

EA-1219; ENVIRONMENTAL ASSESSMENT for HOE CREEK UNDERGROUND COAL GASIFICATION TEST SITE REMEDIATION and Finding of No Significant Impact

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DOE/EA-1219

ENVIRONMENTAL ASSESSMENT HOE CREEK UNDERGROUND COAL GASIFICATION TEST SITE REMEDIATION

CAMPBELL COUNTY, WYOMING

October 1997

U.S. DEPARTMENT OF ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

Prepared by

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Final Environmental Assessment for the Hoe Creek Underground Coal Gasification Test Site Remediation; Campbell County, Wyoming

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ABSTRACT

The U.S. Department of Energy (DOE) has prepared this EA to assess environmental and human health Issues and to determine potential impacts associated with the proposed Hoe Creek Underground Coal Gasification Test Site Remediation that would be performed at the Hoe Creek site in Campbell County, Wyoming. The Hoe Creek site is located south-southwest of the town of Gillette, Wyoming, and encompasses 71 acres of public land under the stewardship of the Bureau of Land Management.

The proposed action identified in the EA is for the DOE to perform air sparging with bioremediation at the Hoe Creek site to remove contaminants resulting from underground coal gasification (UCG) experiments performed there by the DOE in the late 1970s. The proposed action would involve drilling additional wells at two of the UCG test sites to apply oxygen or hydrogen peroxide to the subsurface to volatilize benzene dissolved in the groundwater and enhance bioremediation of non-aqueous phase liquids present in the subsurface. Other alternatives considered are site excavation to remove contaminants, continuation of the annual pump and treat actions that have been used at the site over the last ten years to limit contaminant migration, and the no action alternative.

Issues examined in detail in the EA are air quality, geology, human health and safety, noise, soils, solid and hazardous waste, threatened and endangered species, vegetation, water resources, and wildlife. Details of mitigative measures that could be used to limit any detrimental effects resulting from the proposed action or any of the alternatives are discussed, and information on anticipated effects identified by other

government agencies is provided.

AVAILABILITY

This EA is available for public review at the following two public reading rooms:

Campbell County Public Library

2101 4-J Road

Gillette, Wyoming 82716

(307) 682-3223

Wyoming State Library

2301 Capital Avenue

Supreme Court and State Library Building

Cheyenne, Wyoming 82002

(307) 777-7281

PUBLIC INVOLVEMENT

DOE encourages public participation in the National Environmental Policy Act (NEPA) process. A draft EA was released on August 28, 1997, and public comments were solicited through October 1, 1997. Notices of the availability of the draft EA were published in local newspapers and copies of the draft EA were distributed to State and Federal offices considered to be potentially interested parties. Copies of the draft EA were made available to the public in the local libraries noted above and were also provided upon request. Comments received have been addressed in the final EA. Copies of the comments received are included in the appendix

ACRONYMS AND ABBREVIATIONS

EC Degrees Centigrade

EF Degrees Fahrenheit

Fg Microgram(s)

Fg/L Microgram(s) per liter

Fg/m³ Microgram(s) per cubic meter

ac Acre(s)

AQD Wyoming Air Quality Division

AUM Animal unit for 1 month

ACHP Advisory Council on Historic Preservation

BTEX Benzene, toluene, ethylbenzene, and xylenes

BLM Bureau of Land Management

bgs Below ground surface

BTU British thermal unit

CAA Clean Air Act

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

CEQ Council on Environmental Quality

CFR Code of Federal Regulations

cm Centimeter(s)

Corps U.S. Army Corps of Engineers

cu yd Cubic Yard

CWA Clean Water Act

DEQ Department of Environmental Quality

DOE U.S. Department of Energy

EA Environmental Assessment

EIS Environmental Impact Statement

EPA U.S. Environmental Protection Agency

ERDA U.S. Energy Research and Development Administration

ESA Endangered Species Act

FONSI Finding of No Significant Impact

fpd Foot (feet) per day

FS Feasibility study

ft Feet

FWPCA Federal Water Pollution Control Act

GAC Granulated activated carbon

gal Gallon(s)

gpd Gallon(s) per day

gpm Gallon(s) per minute

ha Hectare(s)

in Inch(es)

kg Kilogram(s)

km Kilometer(s)

lb Pound(s)

L Liter(s)

LLNL Lawrence Livermore National Laboratory

LQD Wyoming Land Quality Division

m Meter(s)

m³ Cubic meter(s)

METC Morgantown Energy Technology Center

M Thousand

MM Million

mg Milligram(s)
mg/L Milligram(s) per liter
mg/m³ Milligram(s) per cubic meter
mi Mile(s)
mpd Meter(s) per day
msl Mean sea level
NEPA National Environmental Policy Act
NHPA National Historic Preservation Act
NME No major effect
No. Number
NPDES National Pollutant Discharge Elimination System
NRHP National Register of Historic Places
OSHA Occupational Safety and Health Administration
PM₁₀ Particulate matter 10 microns or less in diameter
ppb Parts per billion
ppm Parts per million
PRG Preliminary remediation goal
RI Remedial investigation
scf Standard cubic foot (feet)
SH State Highway
SHPO State Historic Preservation Officer
TWA Time-weighted average
UCG Underground coal gasification
USC U.S. Code
USFWS U.S. Fish and Wildlife Service
WDEQ Wyoming Department of Environmental Quality
WNDD Wyoming Natural Diversity Database
WQA Wyoming Water Quality Act
WQD Wyoming Water Quality Division
yd³ Cubic yard(s)

SECTION 1

PURPOSE AND NEED FOR ACTION

This environmental assessment (EA) evaluates a remedial action and its alternatives proposed by the U.S. Department of Energy (DOE) for the Hoe Creek Underground Coal Gasification (UCG) field test site in Campbell County, Wyoming. This section describes the history of the test site, the purpose and need for the proposed action, the decision to be made, and the scope of the environmental impact analysis process.

1.1 BACKGROUND

1.1.1 Site History

DOE and its predecessor agency, the U.S. Energy Research and Development Administration (ERDA), conducted experimental *in situ* UCG field tests at a facility located about 20 miles (mi) (32 kilometers [km]) south-southwest of the town of Gillette, Wyoming. The site location is shown in Figure 1.1.

The Lawrence Livermore National Laboratory (LLNL) conducted three UCG tests, designated as Hoe Creek 1, 2, and 3, for the DOE between 1976 and 1979. The locations of the sites are shown in Figure 1.2. Research was conducted to evaluate the feasibility of producing energy-rich gas from subterranean coal that was uneconomical to mine conventionally. The experiments were targeted in the Felix 2 coal seam. The relationship between the Felix 2 coal seam and other lithologic and hydrostratigraphic units is shown in Figure 1.3. The experiments involved fracturing the coal seam to establish a link between the injection and production wells, conducting a controlled burn, and collecting gases produced from the burn that have a high British thermal unit (BTU) content. The Hoe Creek 1 test was conducted over a period of 11 days, beginning on October 25, 1976. Explosive fracturing was used to increase the permeability in the coal seam. Groundwater was pumped at the Hoe Creek 1 site to dewater the burn zone. During the test, 10 million standard cubic feet (MM scf) (280,000 cubic meters [m³]) per day of air were injected at a pressure below hydrostatic to produce 13.2 MM scf (369,000 m³) of dry gas. It is estimated that about 7 percent or about 9 tons (8.2 metric tons) of the product gas was lost during the combustion and gasification of about 130 tons (118 metric tons) of coal. During the test, no extensive roof collapse was detected and it is believed that only the Felix 2 coal seam was affected (Gilbert/Commonwealth, Inc. and James M. Montgomery, 1991a).

The Hoe Creek 2 test was conducted over a period of 59 days, beginning on October 28, 1977 and ending on December 25, 1977. Reverse combustion was used to fracture the coal seam. During the test, air was injected at about twice the hydrostatic pressure of the Felix 2 coal seam until the last 2 days of the test when steam-oxygen was injected at hydrostatic pressure. Based on UCG test data, it was estimated that nearly 20 percent of the product gas (496 tons [450 metric tons]) was lost during the combustion of approximately 2,300 tons (2,086 metric tons) of coal.

Post-test coring indicated that a rubble-filled cavity approximately 75 feet (ft) (25 meters [m]) long by 50 ft (15 m) wide was formed. A roof collapse occurred in the burn cavity which permitted the gas in the reaction zone to move up into the overlying Felix 1 coal seam. Because the test was conducted at pressures exceeding the hydrostatic head of the Felix 2 coal, product gases containing condensable hydrocarbons escaped into adjacent strata and into the water-bearing units above the Felix 2 coal seam (Gilbert/Commonwealth, Inc. and James M. Montgomery, 1991a).

The Hoe Creek 2 burn cavity subsided to the surface in the spring of 1994. The subsidence opening was filled with a combination of bentonite and soil.

The Hoe Creek 3 test was conducted for 57 days, beginning on August 17, 1979. A combination of directional drilling to obtain a long horizontal hole and reverse combustion was used to establish the link between the injection and production wells. During the test, steam-oxygen was injected at a pressure approximately equal to the hydrostatic pressure of the Felix coal seam. Approximately 4,200 tons (3,810 metric tons) of coal were consumed during the test. Gas losses were estimated at about 750 tons (680 metric tons). The reaction zone included both the Felix 1 coal seam and the Felix 2 coal seam.

