RECORD OF DECISION

OGDEN RAIL YARD

OU 1 - 21st Street Pond

September 30, 2004

U. S. Environmental Protection Agency
Region 8
999 18th Street, Suite 300
Denver, CO 80202

TABLE OF CONTENTS

RECORD OF DECISION
OGDEN RAIL YARD SITE
21st Street Pond Operable Unit 1

PART 1: DECLARATION

Site Name and Location

The Ogden Rail Yard is located on the western side of the City of Ogden in Weber County, Utah. The Operable Unit OU 1, the 21st Street Pond, is located on the north end of the rail yard just north of the 21st Street overpass of the tracks. The source of the contamination is located just south of the 21st Street overpass of the tracks (see Figure 1).

Statement of Basis and Purpose

This decision document presents the Selected Remedy for OU 1, the 21st Street Pond, in the Ogden Rail Yard Site in Ogden, Utah, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, 42 U. S. C. § 9601 *et seq.* as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record file for this site.

The State of Utah concurs with the Selected Remedy.

Assessment of Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants and contaminants into the environment

Description of Selected Remedy

The selected remedy includes capping of the contaminated sediments in the 21st Street Pond, prevention of further movement of wastes into the pond through erection of a cofferdam and collection sumps, removal of mobile DNAPLs from the nearby former Pintsch Gas Plant which could recontaminate the pond, monitoring of the pond, and institutional controls to prevent use of ground water in the area, and protect the integrity of the cap.

Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial.

action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy. Treatment of the DNAPLs is very costly, and was not chosen given the uncertainty of the completeness and the potential for mobilization of the wastes during the course of treatment. In this case, treatment as an option was impractical.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a policy review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. This site is not on the National Priorities List (NPL), but five year reviews will be performed to be consistent with NPL requirements.

ROD Data Certification Checklist

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record for this site.

- Chemicals of concern and their respective concentrations
- Baseline risk represented by the chemicals of concern
- Cleanup levels established for chemicals of concern and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonable anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected
- Key factor(s) that led to selecting the remedy.

Authorizing Signatures

The following authorized official at EPA Region 8 and the State of Utah approve the Selected Remedy as described in this Record of Decision.

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U. S. Environmental Protection Agency, Region 8

Date 9/30/04

Dianne R. Nielson, Ph.D.
Executive Director
Utah Department of Environmental Quality

Date 10/14/04

PART 2: DECISION SUMMARY

Site Name, Location, and Brief Description

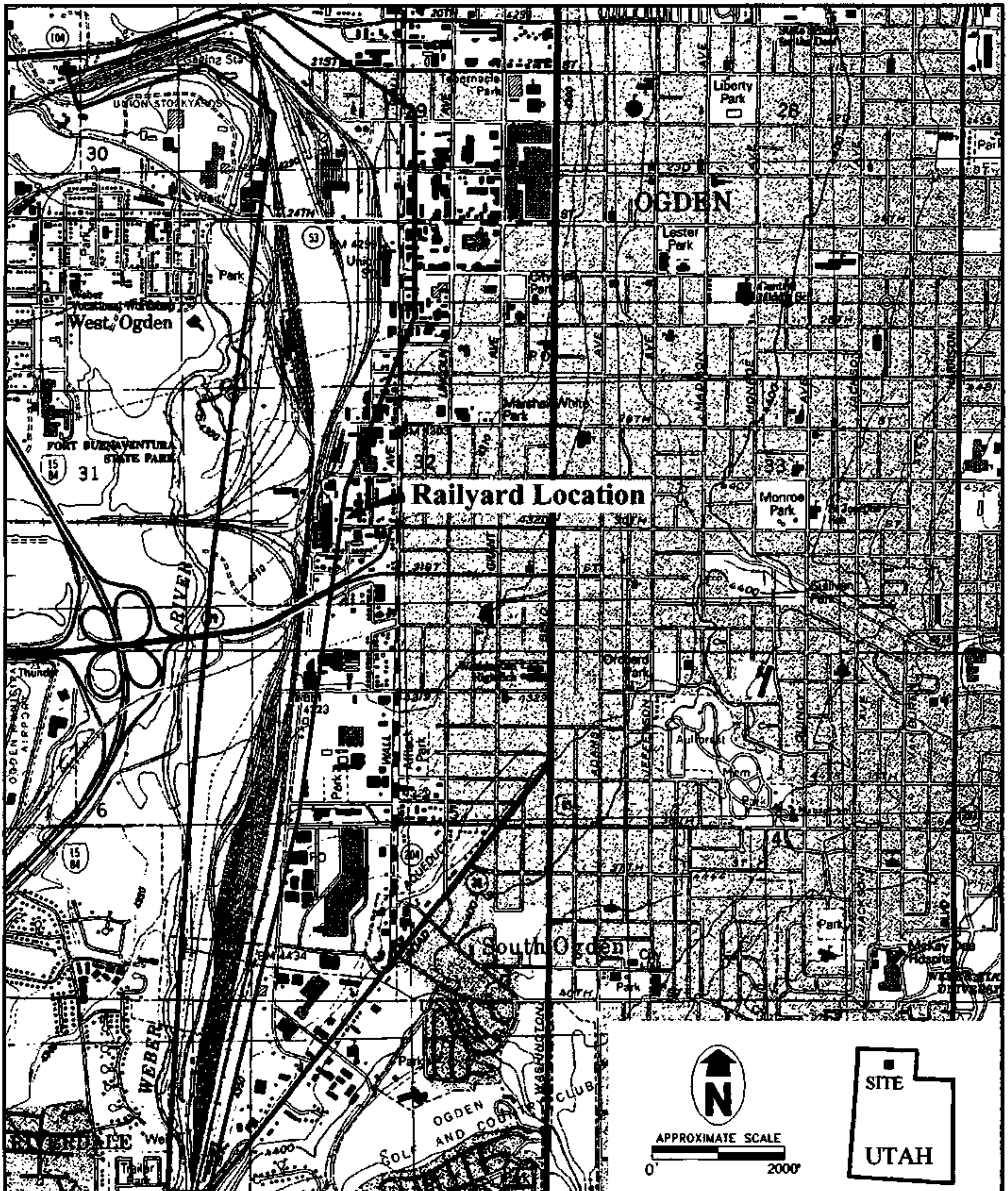
The Ogden Rail Yard site (CERCLIS #UTD000716407) is located in Weber County, Utah, just to the west of the City of Ogden. The lead agency is the U.S. Environmental Protection Agency, with support from the Utah Department of Environmental Quality. The investigation was conducted by the major responsible party, Union Pacific Railroad, which may also perform the remedial actions required. The site type can be considered as an industrial facility/rail yard. The general location of the site is given in Figure 1.

The Ogden Rail Yard has been in operation since the first transcontinental railroad reached the area in 1869. Four major railroad companies used the rail yard for switching, maintenance of locomotives and railcars, and for loading, off-loading, icing, and transferring cargo. The rail yard is 3.5 miles in length, oriented from North to South and about 1/2 mile wide. This Record of Decision addresses the environmental concerns at OU1, the Northern part of the rail yard site. At this portion, investigators discovered the presence of contaminants associated with a former Pintsch Gas plant which had migrated to a nearby pond owned by the State of Utah. This portion of the site includes the location of the former Pintsch Gas plant, the portion of the rail yard overlying the resulting DNAPL plume, and the adjacent 21st Street Pond (OU 1).

Site History and Enforcement Activities

The Ogden Rail Yard was built on farmland just to the west of the City of Ogden in 1869 when the first transcontinental railroad was built through the area. Ogden became the transfer point for passengers and goods between the Central Pacific Railroad (later sold to Southern Pacific Railroad) to the west and the Union Pacific Railroad to the east. Soon other railroads were built into Ogden to provide services to destinations to the north and south. The Utah Central Railroad (1870, later bought by Union Pacific Railroad) provided a connection between Ogden and Salt Lake City, and the Utah Northern Railroad (1874, later bought by Union Pacific Railroad and renamed Oregon Short Line Railroad) provided a connection with Idaho and later Montana. The Denver and Rio Grande Western Railroad arrived in 1882 and served southern Utah and Colorado destinations. In 1889, to aid with the passenger and freight transfers between these railroads at Ogden, the mainline railroads formed another railroad company, the Ogden Union Railway and Depot Company. The Southern Pacific and Denver and Rio Grande railroads used the northern part of the yard and the Union Pacific and Ogden Union railroads used the southern part of the yard.

Located at the rail yard were a wide variety of facilities involved with railroading, including fueling stations and storage tanks, marshaling yards, locomotive repair and



THE FORRESTER GROUP

INSIGHTFUL ENVIRONMENTAL SOLUTIONS℠

TITLE:

FIGURE 1
RAIL YARD LOCATION MAP

UNION PACIFIC RAILROAD FACILITY
OGDEN, UTAH

1330-Loc.dwg 2453264.69797111

maintenance shops, grain elevators, ice plant, passenger depot, freight offices, laundry plant, and 125 miles of switching tracks. Now, the entire rail yard is owned by the Union Pacific Railroad (which recently acquired all the other railroads in this area via mergers).

At the northern end of the rail yard, the portion formerly occupied by Denver and Rio Grande Railroad, a Pintsch Gas plant was built and operated from 1891 to about 1935. The plant provided Pintsch Gas, a petroleum based gas used in the railcars for lighting. Each railcar had its own storage tank and regulator. The manufacturing system involved heating the naphtha in cast iron retorts; collecting the purified gas in a condenser; washing the gas with water; drying the gas with a freezer; and then compressing it for storage and distribution to the railcars. The details of the arrangement of the railroad and the operators of the plant are not fully known, but it is suspected that the Pintsch Gas Company operated the plant on land leased from the railroad.

(Pintsch Gas plants were erected in rail yards all across the United States. First developed by Julius Pintsch from Berlin, Germany, and used in German trains, use of Pintsch Gas for lighting rail cars in the United States grew in popularity beginning in 1891, peaking about 1908, and became obsolete with the increasing use of electrical lighting in the 1920s. For example, in 1904, there were 20,000 railcars provided with Pintsch Gas from 70 plants in rail yards across the country. Although a great improvement in rail car lighting, Pintsch Gas did have its problems. Leaks in the piping and regulators for the Pintsch Gas were not appreciated by the train passengers and Pintsch Gas was implicated in several explosions.)

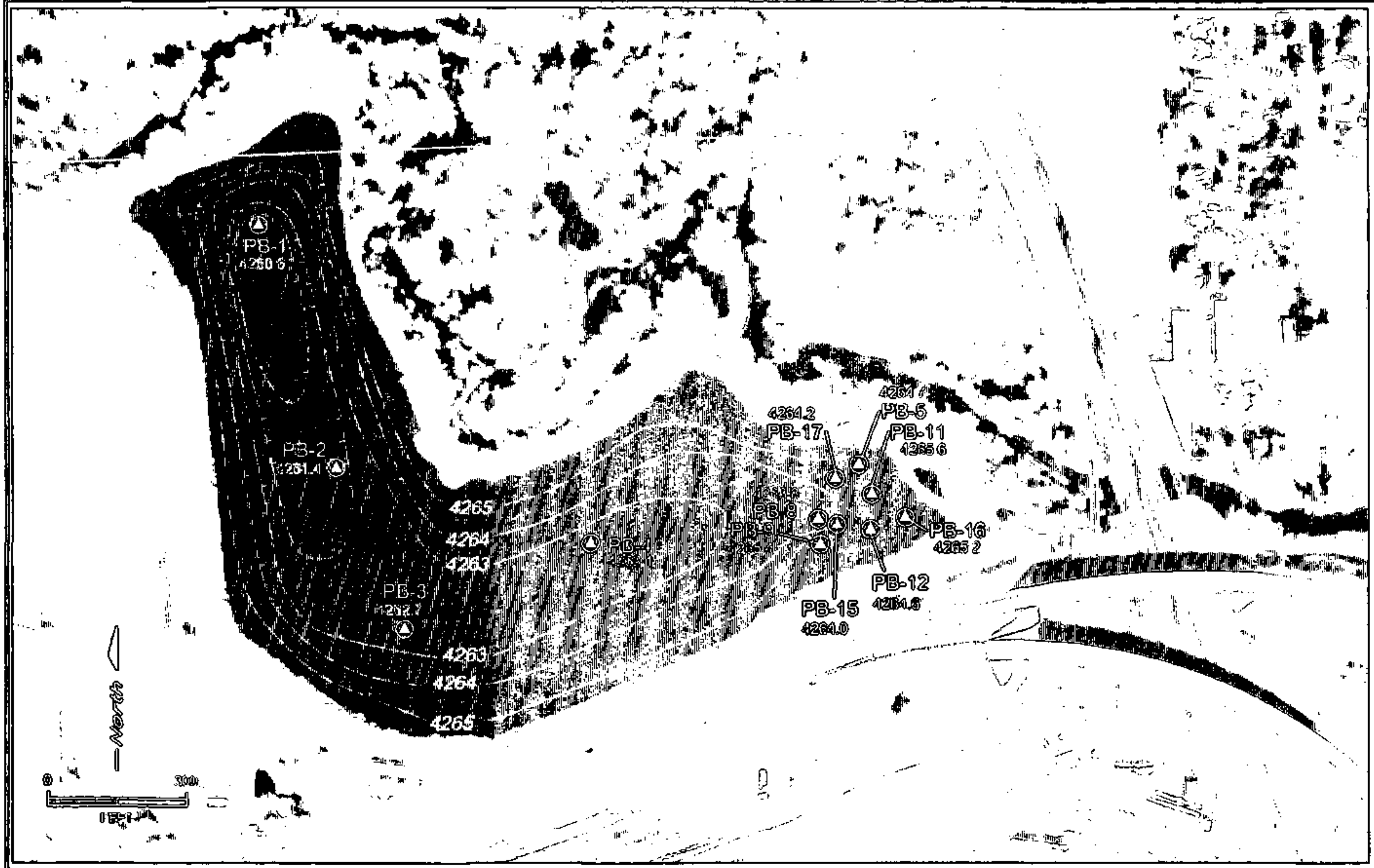
Also at the northern end of the rail yard across the 21st Street Highway is a 25-acre pond called the 21st Street Pond (see Figure 2). The pond was created in 1973 when the Utah Department of Transportation used the farm land as a borrow pit for sand and gravel to be used in construction of nearby highways. During their excavations, the Utah Department of Transportation workers encountered a layer of tar. They built a cofferdam there to prevent any further intrusion of this tar into their excavation. Following retirement of the sand and gravel pit operations, the state allowed the excavation to fill with water from an intake structure on the Ogden River. Later, the pond was stocked with fish by the Utah Department of Natural Resources, Division of Parks and Recreation, and was used by local residents for recreational fishing. Occasionally, slicks with a rainbow of colors appeared on the surface of the pond water along the southern shoreline and it was assumed that the slicks came from the highway. Utah Department of Transportation officials, however, remembered their encounter with the tar 30 years ago and suggested that the slicks were coming from the tar layer. When EPA's risk investigations determined that the fish in the lake were contaminated with polychlorinated

Color Photo(s)

The following pages contain color that does not appear in the scanned images.

To view the actual images, please contact the Superfund Records Center at (303) 312-6473.

M:\clients\FORREST\Ogden\RI-2002\9-04\1306-Pond-Topo-Fig2.dwg plotted: 09/16/2004



LEGEND

PB-4 ⊛ SEDIMENT BORING LOCATION

4265 ——— LINE OF EQUAL ELEVATION IN FEET(MSL)

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS

UPRR OGDEN RAILYARD

FIGURE 2
TOPOGRAPHY OF POND BOTTOM
21st STREET POND

SCALE:	DATE:
1" =300'	6/28/01

biphenyls (PCBs), the Utah Division of Parks and Recreation closed the pond to fishing in 2000 and raised the level of the lake to mitigate the potential for shorebird and waterfowl exposure to the impacted sediments. A survey of the sediments in the lake revealed that the sediments covering a quarter acre in the SE corner of the pond were contaminated with a DNAPL composed of high molecular weight petrolum compounds called polycyclic aromatic hydrocarbons (PAHs). No PCBs were found in the DNAPL. The plume of DNAPL was tracked back from the pond, under the Ogden River, under the street, back to the vicinity of the former Pintsch Gas plant, a distance of 600 feet to the southeast. At the present, the Utah Division of Parks and Recreation no longer stocks the pond with fish and signs are posted all around the pond indicating that the pond is closed to fishing.

Because the activities which caused the release of the contamination from the Pintsch Gas plant and its subsequent initial discovery during sand and gravel operations all occurred before state and federal environmental regulations regarding these substances, no enforcement activities took place regarding this situation before the re-discovery during the course of CERCLA investigations.

Initial investigation work began at the site in 1997 (Phase I investigations) to determine if there was a reason for concern at about 30 Areas of Interest within the rail yard facility which warranted further investigations. The work was done with EPA and UDEQ oversight. Based on these initial results, the Remedial Investigation/Feasibility Study (RI/FS) work proceeded with a focus only on those areas shown to have potential environmental concerns. The Union Pacific Railroad completed the RI/FS under the general framework of an Administrative Order on Consent (AOC) CERCLA 8-99-12. Initial work in the area of the 21st Street Pond began in 2000; the Remedial Investigation Report (final) was submitted to the agencies in September, 2003; the Feasibility Study Report (final) was submitted to the agencies in September, 2004. There are no pending lawsuits at this time.

When it was discovered in 2000 that sediments at the southeast corner of the 21st Street Pond were contaminated, the State and Union Pacific Railroad took a number of interim actions in 2001, including installation of a chain link fence around the perimeter of the contaminated portion of the pond, installation of a fish guard at the pond inlet to prevent fish from entering the pond from the Ogden River, and raising the water level of the pond to eliminate nesting areas and reduce the potential for birds to have direct sediment contact.

This site has not been proposed or listed on the National Priorities List of Superfund.

