.6230	96.0000	-0.1550	0.1110
0.1133	-0.0940	1.2320	0.3300	-0.1220	1.1160	5.8000	-0.1650	0.6130	98.0000	-0.0890	0.1060
0.1166	-0.1080	1.2320	0.3333	-0.0700	1.1160	6.0000	-0.1690	0.6040	100.0000	-0.1360	0.1010
0.1200	-0.1030	1.2270	0.3500	0.0230	1.1020	6.2000	-0.1600	0.6090	120.0000	-0.0840	0.0770
0.1233	-0.0660	1.2230	0.3666	-0.0040	1.0970	6.4000	-0.1790	0.6040	140.0000	-0.0990	0.0620
0.1266	-0.0800	1.2230	0.3833	-0.0180	1.0870	6.6000	-0.1320	0.5890	160.0000	-0.0660	0.0530
0.1300	-0.1220	1.2180	0.4000	-0.0230	1.0870	6.8000	-0.1220	0.5840	180.0000	-0.0800	0.1060
0.1333	-0.0940	1.2180	0.4166	-0.0280	1.0730	7.0000	-0.1130	0.5800	200.0000	-0.0750	0.1830
0.1366	-0.0800	1.2180	0.4333	-0.0280	1.0730	7.2000	-0.1030	0.5700	220.0000	-0.0470	0.2030
0.1400	-0.1130	1.2180	0.4500	-0.0140	1.0680	7.4000	-0.1460	0.5750	240.0000	0.0510	0.2070
0.1433	-0.1080	1.2080	0.4666	-0.0230	1.0630	7.6000	-0.1600	0.5600	260.0000	0.0660	0.2170
0.1466	-0.0840	1.2080	0.4833	-0.0280	1.0580	7.8000	-0.1170	0.5550	280.0000	0.0000	0.2170
0.1500	-0.0890	1.2130	0.5000	-0.0420	1.0530	8.0000	-0.1030	0.5510	300.0000	-0.0700	0.2220
0.1533	-0.1220	1.2030	0.5166	-0.0660	1.0440	8.2000	-0.1320	0.5460	320.0000	0.0560	0.2360
0.1566	-0.1030	1.2030	0.5333	-0.0840	1.0490	8.4000	-0.1600	0.5360	340.0000	0.0140	0.2270
0.1600	-0.0800	1.1940	0.5500	-0.0700	1.0390	8.6000	-0.1600	0.5410	360.0000	0.0610	0.2270
0.1633	-0.0940	1.1980	0.5666	-0.0610	1.0340	8.8000	-0.1360	0.5310	380.0000	-0.0040	0.2220
0.1666	-0.1170	1.1940	0.5833	-0.0800	1.0240	9.0000	-0.1170	0.5260	400.0000	0.0370	0.2220
0.1700	-0.0940	1.1940	0.6000	-0.0560	1.0290	9.2000	-0.1170	0.5220	420.0000	0.0090	0.2270
0.1733	-0.0660	1.1940	0.6166	-0.0660	1.0240	9.4000	-0.1320	0.5170	440.0000	0.0510	0.2220
0.1766	-0.0890	1.1940	0.6333	-0.0230	1.0150	9.6000	-0.1550	0.5220	460.0000	0.1030	0.2270
0.1800	-0.0990	1.1890	0.6500	-0.0510	1.0150	9.8000	-0.1690	0.5120	480.0000	0.0750	0.2320
0.1833	-0.0700	1.1840	0.6666	-0.0280	1.0100	10.0000	-0.1320	0.5070	500.0000	0.0890	0.2320
0.1866	-0.0700	1.1840	0.6833	-0.0990	1.0050	12.0000	-0.1170	0.4680	520.0000	0.0750	0.2360
0.1900	-0.0890	1.1840	0.7000	-0.0990	1.0050	14.0000	-0.1220	0.4350			
0.1933	-0.0990	1.1840	0.7166	-0.0940	1.0050	16.0000	-0.1270	0.4060			
0.1966	-0.0700	1.1740	0.7333	-0.0700	0.9910	18.0000	-0.1550	0.3810			
0.2000	-0.0800	1.1740	0.7500	-0.0420	0.9910	20.0000	-0.1360	0.3570			
0.2033	-0.1080	1.1740	0.7666	-0.0230	0.9860	22.0000	-0.1360	0.3330			
0.2066	-0.0940	1.1690	0.7833	-0.0090	0.9860	24.0000	-0.1030	0.3090			
0.2100	-0.0750	1.1690	0.8000	0.0000	0.9810	26.0000	-0.1410	0.2990			
0.2133	-0.0940	1.1690	0.8166	-0.0140	0.9760	28.0000	-0.1220	0.2850			

RU-6A Slug Test



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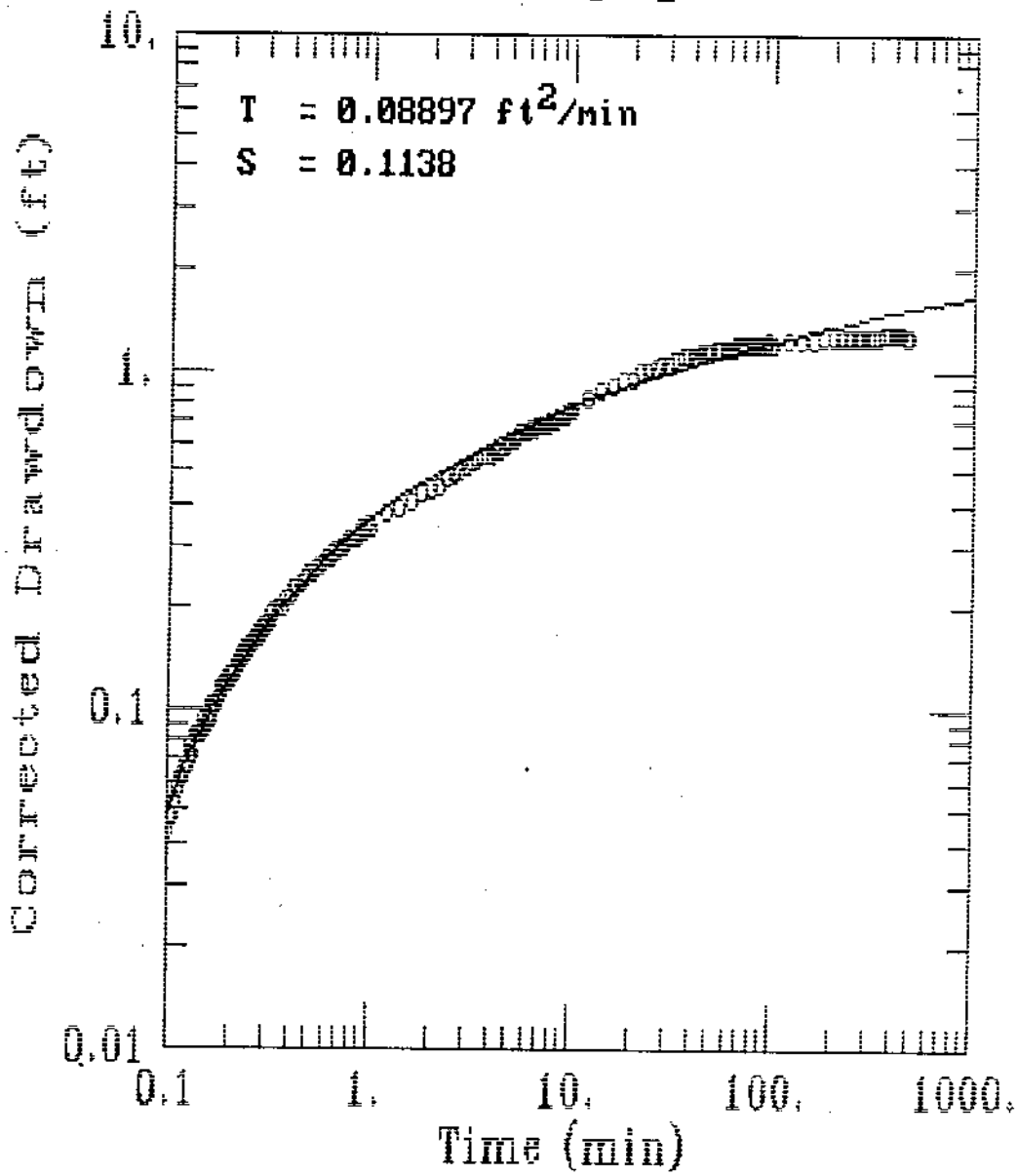
RU-1 Pumping Test