Surface subsidence occurred within 30 days after the burn was completed. The site was filled in and there is little or no risk of further subsidence. Post-burn coring revealed a rubble-filled cavity about 170 ft (55 m) long and 55 ft (17 m) wide (Gilbert/Commonwealth, Inc. and James M. Montgomery, 1991a).

1.1.2 Contaminants of Concern

An estimated 1,255 tons (1,138 metric tons) of gasified coal were not recovered during the UCG tests (Gilbert/Commonwealth, Inc. and James M. Montgomery, 1991a). The loss of gasified coal may be overestimated due to water pressure and reburn of other gases. An energy balance (Gilbert/Commonwealth, Inc. and James M. Montgomery, 1991a) estimated that:

About 63 to 65 percent of the energy produced was from the combustible gas;

About 5 to 8 percent was from coal tars;

About 12 to 15 percent was from steam;

About 7 percent was from sensible heat; and

About 2 to 15 percent was lost to the underground environment.

Contaminant migration was initially controlled by geologic structure and physical properties of the hydrostratigraphic units that occur at the site (Dames & Moore, Inc., 1996a and 1996b). The high-pressure air injected at the Hoe Creek 2 and 3 sites forced the coal gases outward from the burn cavities into the overlying interburden, the Felix 1 coal seam, and portions of the channel sand unit. As groundwater re-entered the burn areas after the test, it came into contact with the condensed coal tars and became contaminated with organic materials. The high hydrostatic pressures generated within the Hoe Creek 2 and 3 burn cavities caused phenols and aromatic hydrocarbons to migrate upward into the overlying strata through vertical fractures (cleats) in the Felix 1 and 2 coal seams. Local groundwater flow carried contaminants downgradient to the east and south. The area of groundwater contamination is more extensive in the Felix 1 than the Felix 2 coal seams, and has been detected off-site, east of the Hoe Creek 2 site.

Benzene, toluene, ethylbenzene, and xylenes (BTEX), and phenols have been detected in monitoring wells at the Hoe Creek UCG site. Based on monitoring well results and previously conducted risk assessments (Dames & Moore, Inc. 1996a), the DOE believes that benzene is the primary contaminant of concern at the Hoe Creek property, and that it is a good indicator for the presence of toluene, ethylbenzene, and xylenes that the Wyoming Department of Environmental Quality (WDEQ) also consider to be of potential concern.

The maximum detected concentrations of organic contaminants in groundwater at the Hoe Creek site were compared to U.S. Environmental Protection Agency (EPA) Residential Water Use Preliminary Remediation Goals (PRGs) and to Federal drinking water standards. Benzene is the only organic contaminant of concern that exceeded its risk-based PRG (0.36 micrograms per liter (Fg/L) for benzene) or Federal drinking water standard for public water systems (5 Fg/L for benzene) (Dames & Moore, Inc., 1996a). Within the Felix 1 coal seam at the Hoe Creek 2 site, a maximum benzene concentration of 1,000 Fg/L was detected (Dames & Moore, Inc., 1996a). Therefore, the term Acontaminants of concern,@ as used in this report, refers primarily to benzene. However, because benzene was closely related to concentrations of toluene, ethylbenzene, and xylenes, it is used as an indicator of the presence of other organic contaminants (Dames & Moore, Inc., 1996a).

1.1.3 Previous Investigations

DOE has conducted many studies and investigations at the Hoe Creek site, beginning during the UCG field testing from 1976 to 1979. Various research, development, and test monitoring investigations were undertaken. Groundwater, gasification zone, restoration, and post-operational investigations and studies were performed by LLNL, Laramie Energy Technology Center, Morgantown Energy Technology Center (METC), E.G.& G. Washington Analytical Services Center, Inc. and Western Research Institute between the late 1970s and the present.

As a result of these investigations, 106 groundwater monitoring wells, shown in Figure 1.4, were drilled on or near the property. These wells were used to establish the groundwater hydrology and water quality, both before and after the UCG tests.

Since the mid-1980s, DOE has been monitoring and analyzing groundwater quality characteristics from 30 monitoring wells at the site on a quarterly or semi-annual basis.

An agreement was signed on August 30, 1993, between the State of Wyoming DEQ and DOE to remediate the effects of DOE/METC fossil energy research and development activities conducted at the Hoe Creek UCG test site (See Appendix B [State of Wyoming Department of Environmental Quality and Department of Energy, 1993]). In response to this agreement, the DOE conducted a remedial investigation and feasibility study (RI/FS) to identify, screen, and select potential remedial alternatives for groundwater restoration (Dames & Moore, Inc., 1996a). The technologies that passed the screening process included limited action, source area excavation, in situ bioremediation, and enhanced pump and treat. The RI/FS evaluated each of the candidate alternatives in terms of their effectiveness in reducing contaminant concentration, permanence of remediation, ease of implementation, and remediation cost.

The technologies described by Dames & Moore, Inc., (1996a) formed the basis for the alternatives analyzed in this EA. However, various aspects of the alternatives have been refined and updated since then, as described in Section 2.

A human health risk assessment was performed by Dames & Moore, Inc. (1996a) to support the alternatives evaluation. The analysis included conservative assumptions for human exposure by direct ingestion of benzene-contaminated groundwater and by inhalation of benzene vapors. The risk analysis results indicate that there is no immediate threat to the health and safety of the residents living in the area surrounding the Hoe Creek site.

1.1.4 Previous Restoration Activities

Small-scale experimental testing programs for groundwater restoration have been performed at the site (Gilbert/Commonwealth, Inc. and J.M. Montgomery, Inc., 1991a). In 1986, approximately 134,000 gallons (gal) (507,200 liters [L]) of water were pumped from two site wells, treated, and reinjected into the Hoe Creek 2 burn cavity. A similar pump and treat program was implemented in 1987 on about 2 million gal (7.6 million L) of water. In 1989, 1992, 1993, and 1994, about 6.5 million gal (24.6 million L) of water each year were pumped from 11 wells and treated with activated carbon to remove organic contaminants. The treated water was spray-evaporated over approximately 16 acres (ac) (6.5 hectares [ha]) (U.S. Department of Energy, 1992).

EG&G Washington Analytical Service Center, Inc. (1995) conducted an air sparging pilot test from the fall of 1995 to the fall of 1996 at the Hoe Creek 2 site. Observations of oxygen content at vent wells indicated that a well spacing of 40 ft (12 m) was adequate coverage for the diffusion of air into the coal fractures, cleats, and groundwater. Data also indicated that cyclic sparging was more effective than continuous operations. Cyclic sparging also reduced the potential for the sparging system to displace dissolved contaminants radially outward from the plume in the Felix 1 coal seam or up-dip in the confined Felix 2 coal seam (U.S. Army Corps of Engineers, 1997).

1.2 PURPOSE FOR ACTION

The purpose of the action (State of Wyoming Department of Environmental Quality and the U.S. Department of Energy, 1993) is to implement an agreement between the State of Wyoming DEQ and DOE to ensure that:

The environmental impacts associated with fossil energy research and development at the Hoe Creek UCG project are thoroughly investigated; and

Cleanup and restoration actions approved by the State of Wyoming are taken to protect public health, safety, welfare, and the environment.

A copy of the agreement is provided in Appendix B.

The WDEQ has established an antidegradation policy for waters of the State of Wyoming. The Wyoming Environmental Quality Act, 35-11-101 et seq., requires that all water uses in existence on June 27, 1979, and the level of water quality necessary to protect those uses, shall be maintained and protected (Wyoming Department of Environmental Quality, 1990).

The Bureau of Land Management (BLM) owns the surface and mineral rights at the Hoe Creek property. A temporary use permit was granted for each UCG experiment. A condition of the permit was to reclaim the site to grazing standards as per BLM regulation following the conclusion of the project.

1.3 NEED FOR ACTION

The need for action consists of two phases. Phase 1 is to select a best practicable technology to remediate contaminants in the affected aquifer(s), and to restore the water quality to a use consistent with the uses for which the water was suitable prior to conducting the research activities.

A best practicable technology is defined as one applicable to the site conditions and nature of contaminants. The technology should be selected based on its effectiveness in reducing contaminant concentrations, permanence of remediation, ease of implementation, and remediation cost. The WDEQ requires the DOE to show that the best practicable technology would be used to remediate contaminants of concern in the groundwater. Based on consultation with the WDEQ, experimental testing conducted at the site, and remediation results obtained at similar sites, the DOE has chosen a target remediation concentration of 50 Fg/L for benzene.

If it is not feasible to restore the water quality, action is needed to contain the migration of the contaminants within the site boundary or to the smallest affected area practicable. The only potential receptor exposure points are Hoe Creek located 0.5 mi (0.8 km) south of the site, a water well located upgradient 0.1 mi (0.2 km) northwest of the site, and a private water well located downgradient 0.9 mi (1.4 km) east of the site. The water well northwest of the site is used for drinking water and the well located east of the site is used for livestock watering. Both of these wells are completed in a different aquifer from the one affected by testing at the Hoe Creek site. Contaminants have not been detected at any of these locations (Dames & Moore, Inc., 1996a).

The Phase 2 need for action is to return the site to pre-test soil productivity, vegetative cover, and topographic conditions. Site reclamation should return the land to its former use, which was livestock and wildlife grazing. Phase 2 would begin once Phase 1 has been successfully completed.

1.4 DECISION TO BE MADE

The DOE would make a decision either to:

- Proceed with the proposed action, based on a finding of no significant impact (FONSI);
- Prepare an environmental impact statement (EIS) to further evaluate any significant impacts before proceeding with the decision process; or

Select the no action alternative.