Community Participation

An initial community meeting was held at the site after the initial investigations

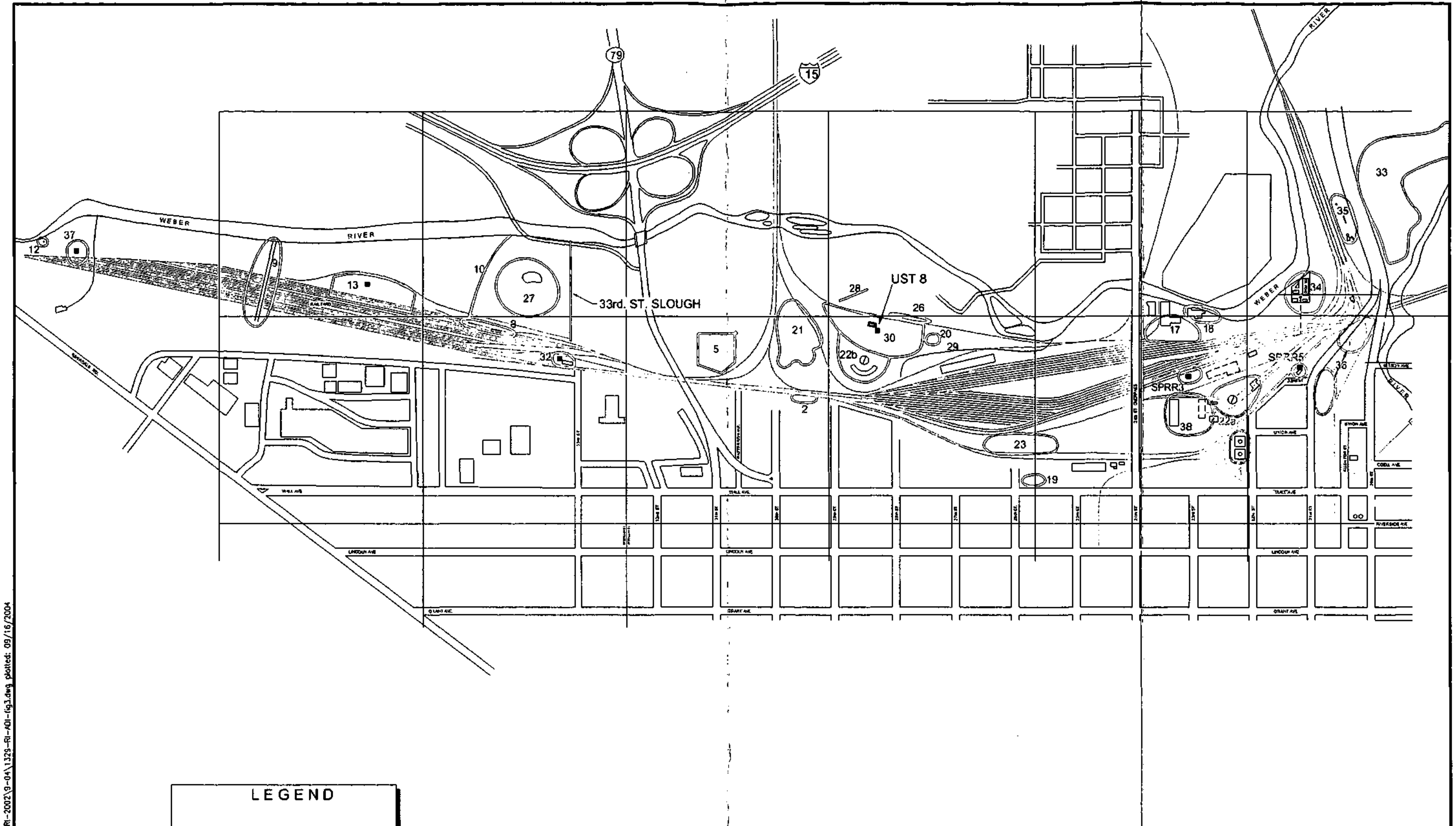
(Phase I) were completed. The purpose of the meeting was to inform the community what was found during the initial work, to announce the beginning of more in-depth investigations, and to gather ideas from the neighbors about issues which should be included in the investigations. EPA and UDEQ went to the neighbors door-to-door to invite them to this meeting. In conjunction with development of the Community Participation Plan, EPA and UDEQ interviewed local residents and local government officials to get their ideas on issues of primary concern.

A committee of local government officials interested in parks, water supply, health, and neighborhoods was formed and met occasionally with the agencies and investigators. City and county officials were kept informed with the latest information as it was discovered. They also kept the investigators and agencies informed as to long-term local plans for future use of the site.

The RI/FS Reports and Proposed Plan for this Operable Unit of the Ogden Rail Yard Site were made available to the public on May 26, 2004. They can be found in the Administrative Record file at the Superfund Records Center and at the local information repository located at the Weber County Environmental Affairs offices, at 2380 Washington Blvd. in Ogden. The notice of the availability of these documents was published in the *Ogden Standard Examiner* on Sunday, May 23, 2004. A public comment period was held from May 26, 2004 to June 28, 2004. In addition, a public meeting was held on May 26, 2004, to present the Proposed Plan to the local citizens. At the meeting, EPA, UDEQ, and Union Pacific Railroad personnel presented the plans and answered questions about the alternatives and future land use. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

Scope and Role of Operable Unit or Response Action

For the purpose of the initial Phase 1 investigations, the Ogden Rail Yard Site was divided into 34 Areas of Interest (AOIs). After a preliminary assessment of these AOIs, those at which no environmental concerns were found were deleted from further investigations and actions. The remaining AOIs which produced data suggesting potential environmental problems were either addressed immediately using a variety of statutes or designated as Operable Units for CERCLA action. A list of the preliminary Areas of Interest is given in Table 1, and the general locations are shown in Figure 3.



LEGEND

(30) RI/FS AREA OF INTEREST

■ LUST LOCATIONS

North

0 1200 FEET

	BY	DATE
DRAWN	FR	9/15/04
CHECKED		
APPROVED		
APPROVED		
APPROVED		

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS

OGDEN RAILYARD - OGDEN, UTAH

FIGURE 3
AREA OF INTEREST (AOI) IDENTIFICATION

SCALE: 1" = 1200'

DWG. NO.: 1329-RI-AOI

M:\clients\FORREST\Ogden\RI-2002\9-04\1329-RI-AOI-fig3.dwg plotted: 09/16/2004

TABLE 1
LIST OF AREAS OF INTEREST FOR THE OGDEN RAIL YARD SITE
(Areas of Interest which are discussed in this ROD are noted in bold)

AOI #	Description	Potential Contamination	Status
1	Above ground diesel storage Tanks	Diesel	Tanks removed in 1998[1]
2	Grain Storage	pesticides	nothing found[1], not owned by the railroad
3	Former city landfill west of Weber River	multiple	removed from the site, not owned by the railroad
4a	Junk/Salvage yard, 1600 feet E of yard	metals	removed from the site, not owned by the railroad
4b	Junk/Salvage yard, 3000 feet W of Weber River	metals	removed from the site, not owned by the railroad
5	RR Tie Storage and distribution, operated by NRM	wood preservatives	risks are below a level of concern[1]
6	Former Pig Farm	multiple	removed from the site, not owned by the railroad
7	TCE[2] Plume, 1600 ft E of yard	VOCs[3], TCE	removed from the site, not owned by the railroad
8	Refrigeration car service area	hydrocarbons, refrigerants	risks are below a level of concern[1]
9	Burch Creek and Above Ground Diesel Storage Tanks	multiple	risks are below a level of concern
10	Storm Drainage Ditch	multiple	risks are below a level of concern
11	Monitoring Wells east of rail yard	multiple	removed from the site, not RR property

AOI #	Description	Potential Contamination	Status
12	Oil/Water Separator, drip pan area	oils, hydrocarbons	separator removed in 2000
13	Rail Car Maintenance Area (UST #3, and 4 LUST sites)	oils, hydrocarbons, metals, diesel	LUST program, now closed[4]
14	City of Ogden construction materials landfill	multiple	removed from the site, not owned by the railroad
15	Laboratory 800 ft E of Weber River	multiple	removed from the site, not owned by the railroad
16	deleted by EPA contractor		
17	Surplus storage and Salvage yard, west of rail yard	heavy metals	risks are below a level of concern
18	Dyce Chemical handling and storage facility	spilled chemicals	risks are below a level of concern
19	Former Laundry Building	solvents, chlorinated	risks are below a level of concern
20	Former Diesel Storage Tank	hydrocarbons	risks are below a level of concern
21	Atlas Steel Salvage Yard	hydrocarbons and metals	subsurface impacted by southern CVOC plume, see OU4 ROD
22a	Locomotive Turntable and fueling rack	hydrocarbons and lube oils	subsurface impacted by northern CVOC plume, LNAPL[5], see OU4 ROD
22b	Former UPRR Roundhouse	hydrocarbons, lube oils, solvents	subsurface impacted by southern CVOC plume, see OU4 ROD
23	Mucking lines	hydrocarbons, PCBs, metals	risks are below a level of concern

AOI #	Description	Potential Contamination	Status
24	identified as a filled channel from photos, was a river meander	multiple	removed from site
25	Day Care Center	multiple	removed from site, not owned by the railroad
26	Oil Sludge Reclamation Area	petroleum, pH	being addressed under removal authorities
27	Sludge Disposal Area	petroleum, pH, metals	being addressed under removal authorities
28	Former Drainage Ditch from roundhouse	solvents, hydrocarbons, metals	risks are below a level of concern
29	Strongs Creek drainage ditch	multiple	risks are below a level of concern
30	Durbano Metals, former wastewater treatment location, and LUST #8 sites	multiple	subsurface impacted by southern CVOC plume, see OU4 ROD[6]
31	Former waste water treatment plant	multiple	merged with AOI-30
32	Oil/water separator	petroleum	LUST program, now closed[7]
33	**21st Street Pond**	**petroleum, PAHs, PCBs**	**Addressed by this ROD**
34a	Waste water treatment plant of Southern Pacific	petroleum, metals	pond sludges removed
34b	Southern Pacific UST 1 and UST 2	petroleum, metals	UST 1 was removed, UST 2 is under a building, now closed by UST program[8]
35	D&RGW RIP Track (RIP = repair in place), kerosene storage	petroleum, metals	risks are below a level of concern

AOI #	Description	Potential Contamination	Status
36	D&RGW Roundhouse and storage yard	petroleum, metals, solvents	risks are below a level of concern
37	UST 6 and 9	petroleum	LUST program, now closed[9]
38	Southern Pacific Machine shop and fueling rack	petroleum, solvents	subsurface impacted by northern CVOC plume, see OU4 ROD
-	33rd Street drainage slough	multiple	risks are below a level of concern
-	Gasoline LUST site SPRR3	petroleum, BTEX	LUST program
-	Weber River Riparian Zone	multiple, PCBs	risks are below a level of concern
-	Weber River	multiple, PCBs	risks are below a level of concern
-	Ogden River	multiple, PCBs	risks are below a level of concern
-	**DNAPL zone near 21st Street Pond**	**petroleum, metals, PCBs**	**Addressed by this ROD**

[1]Remedial Investigation Report, September, 2003
[2]TCE - tetrachloroethene
[3]VOC - volatile organic compound
[4]No Further Action, DERR, UDEQ, Tanks #3 and #4, August 2002
[5]LNAPL - Light Non-Aqueous Phase Layer
[6]No Further Action, DERR, UDEQ, Tank #8, Feb. 2003
[7]No Further Action, DERR, UDEQ, Tank #2, June, 2000
[8]No Further Action, DERR, UDEQ, SPRR Tanks #1 and #2, Jan 2003
[9]No Further Action, DERR, UDEQ, Tanks #6 and #9, June, 2000

The Areas of Interest at which potential problems were found in the initial investigations were organized into five operable units, as described in Table 2.

TABLE 2
OPERABLE UNITS AT THE OGDEN RAIL YARD SITE
(Operable Units which are discussed in this ROD are highlighted in bold)

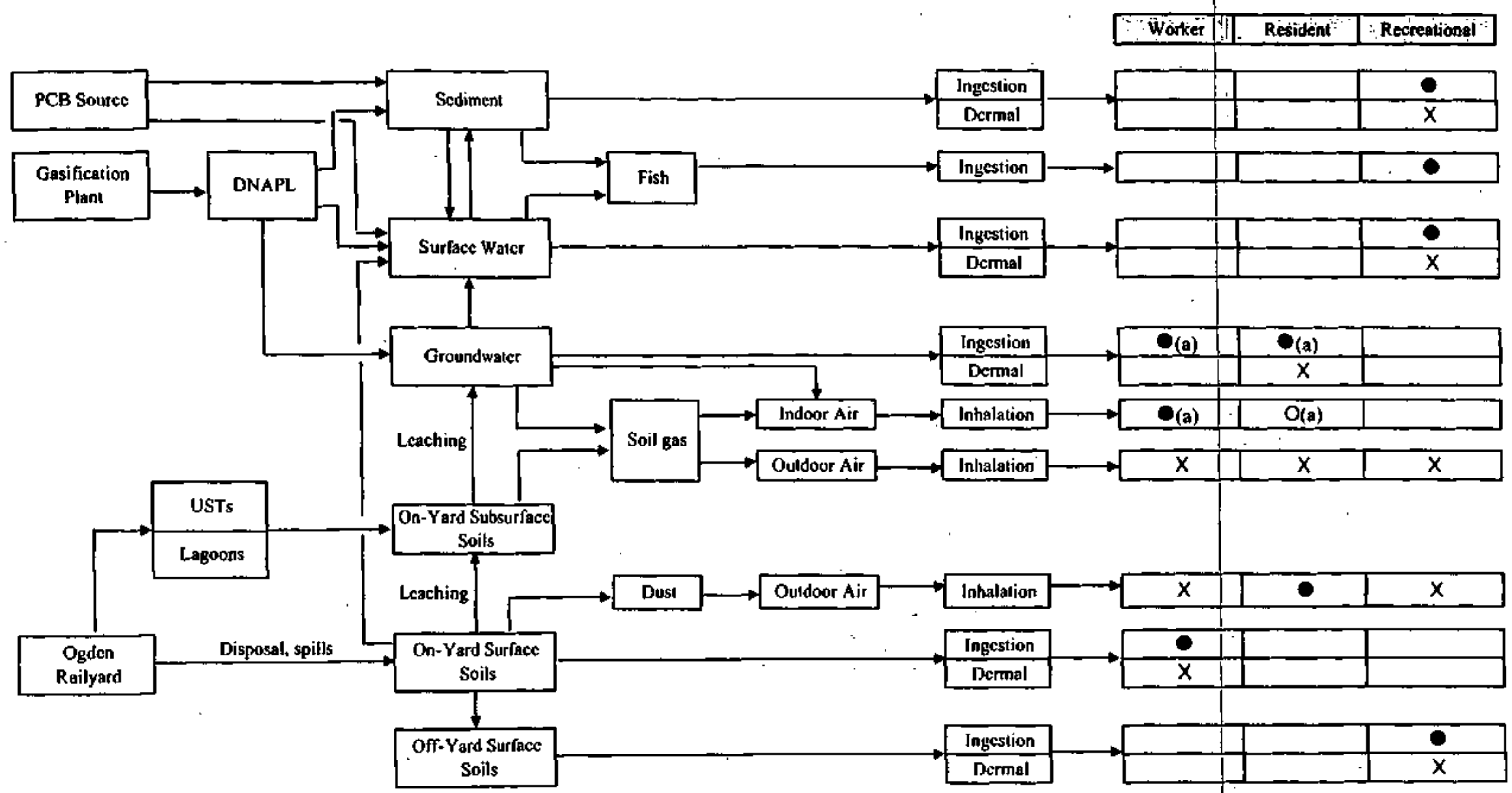
OU #	Description	Contaminants	Status
OU1	**Northern Area, including DNAPL (Dense Non-Aqueous Phase Layer) zone associated with Pintsch Gas plant, Ogden River, and 21st Street Pond**	**Heavy hydrocarbons, PAHs, PCBs**	**pilot DNAPL recovery system tested, pond closed to fishing, addressed by this ROD**
OU2	PCB Contamination	PCBs	Source of PCBs did not originate at the site, risks below a level of concern.
OU3	Waste Water Treatment Plant formerly used by Southern Pacific Railroad	petroleum, metals	Holding lagoon drained and sludges cleaned out
OU4	Ground Water contamination in yard (except in OU1 area)	solvents, chlorinated hydrocarbons and degradation products	Addressed in a separate ROD
6E	Sludge Impoundment Removal Action	heavy hydrocarbons, metals, pH	being addressed using removal authorities
OU 0	All activities not included in other operable units	multiple	Addressed in a separate ROD

This Record of Decision covers Operable Unit 1. Another Record of Decision to be issued simultaneously will cover the remainder of the site.

Site Characteristics

1. Site Conceptual Model. A diagram illustrating the Site Conceptual Model for the entire site was given in the Risk Assessment Document (2003) and is shown on Figure 4. For OU1, the Northern portion of the site (which includes the 21st Street Pond and the Ogden River), the primary concern was uptake of site contaminants into fish of the 21st Street Pond and the Ogden River and the impact that would have on use of the pond and river for recreational fishing. Although swimming is not allowed in the pond, it is likely that this activity might occur once the area is

Figure 4 Site Conceptual Model for Human Exposure



LEGEND

(blank)	Pathway is not complete; no evaluation required
X	Pathway is or might be complete, but is judged to be minor; qualitative evaluation
O	Pathway is or might be complete and could be significant, but data are lacking to support quantitative evaluation; qualitative evaluation
●	Pathway is or might be complete and could be significant; quantitative evaluation

(a) Pathway is not currently complete but might be complete in the future reopened for its traditional uses.

2. Overview (Size and Topography). Of the 60 acres studied as a part of OU-1, the terrain is generally flat with two water bodies. The 21st Street Pond, 25 acres in size, is located in the northwest part of the OU. Transecting the OU is the Ogden River which flows from east to west across the OU. A three-mile stretch of the river was characterized. The river has been channelized upstream of the rail yard, but has natural meanders downstream.

3. Surface and Subsurface Features. Superimposed upon the generally flat terrain are several man-made features, including elevated embankments associated with the approaches to the 20th and 21st Street bridges which carry these streets (highway connectors) over the rail yard, railroad tracks and a trestle across the river, and several buildings in the general area formerly occupied by the Pintsch Gas plant.

4. Sampling strategy. Sampling occurred in phases. In the first phase, BTEX and PAHs, both of which are petroleum fractions, were found in the soils, pond water and pond sediment. To locate the ground water seeps influencing the chemistry of the 21st Street Pond, a Geoprobe program, the second phase, did not locate suspected LNAPL, but found DNAPL at the interface between subsurface gravels and an underlying clay layer. In the third phase, additional studies of the nature of the DNAPL were possible during installation of monitoring wells. In the fourth phase, sediment cores provided additional delineation of the DNAPL in the pond itself. The pond samples were about 50 feet apart and the groundwater borings and wells were about 200 feet apart. Samples were not collected in areas with roads or railroad tracks.

   When PCBs in fish tissue was discovered, a search for the source of the PCBs was launched. When PCBs were not found in the DNAPL, investigators suspected a source on the Ogden River. (The 21st Street Pond has both an intake and outfall on the Ogden River and fish could have been originally exposed there.) The study team collected water and sediment along a three mile stretch of the Ogden River. Sampling was focused on depositional environments, quiet or deep areas where upstream sediments might tend to accumulate.

TABLE 3
SUMMARY OF SAMPLING PROGRAM AT OU1

Site	Sample Type	No. of locations
21st Street Pond	borings	17
21st Street Pond	soils underneath sediments	2

Site	Sample Type	No. of locations
land surrounding 21st St. Pond	ground water monitoring wells	25
land surrounding 21st St. Pond	Geoprobe borings	79
21st Street Pond	Hand borings	18
21st Street Pond	Fish	27
Ogden River	River sediment	14
Ogden River	River water	3

5. Known or suspected sources of contamination

At the northern end of the rail yard, the portion formerly occupied by Denver and Rio Grande Railroad, a Pintsch Gas plant was built and operated from 1891 to about 1935. The plant provided Pintsch Gas, a petroleum based gas used in the railcars for lighting. The plant presumably used the Pintsch process described in *Scientific American* in 1898. In summary, Pintsch Gas was manufactured from naphtha (aka distillate, coal tar) which was purified, compressed in storage tanks, from which it is drawn off through a pressure regulator and burned in railcar lamps. Each railcar had its own storage tank and regulator. The manufacturing system involved heating the naphtha in cast iron retorts; collecting the purified gas in a condenser; washing the gas with water; drying the gas with a freezer; and then compressing it for storage and distribution to the railcars. The Scientific American article of 1898 describes several places where wastes are produced, but did not describe what typically was done with them. One waste stream was allowed to "pass away." Deposits in the retorts required a chisel to remove.

The oily waste is more dense than water and forms DNAPL pools. It has a high content of PAHs suggesting a high temperature process origin such as wastes from a manufactured gas process (e.g. coal gas or Pintsch Gas). Although, at one time, there was a coal gasification plant (to the east of the rail yard) and a Pintsch Gas plant, the distribution of the DNAPL contamination clearly implicated the Pintsch Gas plant as the origin of the wastes.

The original source of the PCB contamination in the fish and sediments of the 21st Street Pond is unknown. The Pintsch Gas DNAPLs did not contain any PCBs. Investigators found PCBs in the sediments of the Ogden River as far as 3 miles upstream from the 21st Street Pond, suggesting that the original source of the

PCBs was in the watershed of the Ogden River upstream of the 21st Street Pond and the rail yard. The sampling results suggested a source in the watershed of a City of Ogden storm sewer which had an outfall on the Ogden River located 1000 feet west of Wall Ave. along the river (1600 feet up gradient of the 21st Street Pond). EPA and UDEQ have concluded that the PCBs did not originate at the site.