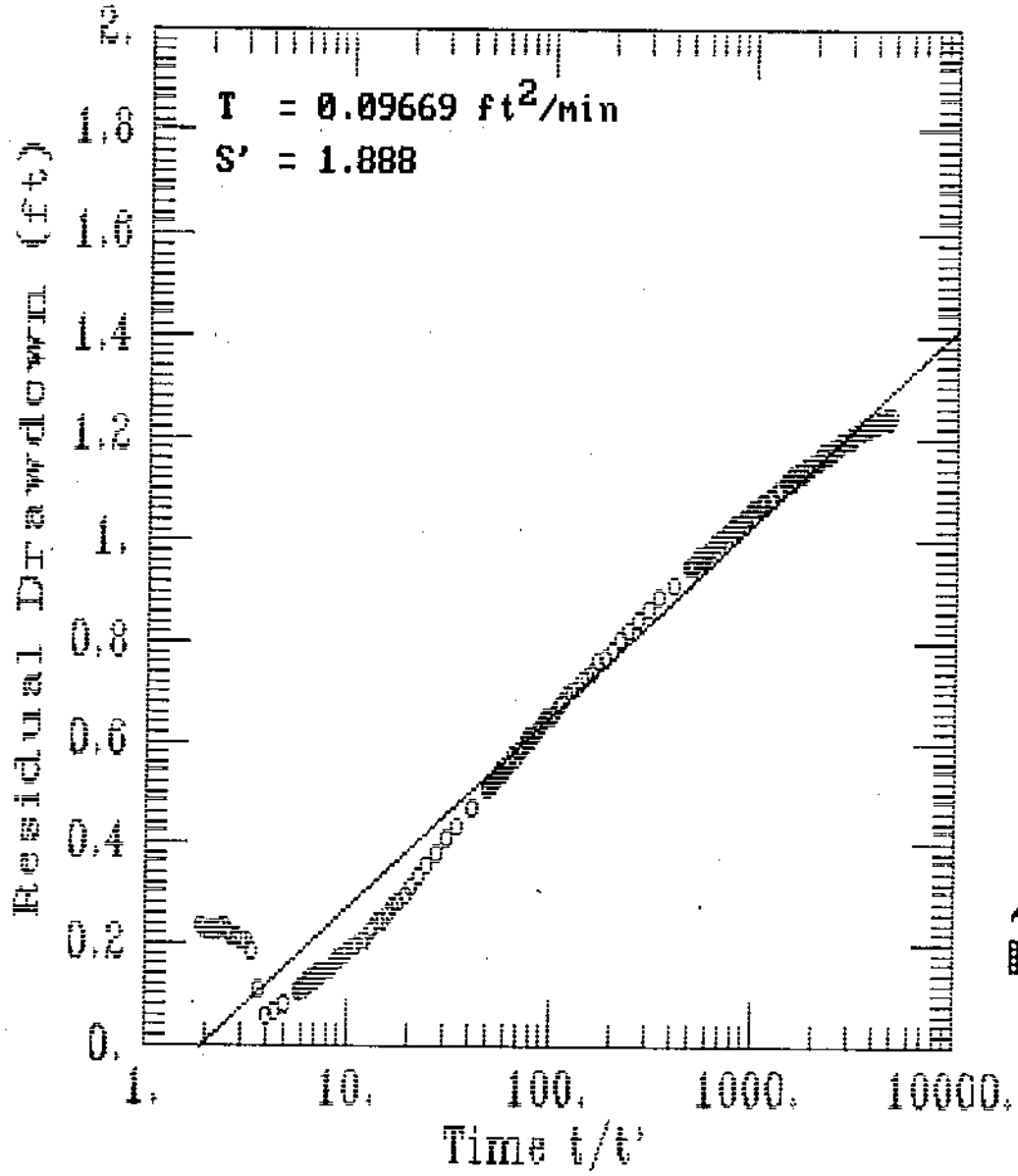


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

RU-1 Pumping Well Recovery Analysis



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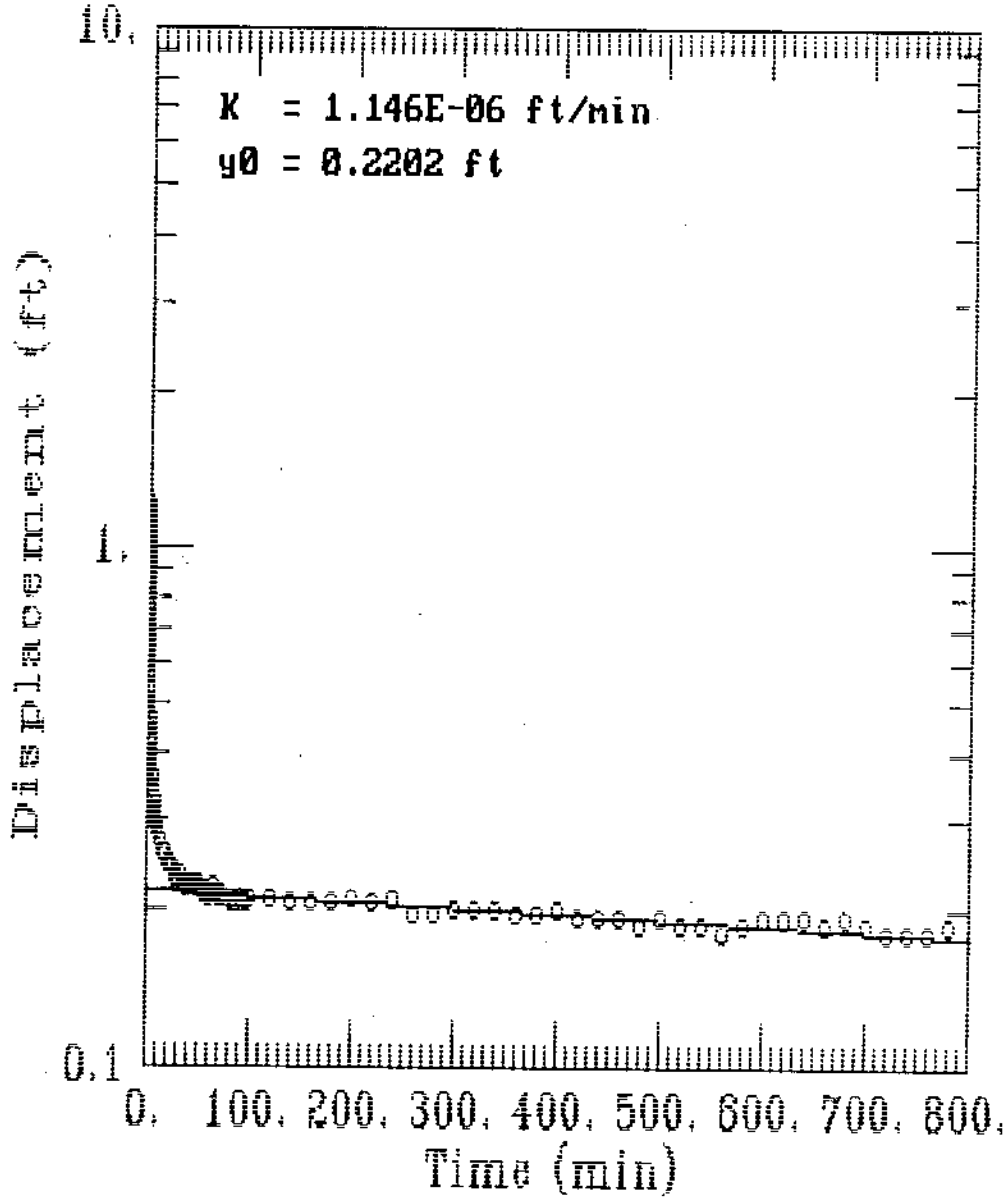
RU-3 Slug Test



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Appendix I

Risk Assessment

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List of Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
atm-m^3/mol	Atmospheres - cubic meter(s) per mole
°C	Degree(s) Celsius
CASRN	Chemical Abstracts Service Registry Number
CFR	Code of Federal Regulations
cm^2	Centimeter(s) squared
cm/hr	Centimeter(s) per hour
COPC	Constituent of potential concern
CDPHE	Colorado Department of Public Health and Environment
DTSC	Department of Toxic Substance Control
EPA	Environmental Protection Agency
g	Gram(s)
g/m^2	Gram(s) per meter(s) squared
HEAST	Health Effects Assessment Summary Tables
HI	Hazard index
HT	Tritium gas
HTO	Tritium oxide
HQ	Hazard quotient
hr/day	Hour(s) per day
ILCR	Incremental lifetime cancer risk
IRIS	Integrated Risk Information System
kg	Kilogram(s)
kg/day	Kilogram(s) per day
kg/mg	Kilogram(s) per milligrams
L/cm^3	Liter(s) per cubic centimeters
L/day	Liter(s) per day
L/min	Liter(s) per minute
m^2	Square meter(s)
m^3	Cubic meter(s)
m^3/day	Cubic meter(s) per day
m^3/min	Cubic meter(s) per minute
mg/cm^2	Milligram(s) per centimeter(s) squared
mg/day	Milligram(s) per day

mg/hr	Milligram(s) per hour
mg/kg	Milligram(s) per kilogram(s)
mg/kg-day	Milligram(s) per kilogram(s) per day
mg/L	Milligram(s) per liter
mg/m^3	Milligram(s) per cubic meter(s)
μg	Microgram(s)
$\mu g/m^3$	Microgram(s) per cubic meter(s)
$\mu g/dL$	Microgram(s) per decaliter
$\mu g/L$	Microgram(s) per liter
NA	Not applicable, Class D carcinogen or hazard index for radionuclide COPC
ND	No toxicity information available for the given pathway
NCP	National Contingency Plan
pCi	PicoCurie(s)
pCi/g	PicoCurie(s) per gram
pCi/L	Picocurie(s) per liter
PM	Particulate matter
ppm	Part(s) per million
RAGS	Risk Assessment Guidance for Superfund
RfC	Reference concentration
RfD	Reference dose
RME	Reasonable maximum exposure
SF	Slope factor
SGZ	Surface ground zero
TPH	Total petroleum hydrocarbon(s)
UCL	Upper confidence limit
VOC	Volatile organic compound(s)
yr	Year(s)

I.1.0 Introduction

The purposes of the Rulison human health risk assessment were to estimate the risk of potential residential exposure to current site conditions and to determine conservative trigger levels for the constituents of potential concern (COPC) which, if exceeded, would indicate a need to further evaluate site monitoring data. This risk assessment was conducted to comply with the conditions set forth by the Colorado Department of Public Health and Environment (CDPHE) for increasing the drilling effluent pond TPH cleanup criterion from 250 to 1,000 milligrams per kilogram (mg/kg).

The current conditions at the Rulison site indicate two areas of concern: the surface ground zero (SGZ) mud pits and the drilling effluent pond (Figure I.1-1). The SGZ mud pits were backfilled with earth (AEC, 1973), and as described in Section 3.0 of the main body of the report, the drilling effluent pond was cleaned up. However, subsurface soil at both locations is contaminated, and a scenario for this contamination to migrate to and contaminate the groundwater was used to calculate a potential human health risk. This risk assessment was based on an assumption that future land use would involve a residential scenario where human inhabitants would be exposed to contaminants in groundwater from the drilling effluent pond and/or the SGZ mud pits. The risk assessment was also based on the assumption that residents would excavate contaminated subsurface soil at the SGZ mud pits and redistribute the soil on the ground surface, resulting in a scenario where residents are exposed to the contaminants only through direct contact. These future land use assumptions were developed based on consultation with the CDPHE.

Currently available analytical data for groundwater at the Rulison site show no concentrations of COPCs above the analytical detection limits, with the exception of barium, lead, and xylene. Therefore, the risks were calculated using the highest measured concentration in any groundwater monitoring well sample exceeding the detection limit or, when a COPC was not detected, its analytical detection limit was used. Trigger levels were calculated based on a risk threshold of either a hazard index of one or a lifetime cancer risk of 1×10^{-6}.

The risk assessment was performed in accordance with the "Risk Assessment Guidance for Superfund"(RAGS) (EPA, 1989) and with guidance provided by the U.S. Environmental Protection Agency (EPA).

The following major elements are included in this appendix: identification of the constituents of potential concern (Section I.2.0), exposure assessment (Section I.3.0), toxicity assessment (Section I.4.0), risk characterization (Section I.5.0), and trigger levels (Section I.6.0).

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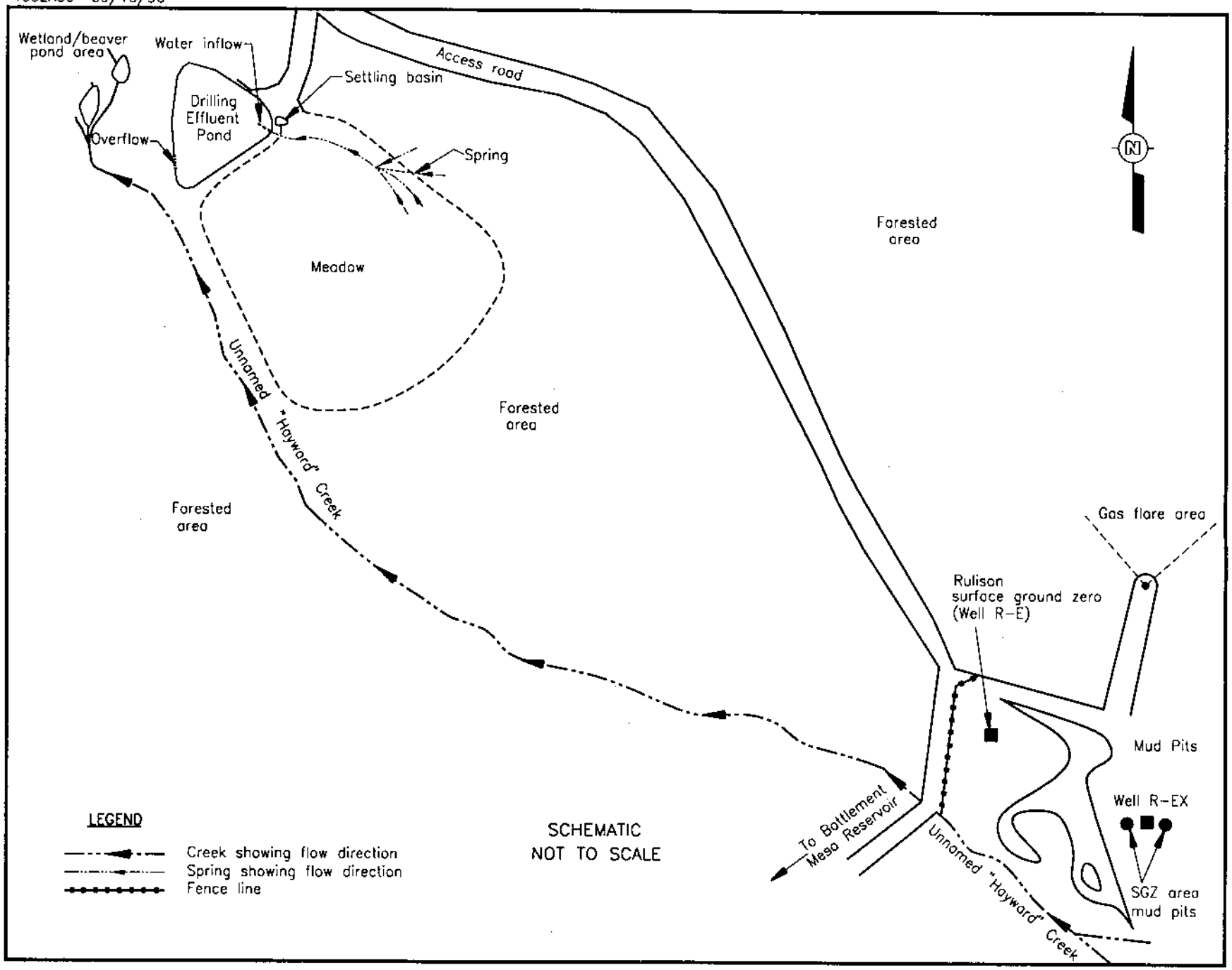

Figure I.1-1
Rulison Site Map

I.2.0 Identification of Constituents of Potential Concern

The constituents of potential concern for the drilling effluent pond and the SGZ mud pits were selected based on an evaluation of currently available information. This process evaluated historical site information, sample collection and analytical methods, analytical data results of samples collected, and quality of the data. Constituents evaluated in this analysis were selected based on technical judgment of constituents likely to be site-related (see Sections 3.0, 4.0, and 5.0 in the main body of the report).

I.2.1 Methodology for Selection of Constituents of Potential Concern

The following sections summarize the analytical information available for each of the areas of concern at Rulison. Included in this summary is a description of the medium sampled, a summary of the levels of COPC detected on site, and the statistical analysis, if any, for each medium.

I.2.1.1 SGZ Mud Pits

Environmental media sampled at and around the SGZ mud pits included soil borings, groundwater samples from two on-site wells, and Hayward Creek sediment, bank soils, and stream water samples.