1.5 SCOPE OF THE ENVIRONMENTAL IMPACT ANALYSIS

This EA was prepared in compliance with:

- The requirements of the National Environmental Policy Act of 1969 (NEPA);
- The President=s Council on Environmental Quality (CEQ, 1991) regulations for implementing the procedural provisions of NEPA, which are contained in Title 40 of the Code of Federal Regulations (CFR), Parts 1500-1508; and
- Recommendations for the preparation of EAs and EISs from the DOE=s Office of NEPA Policy and Assistance (U.S. Department of Energy, 1993).

Issues pertaining to site contamination and remediation have been identified through consultations with the State of Wyoming, the BLM, Wyoming Division of Cultural Resources, Wyoming Nature Conservancy, Wyoming Game and Fish Department, U.S. Fish and Wildlife Service (USFWS), and four private landowners in the immediate vicinity of the site. Correspondence with Federal and State Agencies are provided in Appendix A. The issues that were identified are:

- Whether groundwater would act as a source for movement of contaminants off the site.
- Whether the workers= health would be adversely affected by exposure to airborne or groundwater contaminants.
- Whether groundwater supplies to downgradient users would be affected.
- Whether remediation activities would result in loss of wildlife, wildlife habitat, forage for livestock and wildlife grazing, and loss of hunting opportunities.
- Whether remediation would result in a loss of valuable topsoil. Topsoil is defined as the surface (top 6 to 12 inches) (15 to 30 cm) of soil that has favorable characteristics for production of desired kinds of vegetation.

Whether the surface disturbance can be returned to pre-test conditions in terms of soil productivity, vegetation, and topography.

1.6 PUBLIC INVOLVEMENT

A draft EA was released on August 28, 1997, and written public comments were solicited through October 1, 1997. Notices of the availability of the draft EA were published in the Casper Star Tribune and the Gillette News Record. The draft EA was made available for public viewing in the following public libraries:

Campbell County Public Library	Wyoming State Library
2101 4-J Road	2301 Capitol Avenue
Gillette, WY 82718	Supreme Court & State Library Bldg.
	Cheyenne, WY 82002

Copies of the draft EA were distributed to Federal and State offices considered to be potentially interested parties and were also made available to the public upon request. Responses to the draft EA were received from the Department of Interior=s Fish and Wildlife Service, the Wyoming Office of Federal Land Policy, the Wyoming State Geological Survey, the Wyoming Game and Fish Department, and the Wyoming State Historic Preservation Office. These responses and any subsequent clarifying correspondence are provided in Appendix A; the comments received have been addressed in this final EA.

SECTION 2

DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section describes the site location, proposed action, and two action alternatives to the proposed action. The no action alternative is also

described. The past remedial investigations formed the basis for selecting the proposed action and remedial alternatives that are evaluated in this EA.

2.1 SITE LOCATION

The Hoe Creek UCG test sites are located south-southwest of the town of Gillette, Wyoming in Campbell County in the northeastern part of the state. Access to the sites is south from Gillette on State Highway (SH) 59 for approximately 18 mi (29 km), then west on County Road No. 6041 (Hoe Creek Road) for 5.3 mi (8.5 km). The test sites are located on 71 ac (29 ha) of public land under the stewardship of the BLM in the west 1/2 of the southwest 1/4, Section 7, Township 47 North, Range 72 West. The land surrounding the BLM property is privately owned.

The Hoe Creek 1 and 2 sites are located in the northern half of the property on land that slopes gently to the east-southeast. The Hoe Creek 3 site is located in the center of the property, near the top of a northwest- to southeast-trending ridge, as shown in Figure 1.4

2.2 PROPOSED ACTION

The proposed action is to perform air sparging with bioremediation at the Hoe Creek 2 and 3 sites to remove groundwater contaminants resulting from the UCG experiments. The proposed action would address the benzene dissolved in groundwater, and organic contaminants that are dispersed in a non-aqueous-phase liquid, sludge, or tar in the subsurface. The air sparging systems would target areas where the contaminant plume of benzene concentrations in the groundwater exceed 50 Fg/L.

No remediation is proposed for the Hoe Creek 1 site. The burn at this site was much smaller than at the other sites, and was not overpressurized. As a result, the concentrations of contaminants at this site are much lower and were not dispersed into the surrounding strata. Groundwater sampling at this site shows only a small plume containing benzene, with concentrations of approximately 1 part per billion (ppb) (Dames & Moore, Inc., 1996a).

Groundwater remediation would consist of pumping air into the sparging wells for the mass transfer of oxygen into the groundwater. The dissolved oxygen would enhance the effectiveness of natural bio-degradation taking place in the saturated zones of the channel sand and the Felix 1 and Felix 2 coal seams.

Because the Felix 2 coal seam at the Hoe Creek 3 site is so deep, it may be difficult to deliver adequate quantities of compressed air from the surface to support aerobic biological activity. Therefore, hydrogen peroxide may be used for the first two years of air sparging as an oxygen source for the Felix 2 coal seam at this location. This assumption is based on the results of the remediation demonstration in the Felix 1 coal at the Hoe Creek 2 and 3 sites, and the Felix 2 coal at the Hoe Creek 2 site. Hydrogen peroxide would be used solely to provide dissolved oxygen for bio-stimulation. Decisions on the use of hydrogen peroxide, with or without air injection, would be based on the results of tests conducted at the Hoe Creek 3 site. If hydrogen peroxide is used, the solution would be mixed in existing 6,000-gal (22,700 L) tanks. Solution water for mixing would be transported to the site. The estimated hydrogen peroxide requirements for 2 years would be 475 gal (1,797 L) of 30-percent hydrogen peroxide solution.

Increasing phosphorus and ammonia concentrations in the groundwater to 5 and 10 milligrams per liter (mg/L), respectively would provide an adequate amount of these nutrients for the bioremediation process to take place. Diabasic ammonium phosphate would be injected into the groundwater over a 4-month period (summer months) on a one-time basis. Because these nutrients are recycled in the groundwater through microbial decay, only one application would be required. Groundwater pumping would be used to disperse the ammonium phosphate solution across the affected area and to provide solution water for injection. An estimated 700 pounds (lb) (320 kilograms [kg]) of ammonium phosphate would be used at the Hoe Creek 2 site and 1,000 lb (455 kg) would be used at the Hoe Creek 3 site.

The existing interim groundwater pump and treat system has not been operated since 1994. This system would be decommissioned at the start of the remedial action.

The proposed system at the Hoe Creek 2 site would consist of 45 wells, 26 of which would be completed in the Felix 1 coal seam aquifer only, and 19 of which would be completed in both the Felix 1 and Felix 2 coal seam aquifers (Figure 2.1). Most of the air sparging wells at the Hoe Creek 2 site would be situated in eight rows with 40-ft (12-m) spacing. The well spacing was designed to provide complete coverage of the contaminated area and to optimize the downgradient radius of influence.

A cyclic air-delivery approach evaluated in the pilot program showed enhanced benzene degradation compared to a continuous sparging approach (U.S. Army Corps of Engineers, 1997). Therefore, air initially would be supplied to alternate rows of wells for 8-hour periods, with 8-hour resting of wells between injection intervals. The periods of air supply and rest would be adjusted during the project based on testing results.

The air sparging system at Hoe Creek 3 would consist of 61 wells, including 40 completed in the Felix 1 coal seam aquifer, and 21 completed in the Felix 2 coal seam aquifer (Figure 2.2). The system would consist of nine rows, with spacing between the wells similar to the Hoe Creek 2 site (U.S. Army Corps of Engineers, 1997). Cyclic operation of the air sparging system would be the same as at the Hoe

Creek 2 site.

The air sparging systems at the Hoe Creek 2 and 3 sites would be operated for 90 days. They would then be shut down for 14 days, and sampled over a period of 7 days to track the benzene desorption rates.

Groundwater monitoring at the Hoe Creek 2 site would consist of collecting seven samples from the Felix 1 coal seam aquifer, seven samples from the Felix 2 coal seam aquifer, and four samples from the channel sand unit aquifer. Four of the existing monitoring wells around the Hoe Creek 2 site that would be used for monitoring have been out of service for an extended period of time and would require rehabilitation prior to groundwater sampling (U.S. Army Corps of Engineers, 1997). The total purge water volume produced per sampling event at the Hoe Creek 2 site is estimated at 20,000 gal (75,600 L). There would be four sampling events per year.

Groundwater monitoring at the Hoe Creek 3 site would consist of collecting nine samples from the Felix 1 coal seam aquifer and four samples from the Felix 2 coal seam aquifer (Dames & Moore, Inc., 1996a; U.S. Army Corps of Engineers, 1997). The total purge water volume produced per sampling event at this site is estimated at 45,000 gal (170,100 L). There would be eight sampling events per year.

In addition to the monitoring at the Hoe Creek 2 and 3 sites, groundwater samples from 22 other monitoring wells that are part of the Hoe Creek long-term monitoring plan would be collected. The total purge water volume produced per sampling event from these 22 wells is estimated at 2,000 gal (7,560 L). There would be four sampling events per year.

The total volume of purge water that would be produced annually from all of the monitoring wells is approximately 268,000 gal (1,013,040 L). At all monitoring wells, if the benzene concentration in the purge water was less than 50 Fg/L, the purge water would be discharged to the surface and allowed to flow into Hoe Creek. If the benzene concentration was greater than 50 Fg/L, the water would be treated with activated carbon and field-sprayed through atomizers to volatilize the benzene in the air.