6. Types of contamination and affected media (types, volume, concentrations, RCRA). The contamination producing sheens and slicks in the 21st Street Pond is attributed to a plume of DNAPLs originating at the location of the former Pintsch Gas plant. The contamination is an oily waste, insoluble in water, denser than water, and containing a high content of PAHs (some of which are known carcinogens). At the location of the former Pintsch Gas plant, the soils were contaminated with the wastes from eight feet below the surface down to the ground water level, through the ground water where it began to pool on top of a clay layer aquitard. The DNAPL plume on top of the aquitard then flowed down the structural gradient toward the 21st Street Pond, a local ground water sink. The DNAPL plume underlies a 12.5 acre area of land in the vicinity of the plant and has contaminated about 0.25 acre of pond sediments.

The DNAPL wastes contained a number of components in excess of the health screening levels including arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and total petroleum hydrocarbons. For example, the highest detected benzo(a)pyrene concentration was 300 mg/kg, a value 385 times greater than the screening level of 0.78 mg/l. The PAHs concentrations in this sample are given in Table 4.

TABLE 4
CONCENTRATIONS OF PAHs IN DNAPL LAYER, SAMPLE 33-B25
(at a depth of 17-18 feet below the ground surface)

Constituent	Concentration (in mg/Kg or ppm)
1-Methylnaphthalene	1000
2-Methylnaphthalene	1300
Acenaphthene	530
Acenaphthylene	55
Anthracene	350
Benzo(a)anthracene	260

Constituent	Concentration (in mg/Kg or ppm)
Benzo(a)pyrene	300
Benzo(b)fluoranthene	100
Benzo(ghi)perylene	94
Benzo(k)fluoranthene	95
Chrysene	270
Dibenzo(a,h)anthracene	18
Fluoranthene	370
Fluorene	340
Indeno(1,2,3-cd)pyrene	100
Naphthalene	1800
Phenanthrene	1400
Pyrene	1100
hydrocarbons with 10 - 28 carbons	37,000
hydrocarbons with 28 - 36 carbons	35,000
hydrocarbons with 6 - 10 carbons	3100
Total hydrocarbons (6 - 36 carbons)	75,000

The DNAPL oily wastes had contaminated soils in the area of the Pintsch Gas plant and had migrated along the clay aquitard toward the north and the 21st Street Pond. Pond sediments were also contaminated with DNAPL components and released some contamination to the surface waters of the pond upon agitation.

The DNAPL waste had contaminated the 21st Street Pond sediments with PAHs. A comparison of PAH concentrations in the pond sediments with nearby river sediments is given in Table 5.

TABLE 5
PAH CONCENTRATIONS IN POND AND RIVER SEDIMENTS

PAH Compound	21st Street Pond sediments - Range of concentrations, in μg/Kg	Ogden River sediments - Range of concentrations, in μg/Kg
naphthalene	non detect - 160,000	non detects
anthracene	non detect - 520,000	non detect - 210
phenanthrene	non detect - 1,900,000	non detect - 220
pyrene	non detect - 1,200,000	non detect - 260
benzo(a)pyrene	non detect - 350,000	non detect - 200

The DNAPL oily wastes are exempt from RCRA regulations unless they exhibit physical characteristics, such as corrosivity, ignitability, etc. An analysis of the DNAPL recovered during a pilott study showed the DNAPL to be non-reactive, non corrosive, and to have an ignitability temperature of 160°F (which is above the threshold of 140°F).

The other contaminants of concern at this Operable Unit were PCBs which were found in fish collected from the 21st Street Pond. PCBs were also found in the sediments of the pond and sediments in the Ogden River (a source of water to the pond). A summary of concentrations of PCBs in fish filets is given in Table 6.

TABLE 6
PCB CONCENTRATIONS IN FISH FILETS FROM 21st STREET POND

FISH SPECIES	RANGE OF PCB (AROCLOR 1260) in fish, μg/kg wet weight
Brook Trout	5.3 - 14
Rainbow Trout	not detected - 22
Largemouth Bass	36 - 55
White Sucker	96 - 910
Common Carp	200 - 1900
Bluegill	150 (ave)
Perch	170 (ave)

White crappie	130 (ave)
Red-sided shiner	240 (ave)
Largemouth bass	230 (ave)

The PCB concentrations found in 21st Street Pond and Ogden River sediments are given in Table 7.

TABLE 7

PCB CONCENTRATIONS IN POND AND RIVER SEDIMENTS

Sediment Location	Range of PCB concentrations, in μg/kg
Ogden River	51 (estimated) - 4200 (estimated)
21st Street Pond	non-detect - 110

7. Location of contamination and potential routes of migration

The Pintsch Gas plant residues have spread as a DNAPL from the footprint of the former manufactured gas facility towards the north along the boundary of the alluvium soils (sands and gravels) and the aquitard clay layer. It has collected in pools where the clay layer dips. The DNAPL has also flowed via seeps into the 21st Street Pond where it has contaminated the sediments at the bottom of the pond. The lateral extent of the contamination is shown in Figure 4. The DNAPL layer is 14.8 to 23.9 feet from the surface and varies in thickness from 0.2 to 12.5 feet. It underlies a 12.5 acre parcel of land near the 21st Street crossing of the rail yard and impacts a 0.25 acre part of the pond.

The DNAPL has already migrated from the Pintsch Gas plant site to one corner of the 21st Street Pond (and extends 400 feet to the north of the Ogden River) and contaminates the sediment immediately overlying the clay layer in the pond. DNAPL PAHs were also detected in 8 of 55 fish samples. Recreational users of the pond can be exposed to the contaminants in the water and sediments through ingestion or dermal contact. Recreational fishermen may be exposed to contaminants if they ingest the fish they catch from the pond, although this pathway is insignificant. Additional pathways exist for future exposures depending on the land use. The ground water above the DNAPL layer is contaminated with volatile organics. Use of that water for drinking or even for sanitary purposes could release these compounds into the air exposing residents, or workers and visitors.

Exposure to PCBs would come mainly through ingestion of fish caught in the pond. However, the data suggest that the fish themselves were exposed to the PCBs in the Ogden River. Then the fish entered the pond through the inlet or outfall structures on the river. The PCBs were present in the sediments of the river beginning with the City of Ogden stormwater sewer and then transported downstream by the river. People are exposed to the PCBs when they eat the fish from the Ogden River or the 21st Street Pond. The PCBs appear to be unrelated to rail yard activities. The exposure to PCBs in fish flesh was later found to be an insignificant human health concern.

Ecological impacts of concern are exposure of aquatic organisms (fish and macroinvertebrates) to the DNAPL and PCBs and transfer up the food chain to other wildlife including birds. Direct contact with the contamination is also possible for shorebirds and other wildlife.

8. Ground water contamination

The ground water is contaminated under approximately 12.5 acres of the site and is associated with the DNAPL. The affected aquifer is the shallow aquifer composed of alluvial deposits associated with the Ogden and Weber Rivers. The shallow soils consist of fill, overbank silts, point bar sands, on a bed of channel gravels. The fill layer, used to create a flat surface for railroad operations, can include soils (silts to gravels) plus construction debris and coal. This layer ranges in thickness from zero to 10 feet thick. Underlying the fill is the overbank silts deposited in the area during floods. These deposits extend down to the water table which is 5 - 15 feet below grade. Channel deposits include sand and gravel and are the media through which the water flows underground. The gravel layer is continuous throughout the region and this site. The gravel is 2.2 - 20.5 feet thick.

Contaminants are prevented from moving to lower aquifers by a thick and continuous clay layer which serves as an aquitard. This clay layer, known as the Alpine Formation, is a lacustrine clay formation associated with historic Lake Bonneville. The clay is olive gray, homogeneous, soft, highly plastic, "fat" clay with occasional silt lenses. The layer, which is greater than 50 feet thick at the site, serves as a confining layer preventing penetration of the DNAPL and ground water contaminants into the deeper aquifers. Deeper aquifers include the Sunset and Delta aquifers which are confined by the clay layer and have upward hydraulic gradients.

The shallow aquifer flows generally in a northerly direction toward the 21st Street Pond which serves as a local discharge point. Near the Ogden River, the ground water flow is westward toward the pond. With the Ogden River being a losing stream, the river serves as a divide. The DNAPL moved to the other side of the river by gravity. The ground water seeps at the 21st Street Pond confirm that the pond is a local discharge point to surface water.

Investigators have found a layer of DNAPLs sitting on top of the Alpine Clay Formation aquitard. The DNAPL layer is 0.1 to 7.0 feet thick and has pooled in low spots in the clay layer. An investigation has revealed about 5 potential pooling locations in the area. The DNAPL consists of two fractions: a mobile phase which can move within the aquifer and which can be removed by pumping; and a residual phase which has adhered to particles in the aquifer and is immobile. The residual phase does not move within the aquifer and can not be recovered using conventional flushing or pumping techniques. The DNAPLs provide a continuing source of ground water contamination to the waters of the shallow aquifer directly above the DNAPL, including volatile organic compounds (VOCs), benzenes, toluenes, and xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAHs). The waters in aquifers beneath the clay layer are unaffected by the DNAPL. Only the ground water above the DNAPL layer is contaminated, presumably from the more volatile and soluble DNAPL compounds. These have not moved perhaps due to interaction with particles in the aquifer. The contaminated ground water has not formed a plume and remains only above the DNAPL.

9. Site specific factors. Access to a portion of the contaminated area is restricted because of the presence of two major highway overpasses, several active rail lines with associated access roads and support facilities, and a river which flows through the site. These factors limit the feasibility of certain remedial options requiring area-wide excavation. Such excavation could undermine the stability of these important structures and damage extensive riparian habitat along the river. Also, the proximity of the river dictates that any remedial activities on the pond include special precautions to protect the water quality of the river.

The area is surrounded by commercial, industrial, recreational, and residential development. The northerly edge of the contamination also has extended beyond the boundaries of the rail yard into a neighboring industrial site (auto salvage yard). This presents additional health and safety concerns to consider during remedial projects.

Current and Potential Future Site and Resource Uses

The area formerly occupied by the Pintsch Gas facility (1891 - 1935) is now an active part of the Ogden Rail Yard owned and operated by Union Pacific Railroad. The building on the former footprint of the facility has been used as a crew change facility and the office of the yardmaster for the Southern Pacific part of the yard. Today the building is in use as an office for Union Pacific's Yard Maintenance Staff. The area is also transected by east-west rail lines (parallel to 21st Street) which intersects with a wye to a north-south rail line. Union Pacific Railroad has no plans to change the land use of the rail yard and plans to continue to use it well into the future.

During the 1970s, the 21st Street Pond was a sand and gravel pit owned by the Utah Department of Transportation which used the materials during construction of the nearby highway overpasses. Prior to its use as a borrow pit, the land was agricultural. When the construction projects were finished, the former borrow pit was transferred to the State Division of Parks and Recreation which constructed intake and outfall structures to the Ogden River and allowed the pit to fill with water. The Pond created from the former borrow pit became known locally as the 21st Street Pond. Around the perimeter of the pond is an access road with parking spots, and a management building. Until the pond was closed to fishing in 2000, the state stocked the pond with fish and the pond was a popular recreational fishing spot for local residents. Although swimming was theoretically prohibited, this practice has been observed occasionally. The perimeter of the pond is vegetated with typical riparian vegetation and serves as a fishing access and wildlife habitat. Surrounding the forested area adjacent to the pond are commercial, industrial, and residential properties. The former Pintsch Gas plant is located about 560 feet south of the south-east corner of the 21st Street Pond.

Currently future use includes incorporation of the pond area pathways into the Ogden City Trails Network, and the pond may be returned to its traditional use as a recreational fishing spot.

The property at the northern edge of pond and adjacent to the ground water plume is an automobile salvage yard owned and operated by A-One Auto Parts.

The ground water is not used at this time for any purpose in this area, and there are no plans to develop this potential resource.

Summary of Site Risks

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment at the site.

Part 1. Summary of the Human Health Risk Assessment

Contaminants of Potential Concern. The chemicals of potential concern included PAHs and solvents in the area of the Pintsch Gas Plant and the 21st Street Pond. The chemicals found to be of actual concern in this area are given in Table 8.

TABLE 8
CHEMICALS OF CONCERN TO HUMAN HEALTH
AT THE 21st STREET POND

Exposure Point	Chemical of Concern	Concentrations (ppm)			Detec-tions	Exposure Point Conc.	Statistics
		min	max	mean			
sediment	aroclor - 1260 (PCBs)	1.0E-02[#]	1.3E-01	8.2E-2	5/16	1.3E-01	UCL 95[*] - log
~~sediment~~	~~Benzo(a) pyrene~~	~~6.0E-03~~	~~3.5E+02~~	~~1.2E+01~~	~~29/43~~	~~2.6E+01~~	~~UCL 95~~
ground water	Aroclor-1260	4.8E-06	1.0E-04	7.7E-04	1/7	1.0E-04	max
ground water	benzo(a)pyrene	5.0E-05	1.9E-02	1.6E-03	20/82	2.3E-03	UCL 95 lognorm
ground water	ethylbenzene	5.0E-04	2.2E+00	1.8E-01	40/78	1.7E+00	UCL 95 lognorm
ground water	naphthalene	5.0E-05	6.9E+00	4.8E-01	43/82	5.5E+00	UCL 95 lognorm
Surface soil	benzo(a)pyrene	4.4E-02	1.6E+00	3.9E-01	3/11	9.3E-01	UCL 95 lognorm
Fish	Aroclor-1260	5.3E-03	1.9E+00	2.9E-01	27/28	8.0E-01	UCL 95 lognorm

[#]1.0E-02 is mathematical shorthand for 1×10^{-2}
[*]UCL 95 is 95% upper confidence limit, or 95% of all values are below the amount listed.

All the analytical chemistry data used in the risk assessment calculations came from data produced during the Remedial Investigation/Feasibility Studies and were produced using standard analytical methodologies. The chemistry data were then validated to ensure that the procedures were followed. If serious flaws were discovered during validation, the data were rejected and not used. If only a minor problem was discovered, the data were flagged as an estimation.

Exposure assessment. There are two main uses of the site. The 21st Street Pond is a recreational area where people hike around the perimeter, and they fish. Occasionally people swim or wade in the pond. While doing these activities, they can be exposed to soils at the site, they can eat the fish, they can inadvertently swallow the water during swimming and they can get dirty with sediments from the pond. The other part of the site, near the former Pintsch Gas facility, is used by railroad and rail yard workers. Currently, there is a building on the site used as an office. These workers can be exposed to the soils at this location. In the future, if the ground water from the area is used by the workers (it is not used currently), future exposures could occur by drinking the water or from inhaling volatile compounds that degas from the ground water.

Other pathways of exposure were considered as well, but were not estimated to be significant, such as exposure to off-site residents and exposure of workers to gasses in the outdoor air.

Using proposed exposure pathways, ways that people could be exposed at or near the site, EPA risk assessors calculated how much exposure might occur. This was done using two different scenarios: Central Tendency Estimate (CTE) and Reasonable Maximum Estimate (RME). For example, the Central Tendency Estimate would give an idea of how much fish an average person would normally eat, but the Reasonable Maximum Estimate would give an idea of the maximum a person could eat. Both methods would tend to overestimate the exposure because the concentrations of contaminants used in the calculation are from the upper end of the concentrations found at the site. In general, standard assumptions used for EPA risk assessments were used for these calculations. The assumptions used for exposures are given in Tables 9 and 10.

TABLE 9
EXPOSURE ASSUMPTIONS USED FOR THE 21[st] STREET POND AREA RECREATIONAL VISITORS
(from Table 3-7, Ogden Rail Yard Risk Assessment)

Exposure Input Parameter	Units	Central Tendency Estimate (CTE)		Reasonable Maximum Estimate (RME)	
		Adult	Child	Adult	Child
General					
Averaging Time, Cancer	yr	70	70	70	70
	days	25550	25550	25550	25550
Averaging Time, Noncancer	yr	15	5	30	10
	days	5475	1825	10950	3650
Body Weight	kg	70	39	70	39
Ingestion of Soil					
Ingestion rate	mg/day	50	100	100	200
Conversion factor	Kg/mg	1E-06	1E-06	1E-06	1E-06
Exposure frequency	days/yr	10	24	20	48
Exposure Duration	yr	15	5	30	10
HIF (noncancer)	kg/kg-day	1.96E-08	1.67E-07	7.8E-08	6.67E-07
HIF (cancer)	kg/kg-day	4.19E-09	1.19E-08	3.34E-08	9.53E-08
Ingestion of Fish					
Ingestion rate (total)	g/day	8	4	25	12.5

Exposure Input Parameter	Units	Central Tendency Estimate (CTE)		Reasonable Maximum Estimate (RME)	
		Adult	Child	Adult	Child
Fraction from site		0.2	0.2	0.4	0.4
Conversion factor	kg/g	1E-03	1E-03	1E-03	1E-03
Exposure Frequency	days/yr	350	350	350	350
Exposure Duration	yr	15	5	30	10
HIF (noncancer)	kg/kg-day	2.19E-05	1.95E-05	1.37E-04	1.22E-04
HIF (cancer)	kg/kg-day	4.70E-06	1.39E-06	5.87E-04	1.74E-05
Ingestion of Sediment					
Ingestion rate	mg/day	50	100	100	200
Conversion factor	kg/mg	1E-06	1E-06	1E-06	1E-06
Exposure Frequency	days/yr	10	24	20	48
Exposure Duration	yr	15	5	30	10
HIF (noncancer)	kg/kg-day	1.96E-08	1.67E-07	7.83E-08	6.67E-07
HIF (cancer)	kg/kg-day	4.19E-09	1.19E-08	3.35E-08	9.53E-08
Ingestion of Surface Water					
Ingestion rate	mL/hr	25	25	50	50
Exposure time	hr/day	1	2	1	2
Conversion factor	L/mL	1E-03	1E-03	1E-03	1E-03
Exposure Frequency	days/yr	10	24	20	48
HIF(noncancer)	L/kg-day	9.78E-06	8.34E-05	3.91E-05	3.34E-04
HIF (cancer)	L/kg-day	2.10E-06	5.96E-06	1.68E-05	4.76E-05

TABLE 10
EXPOSURE ASSUMPTIONS USED FOR THE RAIL YARD PORTION
ON-SITE WORKERS
(from Table 3-5, Ogden Rail Yard Risk Assessment)

Exposure Input Parameter	Units	Central Tendency, Adults	Reasonable Maximum, Adults
General			
Averaging Time, Cancer	yrs	70	70
	days	25550	25550
Averaging Time, Noncancer	yrs	5	25
	days	1825	9125
Body Weight	kg	70	70

Exposure Input Parameter	Units	Central Tendency, Adults	Reasonable Maximum, Adults
Ingestion of Ground Water			
Ingestion rate	L/day	0.7	1
Exposure frequency	days/dy	219	250
Exposure duration	yr	5	25
HIF (noncancer)	L/kg-day	86.00E-03	9.78E-03
HIF(cancer)	L/kg-day	4.29E-04	3.49E-03
Inhalation of Indoor Air			
Inhalation rate (indoors	m^3/day	10	20
Exposure frequency	days/yr	219	250
Exposure Duration	yrs	5	25
HIF (noncancer)	m^3/kg-day	8.57E-02	1.96E-01
HIF (cancer)	m^3/kg-day	6.12E-03	6.99E-02
Ingestion of Soil			
Ingestion Rate	mg/day	50	100
Conversion factor	kg/mg	1E-06	1E-06
Exposure Frequency	day/yr	219	250
Exposure Duration	yr	5	25
HIF (noncancer)	kg/kg-day	4.29E-07	9.78E-07
HIF (cancer)	kg/kg-day	3.06E-08	3.49E-07

Toxicity assessment. The toxicity information used in the risk assessment (Table 4-1) came from the health literature as compiled in IRIS (Integrated Risk Information System), HEAST (Health Effects Assessment Summary Tables) or from the interim recommendations from EPA's Superfund Technical Assistance Center. The values were all available in a table of toxicity data assembled by USEPA Region 3 (http://www.epa.gov/reg3hwmd/risk/).