The analytical data for the SGZ mud pits soil borings are summarized in Section 4.1.3 of the main body of the report; the COPCs are barium, chromium, lead, benzene, ethylbenzene, toluene, xylene, tritium, and total petroleum hydrocarbons (TPH) as diesel. Using the Excel® statistical software package, the following statistics were calculated for each data set: maximum detected value, minimum detected value, mean, standard deviation, and 95 percent upper confidence limit (UCL) of the mean. One half of the detection limit was used for all non-detects. The statistics for soil/sediment samples from the SGZ mud pits area are summarized in Table I.2-1. The analytical data for all SGZ mud pits samples are presented in Table 4-1 of the main body of the report.

Samples collected for chromium were analyzed for total chromium and did not differentiate between trivalent (III) and hexavalent (VI) chromium. A ratio of 1 part chromium VI for every 6 parts of total chromium was assumed. The remaining chromium was assumed to be all trivalent.

I.2.1.2 Groundwater Downgradient of the Drilling Effluent Pond and the SGZ Mud Pits

Groundwater is a medium of concern for drilling effluent pond and the SGZ mud pits area. Data are available from the October 1995 quarterly sampling from three groundwater monitoring wells for the drilling effluent pond and from two wells for the SGZ mud pits (Figure I.1-1) (see Section 5.0 of the main body of the report for a detailed description of the monitoring wells). The COPCs for groundwater were assumed to be the same as those detected in the SGZ mud pits. With the exception of tritium, these also were the COPCs for the pond cleanup. No statistics were calculated on the groundwater analytical data. The data from groundwater monitoring wells near the drilling effluent pond and the SGZ mudpits are summarized in Table I.2-2. Groundwater analytical results for all monitoring wells are presented in Table 5-1 of the main body of the report.

Table I.2-1
Constituents of Potential Concern Summary Statistics for Soil at the SGZ Mud Pits for Rulison, Colorado

Radiological					
Radionuclide	**Minimum[a]** (pCi/g)	**Maximum** (pCi/g)	**Mean** (pCi/g)	**Standard Deviation**	**95% UCL[b] of the Mean** (pCi/g)
Tritium	0.015	0.98	0.123	0.253	0.24
Chemical					
Chemicals	**Minimum[a]** (mg/kg)	**Maximum** (mg/kg)	**Mean** (mg/kg)	**Standard Deviation**	**95% UCL of the Mean** (mg/kg)
Barium	113	3990	557	937	1003
Benzene	0.0025	0.29	0.019	0.068	0.051
Chromium	13.2	112	37.7	25.1	49.7
Ethylbenzene	0.0025	1.4	0.087	0.328	0.238
Lead	6.7	119	30.3	34.9	46.91
Toluene	0.0025	0.12	0.014	0.0030	0.028
TPH as Diesel	12	4700	934	973	1633
Xylene	0.0025	23.0	1.33	5.41	3.83

[a]Minimum value is the lowest detected concentration or half the detection limit where non-detects occur.
[b]Upper confidence limit
Samples collected on October 6-8, 1995

Table I.2-2
Constituents of Potential Concern Summary Data for Groundwater for Rulison, Colorado

Radiological			
Radionuclide	**Minimum**[a] (pCi/L)	**Maximum** (pCi/L)	**Concentration Used in Risk Assessment** (pCi/L)
Tritium	254 U [b]	254 U [b]	254 U [b]
Chemical			
Chemicals	**Minimum**[a] (mg/L)	**Maximum** (mg/L)	**Concentration Used in Risk Assessment** (mg/L)
Barium	0.0682 [c]	0.258 [d]	0.258
Benzene	0.001 U [e]	0.001 U	0.001 U
Chromium	0.0027 U	0.02 U	0.02 U
Ethylbenzene	0.001 U	0.001 U	0.001 U
Lead	0.0008 U	0.0051 [d]	0.0051
Toluene	0.001 U	0.001 U	0.001 U
TPH as Diesel	0.5 U	0.5 U	0.5 U
Xylene	0.001 U	0.0015 [f]	0.0015

[a] Minimum value is the lowest detected concentration or the detection limit where non-detects occur.
[b] Sampling results for tritium are available only from the SGZ mud pits area monitoring wells.
[c] Sample is from SGZ mud pits area monitoring well RU-01
[d] Sample is from drilling effluent pond monitoring well RU-08
[e] Compound was analyzed but not detected above the specified detection limits in any of the monitoring well samples.
[f] Sample is from SGZ mud pits area monitoring well RU-02
Samples collected on October 23-27, 1995

I.3.0 Exposure Assessment

The exposure assessment estimates the type and magnitude of exposure to humans from the constituents of potential concern. The exposure pathways and calculations of chemical intakes are outlined below for both of the Rulison areas.

I.3.1 Exposure Pathways

For exposure and potential risks to occur, complete exposure pathways must exist. A complete pathway requires the following elements (EPA, 1989):

- A source and mechanism for release of contamination
- A transport or retention medium
- A point of potential human contact (exposure point) with the contaminated medium
- An exposure route at the exposure point.

If any one of these elements is missing, the pathway is not considered complete. Figure I.3-1 is an illustration of how these elements are combined into a complete pathway.

I.3.1.1 SGZ Mud Pits Exposure Pathways

Contamination sources are addressed in Section I.2.0. As discussed above, the only COPCs at the SGZ mud pits occur in subsurface soils. Therefore, subsurface soil is both the transport and retention medium.

Exposure points are locations of human contact with contaminated media. Exposure points consider human activity patterns and the location of potentially exposed individuals relative to the location of contaminated media. For this assessment, contact with potentially contaminated media takes place as a result of residential exposures only. To maintain the conservative methodology of RAGS (EPA, 1989), the contact point for soil contamination with all exposure scenarios is located at the contaminant source.

The following three exposure routes were examined:

- Ingestion
- Inhalation of dust
- Dermal contact

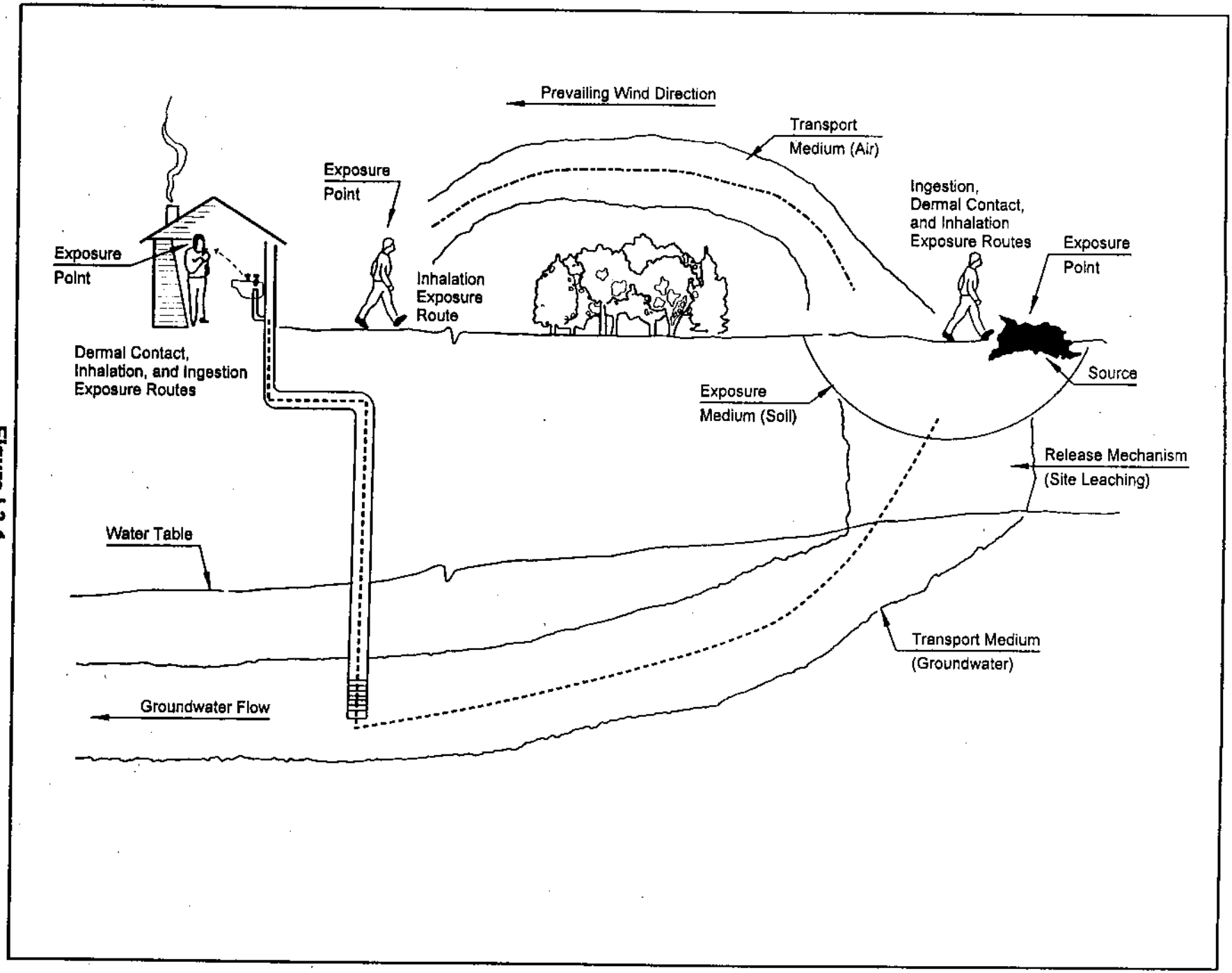

Figure I.3-1
Illustration of Exposure Pathways

Because the only contamination source is subsurface soil, there are no current feasible pathways, and there is no exposure point (point of human contact) for subsurface soil under current conditions. The only potential complete exposure pathway is a hypothetical future residential exposure to subsurface soil due to the removal of the surface soil. Figure I.3-2 illustrates the site conceptual model for Rulison.

Table I.3-1 lists the complete human exposure pathways for future land use. This table indicates which pathways have been selected for risk characterization and presents the rationale for inclusion or exclusion of each pathway.

I.3.1.2 Groundwater

As discussed above, the medium of concern at the drilling effluent pond is groundwater. This scenario is also used to represent the groundwater medium risk evaluation for the SGZ mud pits area. The only potential exposure point currently present is a spring used by the drilling effluent pond land owner. However, this spring is thought to be cross-gradient from the pond. There currently are no domestic groundwater wells in the area. Because of this, a future residential receptor is the only potential exposure to population at Rulison (Table I.3-1). The following three exposure routes were considered:

- Ingestion
- Inhalation of VOCs while showering
- Dermal contact while showering.

I.3.2 Quantification of Exposure

This section describes the estimation of exposures for the constituents of potential concern that may come in contact with human receptors. The process involves the following:

- Identification of applicable human exposure models and input parameters
- Determination of the concentration of each constituent in environmental media at the point of human exposure
- Estimation of human intakes.