The bioremediation program is expected to operate for about 5 years (Dames & Moore, Inc., 1996a). However, remediation would continue until requirements set forth by the WDEQ were satisfied.

Construction would disturb approximately 2.0 ac (0.8 ha) for additional parking space, air sparging wells, soil spoil area, two equipment staging areas, and two compressor buildings. Approximately 1,600 cubic yards (yd^3) ($1,220 \text{ m}^3$) of topsoil would be salvaged from these areas. This topsoil would be stockpiled for post-reclamation activities. The topsoil piles would be identified by a sign, temporarily seeded with a mixture of grasses, and protected from wind and water erosion with a straw mulch or silt fences, as deemed necessary.

During the construction and remediation phase, disturbed soils may be subject to wind and water erosion. Wind erosion would be prevented or reduced by using water or chemicals to stabilize the soil surface. Water erosion would be mitigated by minimizing the amount of soil disturbance, and placement of sediment control structures around the parking lots and storage areas. Fugitive dust from roads would be mitigated by applying water and reducing traffic speed.

Approximately 320 yd^3 (245 m^3) of soil generated from drilling wells at the Hoe Creek 2 site and 680 yd^3 (520 m^3) from the Hoe Creek 3 site would be stockpiled in a spoil area near the compressor buildings. This process would include stripping and stockpiling the topsoil, installing a plastic liner, and spreading the drill cuttings on the liner to volatilize the organic compounds. Soil cuttings would be sampled and tested to determine their proper disposal. Sediment fences or erosion control berms would be placed around the stockpile areas to prevent sedimentation and movement of contaminants off site. Site reclamation of the spoil area would consist of removal of the plastic liner, replacing the topsoil, and revegetating the disturbed areas.

At project completion, the two compressor buildings, mobile work trailer, and remediation equipment would be removed. A number of the air sparging wells would be retained for post-reclamation monitoring. The remainder of the wells would be properly abandoned according to WDEQ regulations and the surface disturbance reclaimed as described below.

The abandoned wells would have a minimum of 2 ft (0.6 m) of soil cover over a metal cover that identified the well. Abandoned well refuse and drill cuttings would be disposed of as a non-hazardous solid waste in the Campbell County landfill. Through previous discussions with the County, it was determined that waste analysis would not be required (U.S. Army Corps of Engineers, 1997).

Reclamation activities would consist of spreading topsoil on the areas stripped prior to remediation activities. The topsoiled areas (areas that have been prepared and recovered with topsoil) would be seeded with a mixture of native grasses approved by the WDEQ. Seeding would preferably take place in late fall before the soil froze and the temperatures were cool enough to prevent germination. New seedings would be covered with a straw mulch to protect against loss of soil moisture, and wind and water erosion until they became established.

The success of the reclamation would be evaluated by the WDEQ. The agreement between the DOE and the State of Wyoming would be expected to be extended if remediation goals are not met within the time frame identified in the original agreement.

The DOE expects to maintain a limited groundwater monitoring program at the site for several years following any action taken as long as required by the WDEQ. At such time as the DOE is released from responsibility at the site, the BLM may sell the surface rights of the property. If this takes place, the property would likely continue to be used privately for livestock grazing.

2.3 ALTERNATIVES TO THE PROPOSED ACTION

Three alternatives to the proposed action are evaluated in detail. They include:

- Excavation of the source material in the immediate vicinities of the burn cavities at the Hoe Creek 2 and 3 sites;
- Annual groundwater pump and treat; and
- No action.

An alternative for excavation of the entire area with benzene in groundwater was considered, but eliminated from further analysis. This alternative would be similar to the excavation of the source material in the burn cavities but it would disturb an area approximately 2.3 times larger (Dames & Moore, Inc., 1996a). An intermediate-sized area would be disturbed if excavation was performed only in areas where the benzene concentration in groundwater exceeded 50 Fg/L. The environmental effects from alternatives involving larger areas of excavation would be similar to but proportionally larger than those identified for the excavation of the source material only.

2.3.1 Excavation

This alternative would consist of excavating the contaminated soils in the vicinity of the Hoe Creek 2 and 3 burn cavities. Activities associated with this alternative would disturb approximately 40 ac (16 ha) for site excavation, stockpile areas, and soil and groundwater treatment staging area (Figure 2.3). Prior to excavation, approximately 24,600 yd³ (18,800 m³) of topsoil would be salvaged from the areas to be disturbed and stockpiled for surface reclamation (Dames & Moore, Inc., 1996a). Areas that would be disturbed include the following:

- Excavation would take place on approximately 14 ac (5.7 ha) at the Hoe Creek 2 site, and on approximately 11.5 ac (4.6 ha) at the Hoe Creek 3 site.
- Approximately 1,400,000 yd³ (1,070,000 m³) of clean overburden material from these excavations would be stockpiled in the northwest corner of the property on an 11-ac (4.4-ha) area. The large volume of clean overburden material and the need to maintain a 3-to-1 slope on the stockpile would require that 3 of the 11 ac (1.2 of 4.4 ha) would be on land outside the property boundary. This land would need to be obtained from the adjoining private landowner.
- A 2.0-ac (0.8-ha) staging area for treating contaminated soil and groundwater would be located east of the Hoe Creek 3 site.
- A 1.5-ac (0.6-ha) lined holding area would be constructed along the east side of the Hoe Creek property for contaminated material. This would contain the approximately 50,000 yd³ (38,200 m³) of contaminated material excavated from the bottom 5 ft (1.5 m) of the channel sand, the top 5 ft (1.5 m) of the Felix 1 coal seam, and the top 5 ft (1.5 m) of the Felix 2 coal seam.

The contaminated material would be allowed to drain by gravity to reduce the moisture content. It would then be crushed to a diameter of less than 3 inches (in) (8 centimeters [cm]) and fed into a thermal desorption unit to remove the organic compounds. Erosion and drainage controls would be placed around the stockpiled contaminated material to prevent sediment transport and surface runoff. Water from the drainage controls would be collected and treated at an onsite groundwater treatment system, which would need to be constructed.

Both the Hoe Creek 2 and 3 sites would require dewatering before and during excavation. The groundwater would be treated to remove organic compounds in a biological fluidized bed reactor. This technology uses a combination of granulated activated carbon (GAC) and biological treatment to destroy the low concentrations of organics in the groundwater. There would be no off-gas streams requiring treatment. The GAC containers would be sent to a licensed recycler to remove and destroy the organic compounds.

The treated groundwater would be discharged to Hoe Creek approximately 2,000 ft (610 m) south of the treatment area through a 4-in (10-cm) -diameter buried pipeline. A portion of the treated water may be used to control fugitive dust emissions on the road and excavation areas.

Groundwater throughout the Hoe Creek site is encountered at approximately 80 to 100 ft (25 to 30 m) below ground surface (bgs). Dewatering would be required to lower the groundwater surface to approximately 135 and 180 ft (40 and 55 m) bgs for the Hoe Creek 2 and 3 sites, respectively. Once the excavations were dewatered, sumps around the perimeters of the pits would be required to maintain the cones of depression. Pump rates of approximately 30 to 40 gallons per minute (gpm) (115 to 150 liters per minute) would be needed to dewater the proposed excavations at the Hoe Creek 2 and 3 sites. These pumping rates would require a groundwater treatment plant with a capacity of approximately 50,000 gallons per day (gpd) (190,000 liters per day). On an annual basis, about 18 million gal (68 million L) of water would require treatment.

After the contaminated soil had been excavated and treated, all soil would be replaced in the excavations and the sites would be regraded, topsoiled, and revegetated. Following remediation, 10 wells would be installed around the excavated areas to monitor the effectiveness of the remediation. Monitoring would be performed annually for 10 years. Approximately 1,600 gal (6,050 L) of purge water would be produced annually. Salvage of topsoil and reseedling of disturbed area would take place as described for the proposed action in Section 2.2.

Site remediation would be expected to take 4 years. Earth moving would occur for about 2 years, assuming two shifts per day. Treatment of the contaminated soil would take 1 year, assuming an operational schedule of 12 hours per day, 6 days per week. Two portable thermal desorption units would each process 10 to 20 tons per hour (9 to 18 metric tons per hour) of contaminated soil. The units would use propane

for the gas-fired burners. The air stream from the thermal desorption units would be treated by catalytic oxidation to reduce the hydrocarbons to carbon dioxide and water.

2.3.2 Annual Pump and Treat

The existing interim groundwater pump and treat system has not been operated since 1994. Under this alternative, the pump and treat system would be refurbished, or new equipment would be installed. The pump and treat system would be used each summer to reduce the potential for contaminants of concern in groundwater to migrate off the site and to reduce the possibility of contaminated groundwater reaching a receptor.

This alternative would consist of annually pumping approximately 8.6 million gal (32.5 million L) of groundwater from 13 wells over a period of 120 days (U.S. Department of Energy, 1992). Hydraulic modeling has indicated that pumping 50 gpm (190 liters per minute) from selected wells on the site for approximately 4 months per year would effectively halt the movement of groundwater flowing through the burn zones where contaminants have been deposited (Gilbert/Commonwealth, Inc., and J.M. Montgomery, Inc., 1991b). A combination of nine existing wells and four new wells would be used for this alternative.

Groundwater would be pumped from the water wells into two 2,500-gal (9,460-L) steel tanks. Water from the tanks would be piped to a centralized filtration system. A schematic of the existing water treatment system is shown in Figure 2.5. The carbon adsorption filters would contain 2,000 lb (900 kg) of GAC which would be able to process approximately 75 gpm (285 liters per minute) of water with a combined residence time of 13 minutes (U.S. Department of Energy, 1992).