Risk Characterization. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: risk is a unitless probability (e.g. 2E-5, or 2×10^{-5}, or 0.00002) of an individual's developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg-day);
SF = Slope factor, expressed as mg/mg-day, a measure of carcinogenicity)

These risks are probabilities that usually are expressed in scientific notation (e.g. 2E-5 or 2×10^{-5}). An excess lifetime cancer risk of 1×10^{-6} indicates than an individual experiencing the CTE or RME has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all the other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range from site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1.0 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same organ or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1.0 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects for all contaminants are unlikely. An HI greater than one indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: CDI = Chronic daily intake
RfD = Reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

A summary of the risks and hazards calculated for the 21st Street Pond and former Pintsch Gas portion of the Ogden Rail Yard is given in Table 11.

TABLE 11

RISKS AND HAZARDS FOR THE 21st STREET POND AND PINTSCH GAS SITE

(Taken from various tables in the site risk assessment)

risks noted in bold exceed EPA acceptable risk range

Pathway	non-cancer		cancer	
	CTE	RME	CTE	RME
On-site workers				
Surface Soil Ingestion	3E-02	6E-02	7E-07	8E-06
Ground water Ingestion	**2E+00**[a]	**4E+00**[a]	2E-05	**2E-04**[b]
Inhalation of indoor air	**3E+02**[c]	**6E+02**[c]	3E-05	**3E-04**[d]
Recreational visitors				
Surface Water Ingestion	2E-07	6E-07	2E-11	1E-10
Sediment Ingestion	2E-04	9E-04	1E-06	9E-06
Surface Soil Ingestion	6E-04	2E-03	9E-08	7E-07
Fish Ingestion (PCBs only)	9E-01	**6E+00**	1E-05	**2E-04**
Fish Ingestion (other COCs)	2E-02	1E-01	7E-07	8E-06

[a]76% of the risk comes from naphthalene

[b]33% of the risk comes from benzo(a)pyrene

[c]99% of the risk comes from naphthalene

[d]76% of the risk comes from ethylbenzene

Part 2: Ecological Risk Assessment

The site characterization occurred in three phases. During the first phase, a number of contaminants were identified at the site including diesel fuel, oils, petroleum hydrocarbons, chlorinated solvents (and degradation products), metals, and PAHs (polycyclic aromatic hydrocarbons). During the second phase, a large plume of DNAPL (dense non-aqueous phase liquid) was found at the 21st Street Pond affecting the sediments and occasionally releasing slicks into the surface water. Moreover, the investigators found that the fish in the 21st Street Pond had elevated levels of PCBs (polychlorinated biphenyls) in their flesh. As a precaution, the state immediately closed the pond to fishing until more could be learned about the fish, the source of the PCBs, and the risk of eating such fish. These concerns led to another investigation of this area to further characterize the extent, nature, source, and impacts of the encroaching DNAPL plume on the 21st Street Pond.

The ecological risk assessment at the 21st Street Pond consisted of three approaches: comparison of concentrations of media at the site with benchmarks of these media available in the scientific literature; site-specific experiments; and observations of populations of species in the field. Therefore, the assessment and measurement endpoints were hazard indices, toxicity as measured in site-specific tests, and populations changes due to contamination as measured in tests.

Contaminants of Potential Concern: The contaminants of potential concern to aquatic and terrestrial wildlife in the area of the 21st Street Pond and the Pintsch Gas Plant are given in Tables 12A, 12B, 12C and 12D. These lists were compiled by comparing the concentrations observed at the site with benchmark values derived from the scientific and regulatory literature. (See Ecological Risk Assessment.)

TABLE 12A
CHEMICALS OF POTENTIAL CONCERN TO ECOLOGY OF SITE
RANGES AND COMPARISON WITH BENCHMARKS
PART A: SURFACE WATER (mg/L)
(Pond values highlighted in bold exceed one or more benchmark concentrations)

Chemical	concentrations (mg/L)				detections	benchmark (mg/L)	
	detection limit sitewide	maximum sitewide	21st Street Pond min	21st Street Pond max		aquatics	terrestrial
aluminum	2.1E-01	1.85E+00	2.2E-02	**8.4E-01**	33/50	8.7E-02	1.85E+00
barium	-	1.30E-01	**3.4E-02**	6.7E-02	67/67	4.0E-03	4.18E+01
cadmium	1.69E-03	2.93E-03	1.4E-04	**2.9E-03**	19/67	4.52E-04	7.49E+00
nickel	8.45E-03	2.03E-01	1.7E-03	**2.0E-01**	21/50	9.38E-02	3.11E+02
selenium	7.56E-03	5.20E-03	1.1E-03	**5.2E-03**	3/67	5.0E-03	1.55E+00
silver	3.53E-03	1.40E-03	5.0E-04	**2.5E-03**	11/57	1.34E-03	-
zinc	9.27E-03	2.82E+00	4.5E-03	**2.8E+00**	5/50	2.16E-01	1.05E+02
Acenaphthene	3.11E-03	1.61E-01	2.0E-04	**1.6E-01**	8/77	1.70E-02	-
anthracene	3.03E-03	1.60E-02	**8.0E-04**	**1.6E-02**	2/77	7.30E-04	-
Benzo(a)anthracene	3.03E-03	4.00E-04	**9.0E-05**	**5.0E-03**	2/77	2.70E-05	-
Benzo(a)pyrene	2.98E-03	1.00E-04	**1.0E-04**	**5.0E-03**	2/77	1.40E-05	4.20E+00
Fluorene	-	6.20E-02	5.0E-04	**6.2E-01**	2/77	3.90E-03	-
naphthalene-		5.20E-01	2.0E-04	**5.2E-01**	4/86	1.20E-02	-
pyrene	-	1.00E-02	**8.0E-05**	**1.0E-02**	5/77	2.50E-05	-
bis2-ethylhexylphthalate	-	4.70E-03	4.5E-05	**5.0E-03**	4/74	3.00E-03	7.9E+00

Chemical	concentrations (mg/L)				detections	benchmark (mg/L)	
	detection limit sitewide	maximum sitewide	21st Street Pond min	21st Street Pond max		aquatics	terrestrial
carbon disulfide	-	1.20E-03	5.0E-04	**2.5E-03**	1/84	9.20E-04	-
ethylbenzene	-	8.10E-03	5.0E-04	**8.1E-03**	2/84	7.30E-03	-

TABLE 12B
CHEMICALS OF CONCERN TO ECOLOGY OF SITE
RANGES AND COMPARISON WITH BENCHMARKS
PART B: SEDIMENT (mg/kg)
(Pond values in bold exceed one or more benchmark concentrations)

Chemical	Concentration (mg/kg)				detections sitewide	Benchmarks (mg/kg)	
	detection limit sitewide	maximum sitewide	21st St. Pond min	21st St Pond max		aquatic	terrestrial
aluminum	-	1.67E+04	**3.5E+03**	**1.7E+04**	32/32	2.55E+04	3.83E+00
antimony	2.09E-03	1.40E+00	**2.6E-01**	**7.0E+00**	2/32	2.00E+00	2.43E-01
arsenic	2.36E-03	5.40E+00	**7.5E-01**	**5.4E+00**	30/50	9.79E+00	2.50E-01
barium	2.72E-02	2.49E+02	**2.7E+01**	**1.5E+02**	45/50	4.80E+04	1.72E+01
chromium	5.00E-04	2.23E+01	**6.2E+00**	**2.2E+01**	49/50	4.34E+04	8.30E-01
copper	-	3.76E+01	6.0E+00	**3.3E+01**	32/32	3.10E+01	3.89E+01
iron	-	2.10E+04	6.0E+03	**2.1E+04**	32/32	2.00E+04	-
lead	1.00E-03	1.20E+02	**7.2E+00**	**4.0E+01**	49/50	3.58E+01	9.40E-01
manganese	-	9.60E+02	1.3E+02	**9.6E+02**	32/32	1.67E+03	3.22E+02
mercury	2.04E-05	5.30E-01	**2.0E-02**	**5.3E-01**	28/50	1.80E+01	5.0E-03
selenium	1.20E-03	5.80E+00	2.2E-01	**2.5E+00**	8/50	1.00E+00	3.31E-01
vanadium	-	3.18E+01	**8.8E+00**	**3.2E+01**	32/32	5.70E+01	7.14E-01
zinc	-	1.82E+02	**2.7E+01**	**1.1E+02**	32/32	1.21E+02	1.20E+01
4,4'-DDE	4.50E-06	1.20E-02	**2.3E-03**	**1.2E-02**	7/65	3.10E-03	2.00E-03
4,4'-DDT	4.50E-06	6.10E-03	2.3E-03	**5.5E-01**	2/65	4.16E-03	2.00E-03
dieldrin	4.47E-06	5.43E-03	**2.3E-03**	**5.5E-03**	1/65	1.90E-03	6.4E-02
1-methylnaphthalene	4.64E-04	2.10E+02	2.9E-01	**2.1E+02**	2/21	1.34E+00	-
2-methylnaphthalene	6.68E-04	1.20E+03	3.0E-03	**1.4E+03**	12/100	1.34E+00	-
acenaphthene	6.22E-04	8.50E+02	3.0E-03	**8.5E+02**	24/114	1.36E+00	-

Chemical	Concentration (mg/kg)				detections sitewide	Benchmarks (mg/kg)	
	detection limit sitewide	maximum sitewide	21st St. Pond min	21st St Pond max		aquatic	terrestrial
acenaphthylene	6.00E-04	1.30E+02	2.0E-03	1.3E+02	22/114	1.47E+00	-
anthracene	7.09E-04	5.20E+02	4.0E-03	5.2E+02	36/114	5.72E-02	-
benzo(a)anthracene	8.27E-04	3.40E+02	5.0E-03	3.4E+02	54.114	1.02E-01	-
benzo(a)pyrene	8.63E-04	3.50E+02	6.0E-03	3.5E+02	59/114	1.50E-01	1.98E+00
benzo(b)fluoranthene	8.58E-04	3.60E+02	5.0E-03	1.6E+02	57/114	2.94E+00	-
benzo(ghi)perylene	8.03E-04	2.00E+02	3.0E-03	2.0E+02	50/114	1.94E+00	-
benzo(k)fluoranthene	8.28E-04	1.70E+02	5.0E-02	1.7E+02	54.114	2.94E+00	-
chrysene	9.16E-04	3.60E+02	7.0E-03	3.6E+02	63/114	1.66E-01	-
dibenz(a,h)anthracene	6.54E-04	7.20E+01	3.0E-03	7.2E+01	28/114	3.30E-02	-
fluoranthene	9.44E-04	6.40E+02	1.1E-02	6.4E+02	65/114	4.23E-01	-
fluorene	6.15E-04	4.20E+02	3.0E-03	4.2E+02	20/114	7.74E-02	-
indeno(1,2,3-cd)pyrene	8.14E-04	1.60E+02	3.0E-03	1.6E+02	51/114	3.35E+00	-
naphthalene5.48E-04		1.90E+03	4.0E-03	1.9E+03	21/129	1.76E-01	-
phenanthrene	8.22E-04	1.90E+03	5.0E-03	1.9E+03	51/114	2.04E-01	-
pyrene	1.05E-03	1.20E+03	1.6E-02	1.2E+03	76/114	1.95E-01	-
aroclor 1254	5.89E-05	1.40E-01	2.0E-02	5.5E-01	2/85	5.98E-02	1.11E-01
aroclor 1260	4.31E-05	4.20E+00	2.0E-02	5.5E-01	20/86	5.98E-02	7.10E-02
biphenyl	1.10E-03	7.90E+00	2.3E-01	7.9E+00	1/20	5.88E-02	-
bis2-ethylhexylphthalate	1.31E-03	4.00E+00	4.0E-02	6.5E+00	46/82	5.22E-02	9.20E-01
dibutylphthalate	8.96E-04	9.90E-02	4.8E-02	6.3E+00	5/81	6.63E-01	9.00E-02
acrolein	3.16E-05	4.30E-03	1.6E-02	9.0E-02	1/53	3.15E-05	-
acrylnitrile	2.00E-05	1.00E-02	6.5E-03	3.5E-02	1/53	2.04E-03	-
benzene	3.00E-06	4.80E-02	1.4E-03	4.8E-02	3/68	1.91E-02	5.22E+01
methylbromide	5.96E-06	1.00E-02	1.5E-03	1.7E-02	4'68	3.23E-03	-
carbon disulfide	3.17E-06	7.00E-03	7.5E-04	8.5E-03	12/68	2.46E-04	-
ethylbenzene	3.00E-06	2.70E-01	1.4E-03	2.7E-01	4.68	5.48E-03	-
o-xylene	1.02E-06	8.05E-02	1.4E-03	8.1E-02	1/15	5.02E-03	4.11E+00
toluene	3.62E-06	1.90E+00	1.4E-03	8.5E-02	29/68	2.79E-03	5.15E+01

Chemical	Concentration (mg/kg)				detections sitewide	Benchmarks (mg/kg)	
	detection limit sitewide	maximum sitewide	21st St. Pond min	21st St Pond max		aquatic	terrestrial
xylenes (t)	9.46E-06	1.30E-01	9.5E-03	**1.3E-01**	5/53	5.03E-03	4.16E+00
p+m xylenes	1.02E-06	5.12E-02	**1.4E-03**	**5.1E-02**	1/15	1.40E-03	4.16E+00

TABLE 12C
CHEMICALS OF CONCERN TO SITE ECOLOGY
RANGE AND COMPARISON TO BENCHMARKS
PART C: SOILS
(Values in Bold exceed one or more benchmark concentrations)

chemical	concentrations (mg/kg)				detections sitewide	benchmarks (mg/kg)	
	detection limit sitewide	maximum sitewide	21st St. Pond, min	21st St Pond, max		plants and inverts	wildlife
aluminum	-	1.30E+04	**6.2E+03**	**9.6E+03**	44/44	5.00E+01	3.83E+00
antimony	1.09E-03	8.00E+00	1.8E-01	**3.8E+00**	9/44	3.00E+00	2.48E-01
arsenic	3.19E-03	2.41E+01	**2.5E+00**	**1.3E+01**	48/60	1.00E+01	2.50E-01
barium	3.81E-02	2.58E+02	**3.4E+01**	**2.6E+02**	54/60	1.60E+02	1.72E+01
cadmium	8.00E-05	7.70E+00	1.5E-02	**1.9E+00**	47/60	8.00E-01	1.20E+00
chromium	-	1.96E+01	**5.2E+00**	**2.0E+01**	60/60	4.00E-01	8.30E-01
copper	-	1.04E+02	1.2E+01	**9.4E+01**	44/44	3.60E+01	3.89E+01
iron	-	1.60E+04	**7.4E+03**	**1.3E+04**	44/44	2.00E+02	-
lead	-	9.40E+02	**4.7E+00**	**2.2E+02**	60/60	5.00E+01	9.40E-01
manganese	-	6.30E+02	**1.8E+02**	**3.6E+02**	44/44	1.00E+02	3.32E+02
mercury	1.89E-05	3.60E+00	**1.5E-02**	**1.4E-01**	58/65	1.00E-01	5.00E-03
selenium	1.01E-03	1.10E+00	1.9E-01	**4.0E+00**	15/60	7.00E-01	3.31E-01
silver	1.44E-04	4.30E+00	5.5E-02	**3.4E+00**	18/60	2.00E+00	-
vanadium	-	2.25E+01	**1.4E+01**	**2.3E+01**	44/44	2.00E+00	7.14E-01
zinc	-	9.40E+02	**3.6E+01**	**1.7E+02**	44/44	5.00E+01	1.20E+01
4,4'DDT	3.99E-06	1.50E-02	1.7E-03	**1.5E-02**	4/22	-	2.00E-03
Aroclor 1260	2.99E-05	5.50E-01	1.7E-02	**5.5E-01**	6/22	2.00E-02	7.10E-02
bis2-ethylhexylphthalate	2.96E-04	1.50E+00	4.5E-02	**1.5E+00**	32/73	-	9.10E-01

chemical	concentrations (mg/kg)				detections sitewide	benchmarks (mg/kg)	
	detection limit sitewide	maximum sitewide	21st St. Pond, min	21st St Pond, max		plants and inverts	wildlife
dibutylphthalate	3.12E-04	2.20E-01	**1.7E-01**	**9.5E-01**	20/73	2.00E+02	9.00E-02

TABLE 12D
CHEMICALS OF CONCERN TO SITE ECOLOGY
RANGE OF CONCENTRATIONS AND COMPARISON TO BENCHMARKS
PART D: FISH TISSUE (mg/kg)
(Values in bold exceed benchmark concentrations)

chemical	concentrations				detections	benchmark
	detection limit	maximum	21st St Pond min	21st St Pond, max		wildlife diet
aroclor 1260	3.09E-05	1.86E+00	5.5E-03	**1.9E+00**	28/29	7.10E-02
4,4'DDD	2.04E-06	1.59E-02	1.5E-03	**1.6E-02**	18/29	2.00E-03
4,4'DDE	-	5.85E-01	1.9E-03	**5.9E-01**	29/29	2.00E-03
4,4'DDT	2.03E-06	2.69E-03	1.9E-03	**2.7E-03**	1/29	2.00E-03
bis2-ethylhexylphthalate	9.96E-04	2.73E+00	**9.8E-01**	**1.2E+00**	22/29	9.10E-01
dibutylphthalate	1.01E-02	1.06E+00	**9.8E-01**	**1.2E+00**	1/29	9.00E-02

Although metals would appear to be a problem in the sediments and soils of the 21st Street Pond area, the concentrations of metals are well within the background concentrations of metals in Utah as demonstrated in Table 13.

TABLE 13
COMPARISON OF BACKGROUND CONCENTRATIONS OF METALS
WITH CONCENTRATIONS AT 21st STREET POND
(From Ecological Risk Assessment, 2002)

Chemicals	Utah Background Range (mg/kg)	Toxicity Benchmark (mg/kg)	21st Street Pond average (mg/kg)
Aluminum	15,000 - 100,000	50	7,358
Arsenic	1.5 - 48	10	5.7
Barium	150 - 1,500	160	86
Chromium	15 - 150	0.40	12

Chemicals	Utah Background Range (mg/kg)	Toxicity Benchmark (mg/kg)	21st Street Pond average (mg/kg)
Copper	7 - 100	36	24
Iron	7,000 - 100,000	200	9,729
Mercury	0.01 - 4.6	0.1	0.05
Manganese	100 - 1000	100	240
Lead	5 - 700	50	68
Antimony	1.1.4	3.0	0.97
Selenium	0.1 - 1.5	0.70	0.96
Vanadium	20 - 300	2.0	16
Zinc	20 - 2,000	50	60

However, just because a few samples exceed the benchmark concentrations, investigators indicated that concern is not warranted until 20% or more of the samples are above the benchmark.

Having identified the Chemicals of Concern through comparison with benchmarks, the ecological investigators proceeded to look at representative species present at the site (for which reference toxicity information was available) and the calculated the dose these species would get living and feeding at the site. A summary of the comparison expressed in Hazard Indices are given in Table 14. (Hazard Index = calculated dose at site/reference dose where effects have been noticed). Any Hazard Index greater than 1.0 suggests that effects due to site exposure may be occurring.