For each potentially complete future exposure pathway identified in Section I.3.1, a reasonable maximum exposure (RME) scenario has been developed. The RME is the highest exposure that is reasonably expected to occur at a site (EPA, 1989). The intent of the RME, as defined by the

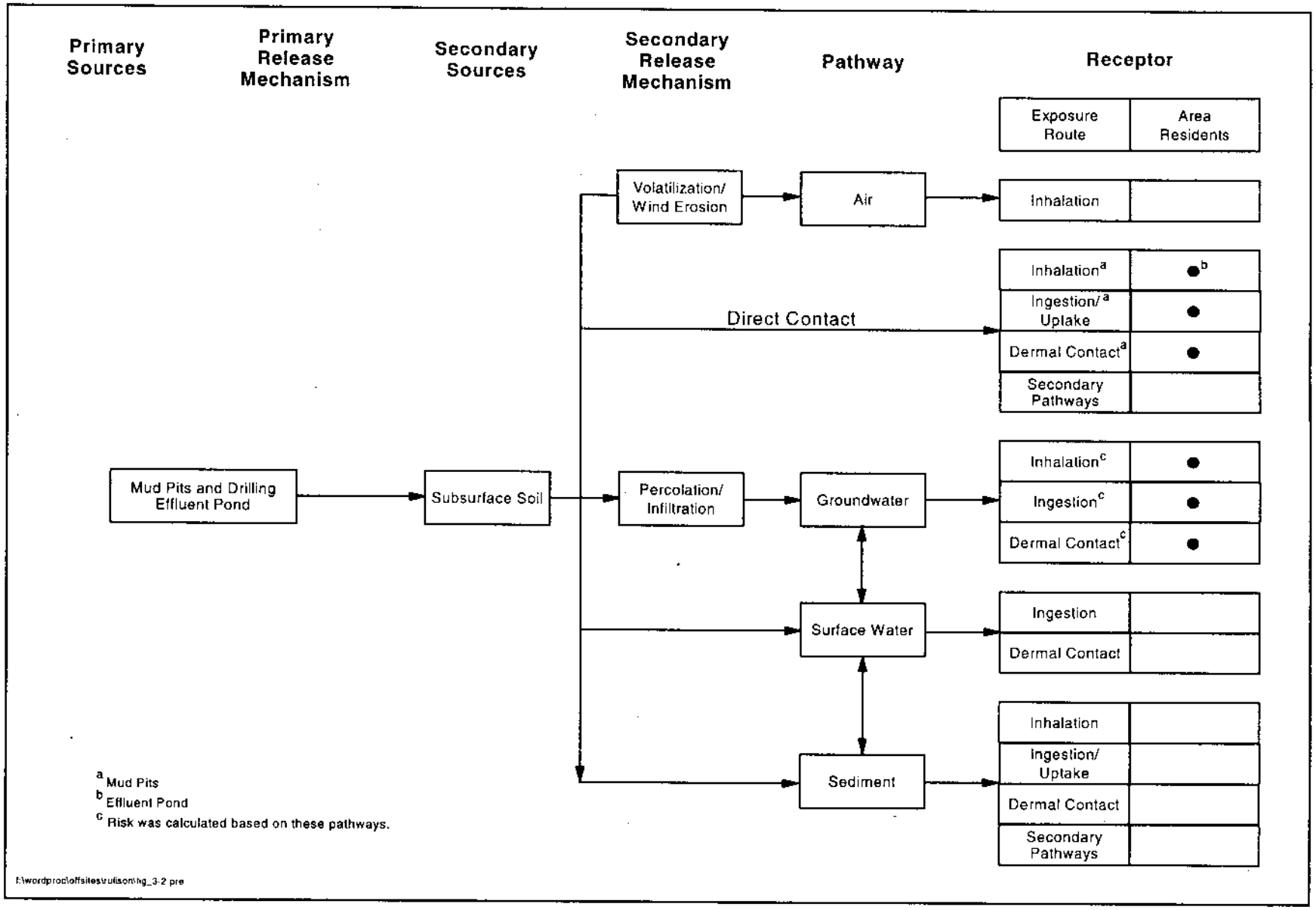

Figure I.3-2
Site Conceptual Model for Future Land Use

Table I.3-1
Potentially Complete Human Exposure Pathways for Future Land Use at Rulison

Environmental Medium	Exposure Route	Potentially Exposed Population	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Surface Soil	Inhalation Ingestion Dermal Contact	Residents Trespassers Workers	No	No surface contamination was found.
Surface Water	Inhalation Ingestion Dermal Contact	Residents Trespassers Workers	No	No surface water contamination was found.
Air[a]	Inhalation	Residents Trespassers Workers	No	No air sampling occurred.
Groundwater	Inhalation Ingestion Dermal Contact	Residents	Yes	Potential transport of COPCs from subsurface soil to groundwater was considered. Current groundwater analytical data were used in the calculation of risk. The groundwater pathway is considered future due to a lack of current residential wells in the potentially affected area.
Groundwater	Inhalation Ingestion Dermal Contact	Trespassers Workers	No	Consideration of a residential receptor is more conservative. No long-term occupational activities are planned at the site.
Subsurface Soil	Inhalation Ingestion Dermal Contact	Residents	Yes	Direct or indirect exposure to subsurface soil at depth of contamination is improbable (i.e., no complete exposure pathway exists). However, upon removal of surface soil, a residential receptor is the most likely and conservative.
Subsurface Soil	Inhalation Ingestion Dermal Contact	Workers Trespassers	No	Consideration of a residential receptor is more conservative. No long-term occupational activities are planned at the site.

[a]Air refers specifically to evaluating exposure using air sample data. Potential exposure by inhalation to constituents from other media (e.g., soil) is presented with those media.

I-3-5

U.S. Environmental Protection Agency (EPA), is to estimate a conservative exposure case (i.e., well above the average case) that is still within the possible range of exposures. The RME is both protective and reasonable, but not the worst possible case (EPA, 1991a).

I.3.2.1 Exposure Models

The primary source for the exposure models used in this baseline risk assessment is RAGS (EPA, 1989). Shown below is the generalized equation for calculating chemical intakes:

$$I = C \frac{CR \ x \ EFD}{BW \ x \ AT}$$

where

I = Intake; the amount of chemical at the exchange boundary (milligrams [mg] per kg body weight-day).

C = Chemical concentration at the exposure point; the concentration contacted over the exposure period (e.g., mg per liter [L] water or mg/kg soil).

CR = Contact rate; the amount of contaminated medium contacted per unit time or event (e.g., mg per day soil ingestion rate or m^3 per hour air inhalation rate).

EFD = Exposure frequency and duration; describes how often and how long exposure occurs. Often calculated using two terms (EF times ED).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight; the average body weight over the exposure period (kg).

AT = Averaging time; period over which exposure is averaged (days).

Pathway-specific exposure models are summarized in the following sections.

I.3.2.1.1 Ingestion of Soil and Groundwater

For estimating intake from ingestion of groundwater and soil the following equation applies.

$$Intake = \frac{C_i \ x \ EF \ x \ F}{AT} \ x \ [(\frac{IR \ x \ ED}{BW})_{child} + (\frac{IR \ x \ ED}{BW})_{adult}]$$

where

Intake = Intake of chemical through ingestion of medium (mg/kg-day)

C_i = Chemical concentration in medium i (mg/kg or mg/ L)

IR = Ingestion rate for medium i and receptor (kg/day or L/day)

F = Fraction of ingested medium from contaminated source (unitless)

EF, ED, BW, and AT are defined in Section I.3.2.1.

For the soil pathway, the child is considered to be exposed for 6 of the 30 years; this is conservative because children ingest more dirt than adults when compared on the basis of body weight. For the groundwater pathway, the adult is modeled for the 30 years; this is conservative because water ingestion is proportional to body weight.

I.3.2.1.2 Inhalation of Dust

For estimating respirable particulate emission from wind erosion, assuming an unlimited reservoir, the equation is (EPA, 1985)

$$E_{10} = 0.036 \ (1-V) \ (\frac{[u]}{u_t})^3 \ f(x)$$

where

E_{10} = PM_{10} emission factor (grams [g]/m^2-hour [hr])

V = Fraction of contaminated surface vegetative cover (unitless, assumed to be 1.0)

[u] = Mean annual wind speed (m/second [sec], 3.2 m/sec)

u_t = The threshold value of wind speed at 7 m (m/sec)

F(x) = Function plotted in EPA, 1985 [F(x) = 1.5]
where $x = 0.886\ u_t/[u]$.

Once the PM_{10} emission factor is calculated, the emission rates for the individual constituents of potential concern were calculated according to the following:

$$R_{10} = \alpha\ x\ E_{10}\ x\ A\ x\ C$$

where

R_{10} = Emission rate of contaminant as PM_{10} (mg/hr)

α = Chemical concentration (mg/kg)

E_{10} = PM_{10} emission factor (g/m^2-hr)

A = Site areas (m^2, assumed to be 1,000 m^2)

C = Conversion factor for kg to g 10^{-3}.

Once the dust concentration in the air has been calculated for each COPC, the constituent intake is

$$Intake = \frac{C_i\ x\ BA\ x\ IR\ x\ ET\ x\ EF\ x\ ED}{BW\ x\ AT}$$

where

C_i = Chemical-specific air concentration (mg per cubic meter [m^3])

BA = Bioavailability factor (unitless)

IR = Inhalation rate (m^3/event, typically m^3/hr)

ET = Exposure time (hr/day)

EF, ED, BW, and AT are defined in Section I.3.2.1.

I.3.2.1.3 Inhalation of VOCs while Showering

This section presents the methodology for estimating vapor phase concentrations in bathroom air as a result of showering. This model uses experimental results for trichloroethene to estimate the release of other volatile organic compounds by comparing their Henry's Law constants (IT, 1992).

The average concentration of a volatile compound in the shower air over a period of t_s minutes is

$$C_s = C_{infa} \ x \ [1 + \frac{1}{kt_s} (\exp^{-kt_s} - 1)]$$

where

C_s = Average concentration of a volatile compound in the shower air over a duration of t_s minutes (mg/m^3)

C_{infa} = Asymptotic concentration in air if shower ran for a long time (much longer than 5 minutes) (mg/m^3), calculated below:

$$C_{infa} = \frac{E \ x \ F_w \ x \ C_t}{F_a}$$

t_s = Time in shower (minutes [min])

k = Rate constant for exponential function (1/min), $k = F_a/V_b$

E = Efficiency of release of a compound from water to air (unitless), defined below; $0 \leq E \leq 1$; if E has a calculated value greater than 1, then E must be set equal to 1:

$$E = \frac{E_{TCE} \ x \ H}{H_{TCE}}$$

F_w = Flow rate of water in shower (L/min)

C_t = Concentration of organic compound in shower water (mg/L)

F_a = Flow rate of air in shower (m^3/min)

V_b = Volume of bathroom (m^3)

E_{TCE} = Efficiency of release of trichloroethene from water to air (unitless)

H = Henry's Law constant for an organic compound (m^3-atm/mol) (see Table I.3-2)

H_{TCE} = Henry's Law constant for trichloroethene (m^3-atm/mol).

Once the VOC air concentration has been calculated, the chemical intake while showering can be calculated using the intake equation in the previous section.

I.3.2.1.4 Dermal Contact Soil and Sediment

The following is the intake equation for dermal absorption of chemicals due to contact from soil or sediment:

$$AD = \frac{C_i \ x \ x \ AF \ x \ ABS \ x \ CF}{AT} \ x \ [(\frac{SA \ x \ EF \ x \ ED}{BW})_{adult} + (\frac{SA \ x \ EF \ x \ ED}{BW})_{child}]$$

where

AD = Absorbed dose (mg/kg-day)

C_i = Chemical concentration in medium i (mg/kg)

SA = Skin surface area available for contact (square centimeters [cm^2/event])

AF = Soil-to-skin adherence factor (mg/cm^2)

ABS = Skin absorption factor (unitless) (see Table I.3-2)

CF = Conversion factor (10^{-6} kg/mg)

EF = Exposure frequency (events/yr)

ED, BW, and AT are defined in Section I.3.2.1.

Table I.3-2
Constituent-Specific Input Parameters

Constituent	Absorption Fraction [a]	Dermal Permeability Constant (cm/hr)[a]	Henry's Law Constant (atm-m^3/mol)[b]
Barium	None	1.0E-03	None
Benzene	0.1	2.1E-02	0.00543
Chromium	None	1.0E-03	None
Ethylbenzene	0.1	7.4E-02	0.00844
Lead	None	1.0E-03	None
Toluene	0.1	4.5E-02	0.00594
TPH as Diesel	0.1	2.1E-02	None
Tritium	0.1	1.6 E-04	0.001
Xylenes	0.1	8.0E-02	0.0068

[a] EPA, 1992
[b] EPA, 1986

The exposed population and exposure-related parameters are summarized in Table I.3-3. All values shown in the table apply to the RME scenario. The exposure parameters have been taken from EPA guidance and are based on best professional judgment using site-specific information, where available. Upper-bound values are generally 90th or 95th percentile values, depending on the data available for each parameter. A combination of upper-bound and average exposure parameters were used to estimate the RME for each scenario.

Most of the RME input parameters are from current EPA guidance. The only exception is the exposure frequency for both the soil and groundwater pathways. A value of 180 days/year was assumed due to regional snow cover and corresponding site access limitations.

I.3.2.2 Intakes for Constituents of Potential Concern

Noncarcinogenic and carcinogenic intakes of subsurface soil COPCs at the SGZ mud pits are tabulated in Table I.3-4, and intakes for groundwater COPCs are tabulated in Table I.3-5. Intakes are expressed in units of milligrams of individual constituent per kilogram of receptor per day.