The carbon adsorption filters would not be completely effective in the removal of benzene. However, the small quantities of contaminants remaining in the water would be discharged through spray atomizers into the atmosphere where they would be volatilized. The treated groundwater would be discharged through the spray atomizer system over approximately 16 ac (6.5 ha), as shown in Figure 2.4 (U.S. Department of Energy, 1992). From telephone discussions with the WDEQ, it was determined that the treated water could be discharged to the surface if the phenol levels were below 20 µg/L and the benzene levels were below 50 µg/L (Gilbert/Commonwealth, Inc. and James M. Montgomery Inc., 1991b). If the benzene levels were greater than 50 µg/L, the treated water would be spray atomized into the atmosphere to volatilize the organics.

The pump and treat system would have fail-safe features to ensure system shutdown in the event of pressure drops. A rigorous soil and water sampling program would be implemented to ensure that discharged water would meet State of Wyoming water quality standards.

The pump and treat system would be operated during the summer to avoid freezing of pipes and to increase the volatilization effectiveness of the spray atomizing system. The filtration equipment would be housed in a small metal building. The system would be drained, disassembled, and stored offsite during the winter months. Noise would be minimized by using power from the local electric cooperative rather than diesel generators. Soil disturbance would be minimized by placing the piping system aboveground.

Monitoring of the groundwater would continue on an annual basis for as long as the pump and treat alternative was in effect. Approximately 2,500 gal (9,450 L) of purge water from the 30 monitoring wells would be produced annually. The purge water would be disposed as described in Section 2.2.

The pump and treat alternative would continue for a period of time agreed upon between the WDEQ and DOE. When pump and treat system was no longer required, equipment would be removed, and the site would be reclaimed as described in Section 2.2.

2.3.3 No Action

Under this alternative, no remedial actions to treat the groundwater or subsurface material would be performed. Groundwater contaminant concentrations would be affected only by natural degradation processes. This alternative may not meet the intent of the agreement signed between the DOE and State of Wyoming DEQ. Under this agreement, if contaminated groundwater moved off the site, the DOE may be subject to litigation or substantial fines under state jurisdiction, and enforcement under Section 401 of the Clean Water Act.

Under the no action the existing pump and treat system, air compressor building and any surface piping would be removed. Soil from the topsoil stockpile would be spread over the disturbed areas. Prior to construction of the site, the topsoil was removed from the areas of construction and placed in a stockpile near the air compressor building. The topsoiled area would be seeded with native grasses, and fertilized as needed to restore the native vegetation according to the reclamation requirements of the agreement between the WDEQ and DOE.

This alternative would restrict site access along the perimeter of the site by maintaining the existing barbed wire fence and gate. This alternative also would continue the institutional controls already in place. A notice has been placed on the plat maps located in Cheyenne, Wyoming to notify other parties interested in the property that there is a potential for groundwater contamination.

Groundwater monitoring would be continued to determine if any changes occurred in concentrations of contaminants of concern or in

contaminant migration patterns. The groundwater monitoring program would consist of quarterly sampling of 27 monitoring wells for BTEX. Four of the monitoring wells would be located in the channel sand, 13 would be in the Felix 1 coal seam, and 10 would be in the Felix 2 coal seam. Groundwater monitoring would be continued for a period of time agreed to by the WDEQ Land Quality Division (LQD) and DOE.

Approximately 8,400 gal (31,750 L) of purge water would be produced annually. The purge water from the monitoring wells would be disposed as described in Section 2.2.

2.4 SUMMARY

The characteristics of each of the alternatives, including the proposed action, are summarized in Table 2.1.

Characteristic

Air Sparging/ Bioremediation

Excavation

Annual Pump and Treat

No Action

Area of disturbance

2.0 ac

(0.8 ha)

40.0 ac

(16.2 ha)

2.0 ac

(0.8 ha)

2.0 ac

(0.8 ha)

Volume of contaminated soil removed and treated

1,000 yd³

(765 m³)

50,000 yd³

(38,200 m³)

0

0

Volume of topsoil stripped

1,600 yd³

(1,220 m³)

24,600 yd³

(18,800 m³)

	0
	0
Volume of groundwater requiring treatment annually	
	0
	18 MM gal ^{a/}
	(68 MM L)
	8.6 MM gal ^{a/}
	(32.5 MM L)
	0
Number of sampling events annually	
	8
	1
	1
	4
Volume of purge water produced annually	
	268,000 gal
	(1,013,040 L)
	1,600 gal (6,050 L)
	2,500 gal (9,450 L)
	8,400 gal (31,750 L)
New water wells installed for processing or monitoring	
	106
	10
	4
	0
Number of monitoring wells sampled per round of sampling during remediation	
	53
	10
	30
	27
Time period for site remediation	
	5 years
	4 years

To be determined by WDEQ and DOE

To be determined by WDEQ and DOE

a/ Does not include purge water extracted from monitoring wells for groundwater quality monitoring.

SECTION 3

EXISTING ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

This section describes existing conditions of the environmental resources that may be affected by the proposed action and alternatives. The analysis of environmental consequences focuses on the major effects or changes within each resource area. A definition of a major change is described for each resource type under the proposed action. The proposed action and alternatives are compared to these standards to determine if there are any changes, and if these changes would cause a major impact. The environmental consequences for the proposed action and alternatives are discussed in terms of direct or indirect, short-term or long-term, and potential cumulative effects.

This document concentrates on those resources that may be impacted by the alternatives including the proposed action. During the preliminary analysis, several resources were identified that would not be expected to be adversely impacted by the proposed action or other alternatives. These resources included biodiversity, cultural resources, environmental justice, fisheries, flood plains, land use, pollution prevention, socioeconomics, transportation, utilities, visual, and wetlands. The reasons for eliminating these resources from detailed analysis are discussed in Section 3.2. The resources analyzed in detail include air quality, geology, human health and safety, noise, soils, solid and hazardous waste, threatened and endangered species, vegetation, water resources, and wildlife. These resources are discussed in Section 3.3 through 3.12. Cumulative effects for the proposed action and alternatives are discussed in Section 3.13.

3.1 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The alternatives evaluated in this EA included air sparging with bioremediation, excavation, continuation of annual pump and treat, and no action. A summary of the analysis of all resources evaluated, including cumulative effects are summarized in Table 3.1.

3.2 RESOURCES NOT EVALUATED IN DETAIL

Resources that would not be expected to be impacted by the proposed action or other alternatives were eliminated from detailed analysis.

TABLE 3.1

SUMMARY OF EXPECTED ENVIRONMENTAL EFFECTS FOR HOE CREEK UCG TEST SITE REMEDIATION ^{a/}

Resource

Resources not Examined in Detail

Biodiversity	The site is surrounded by a large area of similar topography, vegetation, and wildlife habitat.
Cultural resources	Previous surveys have not identified any sites meeting the eligibility criteria for the National Register of Historic Places.
Environmental justice	No communities of minority or lower income populations are located in the vicinity of the site.
Fisheries	There are no water bodies on the project site.
Flood plains	The project is not associated with a delineated 100-year flood plain.
Land use	Grazing resource losses would be small. Low potential effect on other potential uses.
Pollution prevention	The alternatives have been designed with pollution prevention in mind and include mitigative measures to minimize pollution.+++

Socioeconomics	The small size of the project would result in little change in labor force, housing demand, or additional infrastructure.
Transportation	The level of service for the county road would not change.
Utilities	Electrical power demands of pumps are relatively low. Water will be trucked to the site.
Visual	The site is in a remote location, is not visible from the state highway, and can be seen from only one residence.
Wetlands	No wetlands are located on the Hoe Creek property.

Resource	Air Sparging with Bioremediation	Excavation	Continuation of Annual Pump and Treat	No Action
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Detailed Evaluation of Resources

Air quality

Short term	No major effect (NME). Small increases in fugitive dust would occur from soils disturbance.	Under some conditions, fugitive dust would be a nuisance to the nearby resident. NME from vehicle emissions.	Same as air sparging for fugitive dust. Air emissions of benzene are below levels of concern according to the AQD WDEQ.	NME
Long term	NME	NME	NME	NME

Geology

Short term	Air sparging would not change the site hydrology. NME on downgradient users.	Temporary change in site hydrology due to dewatering of aquifer around pits, and shortly after until equilibrium in aquifer is reached.	Cone of depression would not affect any nearby water wells or recharge to Hoe Creek.	NME
Long term	NME	Mineral resources in the area of excavation would be permanently removed.	NME	NME

Human health and safety

Short term	No risk or threat to human health from inhalation of benzene vapors. Safety risk from construction activities is minimal.	Risk to workers health and safety would be minimized by close adherence to site health and safety plan.	No risk or threat to human health from inhalation of benzene vapors. Safety risk from construction activities is minimal.	NME
Long term	NME	NME	NME	Institutional controls would be maintained to prevent uses of groundwater resource.