TABLE 14
HAZARD INDICES OF REPRESENTATIVE SPECIES AT 21St STREET POND

Chemical of Concern	Belted Kingfisher	American Robin	Mallard Duck	Masked Shrew	Mink
Aluminum	1E-01	5E-01	7E-02	**5E+01**	4E-01
Antimony	-	-	-	9E-02	7E-04
Arsenic	3E-03	3E-02	1E-03	8E-01	4E-03
Barium	2E-02	8E-02	1E-02	6E-01	5E-03

Cadmium	-	5E-03	-	4E-02	-
Chromium	2E-02	1E-01	1E-02	2E-04	1E-06
Copper	-	1E-02	-	3E-01	-
Lead	1E-02	9E-01	1E-02	6E-01	6E-04
Manganese	9E-04	2E-03	4E-04	1E-01	2E-03
Mercury	2E-02	2E-03	1E-02	1E-01	4E-03
Selenium	3E-03	3E-02	1E-02	6E-02	2E-03
Thallium	-	-	-	-	6E-04
Vanadium	2E-02	1E-02	1E-03	1E+00	8E-03
Zinc	6E-03	3E-02	3E-03	3E-02	2E-04
4,4'-DDD	**3E+01**	-	2E-03	-	5E-02
4,4'-DDE	1E-01	-	-	-	2E-04
4,4'-DDT	1E-01	3E-02	6E-04	6E-04	2E-04
Benzo(a)pyrene	-	-	-	-	1E-02
Aroclor-1254	3E-04	-	2E-04	-	9E-05
Aroclor-1260	1E+00	1E-02	6E-04	2E-01	8E-01
bis(2-ethylhexyl)phthalate	3E-01	9E-03	8E-04	2E-03	4E-03
Dibutylphthalate	1E+00	1E-02	4E-04	2E-05	2E-04

The second approach used at the site was site-specific toxicity tests. Of particular interest was the toxicity of the impacted sediments from the 21st Street Pond. No toxicity to the test benthic organism was found. Investigators indicated that this result might be due to the fact that the test species lived on top of the sediment with continual renewals of fresh water rather than in the sediment. The third approach used population surveys. This technique is typically used for streams and rivers where the benthic organisms live within the sediments. Although this was not the case for the 21st Street Pond, investigators were able to compare the populations from the site with a nearby reference site (Buena Ventura Park Pond). They found that the diversity of scrapers at the impacted

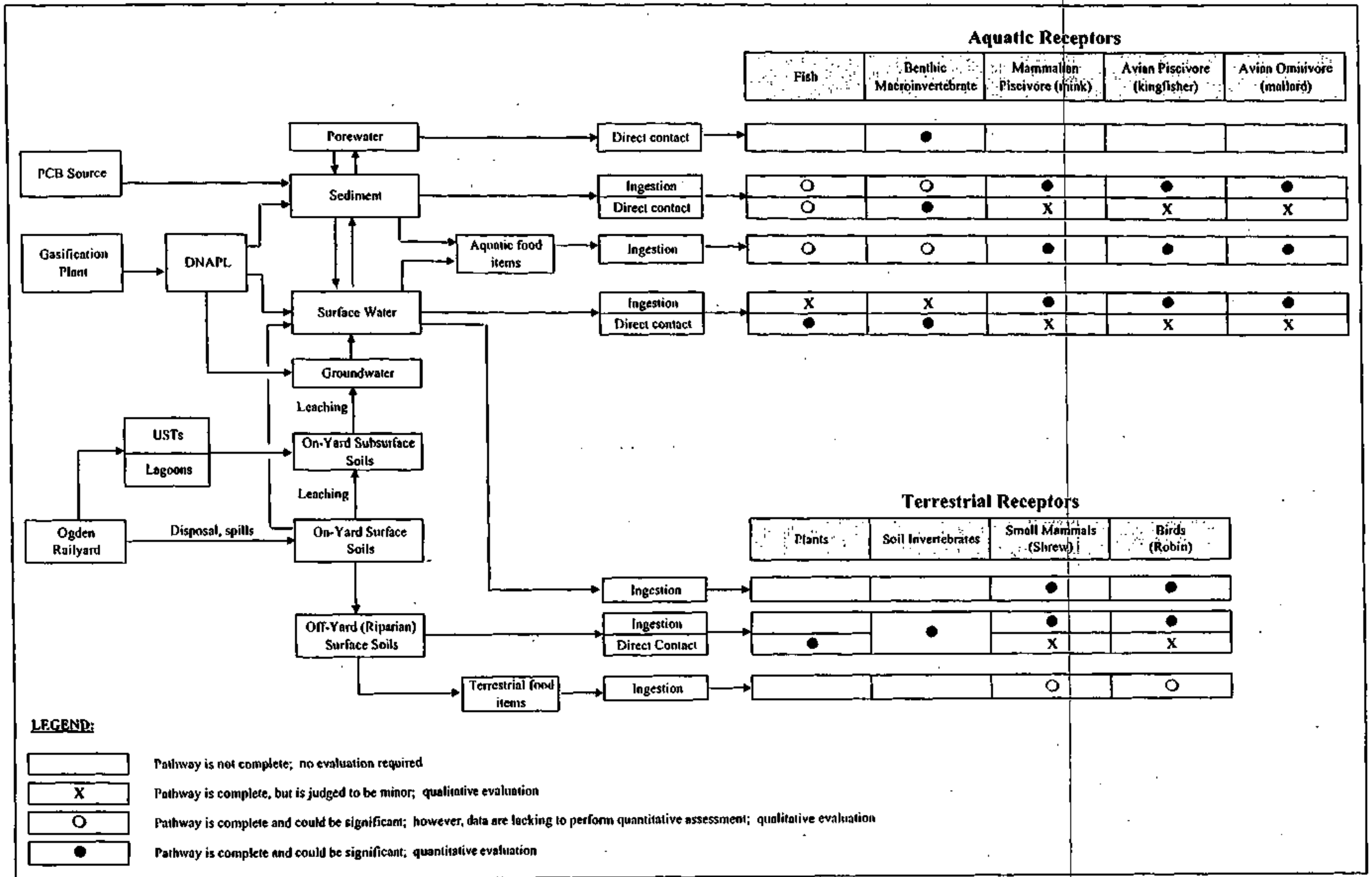


Figure 5
Site Conceptual Model for Ecological Exposure
Baseline Ecological Risk Assessment for the Ogden Railyard Site

end of the 21st Street Pond was lower than scrapers at the unimpacted portion of the pond and the reference site, but the impacts were not severe.

Based on the weight of evidence, the investigators summarized their results in a Site Conceptual Model (for the entire site) as shown in Figure 5. A summary of the findings regarding the 21st Street Pond portion of the site is given in Table 15.

TABLE 15
SUMMARY OF ECOLOGICAL RISK CONCLUSIONS
21st STREET POND

Evidence	Conclusions
RISKS TO AQUATIC LIFE DIRECT CONTACT WITH SURFACE WATER	
Comparison to Benchmarks	For inorganics, concentrations were greater than benchmarks at 21st Street Pond, but also at an uncontaminated reference location, and concentrations were not above background. For organics, several PAHs were of potential population significance at the east end of the 21st Street Pond. If the PAHs were associated with suspended sediments in the water, the risk to aquatic life would be less than calculated.
RISK TO AQUATIC LIFE DIRECT CONTACT WITH SEDIMENT	
Comparison to Benchmarks	For inorganics, concentrations were greater than benchmarks at 21st Street Pond, but also at an uncontaminated reference location. Contamination likely not associated with the site. Selenium concentrations were highest at the non-contaminated part of the Pond, not a concern. For organics, bis(2-ethylhexyl)phthalate, carbon disulfide, and toluene were similar to reference area and bis(2-ethylhexyl)phthalate and carbon disulfide are common laboratory contaminants. Risks from Aroclor 1260 were above benchmarks at a population level at the 21st Street Pond and a nearby stretch of the Ogden River. Risks from 4,4'-DDE were higher at the western part (largely uncontaminated area) than at the contaminated eastern part, but this is likely non-site related. Xylenes were above the level of concern for 40% of the eastern end of the pond and is probably related to the DNAPL plume.
Direct Toxicity Testing	No toxicity was found associated with the east end of the 21st Street Pond

Population Observations	There may be some shifts in community structure in the east end of the 21st Street Pond compared to the west end, but comparison with the reference area (Buena Ventura Park Pond) does not reveal substantial impacts.
Calculations from fish body burdens	Risks from 4,4'-DDD and 4,4'-DDE may be significant, but are probably not site related. These are pesticide degradation products and probably come from the time when the 21st Street Pond area was in agricultural use.
RISKS TO TERRESTRIAL PLANTS AND SOIL ORGANISMS	
Comparison to Benchmarks	For inorganics, metals were above a level of concern, but the metals were well within background levels for the area. The benchmarks were probably overly conservative. For organics, PCBs were above a level of concern in soils near the 21st Street Pond, but these appear to be related to abandoned meanders of the Ogden River near the Pond.
RISKS TO WILDLIFE	
Comparison to Benchmarks	For piscivorous birds (e.g. kingfisher), risks were found due to eating of fish with 4,4'-DDE at 21st Street Pond. The 4,4'-DDE is a degradation product of the pesticide DDT, probably used when the 21st Street Pond area was agricultural land For passerine birds (robin), there were no risks associated with 21st Street Pond. For aquatic birds (mallard duck), there were no risks associated with 21st Street Pond. For mammalian insectivores (masked shrew), there are risks calculated for aluminum, arsenic, lead and mercury at the 21st Street Pond. But the same is true for the reference site and the soils are at background levels. The benchmark concentration is likely overly conservative. For piscivorous mammals (mink) risks appear to all be beneath a level of concern.

PCB toxicity calculations	Total Aroclor method suggests no reason for concern for PCBs in wildlife. Toxicity equivalent calculations suggests some potential concern for the kingfisher and mink due to eating PCBs in fish. Risk levels are low to moderate.

Remedial Action Objectives

The Remedial Action Objectives at the 21st Street Pond - PintschGas Plant portion (Northern Area, OU1) of the Ogden Rail Yard are as follows:

- Protect human and ecological receptors from exposure to DNAPL contaminated sediments at the 21st Street Pond.

- Prevent unacceptable exposure risk to current and future human populations presented by direct contact, inhalation, or ingestion of contaminated ground water.

- Prevent potential future ground water plume migration as necessary to protect current beneficial uses and potential beneficial uses of ground water in the vicinity of the site, and to be protective of surface waters and their designated uses.

- Restore the ground water to beneficial uses (as technically practicable).

- Treat, contain, or remove DNAPL to prevent or minimize further spread of the DNAPL.

Description of Alternatives

The Feasibility Study conducted by the Union Pacific Railroad proposed five (5) alternatives for addressing the environmental problems and reducing exposures at the 21st Street Pond and the former Pintsch Gas plant site:

- Alternative 1: No Further Action

- Alternative 2: Interim actions implemented to date with Monitored Natural Attenuation and institutional controls. Actions implemented to date include the fence around the DNAPL impacted sediments, pond water level management, and limited DNAPL recovery. Additional ground water sampling would be conducted to monitor DNAPL-related contaminant levels in ground water.

- Alternative 3: Pond sediment containment remedy with DNAPL recovery and institutional controls. The DNAPLs in the pond sediments would be contained and capped in place, then backfilled with clean soils. The pooled DNAPLs which are mobile will be recovered from the clay aquitard by flushing with water and pumping.

- Alternative 4: Excavation of Pond sediments, DNAPL zone treatment and institutional controls. The sediments are excavated and the DNAPLs are recovered using underground steam stripping.

- Alternative 5: Excavation of Pond sediments, and mobile DNAPL recovery. The DNAPLs in the pond sediments are removed by excavation. The pooled DNAPLs which are mobile will be recovered from the clay aquitard by flushing with water and pumping.

Each alternative evaluated by the Feasibility Study is described as follows:

Alternative 1: Alternative 1 is the "No Further Action" alternative which is largely used as a baseline for comparison to other alternatives. It includes no monitoring, no control or treatment of impacted sediments, no control or treatment of the DNAPL plume, and no control or treatment of impacted ground water. Because there are no action elements, there are no ARARs.

Alternative 2: Alternative 2 is maintenance of interim controls, Monitored Natural Attenuation coupled with institutional controls.

- To prevent contact of humans with DNAPL contaminated pond sediments, the prior interim controls, including the fence around the impacted sediments, will be maintained.

- To prevent wildlife from coming in contact with the impacted sediments, the prior interim action which kept the pond water level at a high level will be maintained.

- To prevent entry of fish contaminated with PCBs from entering the pond from the Ogden River, the screen across the inlet to the pond from the river will be maintained.

- To evaluate whether the DNAPL plume is continuing to move toward the pond or impacting the river, a monitoring network will track any DNAPL movement.

- To evaluate whether the impacted ground water is continuing to move toward the pond or the river, a monitoring network will insure that the water entering the pond does not degrade the water quality of the pond.

- To prevent current and future use of the ground water, institutional controls will be used to prevent access of outside parties to the ground water and prevent use of the ground water for any domestic purposes.

The cost of this alternative is estimated to be about $501,000, primarily for 30 years of monitoring and reporting.

Alternative 3 which is capping of the contaminated sediments, DNAPL recovery and institutional controls, consists of the following elements:

- To prevent humans, wildlife, and fish from coming in contact with the contaminated pond sediments, a cofferdam will be constructed at the outer limits of the contaminated sediment area, and then the contaminated sediments will be capped. The fish in this area will be relocated to the remaining uncontaminated part of the pond. The contaminated area will be backfilled and will no longer be used as a part of the pond. A collection drain will be constructed to collect any DNAPL that encounters the cofferdam. The sump will be inspected monthly.

- To mitigate DNAPL movement toward the pond, mobile DNAPLs will be removed from pools where it has collected on top of the clay aquitard and disposed or re-used.

- To evaluate whether the DNAPL plume is continuing to move toward the pond or impacting the river, a monitoring network will track any DNAPL movement.

- To evaluate whether the impacted ground water is continuing to move toward the pond or the river, a monitoring network will insure that the water entering the pond does not degrade.

- To prevent current and future use of the ground water, institutional controls will be used to prevent access of outside parties to the ground water and prevent use of the ground water for any domestic purposes.

- The pond will be reopened for public use.

The cost of Alternative 3 is estimated at $1,617,000.

Alternative 4 which includes removal of contaminated sediments and removal of the DNAPL plume by dynamic underground stripping (i.e. steam injection), and institutional controls, consists of the following elements:

- To prevent exposure of humans, wildlife and fish to contaminated sediments, a temporary cofferdam will be constructed and contaminated sediments behind it will be excavated. The wastes will be stabilized with cement and disposed off-site. The disposal location would depend on the characteristics of the wastes.

- To prevent recontamination of the pond with DNAPLs, the DNAPLs will be removed by dynamic underground stripping/hydrous pyrolysis oxidation (DUS/HPO) which involves injection of steam and oxygen underground to volatilize and solubilize the contaminants while oxidizing them.

- To evaluate whether the impacted ground water is continuing to move toward the pond or the river, a monitoring network will insure that the water entering the pond does not degrade.

- To prevent current and future use of the ground water, institutional controls will be used to prevent access of outside parties to the ground water and prevent use of the ground water for any domestic purposes.

The cost of Alternative 4 is estimated at $50.43 M, most of which ($49.75 M) is due to the DUS/HPO system.

Alternative 5 includes excavation and removal of contaminated pond sediments, installation of a barrier wall between the pond and the DNAPL plume, mobile phase DNAPL recovery from pools at the clay layer, monitoring of the groundwater plume and institutional controls. A hybrid of Alternatives 3 and 4, the elements of Alternative 5 include:

- To prevent exposures of humans, wildlife, and fish to DNAPL components in pond sediments, the pond sediments will be excavated from the pond, stabilized, and disposed off-site.

- To prevent recontamination of the pond sediments a barrier wall and sump will be installed upgradient of the pond.

- To mitigate the DNAPL movement toward the pond, mobile DNAPL wastes will be pumped from pools where it has collected on the clay aquitard, then disposed or reused.

- To evaluate whether the DNAPL plume is continuing to move toward the pond or impacting the river, a monitoring network will track any DNAPL movement.

- To evaluate whether the impacted ground water is continuing to move toward the pond or the river, a monitoring network will insure that the water entering the pond does not degrade in quality.

- To prevent current and future use of the ground water, institutional controls will be used to prevent access of outside parties to the ground water and prevent use of the ground water for any domestic purposes.

The estimated cost of Alternative 5 is about $2.3 M.

Common features and distinguishing features of the alternatives. Alternatives 2-5 (the alternatives where some action is indicated) all have some features in common. These include (1) monitoring program to track the potential movement of the ground water plume and/or the DNAPL plume, and (2) institutional controls to prevent the ground water to be accessed and used for domestic purposes. None of the alternatives address ground water by treatment.

The alternatives differ in the degree to which they each address the pond sediments and the DNAPL plume. Alternative 2 simply prevents access to the pond sediments by fencing it off. Alternative 3 goes one step further preventing exposure by capping the sediments with fill, and filling in that part of the pond. A cofferdam will prevent further encroachment of the DNAPLs into the pond. Alternatives 4 and 5 remove the sediment from the pond altogether. Alternative 4 prevents pond recontamination by removing the DNAPL with treatment. Alternative 5 prevents pond recontamination with a barrier wall. Alternative 2 does not do anything to the DNAPL plume. Alternatives 3 and 5 remove the mobile DNAPL phase by water flushing. Removal of the mobile portion should prevent further movement. Alternative 4 attempts to remove most of the DNAPL by heat and oxidation. All the action alternatives (Alternatives 2, 3, 4, and 5) all rely on natural attenuation for ground water contaminants, but Alternatives 3, 4, and 5 have a source control component. Alternatives 2, 3, and 5 are modest in costs ($0.5M, $1.6M and $2.3M) while Alternative 4 is a factor of 20 to 100 times more expensive ($50M).

Expected outcomes of each alternative. There are no environmental benefits in Alternative 1. Exposures continue to occur and may get progressively worse if the DNAPL plume moves contaminating more pond sediments and more ground water. This could lead to contamination of the Ogden River

Alternative 2 allows use of a portion of the 21st Street Pond so long as the ground water plume remains stable and the DNAPL remains in place. At this time, ground water resources in the area are not used because of its contamination and risks presented by its use. The contaminated sediments might pose a continuing threat to wildlife in the area.

Alternative 3 allows potential use of the 21st Street Pond by cutting off the DNAPL contamination from the pond and preventing recontamination. Because the more mobile fraction of the DNAPLs are recovered, it is unlikely that the DNAPL will move into new areas. It is unlikely that ground water resources in the area will have any beneficial uses because the residual DNAPL contaminants will continue to affect the ground water. The method used to prevent leaching of contaminants into pond water will result in filling of that part of the pond, a net loss of water habitat. Given the size of the pond, this net loss is insignificant.

Alternative 5, similar to Alternative 3, will allow use of the 21st Street Pond because the DNAPL contaminated sediments will be removed from the site and that area will continue to be a part of the pond. Recontamination of the pond is prevented through the use of a barrier wall. Like Alternative 3, the mobile fraction of the DNAPLs are recovered so that it is unlikely that the DNAPL will move into new areas, but ground water contamination through leaching of the residual DNAPLs will continue and prevent beneficial use of the ground water.

Alternative 4 allows full use of the 21st Street Pond because the contaminated sediments are removed. This alternative attempts to remove all the DNAPLs and cut off the source of the ground water contamination, but may not be effective, and could have unwanted side effects, such as accelerating the release of contaminants into the ground water due to the high temperatures. If the temperature of the water increases significantly, the water could get into the river and the pond causing unwanted algal blooms or worse. Moreover, success is not assured for the DNAPL treatment. All the land at the surface will be pockmarked with injection and recovery wells. In addition the ground water hydrology could be impacted causing a shift of direction of the plume.

Comparative Analysis of Alternatives

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives, except the no-action alternative (Alternative 1), prevent exposures of humans to contaminants in ground water largely by preventing the community and workers from drilling wells or using the ground water for domestic purposes, by use of institutional controls and/or controlling access through property ownership. Alternatives 1 and 2 reduce exposures of humans to PCBs in fish by keeping fish which have accumulated PCBs from Ogden River out of the 21st Street Pond. However, fish within the pond may continue to take up PCBs from the pond sediments. Alternative 3 - 5 prevent the small PCB exposures by capping or removing pond sediments.