Table I.3-3
Exposure Parameters
(Page 1 of 2)

Parameter	Value	Units	Reference/Rationale
RESIDENTIAL INGESTION OF SOIL			
Ingestion Rate Adult Child	 100 200	mg/day	EPA, 1991a
Fraction Ingested	1	unitless	Assumes all of soil intake from site
Exposure Frequency	180	day/year	Value assumed, due to snow cover
Exposure Duration Adult Child	 24 6	years	EPA, 1991a
Body Weight Adult Child	 70 15	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens Adult Child	 25,550 8,760 2,190	 days days	EPA, 1989
RESIDENTIAL DERMAL CONTACT WITH SOIL			
Adherence Factor	1.0	mg/cm^2	EPA, 1992
Absorption Fraction	chemical specific	unitless	DTSC, 1993 (see Table I.3-2)
Skin Surface Area Adult Child	 5000 2000	cm^2/event	EPA, 1992
Exposure Frequency	180	event/year	Value assumed, due to snow cover
Exposure Duration Adult Child	 24 6	years	EPA, 1991a
Body Weight Adult Child	 70 15	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens Adult Child	 25,550 8,760 2,190	 days days	EPA, 1989
RESIDENTIAL INHALATION OF DUST			
Inhalation Rate	20	m^3/day	EPA, 1991a

Table I.3-3
Exposure Parameters
(Page 2 of 2)

Parameter	Value	Units	Reference/Rationale
Exposure Frequency	180	day/year	Value assumed, due to snow cover
Exposure Duration	30	years	EPA, 1991a
Body Weight	70	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens	 25,550 10,950	 days days	EPA, 1989
RESIDENTIAL INGESTION OF GROUNDWATER			
Ingestion Rate	2	L/day	EPA, 1991a
Fraction Ingested	1	unitless	Assumes all of soil intake from site
Exposure Frequency	180	day/year	Value assumed, due to snow cover
Exposure Duration	30	years	EPA, 1991a
Body Weight	70	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens	 25,550 10,950	 days days	EPA, 1989
RESIDENTIAL DERMAL CONTACT WITH GROUNDWATER (SHOWERING)			
Dermal Permeability Constant	chemical specific	cm/hr	EPA, 1992, (see Table I.3-2)
Skin Surface Area	23,000	cm^2	EPA, 1992
Exposure Duration	30	years	EPA, 1991a
Exposure Frequency	180	day/year	Value assumed, due to snow cover
Exposure Time	0.25	hr/day	EPA, 1991a
Body Weight	70	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens	 25,550 10,950	 days days	EPA, 1989
RESIDENTIAL INHALATION OF VOCS (SHOWERING)			
Inhalation Rate	0.6	m^3/hr	EPA, 1991a
Exposure Frequency	180	day/year	Value assumed, due to snow cover
Exposure Duration	30	years	EPA, 1991a
Exposure Time	0.25	hr/day	EPA, 1991a
Body Weight	70	kg	EPA, 1991a
Averaging Time: Carcinogens Noncarcinogens	 25,550 10,950	 days days	EPA, 1989

Table I.3-4
Intake Concentrations for Subsurface Soil at the SGZ Mud Pits of Rulison

Exposure Pathway	Constituent	Estimated Intake (mg/kg-day)	
		Carcinogenic	Noncarcinogenic
Incidental Ingestion	Barium	NA[a]	7.30E-03
	Benzene	4.11E-08	NA
	Chromium III	NA	3.02E-04
	Chromium VI	NA	6.03E-05
	Ethylbenzene	NA	1.73E-06
	Lead	NA	3.41E-04
	Toluene	NA	2.04E-07
	TPH as Diesel	NA	1.19E-02
	Xylene	NA	2.79E-05
	Tritium	1.56E+02 (pCi)	NA
Dermal Contact	Barium	NA	1.01E-03
	Benzene	9.03E-08	NA
	Chromium III	NA	4.18E-05
	Chromium VI	NA	8.36E-06
	Ethylbenzene	NA	2.40E-06
	Lead	NA	4.74E-05
	Toluene	NA	2.83E-07
	TPH as Diesel	NA	4.95E-03
	Xylene	NA	3.87E-05
	Tritium	2.84E+00 (pCi)	NA
Inhalation of Dust	Barium	NA	7.94E-07
	Benzene	1.73E-11	NA
	Chromium III	NA	3.28E-08
	Chromium VI	2.81E-09	NA
	Ethylbenzene	NA	1.88E-10
	Lead	NA	3.71E-08
	Toluene	NA	2.22E-011
	TPH as Diesel	NA	1.29E-06
	Xylene	NA	3.03E-09
	Tritium	7.28E-02 (pCi)	NA

[a]Not applicable

Table I.3-5
Intake Concentrations for Groundwater in the Vicinity of Rulison

Exposure Pathway	Constituent	Estimated Intake (mg/kg-day)	
		Carcinogenic	Noncarcinogenic
Incidental Ingestion	Barium	NA	3.64E-03
	Benzene	6.04E-06	NA
	Chromium III	NA	2.35E-04
	Chromium VI	NA	4.70E-05
	Ethylbenzene	NA	1.41E-05
	Lead	NA	7.19E-05
	Toluene	NA	1.41E-05
	TPH as Diesel	NA	7.05E-03
	Xylene	NA	2.11E-05
	Tritium	2.74E+06 (pCi)	NA [a]
Dermal Contact while Showering	Barium	NA	1.05E-05
	Benzene	3.65E-07	NA
	Chromium III	NA	6.75E-07
	Chromium VI	NA	1.35E-07
	Ethylbenzene	NA	3.00E-06
	Lead	NA	2.07E-07
	Toluene	NA	1.82E-06
	TPH as Diesel	NA	4.25E-04
	Xylene	NA	4.86E-06
	Tritium	1.26E+03 (pCi)	NA
Inhalation of VOCs While Showering	Barium	NA	NA
	Benzene	3.26E-07	NA
	Chromium III	NA	NA
	Chromium VI	NA	NA
	Ethylbenzene	NA	1.18E-06
	Lead	NA	NA
	Toluene	NA	6.33E-07
	TPH as Diesel	NA	NA
	Xylene	NA	2.25E-06
	Tritium	2.73E+04 (pCi)	NA

[a]Not applicable

I.3.2.2.1 Dermal Contact with Groundwater

The following is the intake equation for dermal absorption of chemicals due to contact with groundwater:

$$AD = \frac{C_i \ x \ SA \ x \ PC \ x \ CF \ x \ ET \ x \ EF \ x \ ED}{BW \ x \ AT}$$

where

AD = Absorbed dose (mg/kg-day)

C_i = Chemical concentration in shower water, adjusted for volatilization (mg/L)

SA = Skin surface area available for contact (cm^2)

PC = Chemical-specific dermal permeability (EPA, 1992) (see Table I.3-2 for specific values)

CF = Conversion factor (10^{-3} L/cm^3)

ET = Exposure time (hr/day)

EF, ED, BW, and AT are defined in Section I.3.2.1.

I.3.2.3 Exposure Parameters

Three types of parameters are used in exposure models to estimate intake (EPA, 1989):

- Constituent-related parameters (i.e., exposure point concentrations)
- Parameters that describe the exposed population (e.g., contact rate, exposure frequency and duration, and body weight)
- Toxicity-related parameters (i.e., slope factors and reference doses).

I.4.0 Toxicity Assessment

Toxicity information is given in the same units provided by the source material (dose rates and concentrations are primarily used). In a few cases, however, conversions were made as specifically indicated in Section I.4.1. Toxicological profiles for each constituent of potential concern are presented separately in this chapter, along with the corresponding Chemical Abstracts Service Registry Number (CASRN).

The EPA weight-of-evidence classification (cancer class) system for carcinogenicity is presented here for reference. The classification is as follows (EPA, 1989):

- Class A—Human carcinogen
- Class B1—Probable human carcinogen; limited human data available
- Class B2—Probable human carcinogen; sufficient evidence in animals; inadequate or no evidence in humans
- Class C—Possible human carcinogen
- Class D—Not classifiable as to human carcinogenicity
- Class E—Evidence of noncarcinogenicity for humans

Slope factors are typically calculated for potential carcinogens in Classes A, B1, and B2. Quantitative estimation of slope factors for chemicals in Class C proceeds on a case-by-case basis.

The primary source for toxicity values, both reference doses (RfD) and slope factors (SF), is the Integrated Risk Information System (IRIS) (EPA, 1996). If a toxicity value for a given chemical is not available in IRIS, the secondary source is the Health Effects Assessment Summary Tables (HEAST) (EPA, 1995). For TPH, an EPA Region II reference document provided a reference dose (EPA, 1993). No surrogate values were developed for chemicals for which no toxicity information existed in one of the above references.

I.4.1 Toxicological Profiles

Barium, CASRN 7440-39-3. Barium is a silver-white, malleable metal. It is rarely encountered in elemental form but more often in ores or as an ion. In that form, barium is relatively abundant

in nature and occurs in plant and animal tissues. Barium is used primarily as a carrier for radium and in alloys of barium and aluminum or magnesium. Barium is a common additive to drilling mud, and is naturally occurring in areas of igneous origin as supported by the concentration of barium detected in the upgradient background monitoring well RU-03. From soluble compounds, barium is absorbed in small quantities into the human body and retained there. The daily intake is about 0.75 mg, but the retention time is short--probably less than a day (ICRP, 1975). The considerable oral toxicity of barium is usually masked by the low solubility of most common barium compounds. In soluble form, however, it leads to gastroenteritis and to effects on the heartbeat, up to and including ventricular fibrillations (Doull et al., 1980). By inhalation, barium ores (mostly barium sulfate and barium carbonate) lead to a mild form of pneumoconiosis, which is usually reversible after termination of the exposure. The reference concentration (RfC) for barium is 5.0×10^{-4} mg/kg-day for inhalation, and the RfD is 7.0×10^{-3} mg/kg-day for ingestion, with an uncertainty factor of 3 (EPA, 1996; EPA, 1995). The cancer class and SFs for barium are unknown at this time.

Chromium, CASRN 16065-83-1. The primary uses of chromium are for plating metals, steel fabrication, paint and pigment manufacturing, and leather tanning. The likely source of chromium at the site is chromium lignosulfonate, a drilling mud additive. Chromium exists in several valence states; however, only the trivalent and hexavalent states are biologically significant. For this risk assessment, the hexavalent state was initially considered because of its high toxicity. Hexavalent chromium is a Class A carcinogen. Acute exposure to chromium compounds causes dermatitis, penetrating ulcers on the hands and forearms, perforation of the nasal septum, and inflammation of the larynx and liver. Epidemiologic studies indicate that chromate is a carcinogen, with bronchogenic carcinoma as the principal lesion. The relative risk to chromate plant workers in the development of respiratory cancer is 20 times greater than in the general population (Doull et al., 1980). The oral RfD for chromium-VI is 5.0×10^{-3} mg/kg-day (EPA, 1996), with an uncertainty factor of 500. No inhalation RfC is reported. The inhalation SF for chromium-VI is 42 kg-day/mg (EPA, 1995). The oral RfD for chromium-III is 1.0 mg/kg-day (EPA, 1996), with an uncertainty factor of 100. No other values are available for chromium-III.

Lead and Inorganic Lead Compounds, CASRN 7439-92-1. The toxicity of lead and its compounds has probably received more attention than most other metals. Lead is used as a construction material for tank linings, piping, and equipment-handling corrosive gases and liquids. On the basis of the data generated in these investigations, there are a number of standards for air and water. Lead is a regular contaminant in most foods, resulting in a daily

intake of about 0.4 mg (ICRP, 1975). However, even at low levels of exposure, some human responses to chronic lead poisoning have been found. The toxic effects of lead are widespread, encompassing the central nervous system, the peripheral nervous system, the kidneys, and the blood. The EPA has published no oral RfD for lead because its toxicity is thought not to demonstrate a threshold.

There is sufficient evidence of carcinogenicity in animal experiments with lead compounds to classify lead and its inorganic compounds as probable Class B2 human carcinogens. Kidney tumors were observed in these experiments, although usually only at high doses. However, because of problems with dosimetry, no estimates for the SFs are currently available.

Benzene, CASRN 71-43-2. Benzene is a clear, colorless liquid (boiling point 80.1 degrees Celsius [°C], melting point 5.51°C [Sax, 1989]). It has widespread use in the chemical and drug industries and is used as a solvent for paints, resins, lacquers, and plastics. The likely source of benzene at the site is diesel fuel used as a drilling mud additive. Exposures in humans occur mostly by inhalation because of the high volatility of benzene. In acute exposure, benzene toxicity appears primarily to have an effect on the central nervous system; an exposure of 20,000 parts per million (ppm) for humans is usually fatal within 5 to 10 minutes. Symptoms of intoxication are drowsiness, dizziness, headache, and loss of consciousness (Doull et al., 1980). Chronic exposure rather than acute exposure to benzene is a primary concern in industry. It is a leukemogen, and daily exposure to a concentration of 100 ppm or less will usually cause damage if continued over a protracted period of time. The early symptoms of chronic benzene poisoning consist of headaches, fatigue, and loss of appetite (Sax, 1989). Benzene is a Class A human carcinogen, with oral and inhalation SFs of 2.9×10^{-2} kg-day/mg from IRIS (EPA, 1996).