Noise

Short term	Noise would not have any major affect on nearby residents.	Construction activities would produce noise that may be unacceptable to one nearby residence.	Noise would not have any major affect on nearby residents. Pumps would be housed in a building and run by electrical power.	Noise would not have any major affect on nearby residents.
Long term	NME	NME	NME	NME

Soils

Short term	No loss of topsoil resources	No loss of topsoil resources, erosion and sediment controls would prevent transport of contaminated soils off site.	No loss of topsoil resources	NME
Long term	No loss of soil productivity	No loss of soil productivity	No loss of soil productivity	NME

Solid and hazardous waste

Short term	All solid and hazardous wastes would be disposed of off site in accordance with state regulations.	All solid and hazardous wastes would be disposed of off site in accordance with state regulations.	All solid and hazardous wastes would be disposed of off site in accordance with state regulations.	NME
Long term	NME	NME	NME	NME
Threatened and endangered species				
Short term	NME. No report of T&E species in the project vicinity	NME. No report of T&E species in the project vicinity	NME. No report of T&E species in the project vicinity	NME. No report of T&E species in the project vicinity
Long term	NME	NME	NME	NME
Vegetation				
Short term	NME. Minimal loss of forage production.	Forage loss on site would be compensated by increased forage production along Hoe Creek resulting from discharge of water from excavation of pits.	Positive affect of water available for plant growth in areas where groundwater is being spray evaporated.	NME
Long term	Reclamation would result in no loss of forage production for livestock and wildlife grazing.	Reclamation would result in no loss of forage production for livestock and wildlife grazing.	Reclamation would result in no loss of forage production for livestock and wildlife grazing.	Reclamation would restore loss of forage production for livestock and wildlife grazing.
Water resources				
Short term	NME of surface water. Groundwater monitoring would affect less than 7 percent of groundwater flow.	Surface and groundwater flows at the site would be reduced during construction. Dewatering would be a positive affect on surface water in Hoe Creek. Erosion control structures would prevent sediment and contaminant transport into Hoe Creek	Groundwater quality would be improved and movement of contaminants off site would be controlled. Removal of groundwater would not affect nearby wells. Treated groundwater discharge would increase available surface water resource in Hoe Creek.	The intent of the agreement between DOE and WDEQ may not be meet. The DOE may be subject to litigation or fine under Section 401 of the Clean Water Act.
Long term	Groundwater quality would be improved through treatment of groundwater contaminants	Groundwater quality would be improved through removal of contaminant source material	Pump and treat would continue until such time water quality meets pre-test conditions, or is no longer a threat to human health and the environment.	The intent of the agreement between DOE and WDEQ may not be meet. The DOE may be subject to litigation or fine under Section 401 of the Clean Water Act.
Wildlife				
Short term	NME. Loss of 12 ac (5 ha) of big game habitat and forage.	NME. Loss of 40 ac (16 ha) of big game habitat and forage may be offset by improved habitat quality along Hoe Creek. Reduced wildlife use caused by human activity in the area.	NME. Improved quality of big game habitat and forage may occur onsite.	NME. Decrease in wildlife use of 12 ac (5 ha) due to human activities associated with revegetation.
Long term	NME. Small increase in hunting opportunities.	NME. Small increase in hunting opportunities.	NME. Small increase in hunting opportunities.	NME.
Cumulative environmental consequences				
Short term	NME	NME. Localized change in groundwater would not affect other groundwater use in the area. Increased water in Hoe Creek	NME. Increased water in Hoe Creek would be a positive affect.	Water wells and surface waters off site have not been affected by the Hoe Creek site. Institutional

would be a positive affect.

controls would warn other parties that water wells/ mining activities should not occur on this property.

Long term	NME	NME	NME	Water wells and surface waters off site have not been affected by the Hoe Creek site. Institutional controls would warn other parties that water wells/mining activities should not occur on this property.
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a/ Assumes that mitigation measures described in Section 3 have been implemented.

3.2.1 Biodiversity

The Hoe Creek test sites are located in an area of similar topography, vegetation, and wildlife habitat as the surrounding land. Loss of habitat would occur for a short term during construction activities but would not be expected to affect wildlife due to the similar type of vegetation on the areas of the property that would not be affected by remediation activities, and the large expanse of undeveloped land around the site.

3.2.10 Visual Resources

The project site is in a remote area of the county and remedial activities would not be visible from State Highway (SH) 59. The site is visible from only one residence.

3.2.11 Wetlands

No wetlands are located on the Hoe Creek property. The nearest wetlands are located along Hoe Creek approximately 2,000 ft (610 m) south of the project area. Hoe Creek is an intermittent drainage and the effects of the remedial alternatives on the surface waters and any wetlands that may be temporarily created during dewatering activities are discussed in Section 3.10.

3.2.2 Cultural Resources

A review of records on May 23, 1997 showed no sites meeting the criteria of eligibility for the National Register of Historic Places (NRHP) would be affected by UCG test site remediation as planned. Letters from the Wyoming State Archives and Historical Department (1979) and the Wyoming Recreation Commission (1979), stated that no historic sites would be impacted by the Hoe Creek UCG test sites. A cultural resources inventory was conducted by North Platte Archaeological Survey on August 1, 1991. It was determined that no archeological resources would be affected at the DOE site. The report was reviewed by the SHPO and a letter granting formal site clearance was sent to the DOE. If any cultural materials are discovered during construction, work in the area would be halted immediately and the BLM, WDEQ staffs and SHPO staff would be contacted. Work in the area would not resume until the materials were evaluated and adequate measures for their protection were taken.

3.2.3 Environmental Justice

Gillette, Wyoming is the nearest town to the Hoe Creek site. Gillette is located 23 miles north (37 km). It has a population of about 17,600. The project would not have disproportionate adverse effects on any minority or low income population.

3.2.4 Flood Plains

The proposed project would not be associated with a delineated 100-year flood plain. The nearest surface water body is Hoe Creek, an intermittent stream 0.5 mi (0.8 km) south, and downgradient of the site.

3.2.5 Land Use

The project site is located on land under the stewardship of the BLM, which manages both the surface and mineral rights. A series of temporary use permits were issued by the BLM for the in situ coal gasification projects at Hoe Creek 1 and 2 in the mid- to late-1970s. In 1979, a change in the law brought the Hoe Creek 3 UCG experiment under WDEQ regulations. On August 13, 1979 WDEQ approved a research and development license (R&D License No. RD1) for the Hoe Creek project, and a performance bond was placed with the State should any reclamation of the site become necessary (Gilbert/Commonwealth, Inc. and James M. Montgomery, Inc., 1991a). Upon the completion of site remediation the BLM may sell the surface rights of the property. If this takes place the land use would likely remain as livestock grazing.

Grazing rights are leased to a local rancher. The range condition of the site is fair to moderate and approximately 15 to 20 ac (6 to 8 ha) of land would be required to support one animal unit for one month (AUM). Even if all grazing at the site were to cease, the loss of 4 to 5 AUMs would not be considered a major effect for livestock or wildlife grazing compared to the large amount of grazing land surrounding the site.

The project would not be located on or near any prime farmland. No change in land ownership would occur as the result of site remediation. No active mining claims are located on the property. A statement on the plat maps in the BLM office in Cheyenne, Wyoming identifies that groundwater quality could be affected, and no water well drilling is allowed until the DOE has proven that the aquifers are not polluted (Weaver, 1997).

3.2.6 Pollution Prevention

Pollution that would result from the proposed action or its alternatives could include air pollution, water pollution, solid waste, and, in some cases, hazardous waste. Cleaning up water pollution is the main aim of the DOE in this effort. The levels of air pollution and waste generated by each of the alternatives are somewhat different, however, in all cases the alternatives include mitigative measures to minimize pollution. The possible pollution effects of each alternative are evaluated in Sections 3.3 through 3.12.

3.2.7 Socioeconomics

A change in the work force would not be expected from the construction phase of the proposed action or the pump and treat alternative. Several temporary construction jobs would be created for the excavation alternative, and several local businesses in Gillette would benefit from materials purchases. No major changes would occur in the labor force, need for housing, or need for additional infrastructure currently in place in Campbell County.

3.2.8 Transportation

An increase in transportation would be expected to occur for a short time during construction of the proposed action or the alternatives to the proposed action. The access road to the site is a gravel road. The increased amount of travel would not change the level of service for the county road.

3.2.9 Utilities

Electrical power is available to the site. Water required for construction activities would be trucked to the site as needed. Potable water for drinking purposes would be provided to the site as bottled water.

3.3 AIR QUALITY

3.3.1 Existing Environment

The climate is semi-arid, with wide variations in temperature and precipitation between summer and winter seasons. Winter temperatures average around 26 degrees Fahrenheit (EF) (-3 degrees Centigrade [EC]) and summer temperatures average around 65EF (18EC). Annual precipitation averages 15.8 in (40 cm). Approximately 50 percent of the moisture occurs during the growing season from April through early July. The prevailing winds are from the southwest with strongest wind velocities recorded in the spring (Dames & Moore, Inc., 1996b).

All areas within Campbell County are in attainment with primary pollutant standards. Air pollutants in the region primarily are from

fugitive dust and vehicle emissions. Fugitive dust is measured in terms of particulate matter 10 microns or less in diameter (PM₁₀).

3.3.2 Environmental Consequences

Changes to air quality would be considered a major impact if they resulted in contributions to an existing or projected air quality violation, or resulted in a nuisance to neighboring residents. The air pollutants that were considered for the proposed action and alternatives included fugitive dust from construction activities, fugitive dust from disturbed areas, carbon monoxide emissions from process and construction equipment, and benzene vapors from contaminated groundwater that would be brought to the surface.

3.3.2.1 Proposed Action

The quantity of fugitive dust emission was estimated using the results of an EPA study in which the amount of fugitive dust was determined to be proportional to the area of ground surface disturbed and the duration of the construction activity (U.S. Environmental Protection Agency, 1985). The study estimated that uncontrolled fugitive dust from ground-disturbing activities expressed as PM₁₀ was 55 lb/ac/day (9.2 kg/ha/day).