Alternatives 1 and 2 do not address exposures of aquatic and terrestrial wildlife to contaminated sediments and surface waters. Alternatives 3 reduces the ecological exposures by capping the contaminated sediments (PAHs would be sequestered, xylenes which are more soluble, can still leach into the ground water). Alternatives 4 and 5 eliminates the ecological exposures completely by removal of contaminated sediments.

2. Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, which are not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

Due to the nature of the DNAPL leakage of some ground water contaminants, only the most expensive alternative (Alternative 4), will be able to achieve drinking water standards in a short time frame, the goal for ground waters in Utah which are potential drinking water sources. Although the ground water in this area has not been identified as a potential drinking water source by local government, achievement of MCLs is relevant and appropriate, but is not time-critical. MCLs will be achieved when the more soluble components of the DNAPL are exhausted. In the interim, institutional controls will prevent access to the DNAPL and ground water. Since the current use of the water is recharge of the pond, the surface water quality standards are appropriate. For the action alternatives, the alternatives were designed to meet ARARs during construction. Because the capping alternative, Alternative 3, involves filling the contaminated corner of the pond, there would be a net loss of open water. However, given the size of the pond, this loss is not significant and can be easily compensated in the design phase.

3. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Alternative 1, the no action alternative, is neither effective or permanent. Alternative 2, which was designed only as an interim measure, is effective in the short term, but is unlikely to be effective in the long term due to the continued presence of nearby DNAPLs adjacent to the pond. Although the pond could re-open for use, the agencies might have to close it again should the situation get worse. Alternative 3 is effective and permanent. Alternatives 4 and 5 have the potential to be more effective and permanent in terms of protection of the pond since the contaminated sediments are removed from contact with the water. Alternative 4 has the highest degree of effectiveness since the DNAPL layer is addressed through treatment and movement of DNAPLs toward the pond would not be a continuing threat, at least theoretically.

4. Reduction of Toxicity, Mobility or volume through treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as a part of the remedy.

Alternatives 1 and 2 would not reduce the toxicity, mobility or volume of the wastes threatening the 21st Street Pond. Alternative 3 would reduce the mobility of the wastes in the contaminated sediments by capping and containment of the sediments and removal of the mobile DNAPLs from pools near the pond. Alternative 5 would reduce both the mobility and volume of the wastes threatening the 21st Street Pond by removal of the contaminated sediments and by removal of the mobile DNAPLs. Alternative 4 would reduce the volume of the wastes by the largest amounts by underground stripping of the DNAPLs plus removal of sediments. However, the mobility of the wastes might actually increase while the steam injection process is underway, actually increasing the toxicity threat to the 21st Street Pond during remediation of the DNAPLs.

5. Short Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 1 (the no action alternative) and 2 would not pose any threats to workers, the community, or the environment because no construction work at the site would be necessary. Alternative 3 would not have adverse short term impacts to the pond since the wastes would not be disturbed during the course of construction. Alternative 4 could have some short term effects on the pond because the injection of steam could increase the mobility of some of the DNAPL components during the start up of the action. Alternative 5 could also have short term effects on the pond during remediation since the contaminants would be disturbed during the excavation process.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All of the alternatives are implementable. There are some concerns that the excavation of contaminated sediments (Alternatives 4 and 5) would require special methods to handle ground water inflows during construction. A portion of the entire DNAPL plume may be inaccessible (railroad tracks, highway overpass), a problem for Alternative 4.

7. Cost

The estimated present worth costs for the alternatives, not including the No Action Alternative, range from $500,000 for Alternative 2 to $50,430,000 for Alternative 4. The cost of each alternative increases as the degree of ground water treatment increases. Cost summaries can be found in Table 16.

TABLE 16
SUMMARY OF COSTS FOR THE REMEDIAL ALTERNATIVES

Alternative	Capital Costs	Annual O+M Costs	NPV O+M Costs	Total NPV costs
Alternative 1 - No action	0	0	0	0

Alternative 2 - Monitored Natural Attenuation	0	$51,500 (varies)	$504,656	$500,000
Alternative 3 - Capping of contaminated sediment and removal of mobile DNAPLs by pumping	$500,000	$51,500 (varies)	$1,107,000	$1,600,000
Alternative 4 - Removal of contaminated sediments and removal of DNAPLs by underground steam injections	$50,436,000	0	0	$50,430,000
Alternative 5- Removal of contaminated sediments and removal of mobile DNAPLs by pumping	$1,210,000	$51,500 varies	$1,107,000	$2,317,000

8. State acceptance

The state environmental staff preferred either alternative 3 or alternative 5. The Utah Department of Transportation, the owner of the pond area, expressed a preference for alternative 3 as being protective but at lower cost than alternative 5. The Utah Department of Natural Resources expressed their views that the pond was a valuable wildlife and recreational resource for the area but did not express a remedial preference.

9. Community acceptance

During the public comment period, community activists pointed out the importance of the pond as a valuable recreational resource and described how they would like the pond to be reopened for that purpose. The City of Ogden in a resolution of the City Council expressed a preference for Alternative 3 as a cost effective alternative that would allow the pond to be reopened for public use. They thought the net loss of wetlands insignificant given the size of the pond and the presence of other nearby wetlands.

Principal Threat Waste:

The principal threat wastes are DNAPLs that were released to the shallow aquifer through the operations of a Pintsch Gas Plant. This historical operation produced Pintsch Gas (manufactured gas) that was used for lighting rail cars prior to the advent of electricity. The residues of this operation were found at the site of the plant and had migrated to the north towards the 21st Street Pond. The wastes are composed of two fractions. (1)The mobile wastes formed a DNAPL layer on the bottom of the shallow aquifer on top of the clay aquitard and, over time, has collected in pools in depressions of the clay layer. A pilot experiment has shown that the DNAPLs in the pools can be recovered by pumping. (2) Residual wastes that are absorbed or attached to aquifer materials which cannot be dislodged by simple flushing. This waste is essentially non-mobile.

The principal threat waste is dealt with in a variety of ways by the various alternatives considered in the RI/FS process. Alternatives 1 and 2 do not address the principal threat waste. Alternatives 3 and 5 address the principal threat wastes by removal of the mobile DNAPLs and, depending on the nature of the wastes, treated or recycled. Alternative 4 addresses the principal threat waste by a high temperature steam injection process, theoretically causing both the mobile and immobile wastes to migrate toward collection point. The efficiency of this approach is unknown.

Selected Remedy

EPA and UDEQ select Alternative 3, capping of contaminated pond sediments, removal of mobile DNAPLs, and institutional controls, as the remedial alternative to be implemented at the 21st Street Pond Operable Unit of the Ogden Rail Yard Site (OU1).

Summary of the rationale for the selected remedy

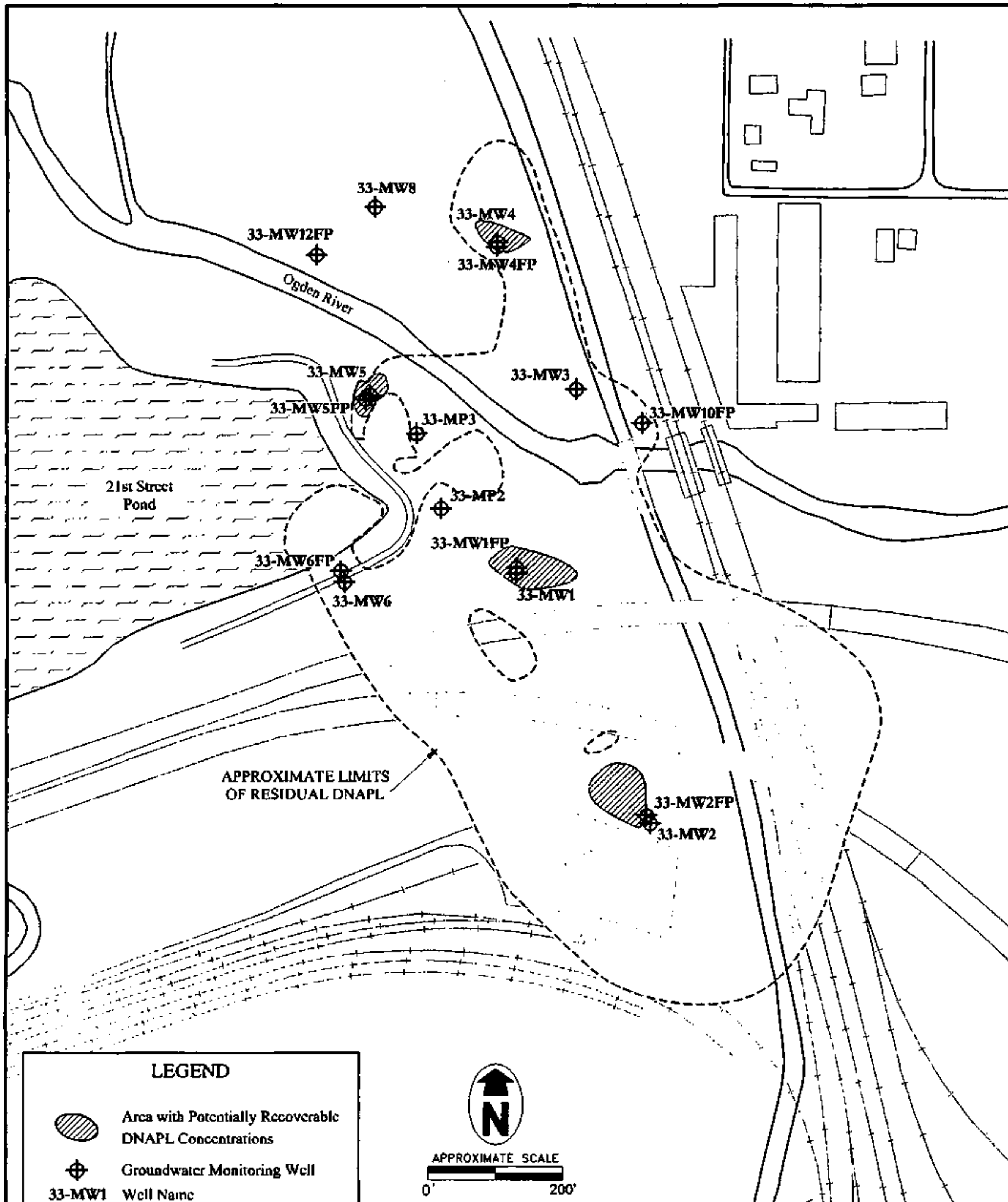
The community was very supportive of the concept of reopening the 21st Street Pond for recreational use and fishing. Therefore, any remedy that did not address the contaminated sediments (e. g., Alternatives 1 and 2) was unacceptable. Because the community did not envision the use of the ground water for any purpose, there was no support for spending excessive funds to address the DNAPLs, especially if they were not moving. Therefore, Alternative 4 was eliminated as being too costly for the questionable benefits. Alternatives 3 and 5 are roughly equivalent. Both address the contamination in the sediments (Alternative 3 by capping and Alternative 5 by removal), both remove mobile DNAPLs to prevent possible movement of the wastes, and both use institutional controls to prevent inappropriate use of the ground water in the area. If the major goal of this action is for the local citizens to have the full use of the 21st Street Pond again, then both Alternatives 3 and 5 achieve this goal, but Alternative 3 does it at a lesser cost. The Ogden City Council passed a resolution in support of Alternative 3, citing its advantage in cost-effectiveness. The owner of the site, the Utah Department of Transportation, also supports Alternative 3, citing its advantage in cost-effectiveness. One of the responsible parties, the Union Pacific Railroad, which has already agreed to perform the work associated with the selected remedy, did not comment during the public comment period, but is known to support Alternative 3, as indicated in their RI/FS documents. The general public did not express a preference between Alternatives 3 and 5; they only indicated that they wanted the use of the pond again. Having seen no clear support for Alternative 5 among the people most affected, the citizens of Ogden, EPA and UDEQ decided to choose Alternative 3, the most cost effective remedy which allowed for reopening of the 21st Street Pond.

Description of the selected remedy

EPA and UDEQ select Alternative 3 for implementation at OU1 (21st Street Pond) area of the Ogden Rail Yard site. The remedy consists of capping of the contaminated sediments in the pond, mobile DNAPL recovery from pools on top of the clay layer and institutional controls. The selected remedy consists of the following elements:

- To prevent humans, wildlife, and fish from coming in contact with the contaminated pond sediments, a cofferdam will be constructed at the outer limits of the contaminated sediment area, and then the contaminated sediments will be capped (see Figure 6). The contaminated area will be backfilled and will no longer be used as a part of the pond. In order to preserve open water habitat, fill material from the shores of another section of the pond may be used. A collection drain will be constructed to collect any DNAPL that encounters the cofferdam. The sump will be inspected monthly (or less frequently depending on the observations during the first 5 years).

- To mitigate movement of DNAPLs, mobile DNAPLs will be removed by pumping from pools where they have collected on top of the clay aquitard. Four such pools have been identified thus far (see Figure 7). Each of the pools will be revisited at the end of the first five year period to determine if additional DNAPL wastes have migrated into them.



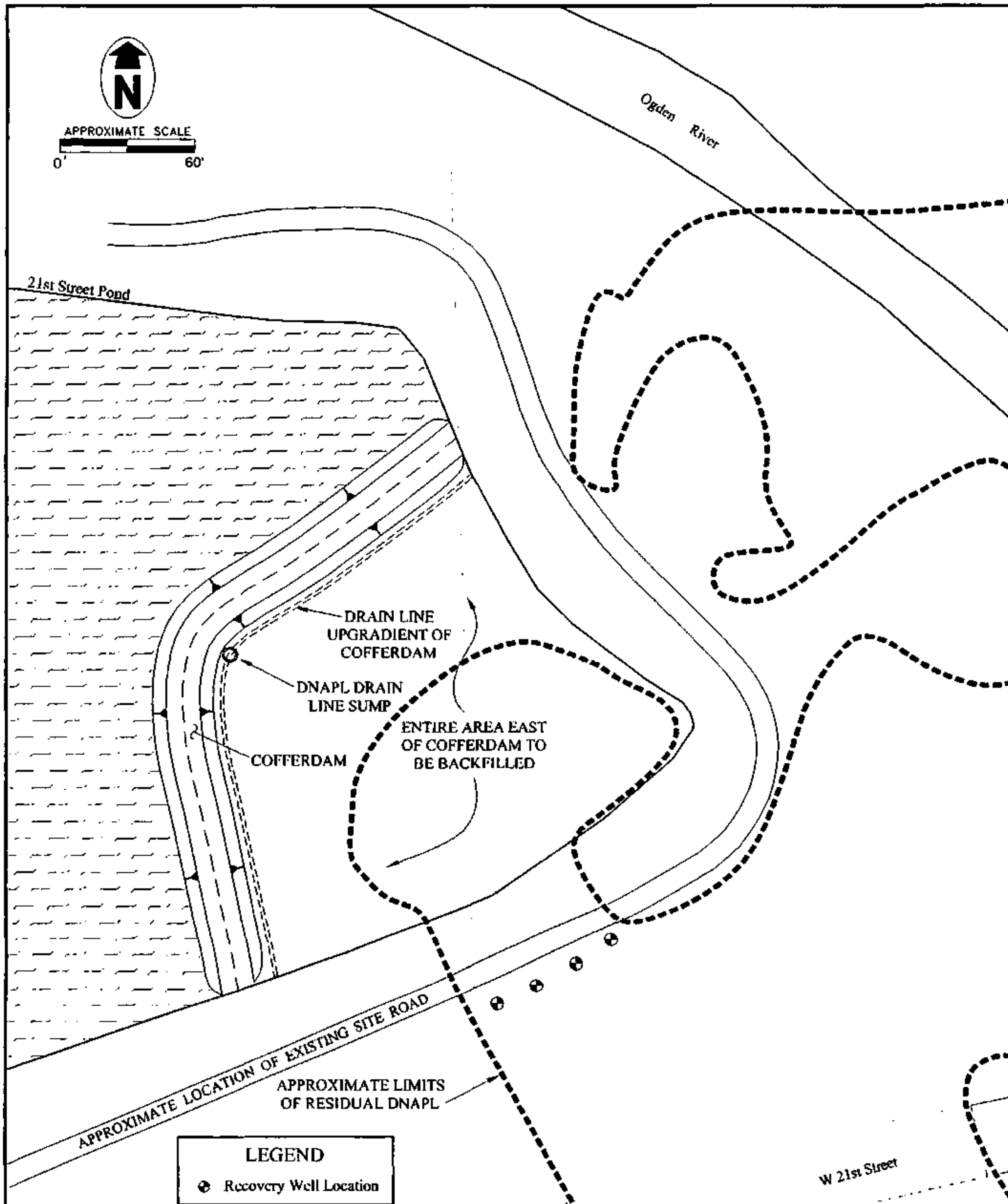
THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

TITLE:

FIGURE 6
DNAPL RECOVERY LOCATIONS

UNION PACIFIC RAILROAD FACILITY
OGDEN, UTAH

1330-X1.dwg 2453081.54878102



THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

TITLE:

FIGURE 7
PLAN OF POND SEDIMENT CONTAINMENT AREA
UNION PACIFIC RAILROAD FACILITY
OGDEN, UTAH

1330-X1.dwg 2453031 34978102

- To evaluate whether the DNAPL plume is moving toward the pond or impacting the river, a monitoring network will continue to track DNAPL movement.

- To evaluate whether the impacted ground water is moving toward the pond or the river, a monitoring network will insure that water entering the pond does not degrade the water quality of the pond.

- To prevent current and future use of the ground water, institutional controls will be used by the property owners through deed restrictions or other mechanism to prevent access of outside parties to the ground water and prevent use of the ground water for any domestic purposes. Institutional controls will also be used to protect the integrity of the cap.

- The pond will be reopened for public use.

Summary of the estimated remedy costs

The cost of Alternative 3 is estimated at $1,617,000. The breakdown of the costs of the selected remedy is given in the RI/FS and is given in Table 17.