Ethylbenzene, CASRN 100-41-4. Ethylbenzene is a colorless, flammable liquid (boiling point 136.2°C) with an aromatic odor. It is primarily used in the production of styrene and synthetic polymers, as a solvent, and as a component in fuels (Sax, 1989). The likely source of ethylbenzene at the site is diesel fuel used as a drilling mud additive. Ethylbenzene is absorbed primarily through the respiratory system. In low concentrations, the vapor is an irritant to the eyes, nose, and throat and may cause dizziness, leading to a sense of constriction of the chest. In chronic exposures, the compound is a kidney and liver toxin. Ethylbenzene has an oral RfD of 1.0×10^{-1} mg/kg-day, with an uncertainty factor of 1,000, and an inhalation RfC of 2.9×10^{-1} mg/kg-day, with an uncertainty factor of 300 (EPA, 1996). The compound is not considered to be a potential human carcinogen (Class D), and, therefore, no SFs are available.

Toluene, CASRN 108-88-3. Toluene is a colorless, volatile liquid (boiling point 110.4°C) that is widely used as a solvent in paints, varnishes, and glues (Sax, 1989). It also serves as an intermediate compound in the synthesis of organic substances. The likely source of toluene at the site is diesel fuel used as a drilling mud additive. At high levels of exposure, toluene is a narcotic and thus affects the central nervous system, leading to fatigue, weakness, and confusion. In low chronic exposures, toluene can cause damage to the liver and kidney. It has an RfD for chronic ingestion of 2.0×10^{-1} mg/kg-day and a chronic inhalation RfC of 1.1×10^{-1} mg/kg-day (EPA, 1996). The uncertainty factors for toluene are 1,000 for oral exposure and 300 for inhalation. Toluene is not suspected of being carcinogenic (Class D), and therefore, no SFs are available.

Total Petroleum Hydrocarbons as Diesel. TPH as diesel is a mixture of organic hydrocarbons. The combined effects of these chemicals are considered when determining the risk for a given pathway. Although no reference doses are available in IRIS or HEAST, an EPA Region II document describes an oral RfD of 0.6 developed by the State of Massachusetts (EPA, 1993), and that value was used in this study.

Xylene, CASRN 1330-20-7. Xylene is a mixture of the three different isomers (o-, p-, and m-) of dimethylbenzene; however, it consists mostly of the last two. It is a clear liquid that boils at 130 to 150°C, depending on the mixture (Sax, 1989). Xylene is a solvent used in resins, lacquers, and enamels and is also used in the synthesis of organic compounds, in aviation gasoline, and in other engine fuels. The likely source of xylene at the site is diesel fuel used as a drilling mud additive. Xylene is moderately toxic by inhalation and ingestion and is an eye and skin irritant in high concentrations. On inhalation, xylene can lead to lung damage. At low exposure levels, liver and kidney damage may occur. The ingestion RfD is 2.0 mg/kg-day, with an uncertainty factor of 100 (EPA, 1996), but no value is listed for inhalation RfC. There is no evidence of carcinogenic activity (Class D) in humans or laboratory animals exposed to xylenes (EPA, 1996), and, therefore, no SFs exist.

Tritium CASRN 010028-17-8. At most tritium facilities, the most commonly encountered forms of tritium are tritium gas (HT) and tritium oxide (HTO). Other forms of tritium may be present, such as a metal tritides, tritiated pump oil, and tritiated gases such as methane and ammonia. As noted earlier, deuterated and tritiated compounds generally have the same chemical properties as their protium counterparts, although some minor isotopic differences in reaction rates exist. These various tritiated compounds have a wide range of metabolic properties in humans under similar exposure conditions. For example, inhaled tritium gas is only slightly incorporated into

the body during exposure, and the remainder is rapidly removed (by inhalation) following the exposure. On the other hand, tritiated water vapor is readily taken up and retained in the body water (tritium half-life is 12.3 yrs). The slope factor for tritium is 7.15E-14 pCi^{-1} for ingestion, and the slope factor is 9.59E-14 pCi^{-1} for inhalation (EPA, 1995).

I.4.2 Toxicity Summary

Table I.4-1 summarizes the toxicity information, including the constituent of potential concern RfDs, slope factors, and EPA cancer classification.

Table I.4-1
Summary of Toxicity Data for COPCs at Rulison, Colorado

Radiological Slope Factors					
Radionuclides	**Half Life** (years)	**Ingestion** (risk/pCi)	**Inhalation** (risk/pCi)		**External Exposure** (risk/pCi-g)
Tritium	12.3	7.15×10^{-14} [a]	9.59×10^{-14} [a]		0.00
Chemical Toxicity Values					
Chemicals	**Oral RfD** (mg/kg-day)	**Inhalation RfC** (mg/kg-day)	**Cancer Class**	**Oral Slope Factor** $(mg/kg\text{-}day)^{-1}$	**Inhalation Slope Factor** $(mg/kg\text{-}day)^{-1}$
Barium	0.07 [b]	0.0005 [a]	No Data	No Data	No Data
Benzene	No Data	No Data	A [c]	0.029[b]	0.029 [b]
Chromium III	1.0 [b]	No Data	No Data	No Data	No Data
Chromium VI	0.005 [b]	No Data	A	No Data	42 [a]
Ethylbenzene	0.1 [b]	0.29 [b]	D [d]	NA [b]	NA
Lead	No Data	No Data	B2 [b]	No Data	No Data
Toluene	0.2 [b]	0.11 [b]	D	NA	NA
TPH as Diesel	0.6 [g]	No Data	NA	No Data	No Data
Xylene	2.0 [b]	No Data	D	NA	NA

[a] EPA, 1995
[b] EPA, 1996
[c] Human carcinogen
[d] Not classifiable as to human carcinogenicity
[e] Not applicable
[f] Probable human carcinogen; sufficient evidence in animals; inadequate or no evidence in humans
[g] EPA, 1993

I.5.0 Risk Characterization

This section provides a characterization of the potential health risks associated with the intake of constituents of potential concern in subsurface soil. Risk characterization compares estimated potential cancer risks with reasonable levels of risk (slope factors) for carcinogens and compares estimated daily intake (rate) with reference levels (reference doses) for noncarcinogens. Carcinogens may also pose a systemic (noncarcinogenic) hazard, and these potential hazards are characterized in the same manner as other noncarcinogens.

Estimation of potential risk from exposure to the COPCs is based on RAGS (EPA, 1989). This assessment employs a health-protective bias that leads to a conservative estimation of the risk. The exposure of individuals to an RME is described in Section I.3.1 and evaluated in Section I.3.2 to provide estimates of daily intakes. These estimated intakes (rates) are evaluated with the individual chemical toxicological values (Section I.4.1) to determine the potential carcinogenic risks and the potential hazards to human health.

I.5.1 Estimation of Carcinogenic Risk

In evaluating the calculated residential exposure from potentially carcinogenic COPCs, a reasonable level of risk must be selected. The EPA uses an incremental lifetime cancer risk (ILCR) (also referred to as excess cancer risk) of 1 in 10,000 (1×10^{-4}) as the upper limit of acceptable risk at contaminated sites. In addition, in the National Contingency Plan (NCP) (CFR, 1990), the EPA specifies a risk range of 10^{-6} to 10^{-4} for developing remediation goals for the purpose of developing and evaluating remedial alternatives for contaminated media.

Based on the regulatory precedents cited above, a reasonable and appropriate maximum acceptable ILCR for the site would be 10^{-4}. As implemented under the NCP, pathway risks greater than 10^{-6} ILCR must receive risk management consideration (CFR, 1990). The quantitative risk assessment is one of many factors that is considered in the decision-making process for remediation. Therefore, there is no single risk value that defines "acceptable" and "unacceptable" risk. The purpose of this risk assessment is to present quantitative and qualitative estimates of potential risk, and thus, all pathway risks greater than the lower bound of 10^{-6} will be examined.

Cumulative site ILCRs were developed for subsurface soil and groundwater COPCs. These cumulative ILCRs included all media and pathways that were appropriate to combine. These

pathways occur when there is potential for an individual to be exposed to multiple pathways at the same given instant in time. Where the cumulative ILCR site risk to an individual based on the RME for both current and future land use is less than 10^{-4}, action generally is not warranted unless there are adverse environmental impacts (EPA, 1991b).

The carcinogenic risk is estimated as the probability of an additional incidence of cancer. This risk is:

$$ILCR = SF \times Intake$$

where

ILCR = Incremental lifetime cancer risk (unitless)

SF = Carcinogenic SF [$(mg/kg\text{-}day)^{-1}$]

Intake = Chronic daily intake averaged over a 70-year lifetime (mg/kg-day).

The carcinogenic SFs for the constituents of potential concern are presented in Table I.4-1. These are the most recent values cited in the EPA's IRIS (EPA, 1996), and the HEAST (EPA, 1995). Surrogate values for constituents were not derived where no SF existed in the IRIS or the HEAST.

For a given pathway and medium with exposure to several carcinogens, the following equation was used to sum the cancer risk:

$$Risk_{t,p} = \sum_{i=1}^{I} ILCR_p\ (chem_i)$$

where

$Risk_{t,p}$ = Total cancer risk for pathway p (unitless)

$ILCR_p(chem_i)$ = Individual cancer risk for constituent i through exposure pathway p (unitless)

Estimates of ILCRs are provided for each exposure scenario and pathway in Section I.5.3.

I.5.2 Estimation of Noncarcinogenic Risk

Constituents that pose a health threat other than cancer were evaluated by comparing an exposure level or intake to an acceptable level or RfD. The ratio of estimated daily intake to the RfD is termed the hazard quotient (HQ) and is defined as

$$HQ_{i,p} = \frac{I_{i,p}}{RfD_i}$$

where

$HQ_{i,p}$ = Individual HQ for exposure to constituent i through exposure pathway p (unitless)

$I_{i,p}$ = Daily intake via a specific pathway p for constituent i (mg/kg-day)

RfD_i = RfD for exposure by the specific pathway (limited to oral and inhalation values) for constituent i (mg/kg-day).

The RfD is an estimate of the intake level to which a human population, including sensitive subpopulations, may be chronically exposed without a significant risk of adverse health effects (EPA, 1989). The RfDs for the constituents of potential concern are listed in Table I.4-1. Because the HQ does not define intake response relationships, its numerical value should not be construed as a direct estimate of risk, but it does suggest that a given situation should be more closely scrutinized. The concept of the HQ implies the existence of a threshold for systemic health effects. The HQ is a numerical indication of the fraction of acceptable limits of exposure or the degree to which acceptable exposure levels are exceeded. As this quotient increases toward unity, concern for the potential hazard of the constituent increases. A value above unity is an indication of risk, although a direct correlation to the magnitude of the risk cannot be drawn. The RfDs used in this risk assessment are the most recent values cited in the IRIS (EPA, 1996) and HEAST (EPA, 1995), and for TPH, an EPA Region II document (EPA, 1993). No surrogate values were derived.

In the case of simultaneous exposure to several constituents, the hazard index (HI) is calculated to evaluate the potential risk from exposure to the mixture by summing the HQs for each

chemical, medium, and pathway. The total HI incorporates the assumption of additive effects when dealing with a mixture of components. The HI formula is as follows (EPA, 1989):

$$HI = \sum_{i=1}^{I} HQ_i$$

where

HI = Hazard index (unitless)

HQ_i = Hazard quotient for exposure to constituent i (unitless)

Summation of the individual HQs could result in an HI that exceeds 1, even if no single chemical exceeds its acceptable level. Mechanistically, it is not appropriate to sum HQs unless the constituents that make up the mixture have similar effects on the identical organ. Consequently, the summing of HQs for a mixture of compounds that are not expected to include the same type of effects could overestimate the potential risk. The EPA recommends that if the total HI is greater than unity, the components of the mixture should be grouped by critical effect, and separate hazard indices should be calculated for each effect.

I.5.3 Results of the Human Health Risk Assessment

Risk for inorganic lead was calculated using the California Department of Toxic Substance Control LEADSPREAD model (DTSC, 1992). The model was run with the plant uptake turned "off" because secondary pathways were not considered at Rulison. There are no regional data for lead in air at Rulison, so the LEADSPREAD default value of 0.15 micrograms [μg]/m^3 was assumed. The maximum detected soil concentration of 119 mg/kg and the maximum detected groundwater concentration of 5.1 μg/L were used as input parameters. The output is summarized as blood level concentrations for three potential receptor groups: adult, child (the most sensitive population), and occupational. The child blood level for Rulison at the 99th percentile was calculated to be 7.2 μg/decaliter [dL] of blood. The lead whole body level of concern is 10 μg/dL of whole blood with a 0.01 risk of exceeding this value (DTSC, 1992). Therefore, based on the above results, lead both in soil and groundwater at Rulison does not exceed the established blood levels of concern.

I.5.3.1 SGZ Mud Pits

Table I.5-1 summarizes the risks for the subsurface soil pathway for the SGZ mud pits. Included in this summary is the ILCR and HQ for each chemical of potential concern and pathway, and pathway total ILCRs and HIs.