The total area of soil disturbance for construction of the air sparging system, new air compressor building, and soil stockpile area would be approximately 2 ac (0.8 ha). If dust is not controlled, this would result in a direct, short-term effect of producing about 110 lb (50 kg) of PM₁₀ emissions per day. This volume of soil loss would not contribute to an existing or projected air quality violation, or be expected to result in a nuisance to nearby residents. However, dust emissions would be mitigated in the following ways:

- The proposed action described in Section 2.2 includes the use of water or chemicals to stabilize the surface of disturbed soils and reduce wind erosion. These measures reduce the amount of fugitive dust by 50 percent or more (U.S. Environmental Protection Agency, 1985).
- Each area of disturbance would be surrounded by a vegetative cover that would minimize wind erosion.
- The soil disturbance would occur in multiple small area rather than a single large area. Therefore, the volume of emissions near any site would be small.

The air sparging equipment would be powered by electricity and no carbon monoxide emissions would be generated on the site. Air emissions from vehicles would occur for a short term during installation of the air sparging system and during maintenance and monitoring activities. However, these fugitive dust and carbon monoxide emissions would be temporary and would dissipate quickly.

Site revegetation following remediation would again result in the short-term production of up to 110 lb (50 kg) of PM₁₀ emissions per day. However, the actual emissions would be lower because of the small size of each disturbed area and the use of erosion control measures during implementation activities. As described in Section 2.2, the revegetation plan prescribes the use of straw mulch, which would reduce dust emissions from disturbed areas until a vegetative cover was established.

3.3.2.2 Excavation Alternative

Air pollutants associated with the excavation alternative would include carbon monoxide emissions from vehicles and heavy equipment, and fugitive dust emissions from the roads, excavation, and stockpile areas. Air emissions would occur during construction, and would cause direct, short-term effects only to the immediate area around the Hoe Creek site. No long-term or indirect effects were identified.

The construction project would last for about 4 years and would disturb a total area of 40 ac (16 ha). Individual areas of disturbance would range in size from 1.5 to 14 ac (0.6 to 5.7 ha). The uncontrolled disturbance of 40 ac (16 ha) would result in 2,200 lb (1,000 kg) of PM₁₀ emissions per day. However, actual emissions would be lower for the following reasons:

- Water or chemicals would be used to stabilize the surface of disturbed soils and reduce wind erosion. These measures reduce the amount of fugitive dust by 50 percent or more (U.S. Environmental Protection Agency, 1985).
- Disturbance to the entire 40 acres would occur for only a portion of the 4-year construction period.
- - According to the plan prepared by Dames & Moore, Inc. (1996a), remediation initially would focus on the Hoe Creek 2 site. Fugitive dust emissions during this phase would be produced only from disturbances of this 14 ac (5.7 ha) site, plus supporting stockpile, staging, and holding areas.
 - When excavation of the Hoe Creek 2 site was completed, the excavation at the Hoe Creek 3 site would begin. During this period, clean materials from the Hoe Creek 3 site would be deposited in the Hoe Creek 2 site hole and the entire 40 acres would produce fugitive dust emissions.
 - Once the Hoe Creek 2 site hole was filled, revegetation would be implemented promptly. During this phase, fugitive dust emissions would be produced only from the 11.5 ac (4.6 ha) Hoe Creek 3 site and supporting facilities.

The ambient standard for PM10 is 50 Fg/m³. Air measurements would have to be taken during construction to ensure that ambient standards were not exceeded. Contingency measures would be included in the project plan, and would be implemented as necessary to ensure that an air quality violation did not occur. This could include suspension of construction activities until atmospheric conditions contributing to the violation potential subsided.

There are no other major sources of carbon monoxide emissions in the vicinity, and ambient levels of carbon monoxide are very low. The winds that are common throughout the year would rapidly disperse carbon monoxide emissions from vehicles. Therefore, carbon monoxide emissions from the excavation alternative would not be expected to reach levels that would result in a violation of air quality standards.

The factors considered to determine nuisance effects from fugitive dust and vehicle emissions were the proximity of neighbors, prevailing winds, and effectiveness of mitigation measures. Fugitive dust and vehicle emissions would seldom be a nuisance to nearby residents for the following reasons:

- Only one residence is located in the area. This home is northwest of the site, about 0.2 mi (0.4 km) from the nearest area of disturbance. Considerable dispersion of fugitive dust and vehicle emissions would occur before they reached the residence.
- Prevailing winds in the area are from the north and west. Therefore, emissions usually would be blown away from, rather than toward, the residence.
- Mitigation measures such as watering or use of chemical soil binders would reduce the amount of fugitive dust by 50 percent or more (U.S. Environmental Protection Agency, 1985).

Fugitive dust may be a nuisance to the nearby residents during windy days or days when the wind blows from the project site toward the house. When a nuisance situation was identified, contingency measures in the project plan would be implemented. This could include suspension of construction activities until atmospheric conditions causing the nuisance condition subsided.

Air emissions during site revegetation following remediation would be similar to those described for the proposed action. Disturbance of the entire 40 acres (16 ha) of soils for revegetation would result in the short-term production of up to 2,200 lb (1,000 kg) of PM10 emissions per day. However, the actual emissions would be lower because revegetation of the two sites would not occur concurrently and erosion control measures would be used during revegetation. Straw mulch would protect disturbed areas until a vegetative cover was established.

3.3.2.3 Pump and Treat Alternative

The pump and treat alternative is similar in scope to the interim pump and treat action conducted in 1992. An EA was conducted for the Hoe Creek groundwater pump and treat project (U.S. Department of Energy, 1992), and no major effects were identified for air quality. Dust emissions would cause direct, short-term effects and would dissipate quickly. All of the groundwater pumps would be electrically operated and there would be no carbon monoxide emissions.

Under this alternative, groundwater would be spray-evaporated into the air. Discussions were held with the Air Quality Division (AQD) of the WDEQ relative to the benzene remaining in the filtered groundwater when it was spray atomized. The AQD found the air emissions from benzene would be insignificant in rate and impact (U.S. Department of Energy, 1992). Based on prior analyses, the maximum concentration of benzene in the groundwater pumped from any well is 1,000 ppb. The WDEQ evaluated the amount of benzene that would be discharged into the air from pumping 13 wells for 120 days over a 16-ac (6.5-hectare) area. The maximum concentration of gaseous benzene in the air in the discharge zone was estimated to be 4.5 Fg/m³ per minute. This is well below the time-weighted average (TWA) for air-borne occupational exposure to benzene of 32 mg/m³. As a result, the WDEQ has waived air permitting requirements for this action with the conditions that:

- The spray atomization system not be operated more than 120 days per year;
- The benzene content of the system effluent (treated water) not exceed 5 ppb; and
- The results of effluent sampling be provided to WDEQ for their review.

3.3.2.4 No Action Alternative

Under the no action alternative, the existing pump and treat system would be removed. The land disturbed by these facilities would be reclaimed. Fugitive dust and carbon monoxide emissions would be expected to occur for a short term during reclamation activities, but they would be quickly dispersed.

3.4 GEOLOGY

3.4.1 Existing Environment

The Eocene-aged Wasatch Formation underlies the Hoe Creek site. This formation dips gently westward at 2 to 3 degrees at the site. The stratigraphy of this formation has been subdivided and described by Gilbert/Commonwealth, Inc. and J.M. Montgomery, Inc. (1991a) and Dames & Moore, Inc. (1996a and 1996b) into six hydrostratigraphic units that are named according to lithology or their location relative to the Felix 1 and 2 coal seams. The upper portion of this formation was subdivided to better describe lithologic, hydrogeologic, and contaminant-related characteristics of this site. As shown on Figure 1.3, in descending order from the surface, units are as follows:

- The overburden consists of clay, silt, and discontinuous sand lenses and is about 35 ft (11 m) thick.
- The channel sand unit consists of about 20 ft (6 m) of silty sandstone underlain by 40 ft (12 m) of sandstone, which is underlain by about 5 ft (1.5 m) of claystone. Depths to the channel sand in the test area range from 50 to 100 ft (15 to 30 m). The channel sand outcrops to the south and east within 500 ft (152 m) of the site boundary.
- The Felix 1 coal seam is about 10 ft (3 m) thick. The Felix 1 coal seam ranges in depth from 80 to 130 ft (24 to 40 m). It outcrops to the east and south within 1,000 ft (305 m) of the site boundary.
- The interburden consists of an approximately 15- to 30-ft (4.5- to 9-m) thick sand bounded by an upper and lower claystone bed, both about 3 to 4 ft (1 m) thick.
- The Felix 2 coal seam is about 25 ft (7.6 m) thick. The Felix 2 coal seam ranges in depth from 110 to 160 ft at the site. It outcrops approximately 1200 ft (365 m) south on the site boundary of Hoe Creek.
- The underburden consists of interbedded claystones and sandstones.

The depth to the bottom of the Felix 2 coal is approximately 155 ft (47 m) at the Hoe Creek 2 site and 185 ft (56 m) at the Hoe Creek 3 site.

The Felix 1 and 2 coal seams contain two sets of cleats or vertical fractures, oriented at approximately N 70 degrees E and N 29 degrees W. The northeast-oriented fractures may be synthetic to a northwest/southeast-oriented set of regional fractures or fault zones that are thought to affect groundwater drainage in the Hoe Creek area (Dames & Moore, Inc., 1996a and 1996b; U.S. Army Corps of Engineers, 1997).