TABLE 17
SUMMARY OF ESTIMATED COSTS OF SELECTED REMEDY

ITEM	BASICS	Quantity	Unit Price	Cost Estimate
CAPITAL COSTS (for pond sediment capping)				
Coffer Dam	350 ft long, 5 feet ave ht, 4:1 slopes, and key trench	1750 sq ft	18.60	32,500
Oil Control Boom	Boom on downstream side of coffer dam	5 days	500/day	2,500
Dewatering of Pond	8 hr of 6" centrifugal pump	4 days	760	3,040
Dewatering during construction	8 hr of 4" diaphragm pump	28 days	610	17,080
Water Treatment during construction				
Baker Tanks	two 23,000 gal tanks rental	76 days	95.00	7,200
Polymer	assist in particle settling	1	2,000	2,000

ITEM	BASICS	Quantity	Unit Price	Cost Estimate
Sediment removal	chemicals and labor to remove sediments from tanks	1	5,000	5,000
Bag Filter	Barnaby-Seteliff BF 300, rental	2.5 Mo	250	625
Bags	one bag/day	76 days	10	760
Carbon Filter	2 single vessel carbon filters model LS360 rental	2.5 Mo	2,780	6,950
Carbon	carbon for carbon vessels	10,000 lb	1	10,000
Carbon Filter Disposal	disposal of carbon filter after construction	10,000	0.10	1,000
Freight	cost of freighting equip to and from NV	2	2,500	5,000
Excavation of DNAPL Trench		248 CCY	4.56/CY	1,130
Drain Trench	Borrow, haul, spread	248 CCY	24	5,940
Trench Pipe	Piping 6" diameter	297 linear ft	9.65	2,866
DNAPL Sumps	CB or manholes precast	1	1,500	1,500
DNAPL Pumps	pneumatic or anchor pump		5,000	already have
DNAPL Pump Controls	operates on timer		2,000	already have
DNAPL Piping	2" carbon steel pipe		15.27 lf	already have
DNAPL Storage Tank	double wall tank with fittings, 2000 gal		5,575	already have
Monitoring wells	2 inch dia, 20 feet deep	2	3,000	6,000
Backfill	bottom three lifts, hauling and placement	5,652 ccy	24/ccy	135,646

ITEM	BASICS	Quantity	Unit Price	Cost Estimate
Topsoil	hauling, placement, weed free	1,602 ccy	15	24,270
Electrical Transformer	Power supply to construction site	1	10,000	10,000
Landscaping	hydroseeding (includes seed and fertilizer)	4,555 sy	0.32/sy	1,458
Subtotal				282,535
Unscoped Items	allow 10%	10%		28,300
Subtotal				310,835
General requirements in subcontract - insurance, bonds, mobilization	allow 10%	10%		31,100
Cost of contract (subtotal)				341,935
Contingency	none			0
Construction cost				341,935
Design	allow 10%	10%		34,200
permitting	allow 10%	10%		34,200
construction oversight	allow 10%	10%		34,200
Total				444,535
Total capital cost (rounded)				440,000
CAPITAL COSTS Mobile DNAPL recovery				
Recovery well installation	3 additional wells	3	6,000	18,000
Injection well installation	3 additional wells	3	6,000	18,000
Observation wells	9 additional observation wells	9	1,100	10,000
Subtotal				46,000
Unscoped items	allow 10%	10%		4,600

ITEM	BASICS	Quantity	Unit Price	Cost Estimate
Contract cost (subtotal)				50,600
Contingency	allow 10%	10%		5,100
Total				55,700
Total (rounded)				60,000
Total capital costs				500,000
OPERATIONS AND MAINTENANCE				
30 years of monitoring	semi-annual as per FS Table 3.1			500,000
3 years of DNAPL operations and monitoring	upgrades, maintenance			150,000
	operation and monitoring			300,000
DNAPL Sumps (30 yrs)	monitoring			12,688
Subtotal Present Net Value	Operations and Maintenance			$1.107M
TOTAL Present Net Value (rounded)	Capital costs + Operations and Maintenance			$1.6M

Expected outcomes of the selected remedy

EPA and UDEQ believe that the selected remedy will prevent pond waters from coming into contact with the contaminated sediments and will cut off all exposures to wildlife attributed to contaminants arising from this source. Because the remedy can be implemented quickly, the pond can be reopened for public recreational use including fishing. By removing the mobile DNAPLs from the area of the pond, the DNAPL movement should stabilize at its present location. It is anticipated that some natural attenuation of the material should begin, probably at a very slow rate. The presence of these hydrocarbons on the solids in the aquifer could release the more soluble hydrocarbons into the ground water, but this should begin to decline as these hydrocarbons are depleted. It is likely that this remedy will do nothing immediately toward the goal of improving water quality in the ground water. The ground water is presently good enough for beneficial use as recharge to the pond, but not good enough for use as a drinking water source or for other indoor uses. The institutional controls will prevent its use. In all likelihood, the institutional controls may have to be perpetual.

Final cleanup levels

The ultimate objectives for the remedial action at the 21st Street Pond are to restore the 21st Street Pond for its traditional use as a recreational resource (primary fishing, birdwatching, hiking, etc.) and to prevent re-contamination of the pond in the future. The ground water is not currently used for drinking water purposes, nor are there any plans to use these ground water resources for a drinking water supply in the future. EPA and UDEQ both believe that the Selected Remedy can achieve a level of contaminants which are safe at the time the ground water discharges into the pond.

Cleanup levels for each chemical of concern is specified in Table 18.

TABLE 18
CLEAN UP LEVELS FOR 21st STREET POND

CONTAMINANT OF CONCERN	CLEAN UP LEVEL	CLEAN UP LEVEL	CLEAN UP LEVEL
Basis of level	Surface Water Quality Standard for 21st Street Pond	Alternate Concentration Limits for 21st Street Pond	Drinking water MCLs
Point of compliance	21st Street Pond	Throughout the plume	Throughout the plume
Consequence of non-attainment	Contingency plans must be implemented to protect the pond	Monitoring must continue	Institutional controls must continue
Consequence of attainment	No additional protective measures	Routine monitoring can cease	Institutional controls may be released
ethyl benzene	29,000 ppb	348,000 ppb	700 ppb
benzo(a)pyrene	0.018 ppb	0.067 ppb	0.2 ppb

Statutory Determinations

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy protects human health and the environment by preventing exposures of aquatic life and wildlife to the constituents present in the contaminated sediments by capping the sediments. Human exposures are limited by capping the sediments and preventing access to contaminated ground water through the use of institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of sediment capping, mobile DNAPL removal and institutional controls complies with all ARARs. The ARARs are presented below.

Chemical, Location , and Action-Specific ARARs include the following:

- Safe Drinking Water Act MCLs (40 CFR Part 141, and R309-200-5 UAC) which specify acceptable concentration levels in ground water that serve as a potential drinking water source. The institutional controls portion of the remedy will remain in place so long as concentrations of contaminants in the ground water exceed the drinking water standards.

- Clean Water Act (40 CFR Part 131, and R317-2-UAC) which specify water quality criteria for protection of aquatic life in state and federal surface waters. The monitoring program will determine if the contaminants begin to move toward receiving waters. The monitoring portion of the remedy will remain in place so long as the concentrations of contaminants in the ground water exceed the water quality standards.

- RCRA (40 CFS Part 262 and R315-5 UAC) which specifies chemical characteristics of a hazardous waste. The wastes recovered during the pumping of the DNAPL pools will be tested so that they can be sent to an appropriate off-site Subtitle C or D TSD (treatment, storage, disposal) facility.

- RCRA (40 CFR 264.554) which has requirements for staging piles of remediation wastes prior to transportation and disposal. If wastes from the pumping of the DNAPL pools are stored prior to transportation for treatment and disposal at an off-site facility, these regulations will be followed.

- Well drilling standards (R655-4 UAC) which establishes standards for drilling and abandonment of wells, will be met during the course of well drilling and abandonment at the site.

Cost Effectiveness

In the lead agency's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The estimated present worth cost of the Selected Remedy is $1,617,000. In terms of cost-effectiveness, Alternative 3 represents the best value for the remediation.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The selected remedy emphasizes stabilization and containment of the DNAPLs by removal of the mobile fraction. The mobile fraction, which can be separated from the water, could be re-used as an asphalt additive, if testing indicates that the material is not hazardous. Due to the nature of the wastes, treatment to the degree necessary for protectiveness is very costly, and therefore impractical.

Preference for Treatment as a Principal Element

The principal threat waste is a layer of DNAPLs which lies on top of the clay aquitard in the region. The selected remedy uses removal of the mobile fraction of the wastes in order to prevent further migration. Treatment of the DNAPLs is very costly, and was not chosen given the uncertainty of the completeness and the potential for mobilization of the wastes during the course of treatment. In this case, treatment as an option was impractical.

Five Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a policy review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Although this site has not been proposed or listed for the National Priorities List, the regional policy review is needed to maintain parallelism between this Superfund Alternative Site with the NPL sites in the region.

Documentation of Significant Changes

On May 23, 2004, EPA and UDEQ released the Proposed Plan for this operable unit which announced that the agencies' preferred alternative was Alternative 5, removal of contaminated sediments, pumping of mobile DNAPLs from the aquifer, and institutional controls. Actually, the agencies were satisfied with either Alternative 5 or a similar approach in Alternative 3, capping of the contaminated sediments, pumping of mobile DNAPLs, and institutional controls. Both of these alternatives would allow reopening of the pond for public use at modest costs. Alternative 5 which involved removal of the sediments was slightly more protective and put the pond footprint back to its original size and shape. However, Alternative 5 was about $600,000 more costly than Alternative 3. EPA and UDEQ sought to find out from the community if these extra benefits were worth the extra cost involved. The agencies learned that the extra benefits were not of prime importance to the Ogden City Council, the Utah Department of Transportation (the owner of the site) or to the past users of the pond. Speakers from the community only wanted the pond returned to its former public use, and did not seem to care which alternative was used to get there.

Because the added protective benefits and retention of the quarter acre of pond area as afforded by Alternative 5 were not valued by the community or the property owner, the additional costs were not warranted for these benefits. Therefore, the agencies, on the basis of the public comments, choose the more cost-effective remedy, Alternative 3, as the selected remedy, rather than the initially preferred, but more costly Alternative 5. Essentially, the owner of the site (Utah Department of Transportation) and the prospective future owner (the City of Ogden), did not think the extra costs were worth the potential benefits. For this reason, the selected remedy, Alternative 3, differs from the proposed plan.

PART 3: RESPONSIVENESS SUMMARY

Stakeholder Comments and Lead Agency Responses

Public Hearing: Weber Center Commission Chambers, Ogden, UT, May 26, 2004

Commenter: Steve Fielding, former park manager, Fort Bonaventura State Park and 21st Street Pond

Comment: The 21st Street Pond was used by 15,000 - 20,000 people per year as a part of the Utah Division of Wildlife Resources urban fisheries program.

Response: EPA and UDEQ agree that the pond was heavily utilized for fishing prior to its closure due to potential contamination concerns.

Comment: There were so many people using the pond for fishing that the division had to close down the water skiing program.

Response: We assume that local managers will have to continue to balance uses to maintain safety of the users.

Comment: The pond is heavily used in the early spring for ice fishing since other nearby fishing holes are closed due to rotten ice. It was nearby and the 21st Street Pond was used particularly when gas prices were high, like today.

Response: We agree that the pond is a valuable recreational resource for year round activities.

Comment: I could recommend either Alternative 3 or 5. The main thing is to get the area back in use again. The prior programs were successful, and I would like to see it back in use again, whatever it takes to do it.

Response: We agree that the major goal of the project should be to restore the pond so that it can be reopened for its traditional uses by local residents.

Commenter: Brent Jensen, Utah Department of Transportation, environmental section. (Note: The Utah Department of Transportation is the current owner/manager of the 21st Street Pond)

Comment: Thirty years ago, UDOT excavated the area to obtain fill material and the pond was formed in that excavation. That is why we are here.

Response: EPA and UDEQ appreciate the help and cooperation of UDOT in *providing some funding and technical support during the study phases of this project. We are counting on continued support from UDOT.*

Comment: UDOT is in full support of Alternative 3 and feel like that is a sufficient solution.

Response: We are pleased to know UDOT's views on this subject. As the property owner, it is important to understand how much protectiveness is expected from this project.

Comment: Alternative 3 is an effective, cost-saving, long-term remediation solution that we feel adequately protects the environment.

Response: The agencies were curious as to what was acceptable in terms of protectiveness to the owner of the site. Thank you for letting us know.

Commenter: Gary Lappin, Mineral Tech

Comment: Zeolite is a mineral that has cation exchange properties and absorbs petroleum and has been used for radiation spills at Three Mile Island and drinking water at Truckee. If you mix it with dirt it will absorb the oil and encapsulate it. It has been used for oil spills putting it right on the water where it ties up the oil and settles out. It can be used as a cap.

Response: EPA and UDEQ has tasked an independent remediation firm to investigate the utility of zeolite in this particular situation. Their conclusions are attached as an Appendix.

Comment: You can put the zeolite behind bentonite, let the zeolite absorb as much as it can and just replace the zeolite. The zeolite with oil qualifies as an industrial (non-hazardous) waste.

Response: EPA and UDEQ are aware of zeolite's utility as an absorbent in spill situations. This particular situation is not strictly analogous to a spill, but is more like a seep. Continual replacement of materials is not particularly attractive and would produce extra long-term operations and maintenance costs. See the appendix.

Comment: We have 33 million tons of it in a mine in Oregon. It is inexpensive in comparison with other things. We would like a chance to put in a proposal

Response: It is our understanding that you have provided the particulars in terms of costs of the product to our independent investigators. Thank you for your *cooperation.*

Commenter: Jay Hudson, volunteer with the Ogden Trails Network

Comment: The Ogden Trails Network will go across the front of the mountains from Weber to Ogden Canyon, down one river and up the other in a 26 mile trail loop. We've been building the trail in sections and a significant part of it is done. We have enough property to complete the trail from the mouth of Ogden Canyon all the way down the Ogden River and back up the Weber River to the far side of Riverdale.

Response: Thank you for this prospective regarding future use of the pond. It will aid EPA and UDEQ as we evaluate the designs for the cleanup activities.

Comment: The Ogden Trails Network has a spinoff which would include economic development of the community because companies look for amenities such as this when they consider relocating.

Response: We agree that the 21st Street Pond is a local recreational asset which would contribute positively to the quality of life in the Ogden area.

Comment: The 21st Street Pond has been a part of the Centennial Trail recreational concept. One weekend 500 volunteers built pads, benches, tables, railings and fences.

Response: We are pleased to know that the value of the Pond is appreciated by the local residents enough to lead them to participate in volunteerism to enhance the recreational opportunities at the Pond. Their efforts are still noticeable at the Pond even now.

Comment: Past uses of the pond include fishing. In the future, we'd like to use the pond for model boat regattas, aquatic functions like races of strange "watercraft," and canoeing. The road around the pond can be used for carriage and buggy rides using local 4H kids and their horses.

Response: Thank you for the information regarding future uses of the pond and the surrounding area. This will be very useful in evaluating the cleanup designs.

Comment: The Pond has significant value as a bird watching spot and would connect with an adjacent property for this.

Response: We believe that health of the birds is a prime goal for the water quality of the lake. We have also observed that waterfowl are frequent visitors to the

Pond.

Comment: It doesn't matter what alternative is used so long as the pond remains for recreational purposes and the water is clean enough for that purpose.

Response: We agree that the cleanup goals of the project should be to reopen the Pond for its traditional purposes and other enhanced recreation. Fish habitat and bird habitat should be considered during the design.

Received via e-mail, May 25, 2004.

Commenter: Sharen Perry

Comment: I oppose the railroad alternative to bury the problem. Please remove the contaminated sediment and mobile wastes of the old gas plant. As a bird-watcher and fisherman, I want to be able to use the pond again. It is important for the Ogden River Parkway project.

Response: We appreciate your thoughtful comment. We believe that with proper design and maintenance the capping alternative coupled with removal of the mobile wastes will be protective long-term and the pond water quality will be good once again. EPA and UDEQ intend to remain vigilant to ensure that the proper maintenance of the dam and cap takes place. This long-term maintenance will be included in our legal agreements with the railroad and UDOT. Your response indicates a love for the Pond that we found prevalent among the local residents and the local government.

Received via letter, June 22, 2004

Commenters: The Ogden City Council and Mayor of Ogden City in a joint resolution (Resolution No. 2004-3) passed on June 22, 2004.

Comment: EPA and UDEQ are soliciting comments regarding preferences of the remedial alternatives.

Response: EPA and UDEQ appreciate that the Mayor and City Council were able to answer our questions with regard to future plans and the degree of protectiveness desired by local government. It was important to us that the remedy achieve the desired protectiveness without overspending monies on items not of value to the community. Thank you for your help.

Comment: The 21st Street Pond and surrounding area have in the past and are anticipated in the future to provide recreational activities to the general public including the citizens of Ogden and the Ogden River Parkway trail as it traverses the 21st Street Pond property.

Response: Thank you for letting us know about the local plans for the future of the Pond.

Comment: Alternative 3 can be accomplished at moderate cost with only a modest reduction in the aggregate pond area and provides for institutional controls which include future continuous monitoring of any future release of contaminants.

Response: We appreciate understanding whether the local government is concerned about the possible loss of pond area which is possible with Alternative 3. This statement lets us know that this is not an issue of concern.

Comment: Alternative 3 can be effected expeditiously over an estimated period of 16 weeks and protects public health and safety now and in the future with institutional controls.

Response: EPA and UDEQ now understand that the less costly remedy is sufficiently protective for the community. Expenditure of extra dollars for a level of protection that is not valued by the local community is therefore unwarranted.

Comment: Alternative 3 for the 21st Street Pond is endorsed and recommended as the preferred alternative for implementation by EPA and UDEQ.

Response: EPA and UDEQ thank you for the views of the local government on the issues of concern to us.

Received via letter, June 28, 2004

Commenter: Robert M. Welch, Regional Habitat Manager, Utah Division of Wildlife Resources, Ogden

Comment: The Division of Wildlife Resources remains concerned about the Ogden River and 21st Street Pond. These have been recreational areas including fishing, hiking, and bird watching. They advocate cleanup so that these activities can be resumed and continued into the future.

Response: EPA and UDEQ appreciate the information about the potential use of the pond in the future. We concur.

Technical and Legal Issues

There are no technical issues which can not be solved by remedial designs. There have been no legal issues identified to date. The responsible parties, Union Pacific Railroad, and the Utah Department of Transportation have been cooperative. The site is being addressed outside the Superfund National Priorities List (NPL).

POTENTIAL USE OF ZEOLITES AS A REMEDIAL TECHNOLOGY PROPOSED PLAN FOR OPERABLE UNITS NUMBERS 1 AND 4 OGDEN RAIL YARD SITE OGDEN, UTAH

The U.S. Environmental Protection Agency (EPA) completed the proposed plan for Operable Units (OU) Nos. 1 and 4 at the Ogden Rail Yard located in Ogden, Utah. The proposed plan informs and solicits the views of the public on the preferred cleanup alternative for these operable units. In a public hearing on the proposed plan, EPA received a comment from Mr. Brent Waters of Mineral Technology Inc. (Min-Tech) (a mining company in eastern Oregon) inquiring about the potential use of zeolites as a remedial technology for the site. In accordance with the National Contingency Plan (NCP), EPA is required to respond to each comment received during the public comment period. As a result, this document was prepared to evaluate the potential use of zeolites as a remedial technology for OUs 1 and 4 at the Ogden Rail Yard site.

Project Background and Remedial Alternatives

The Ogden Rail Yard has been in operation since 1869. Four major railroad companies used the rail yard for switching, maintenance of locomotives and railcars, and for loading, off-loading, icing, and transferring cargo. The rail yard is 3.5 miles long (oriented from north to south) and about ½ mile wide. The boundaries of the site are the 21st Street Pond on the north, the Weber River on the west, the Riverdale Road overpass on the south, and Wall Street on the east.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §117(a) and the NCP at Title 40 Code of Federal Regulations (CFR) Part 300.43(f)(2), EPA has published the proposed plan for the following operable units:

OU 1 – Northern Area, 21st Street Pond and associated source

OU 4 – Groundwater (plumes of chlorinated volatile organic compounds

The following text discusses these operable units.

Operable Unit No. 1 – 21st Street Pond

The 21st Street Pond, which has been designated as OU 1, is at the northern end of the rail yard. Contaminants associated with this operable unit include petroleum-based residues associated with a former Pintsch Gas Plant. As described in the proposed plan, EPA and the Utah Department of Environmental Quality (UDEQ) have tentatively selected a remedy (Alternative 5) that involves the following remedial processes:

- Pumping and disposing wastes that have accumulated underground in pools
- Excavating contaminated sediments from the 21st Street Pond
- Installing an underground dam to prevent wastes from recontaminating the pond
- Implementing institutional controls, which would prevent access and use of the groundwater and prevent any change in land use at this portion of the site.