The human health risk assessment suggests that the level of contamination found on an individual COPC basis at this site for the examined medium (subsurface soil) does not pose a significant risk. None of the individual COPC risks is above an HQ of 1.0 or an ILCR of 1×10^{-6}.

For the SGZ mud pit soils, no total ILCRs and HIs exceed suggested guidance levels (an ILCR of 1×10^{-4} or HI of 1.0) established by both state and federal regulators (see Sections I.5.1 and I.5.2 above).

I.5.3.2 Groundwater

Table I.5-2 summarizes the risks for the groundwater pathway at Rulison. Included in this summary is the ILCR and HQ for each constituent of potential concern and pathway, and pathway total ILCRs and HIs.

The human health risk assessment suggests that the level of contamination found on an individual COPC basis at these sites for the examined medium (groundwater) does not pose a significant risk. None of the individual COPC risks is above an HQ of 1.0 or an ILCR of 1×10^{-6}.

For the drilling effluent pond and SGZ mud pits area groundwater, no total ILCRs and HIs exceed suggested guidance levels (an ILCR of 1×10^{-4} or HI of 1.0) established by both state and federal regulators (see Sections I.5.1 and I.5.2 above).

Table I.5-1
Incremental Lifetime Cancer Risks and Hazard Quotients/Indices for Future Residential Exposure to Subsurface Soil at the SGZ Mud Pits
(Page 1 of 2)

Exposure Route	Chemical/Radionuclide	Hazard Quotient/Index	ILCR[a]
Incidental Ingestion	Barium	1.0×10^{-01}	ND[b]
	Benzene	ND	1.2×10^{-09}
	Chromium III	3.0×10^{-04}	ND
	Chromium VI	1.2×10^{-02}	ND
	Ethylbenzene	1.7×10^{-05}	NA[c]
	Lead	ND	ND
	Toluene	1.0×10^{-06}	NA
	TPH as Diesel	2.0×10^{-02}	ND
	Xylene	1.4×10^{-05}	NA
	Tritium	NA	1.1 E-11
	Pathway Totals	1.4×10^{-01}	1.2×10^{-09}
Dermal Contact	Barium	1.4×10^{-02}	ND
	Benzene	ND	2.6×10^{-09}
	Chromium III	4.2×10^{-05}	ND
	Chromium VI	1.7×10^{-03}	ND
	Ethylbenzene	2.4×10^{-05}	NA
	Lead	ND	ND
	Toluene	1.4×10^{-06}	NA
	TPH as Diesel	8.2×10^{-03}	ND
	Xylene	1.9×10^{-05}	NA
	Tritium	NA	ND
	Pathway Totals	2.4×10^{-02}	2.6×10^{-09}

Table I.5-1
Incremental Lifetime Cancer Risks and Hazard Quotients/Indices for Future Residential Exposure to Subsurface Soil at theSGZ Mud Pits
(Page 2 of 2)

Exposure Route	Chemical/Radionuclide	Hazard Quotient/Index	ILCR[a]
Inhalation of Dust	Barium	5.6×10^{-03}	ND
	Benzene	ND	5.0×10^{-13}
	Chromium III	ND	ND
	Chromium VI	ND	1.2×10^{-07}
	Ethylbenzene	6.6×10^{-10}	NA
	Lead	ND	ND
	Toluene	1.9×10^{-10}	NA
	TPH as Diesel	ND	ND
	Xylene	ND	NA
	Tritium	NA	7.0×10^{-15}
	Pathway Totals	5.6×10^{-03}	1.2×10^{-07}

[a]Incremental lifetime cancer risk
[b]No toxicity information available for the given pathway

Table I.5-2
Incremental Lifetime Cancer Risks and Hazard Quotients/Indices for Future Residential Exposure to Groundwater at Rulison
(Page 1 of 2)

Exposure Route	Chemical/Radionuclide	Hazard Quotient/ Index	ILCR[a]
Incidental Ingestion	Barium	5.2E-02	NA
	Benzene	NA	1.8E-07
	Chromium III	2.3E-04	NA
	Chromium VI	9.4E-03	NA
	Ethylbenzene	1.4E-04	NA
	Lead	NA	NA
	Toluene	7.0E-05	NA
	TPH as Diesel	1.2E-02	NA
	Xylene	1.1E-05	NA
	Tritium	NA	2.0 E-07 [b]
	Pathway Totals	7.4E-02	3.8E-07

Table I.5-2
Incremental Lifetime Cancer Risks and Hazard Quotients/Indices for Future Residential Exposure to Groundwater at Rulison
(Page 2 of 2)

Exposure Route	Chemical/Radionuclide	Hazard Quotient/ Index	ILCR[a]
Dermal Contact	Barium	1.5E-04	NA
	Benzene	NA	1.1E-08
	Chromium III	6.8E-07	NA
	Chromium VI	2.7E-05	NA
	Ethylbenzene	3.0E-05	NA
	Lead	NA	NA
	Toluene	9.1E-06	NA
	TPH as Diesel	7.1E-04	NA
	Xylene	2.4E-06	NA
	Tritium	NA	9.0 E-11 [b]
	Pathway Totals	9.3E-04	1.1E-08
Inhalation of VOCs While Showering	Barium	NA	NA
	Benzene	NA	9.5E-09
	Chromium III	NA	NA
	Chromium VI	NA	NA
	Ethylbenzene	4.1E-06	NA
	Lead	NA	NA
	Toluene	7.6E-06	NA
	TPH as Diesel	NA	NA
	Xylene	NA	NA
	Tritium	NA	2.6E-09 [b]
	Pathway Totals	1.2E-05	1.2E-08

[a] Incremental lifetime cancer risk
[b] Tritium sampling results are available only from the SGZ mud pits area groundwater monitoring wells.

I.5.4 General Uncertainties

The overriding uncertainties associated with the risk characterization are as follows:

- The extrapolation of toxic effects observed at the high doses necessary to conduct animal studies to effects that might occur at much lower, more realistic doses.

- The extrapolation from toxic effects in laboratory animals to toxic effects in humans (i.e., responses of animals may be different from responses of humans).

- The conservative estimation of receptor concentrations for constituents of potential concern are above the true average and include maximum values and upper 95 percent confidence limits.

- The pathways selected are the most conservative (i.e., residential).

- Currently there is not a receptor point of contact at either area of concern. At the SGZ mud pits, the potential contamination source is from subsurface soils; and for both the drilling effluent pond and SGZ mud pits area groundwater, there is no domestic well currently present.

- Pathway analyses have been conservative and generally do not include fate and transport considerations (e.g., dispersion, adsorption) in the estimates.

I.6.0 Groundwater Trigger Levels

Risk-based trigger levels were developed for the COPCs in groundwater. Trigger levels are suggested concentrations of the COPCs which, if exceeded, would indicate a need to further evaluate site monitoring data. These levels are a risk management tool and do not represent risk levels at which remediation is necessary or at which regulatory levels are exceeded.

I.6.1 Methodology and Equations

The trigger levels were calculated using modified intake and risk equations to develop the concentration for a given COPC which would be equal to a pre-established risk level. Using the risk equations to target a specific risk level is often referred to as "back-calculating." The Rulison groundwater trigger levels were calculated based on either a incremental lifetime cancer risk of 1×10^{-6} or a hazard index of 1.0. The trigger level provided for each COPC is the lower of these two risk levels.

The following are the general equations used to calculate the risk-based trigger levels. All of the input parameters, unless otherwise stated, are the same as those listed in Table I.3-3.

The carcinogen trigger levels equation is

$$C_i = \frac{AT \times BW \times TR}{EF \times ED \times F \times (IR \times SF_{oi} + VF \times INR \times ETs \times SF_{ii} + SA \times PC_i \times ETs \times SF_{oi})}$$

where

AT = Averaging time; period over which exposure is averaged (days)

BW = Body weight; the average body weight over the exposure period (kg)

C_i = Constituent-specific trigger level (mg/L)

ED = Exposure duration (years)

EF = Exposure frequency (days/year)

ETs = Exposure time showering (hr/day)

IR = Ingestion rate (L/day)

INR = Inhalation rate (m^3/hour)

F = Fraction of water from site (unitless, 1.0)

PC_i = Constituent-specific dermal permeability (EPA, 1992) (see Table I.3-2 for specific values)

SA = Skin surface area (cm^2)

Sf_{oi} = Oral slope factor ($(mg/kg\text{-}day)^{-1}$)

Sf_{ii} = Inhalation slope factor ($(mg/kg\text{-}day)^{-1}$)

TR = Target risk level (unitless, 1×10^{-6})

VF = Volatilization factor (unitless, see Section I.3.2.1.3 for the chemical specific calculation process)

The noncarcinogen trigger level equation is

$$C_i = \frac{AT \times BW \times TR}{EF \times ED \times F \times \left(\frac{IR}{RfD_i} + \frac{VF \times INR \times ETs}{RfC_i} + \frac{SA \times PC_i \times ETs}{RfD_i}\right)}$$

where

RfD_i = Reference dose (mg/kg-day)

RfC_i = Reference concentration (mg/kg-day)

TR = Target risk level (unitless, 1.0)

AT, BW, C_i, ED, EF, ETs, IR, INR, F, PC_i, SA, and VF are the same as above.

I.6.2 Groundwater Trigger Summary

Table I.6-1 summarizes the risk-based trigger levels for the groundwater COPCs. The detection limits were provided to verify that the established trigger levels are above analytical detection levels.

Table I.6-1
Summary of Rulison Groundwater Trigger Levels

Chemical	Risk-Based Trigger Level (mg/L)	Detection Level (mg/L)
Barium	5.0[a]	0.02
Benzene	0.0052[b]	0.001
Chromium III	71[a]	0.02
Chromium VI	0.36[a]	0.02
Ethylbenzene	5.8[a]	0.001
Lead	1.0	0.002
Toluene	11.5[a]	0.001
TPH as Diesel	40.3[a]	0.5
Xylenes	116[a]	0.001
Radionuclide	**Risk-Based Trigger Level (pCi/L)**	**Detection Level (pCi/L)**
Tritium	1,300[c]	Varies

[a]Based on a combined pathway hazard index of 1.0
[b]Based on a combined pathway incremental lifetime cancer risk of 1×10^{-06}
[c]Trigger level based on a 10^{-6} risk level and not on dose. Established state and federal regulations may differ significantly.

I.7.0 References

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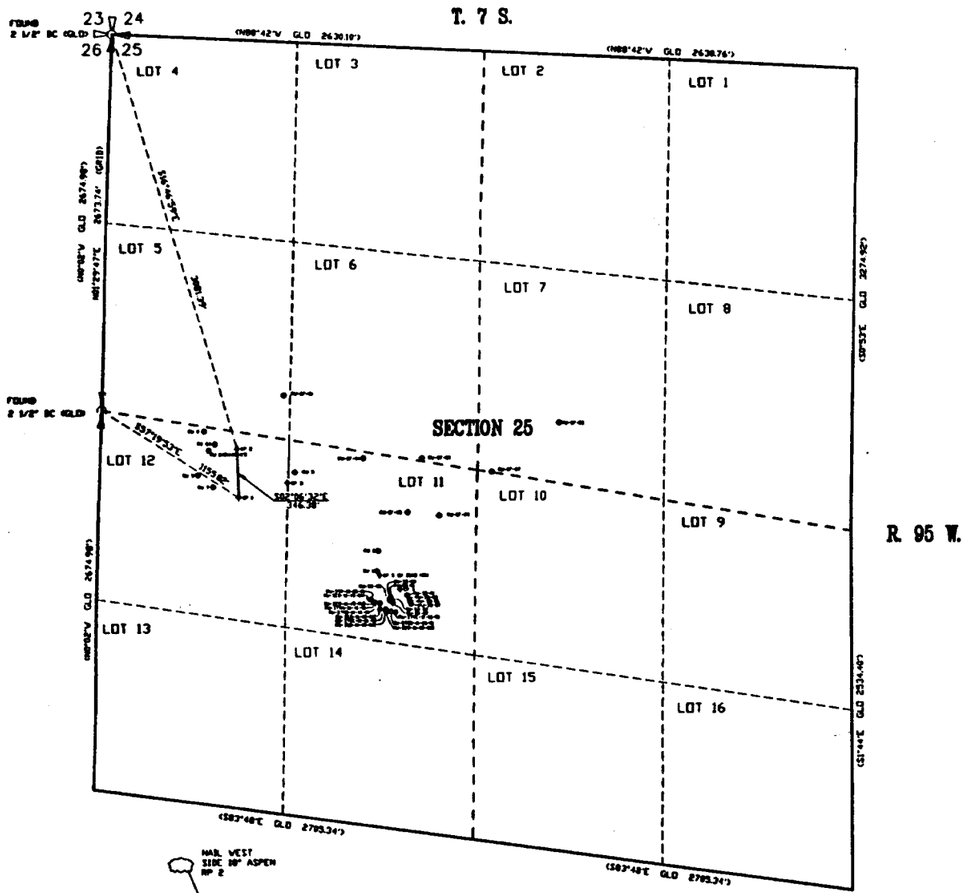
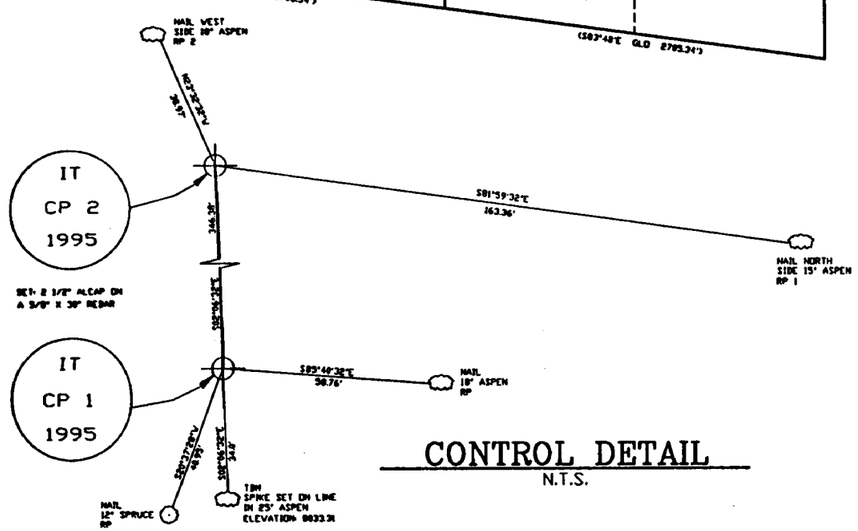
Plates





CONTROL DETAIL

N.T.S.