However, during the public comment period, community activists pointed out the importance of the pond as a valuable recreational resource and described how they would like the pond to be reopened for that purpose. The City of Ogden, in a resolution of the City Council, expressed a preference for Alternative 3 as a cost-effective alternative that would allow the pond to be reopened for public use. Based on information gathered during the public comment period, EPA and UDEQ have reassessed the feasibility of the remedial alternatives. As described in the record of decision (ROD), EPA and UDEQ have selected Alternative 3 for OU1 (21st Street Pond) of the Ogden Rail Yard site. The remedy consists of capping the contaminated sediments in the pond, recovery of mobile dense nonaqeous phase liquid (DNAPL) from pools on top of a buried clay layer, and institutional controls. As described in the Ogden Rail Yard Feasibility Study (TFG 2003), the following other remedial options were also evaluated for this operable unit: no action; maintenance of interim cleanup measures such as fish gates and controls to prevent use of groundwater and the land; burial of the contaminated sediments in the pond and pumping out any pools of accumulated waste; removal of contaminated sediments and treatment of wastes; and removal of contaminated sediments and mobile wastes.

Operable Unit No. 4 – Groundwater

OU 4 involves two plumes of chlorinated solvents in groundwater, one originating near the former Southern Pacific machine ship, and the other originating near the former Union Pacific roundhouse. As described in the proposed plan, EPA and UDEQ have tentatively selected a remedy that involves the following options:

- Institutional controls
- Source removal
- Monitored natural attenuation
- Other actions if needed to prevent the groundwater from contaminating the river or the 21st Street Pond.

As described in the Ogden Rail Yard Feasibility Study (TFG 2003), the following other remedial options were also evaluated for this operable unit: no action; monitored natural attenuation (without source controls); monitored natural attenuation with aggressive treatment near the sources; monitored natural attenuation with treatment at the perimeters of the plume; and treatment throughout the plume.

Potential Use of Zeolites as a Remedial Technology

Available information on the potential use of zeolites as a remedial technology at the site (for example, its adsorption properties, other physical and chemical properties, case studies, and unit costs) was gathered using standard Internet search techniques, including a search using Dialog. Dialog is a collection of more than 900 databases that contain more than 500,000 sources that provide global coverage of scientific, technical, medical, business, news, and intellectual property information. Product information on zeolites from Min-Tech was also solicited and received as part of this literature search. Information provided by Min-Tech included the following publications:

- Bouffard, Sylvie and Duff, Sheldon 2000
- Bowman, Robert and others. 1999d.
- Currier, Brian and others. 2001.
- Davis, Johnston and Davis, G. B. 1997.
- Guney, Yucel and Koyuncu, Dr. Hakan. 2003.
- **NEW JERSEY CORPORATION FOR ADVANCED TECHNOLOGY (NJCAT) TECHNOLOGY VERIFICATION STORMWATER MANAGEMENT, INC. 2002.**
- Swingle, R.F. and others 2001.
- **VIRTA, ROBERT L. 1995**

Available information on the use of zeolites as a remedial technology is summarized and referenced below. In addition, the results of the Dialog literature search and information provided by Min-Tech are included as Attachments 1 and 2.

Zeolites are three-dimensional, microporous, crystalline minerals with well-defined structures that contain aluminum, silicon, and oxygen in their regular framework; cations and water are located in the voids of the framework. These natural minerals are mined in many parts of the world; however; most zeolites used commercially are produced synthetically. The silicon and aluminum atoms form tetrahedral structures with shared oxygen atoms. Void spaces in the zeolites can host cations, water, or other molecules. The three major applications of zeolites are:

<u>Adsorption</u>: Zeolites are used to adsorb a variety of materials. They can remove water to low partial pressures and are effective desiccants, with a capacity of up to more than 25 percent of their weight in water. In 1995, pet litter and animal feed were the two largest markets for natural zeolites (Virta 1995). They are commonly used to remove volatile organic compounds (VOCs) from airstreams and to separate isomers and mixtures of gases. In addition, zeolites are used to remove metals from water. Zeolites are not commonly used to remove VOCs from water.

<u>Catalysis</u>: The main industrial applications for zeolites are as catalysts for petroleum refining, synfuels production, and petrochemical production.

<u>Ion Exchange</u>: The largest-volume use for zeolites is in detergent formulations where zeolites have replaced phosphates as water-softening agents. This replacement is accomplished by exchanging the sodium in the zeolite for the calcium and magnesium in the water.

Several potential remedial technologies were considered using zeolites based on these primary properties of zeolites, the contaminants of concern, and the contaminated media at each operable unit. This approach for technology identification is consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988) and the Ogden Rail Yard Feasibility Study (TFG 2003, Appendix E). The technology identification for zeolites is presented below:

POTENTIALLY AFFECTED MEDIA AND TECHNOLOGIES		
MEDIUM	GENERAL RESPONSE ACTION	CANDIDATE ZEOLITE TECHNOLOGY
OPERABLE UNIT NO. 1 – 21ST STREET POND; CONTAMINANTS OF CONCERN: HYDROCARBONS INCLUDING COAL TAR AND DIESEL FUEL-RELATED CONSTITUENTS		
SEDIMENTS (21ST ST. POND)	**CONTAINMENT**	**ADSORPTIVE LAYER**
	SOIL TREATMENT	**STABILIZATION**
GROUNDWATER	**EX SITU TREATMENT**	**ION EXCHANGE/ADSORPTION**
	IN SITU PHYSICAL-CHEMICAL TREATMENT	**PASSIVE TREATMENT BARRIER**
DNAPL	**IN SITU PHYSICAL-CHEMICAL TREATMENT**	**PASSIVE TREATMENT BARRIER**
LNAPL	**IN SITU PHYSICAL-CHEMICAL TREATMENT**	**PASSIVE TREATMENT BARRIER**
OPERABLE UNIT NO. 4 – GROUNDWATER; CONTAMINANTS OF CONCERN: CHLORINATED SOLVENTS AND DEGRADATION COMPOUNDS		
GROUNDWATER	**EX SITU TREATMENT**	**ION EXCHANGE/ADSORPTION**
	IN SITU PHYSICAL-CHEMICAL TREATMENT	**PASSIVE TREATMENT BARRIER**

Available information on the feasibility for using zeolites in each of these remedial technologies is discussed below.

Cover or Containment for Contaminated Sediments at OU 1

Information on past applications of zeolites as a cover material was not identified during the literature search. A bench-scale pilot study is currently being conducted by the North Atlantic Treaty Organization, Committee on the Challenges of Modern Society (NATO/CCMS) to investigate the possible use of zeolites and zeolites that contain bentonite compounds as a surface barrier to prevent migration of pollution (NATO/CCMS, 2003). This study is still in process, so the full conclusion is not currently available.

Caps or covers are generally constructed to prevent direct exposure to contaminated soils and sediments and infiltration of precipitation into the segregated waste material (in other words, to prevent leaching of contaminants to groundwater). To achieve these objectives, covers are generally constructed of multiple layers of different materials, including native soils, bentonite or other clay materials, and synthetic membranes. Cover materials are not typically selected based on their adsorptive properties, however. Rather, the cover system is designed to function as a stable, long-term barrier to prevent direct exposure to the segregated waste. The unique physical and chemical properties of zeolites (adsorption, catalysis, and ion exchange) are not focused on this objective. Moreover, because of the innate adsorptive properties of zeolites, it allows for transfer of fluid through the entire compound and is therefore not an effective cover material to prevent infiltration of surface water.

In Situ Stabilization of Contaminated Sediments at OU 1

The term "solidification/stabilization" refers to a general category of processes that are used to treat a wide variety of wastes, including solids and liquids. Solidification and stabilization are each distinct technologies, as described below (EPA 1993, 1999a):

- **Stabilization** refers to techniques that chemically reduce the hazard potential posed by a waste by converting the contaminants into forms that are less soluble, mobile, or toxic. The physical nature and handling characteristics of the waste are not necessarily changed by stabilization.

- **Solidification** refers to techniques that encapsulate the waste, forming a solid material, and does not necessarily involve a chemical interaction between the contaminants and the solidifying additives. The product of solidification, often known as the waste form, may be a monolithic block, a clay-like material, a granular particulate, or some other physical form commonly considered "solid."

Stabilization/solidification is typically used to address inorganic (metals) contaminants in soil and sediment. Information on past applications of zeolites as absorbent or stabilization materials for in situ treatment of soil and sediment contaminated by petroleum or chlorinated solvents was not identified during the literature search. It is unclear whether the use of zeolites could function as a cost-effective, long-term stabilization technique without the contaminant repartioning (leaching). Although this remedial technology has been used in the past to address organic contamination, treatment technologies that destroy degradable contaminants such as petroleum hydrocarbons and chlorinated solvents are preferred (EPA 1993).

Ex Situ Groundwater Treatment at OU 1 and OU 4

The conventional approach for remediating contaminated groundwater has been to extract the contaminated water, treat it above ground, and reinject or discharge the clean water in a process known as "pump-and-treat." The contaminants recovered must be disposed of separately. Pump-and-treat technologies require considerable investment over an extended period, and it has been shown that these technologies often do not remove the source of the contamination. Current policies and laws stress "permanent" remedies over simple containment methods. Consequently, there is considerable interest in and effort being expended on alternative, innovative treatment technologies for contaminated groundwater. Accordingly, groundwater extraction and ex situ treatment (pump-and-treat) was not selected as the preferred remedy at Ogden Rail Yard OU 1 and OU 4. Nevertheless, information on past applications of zeolites as an ex situ treatment for groundwater contaminated by petroleum or chlorinated solvents was not identified during the literature search. Therefore, even if ex situ treatment was further considered, the use of zeolites as a contaminant absorbent would not likely be the preferred treatment option. Its selection probably would be precluded by the common and cost-effective use of granular activated carbon (GAC) and other techniques to treat petroleum hydrocarbon and chlorinated solvent contaminants in groundwater.

Use of Zeolites as Permeable Reactive Wall Material at OU 1 and OU 4

A PRB is a passive in situ treatment zone of reactive material that degrades or immobilizes contaminants as groundwater flows through it. PRBs are installed as permanent, semi-permanent, or replaceable units across the flow path of a contaminant plume. Natural hydraulic gradients transport contaminants through strategically placed treatment media. The media degrade, sorb, precipitate, or remove chlorinated solvents, metals, radionuclides, and other pollutants. These barriers may contain reactants for degrading volatile organics, chelators for immobilizing metals, nutrients and oxygen to enhance bioremediation, or other agents (EPA 1999b).

The choice of reactive medium for PRBs is based on the specific organic or inorganic contaminant to be remediated. Most PRBs installed to date use zero-valent iron (Fe^0) as the reactive medium for converting contaminants to non-toxic or immobile species. For example, Fe^0 can reductively dehalogenate hydrocarbons, such as converting trichloroethylene (TCE) to ethylene, and reductively precipitate anions and oxyanions, such as converting soluble Cr^{+6} oxides to insoluble Cr^3 hydroxides. The reactions that take place in the barriers depend on parameters such as pH, oxidation/reduction potential, concentrations, and kinetics. The hydrogeologic setting at the site is also critical: geologic materials must be relatively conductive, and a relatively shallow aquitard must be present to contain the system.

Several studies were identified during the literature search on the potential application of zeolites in a PRB to address petroleum hydrocarbons or chlorinated solvents in groundwater. The NATO/CCMS pilot study mentioned previously is also investigating the large–scale, in situ application of degrading chlorinated hydrocarbons using palladium coated Y-zeolites (NATO/CCMS 2003). One important aspect of this in situ pilot study is the pilot facility. This pilot facility, officially opened in 1999, guarantees that the treatment technologies selected will be tested under realistic conditions. This study is still in process, so the full conclusion is not currently available. A limited conclusion, however, showed that zeolites exhibited a high capability for efficiently degrading aliphatic as well as aromatic chlorinated hydrocarbons. However, Pd-catalysts are deactivated by the production of hydrogen sulfide (H_2S) through the microbiological reduction of sulfate (SO_4). Attempts to suppress microbial activities to increase the longevity by applying periodical pulses of peroxide (H_2O_2) so far showed only limited success (NATO/CCMS 2003).

Few bench-scale studies have been performed to evaluate the potential use of zeolites as a PRB to remove petroleum hydrocarbons from groundwater. Available literature indicates that zeolites have absorbent and ion-exchange capabilities that may effectively remove strontium (Sr) from groundwater (Van Benschoten and others 2001). In addition, a recent large-scale study showed that a PRB that contained zeolites retained 100 percent of Sr-90 since it was installed (EPA 1999b). Bench-scale studies have indicated that surface-modified zeolites may be able to effectively treat cations, organics, and cyanides (Kinser and others 1997). However, pilot- and field-scale studies have not yet been performed.

Recent studies have also evaluated the possibility of using low-cost natural zeolites ($110/ton) treated with cationic surfactants (hexadecyltrimethylammonium [HDTMA] or methyl-4-phenylpyridinium) to remove benzene, toluene, p-xylene, ethylbenzene, tetrachloroethane (TCA), and perchloroethylene (PCE) from aqueous solution (Bowman 1994a, b). This bench-scale study showed that unmodified zeolites had no affinity for the organic compounds. Conversely, surfactant-modified zeolites, which remained stable in aggressive aqueous solution and organic solvents, sorbed these organic compounds via a partitioning mechanism; sorption affinity was in the order of the sorbates' octanol-water partition coefficient. Further pilot-scale studies demonstrated the use of a surfactant-modified zeolite (SMZ) PRB to remediate groundwater contaminated by hexavalent chromium (Cr^{+6}) and PCE in a contained, simulated aquifer at the Oregon Graduate Institute of Science Technology near Portland, Oregon (Bowman and others 1999c). Preliminary results of the pilot test indicate that the barrier is performing according to design specifications, with retardation factors for chromate and PCE both on the order of 50. Based on these experiments, researchers recommend a minimum 100-fold permeability contrast between the PRB and the aquifer material. The causes for poor permeability contrast, whether a result of inherent differences in the property of the media or of barrier installation, can be difficult to isolate. The study concluded that SMZ permeable barriers can be successfully deployed under field-like conditions and can provide hydraulic containment. Furthermore, the physical and chemical properties of the bulk-produced SMZ are essentially identical to SMZ prepared in the laboratory. In particular, the contaminant (chromate and PCE) sorption characteristics of bulk- and laboratory-produced SMZ are the same (Bowman and others 1999d). This study also recommended intensive sampling in evaluating prospective permeable barrier systems. Consequently, performance of the barrier would be difficult to evaluate without an extensive sampling array and close monitoring of contaminant plumes. Long-term compaction of the material with resulting loss in hydraulic conductivity also requires further evaluation (Bowman and others 1999d). Based on information provided by Min-Tech, the unit cost of raw unmodified zeolites is approximately $85/ton. However, given that unmodified zeolites have no affinity for the organic compounds, the cost of modified zeolites are approximately three to five times the cost of natural zeolites (Bowman and others 1999a,b). Information is not currently available regarding long-term operation and maintenance of PRBs containing zeolites.

Conclusions and Recommendations

Based on the literature search and review of the potential uses of zeolites as a remedial technology, the physical and chemical properties of zeolites, and the constituents of concern and remedial objectives for the Ogden Rail Yard OU 1 and OU 4, the use of zeolites at the facility is not recommended. However, the proposed plan allows for contingencies, particularly at OU 4, in the event that the remedial alternatives selected do not achieve the remedial objectives. If the alternatives are re-evaluated in the future, the use of zeolites as a remedial technology may be considered.

References

Bouffard, Sylvie and Duff, Sheldon. 2000. *Uptake of Dehydroabietic Acid Using Organically-Tailored Zeolites.* Proceeding of the 1993 CSCE-ASCE National Conference on Environmental Engineering, July 12-14, Montreal, Quebec, Canada, 1103-1109.

Bowman, Robert. 1994a. *Sorption of Nonpolar Organic Compounds, Inorganic Cations, and Inorganic Oxyanions by Surfactant-Modified Zeolites. Wat. Res.* Vol. 34, No. 9, pp. 2469-2476.

Bowman, Robert. 1994b. *Organo-Zeolites for Sorption of Nonpolar Organics, Inorganic Cations, and Inorganic Anions.* Proceeding of the 1993 CSCE-ASCE National Conference on Environmental Engineering, July 12-14, Montreal, Quebec, Canada, 1103-1109.

Bowman, Robert et al. 1999c. Pilot-Scale *Testing of a Surfactant-Modified Zeolite PRB. GroundWater Currents.* EPA/542/N-99/002. (Available through http://clu-in.org.)

Bowman, Robert et al. 1999d. *Surface-Altered Zeolites as Permeable Barriers for in-situ Treatment of Contaminated Groundwater.* Phase II Topical Report, Contract #DE-AR21-95MC32108.

Currier, Brian et al. 2001. *California Department of Transportation BMP Retrofit Pilot Program.* Proceeding of the 2001 Transportation Research Board 8th Annual Meeting, January 7-11, Washington, D.C.

Davis, Johnston and Davis, G. B. 1997. *An Overview of Current Research on Remediation of Soils and Aquifers Contaminated by Organic Compounds.* Center for Groundwater Studies. Technical Report No 4/97. June.

Guney, Yucel and Koyuncu, Dr. Hakan. 2003. *Improvement and Distribution of Contaminant Dark Green River Sediment.* Proceeding of the 2003 First International Conference on Environmental Research and Assessment, March 23-27, Bucharest, Romania.

KINSER, S. ET AL. 1997. *NOTES ON AN ENGINEERING FORUM ROUNDTABLE DISCUSSION ON PERMEABLE REACTIVE WALLS, U.S. EPA TECHNICAL SUPPORT PROJECT MEETING.* ST. PETERSBURG, FLORIDA. FEBRUARY 12.

NEW JERSEY CORPORATION FOR ADVANCED TECHNOLOGY (NJCAT). 2002. *TECHNOLOGY VERIFICATION STORMWATER MANAGEMENT, INC.* JUNE.

NORTH AMERICAN TREATY ORGANIZATION, COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY (NATO/CCMS). 2003. *PILOT STUDY, EVALUATION OF DEMONSTRATED AND EMERGING TECHNOLOGIES FOR THE TREATMENT AND CLEAN UP OF CONTAMINATED LAND AND GROUNDWATER (PHASE III), 2002 ANNUAL REPORT.* NUMBER 255. JANUARY.

THE FORRESTER GROUP (TFG). 2003. *OGDEN FEASIBILITY STUDY. UNION PACIFIC RAILROAD. OGDEN, UTAH.* DECEMBER 30.

Swingle, R.F. et al. 2001. Data Report: Tank 19F NE Riser Zeolite Mound Sample Analysis. *U.S. Department of Energy*. WSRC-RP-2001-00410. (Available through http://sti.srs.gov)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA). 1988. *GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA.* OFFICE OF EMERGENCY AND REMEDIAL RESPONSE, WASHINGTON, D.C. EPA/540/G-89/004. OCTOBER.

EPA. 1993. *TECHNICAL RESOURCE DOCUMENT, SOLIDIFICATION/STABILIZATION AND IT'S APPLICATION TO WASTE MATERIALS.* OFFICE OF RESEARCH AND DEVELOPMENT, WASHINGTON, D.C. EPA/530/R-93/012. JUNE.

EPA. 1999A. *SOLIDIFICATION/STABILIZATION RESOURCE GUIDE.* OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, WASHINGTON, D.C. EPA/530/B-99/002. APRIL.

EPA. 1999B. *FIELD APPLICATIONS OF IN SITU REMEDIATION TECHNOLOGIES: PERMEABLE REACTIVE BARRIERS.* OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, WASHINGTON, D.C. EPA/542/R-99/002. APRIL.

VAN BENSCHOTEN, J. ET AL. 2001. *APPLICATION OF A COMPETITIVE CATION EXCHANGE MODEL FOR SIMULATING REMOVAL OF STRONTIUM IN A ZEOLITE PERMEABLE REACTIVE BARRIER.* DEPARTMENT OF CIVIL, STRUCTURAL AND ENVIRONMENTAL ENGINEERING, UNIVERSITY AT BUFFALO, BUFFALO, NEW YORK.VIRTA, ROBERT L. *ZEOLITES.*

VIRTA, ROBERT. 1995. *ZEOLITES.* (AVAILABLE THROUGH HTTP://MINERALS.USGS.GOV).