DRAWN BY:	D.R. GRIFFIN & ASSOCIATES, INC.	APPROVED BY:	REVISIONS
DATE	DECEMBER, 1995	PROJ. NO.	
JOB NO.:	9510BCD	DWG. NO.	

	POINT NAME	NAD 27 LATITUDE	NAD 27 LONGITUDE	NAD 27 STATE PLANE NORTHING	NAD 27 STATE PLANE EASTING	NAD 83 STATE PLANE NORTHING	NAD 83 STATE PLANE EASTING	ELEVATION
BASIS OF CONTROL	SLAUGHENHOUPT HIGH HORIZONTAL CONTROL STATION (THIRD ORDER) COLORADO CENTRAL ZONE	N 39°27'26.483"	W 107°54'54.264"	6005238400	1310153.6200			6754
CONTROL POINTS	CP 1	N 39°24'24.439"	W 107°57'04.957"	5823861.6687	1307409.6455	15823941.5859	2307259.5156	8026.94
	CP 2	N 39°24'27.656"	W 107°57'09.230"	5823732.3141	1307396.8590	15823813.7375	2307237.7694	8022.82
	CP 3	N 39°24'25.537"	W 107°57'08.621"	5823684.8595	1307752.7804			8047.79
	CP 4	N 39°24'18.353"	W 107°56'58.2230"	5823739.4692	1308548.4849			8199.84
	CP 3 OR ZERO MON	N 39°24'19.302"	W 107°56'58.189"	5823839.5044	1308402.1017			8199.34
SOIL BORING	RU-SB-01			5816671.467	1308480.5128			8172.36
	RU-SB-02			5816428.9240	1308497.4474			8172.17
	RU-SB-03			5816235.846	1308482.6241			8172.69
	RU-SB-04			5816158.6291	1308492.5267			8172.66
	RU-SB-05			5816611.8019	1308478.4153			8171.71
	RU-SB-06			5816352.7139	1308618.3953			8208.12
	RU-SB-07			5816337.7758	1308828.1432			8208.18
	RU-SB-08			5816667.3198	1308611.8765			8208.69
	RU-SF-01			5831008.478	1307753.5234			8058.96
	RU-SF-03			5829131.661	1309644.6639			8689.64
	RU-SF-04			5826615.732	1309281.4801			8129.27
	RU-SF-05			5826662.2241	1308798.0952			8258.85
	RU-SF-07			5825363.4836	1309198.9458			8379.98
	RU-SF-08			5822279.3192	1308694.3427			8282.16
	RU-SF-09			5822257.2584	1308824.5637			8231.64
	RU-SE-01			5816697.2946	1308598.5026			8208.89
MISCELLANEOUS SAMPLES	RU-SEB-11-15-01A			5816678.8871	1308339.4774			8145.18
	RU-SEB-11-15-01B			5816444.4729	1308368.8787			8146.97
	RU-SEB-11-15-01C			5815982.4467	1308405.4121			8154.52
	RU-SEB-11-15-01D			5815777.3701	1308451.2943			8161.81
	RU-SEB-11-15-01E			5815865.5816	1308453.3900			8165.20
	RU-STR-11-15-01			5816667.4900	1308341.3000			8145.07
	RU-STRA-11-16-01			5816465.9062	1308371.8999			8158.21
	RU-STRB-11-16-01			5816413.6323	1308487.2309			8157.52
	RU-STRC-11-16-01			5815998.8065	1308446.8062			8161.65
	RU-STRD-11-16-01			5815853.3927	1308483.7199			8165.29
	RU-STRE-11-16-01			5815777.7018	1308515.4512			8169.84
MONITORING WELLS						GROUND ELEVATION	ELEVATION TOP CONCRETE	ELEVATION TOP PVC
	RU 1			5818968.9401	1308383.3567	8156.49	8156.69	8158.77
	RU 2			5820819.8898	1308391.6958	8153.60	8153.74	8155.34
	RU 3			5825632.2778	1307804.6605	8052.10	8052.47	8053.98
	RU 5			5825432.8696	1307116.7871	7998.88	7998.76	7993.12
	RU 6A			5827642.5346	1307237.8146	7986.48	7986.48	7988.34
	RU 7			5824603.3155	1307226.8436	8007.10	8007.01	8009.37
	RU 8			5829553.6952	1307159.4589	7972.48	7972.53	7975.18
	RU 6ABANDONED			5827119.4063	1307193.5684			7980.50

NOTES:

CONTROL POINT 5 (CP 5) IS THE NE CORNER OF THE MONUMENT PLAQUE AT GROUND ZERO.
ELEVATION OF THE MONITORING WELLS ARE TAKEN AT TOP OF PVC, NORTH EDGE AT NOTCH.
TOP OF CONCRETE PAD ELEVATION ARE TAKEN ON THE NORTH SIDE OF WELL CASING.
GROUND ELEVATION AT WELLS ARE TAKEN ON THE NORTH SIDE OF CONCRETE PAD.
ALL OTHER ELEVATIONS ARE ORIGINAL GROUND.
BASIS OF CONTROL WAS ESTABLISH BY GPS.

LEGEND

- ✦ CONTROL POINT
- ⓜ MONITORING WELL
- ● SOIL BORING & MISCELLANEOUS SAMPLES
- GRID GRID BEARING & DISTANCE
- ( ) GLO RECORD

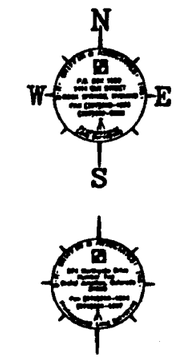
TYPICAL MONUMENT

IT
CP 2
1995

SET: 2 1/2" ALCAP ON
A 5/8" X 30" REBAR

BASIS OF BEARING:
COLORADO CENTRAL ZONE
STATE PLANE GRID NORTH

GRID CONBINED FACTOR:
0.99956655



PREPARED FOR:
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500 0 500 1500

File name: D:\DVG\95BBCB
Plot date: 12/95

SURVEYOR'S CERTIFICATE

I HERBY CERTIFY THAT I AM PROPERLY REGISTERED AND LICENSED TO PRACTICE LAND SURVEYING IN THE STATE OF COLORADO, THAT THIS RECORD OF SURVEY REPRESENTS A SURVEY MADE BY KENNETH JENKINS, AND THAT ALL DIMENSIONS AND OTHER DETAILS ARE CORRECT.

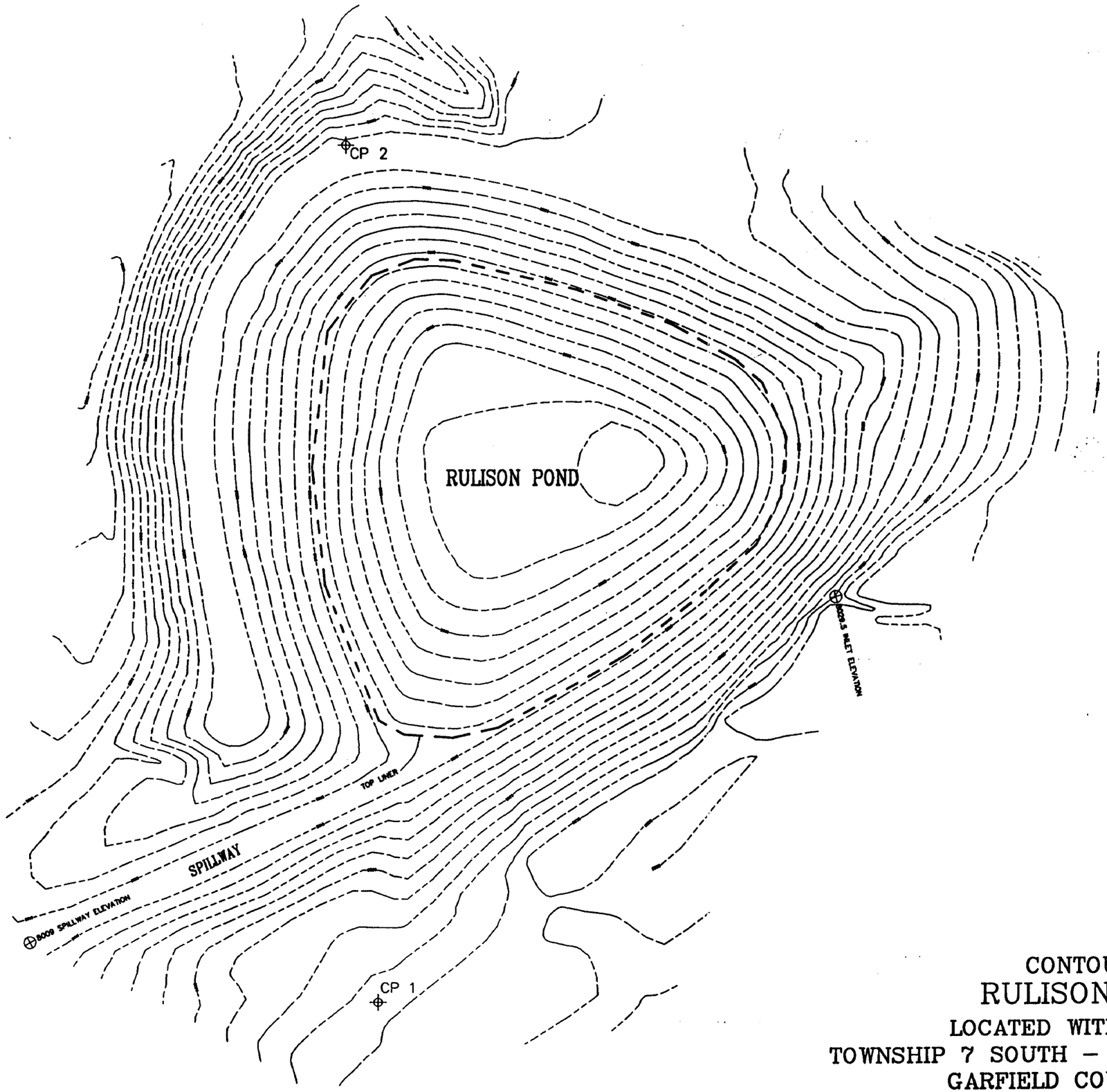
12/15/95
DATE

DR. GRIFFIN, FL. REG. 11486

PLAT OF SURVEY
RULISON PROJECT
LOCATED WITHIN SECTION 25
TOWNSHIP 7 SOUTH – RANGE 95 WEST, 6th P. M.
GARFIELD COUNTY, COLORADO

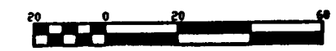
Plate 1

SHT. NO.
1 OF 2



BASIS OF BEARING:
COLORADO CENTRAL ZONE
STATE PLANE GRID NORTH

GRID CONBINED FACTOR:
0.99956655



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12-15-95
DATE

D.R. GRIFFITH PLS No. 1:186

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CONTOUR MAP OF RULISON PROJECT

LOCATED WITHIN SECTION 25
TOWNSHIP 7 SOUTH – RANGE 95 WEST, 6th P. M.
GARFIELD COUNTY, COLORADO

Plate 1