Hot gases from the UCG tests rose through both sets of fractures and emplaced high concentrations of the contaminants of concern in the upper portions of the Felix 1 and 2 coal seams. The northeast set appears to be more continuous and may have provided a primary pathway for contaminant dispersion during and after the gasification experiments when the hydrostatic pressure in the burn cavities exceeded the pressures in the Felix 2 coal seam (Dames & Moore, Inc., 1996a and 1996b; U.S. Army Corps of Engineers, 1997).

All experiments were targeted in the Felix 2 coal seam. However, the affected materials at all sites, including areas that have subsequently collapsed into the actual burn cavities, extend into other overlying stratigraphic units (Dames & Moore, Inc., 1996a).

- The cavity at the Hoe Creek 1 site was estimated to be 16 ft (5 m) by 35 ft (10 m) and included the Felix 2 coal seam and the lower portion of the interburden. During the test, no extensive roof collapse was detected and it is believed that only the Felix 2 coal seam was affected. Contaminants of concern have not been detected in high concentrations at this site, and it is inferred not to be a contaminant source area. Therefore, this site has not been targeted for remedial actions.
- The cavity at the Hoe Creek 2 site includes the Felix 2 coal seam, the interburden, the Felix 1 coal seam, and the lower portion of the channel sand. Post-test coring indicated a rubble-filled cavity approximately 75 ft (23 m) long by 50 ft (15 m) wide. The Hoe Creek 2 burn cavity subsided to the surface in the spring of 1994. Coring performed in 1994 indicated that the maximum extent of the burn reaction in the Felix 1 may be approximately 135 ft (40 m) long and 53 ft (16 m) wide. Groundwater extracted from these units contained elevated levels of contaminants of concern. This site and the surrounding area are considered a source area.
- The cavity at the Hoe Creek 3 site extends into portions of the entire stratigraphic interval, and the surface area above this site has subsided. Post-burn coring revealed a rubble-filled cavity about 170 ft (52 m) long and 56 ft (17 m) wide. Coring performed by Dames & Moore in 1994 indicated that the maximum extent of the burn was approximately 195 ft (60 m) long by 90 ft (27 m) wide in the Felix 1 unit. Surface subsidence occurred within approximately 30 days after the burn was completed. The site was filled in and there is little or no risk of further subsidence. This site and the surrounding area are considered a contaminant source area.

A comment on the draft EA from the Wyoming State Geological Survey expressed concern that the geologists involved in performing this EA be certified per the requirements of the Wyoming Geologists Practice Act passed in June, 1997 (Glass, 1997). All of the geologic studies used as input for this EA were prepared prior to the active date of this Act, however, the following registered Professional Geologists (PG) have provided input into this EA: James K. Theye, PG, project hydrogeologist for Dames and Moore; Thomas D. Liefer, PG, geologist for the U.S. Army Corps of Engineers; and Mark H. Thomas, PG, geologist for EG&G Washington Analytical Services, Inc.

3.4.2 Environmental Consequences

Major impacts to the Hoe Creek property's geology were defined as a permanent change in the hydrogeologic properties of the site that could adversely affect downgradient users of groundwater.

3.4.2.1 Proposed Action

Air sparging would not have any major effect on site hydrogeology because very little groundwater would be removed from the subsurface. Therefore, no major impact is expected. The effects this alternative would have on the migration of contaminants in groundwater are discussed in Section 3.11.2.1.

3.4.2.2 Excavation Alternative

Dewatering, or lowering the water table within a localized area around the site for excavation, would temporarily change the regional hydraulic gradient. This potentially could remove groundwater discharges into Hoe Creek and nearby springs, thereby reducing or eliminating surface water flow in these areas. These effects would occur during excavation and for a short time after site reclamation. They would not have any major, long-term effect on regional hydrology.

Following excavation, treated source materials that were crushed as part of the treatment process would be placed in the excavation below the water table. This action would substantially change hydraulic properties within the excavated area. However, it would not cause a major effect on regional hydrology over the long term.

The potential for future mineral resource recovery in the proposed excavation areas is remote. However, several mining claims have been staked on the Hoe Creek property in the past. These mineral resources (the Felix 1 and 2 coal seams) would be permanently removed (destroyed) from potentially exploitable inventories.

3.4.2.3 Pump and Treat Alternative

The annual, short-term pump and treat action would not have any major effect on site hydrogeology. A cone of depression would be formed around the point of dewatering and would prevent contaminants from migrating off the site. The cone of depression would not affect any nearby water wells, or water recharge to Hoe Creek.

3.4.2.4 No Action Alternative

The no action alternative would not result in any direct, indirect, short-term, or long-term effects to geology. The potential exists for future surface subsidence at the Hoe Creek 1 site. However, this would be a geologic effect of the UCG test rather than the no action alternative.

3.5 HUMAN HEALTH AND SAFETY

3.5.1 Existing Environment

Sampling data indicate that benzene is the primary contaminant of concern at the Hoe Creek site. However, as discussed in Section 1.1.2, other potential contaminants of concern also occur at the Hoe Creek site. Contaminants of concern are present in the groundwater and structural voids in the overburden and strata adjacent to the burn cavities (Dames & Moore, Inc., 1996a and 1996b).

A screening-level risk analysis was conducted during the remedial alternatives evaluation (Dames & Moore, Inc., 1996a). The risk analysis defined current residential receptors as those individuals who live and work in proximity to the Hoe Creek UCG site. Inhalation of air-borne contaminants diffusing from vent wells and groundwater in the shallow aquifers would be the only pathways posing any potential threat to humans at the Hoe Creek site. The analysis concluded that there is no current immediate threat to the health and safety of residents living in the area surrounding the Hoe Creek Site@ (Dames & Moore, Inc., 1996a).

The nearest water supply well is located at a private residence, northwest and upgradient from the site. This well is completed in a different (deeper) aquifer than the one that shows benzene contamination. No contaminants have been found in this well. Therefore, no risk was identified in association with this well.

There is no surface water on the site. The nearest surface water is Hoe Creek, and a spring located approximately 1,800 ft (550 meters) south of the site. Hoe Creek is an intermittent stream that carries water for only a short time during the year. The spring located next to the creek is also seasonal and flows during part of the year. Contaminants have not been detected in Hoe Creek or the spring. Therefore, it was determined that contaminant exposure to humans through surface water is unlikely (Dames & Moore, Inc., 1996a).

3.5.2 Environmental Consequences

A major impact would occur if the contaminants of concern affected human health, or if construction or other remedial activities resulted in

serious injury or fatality to the workers.

3.5.2.1 Proposed Action

The risk assessment determined that inhalation of air-borne contaminants diffusing from the vent wells and groundwater in the shallow aquifers would be the only pathway that posed a potential threat to humans at the Hoe Creek site (Dames & Moore, Inc., 1996a). A pilot study conducted at the Hoe Creek 2 site was performed to test the air sparging design from the fall of 1995 through the fall 1996. The results from this test indicated that a maximum concentration of 325 ppb benzene was present in the vent gas from well VW-3 and less than 15 ppb was present from the remaining four wells sampled (U.S. Army Corps of Engineers, 1997).

Since 1 part per million (ppm) equals 3.25 mg/m³ (U.S. Department of Health and Human Services, 1990), the maximum benzene concentration in the air at the vent source is 0.1 mg/m³. The TWA for occupational exposure to benzene is 32 mg/m³, or 100 times higher than the source concentration (U.S. Department of Health and Human Services, 1990). Ambient air benzene concentrations would be considerably lower than the source concentration because of dispersion and dilution. Therefore air-borne benzene would not present a threat or risk to human health (U.S. Army Corps of Engineers, 1997).

The contractor responsible for system construction, operation, and maintenance would submit a site health and safety plan for approval prior to beginning work. The contractor would be responsible for conforming to all Occupational Safety and Health Administration (OSHA) requirements in 29 CFR Part 1910 Section 120, and CFR 29 Part 1926 Section 65 related to A Hazardous Waste Site Operations and Emergency Response, @ and CFR 29 1910.1000, A Toxic and Hazardous Substances. @

Procedures for operations and emergencies would be maintained on site along with material safety data sheets. Contact numbers and directions to emergency organizations would be maintained in the office trailer on site. Safety glasses, hard hats, and steel-toed boots would be required when working around equipment or when in the compressor building. Workers would be required to wear hearing protection when in the compressor building. With the use of proper safety equipment and compliance with the site health and safety plan, site remediation should not result in any major adverse effects to human health and safety.

3.5.2.2 Excavation Alternative

Construction activities would take place over a 4-year period, with extensive use of heavy equipment during day and night shifts, and increased traffic on Hoe Creek Road. Therefore, the health and safety plan would need to stress vehicular and equipment safety as well as safety associated with hazardous waste site operations. The use of personnel protective equipment would be the same as described in Section 3.5.2.1. The potential for accidents of this alternative is greater in comparison to all other alternatives due to the use of heavy equipment and night working conditions.

The risk assessment determined that inhalation of air-borne contaminants diffusing from the vent wells and groundwater in the shallow aquifers would be the only pathway posing a threat to humans at the Hoe Creek site. This alternative would not have vent wells, and shallow groundwater would be intercepted and treated to remove contaminants of concern. However, workers would be exposed to any contaminants in the soil. The health and safety plan would have to address these issues. Further, the potential for workers to be exposed to contaminants would be greater compared to all the other alternatives.

3.5.2.3 Pump and Treat Alternative

The consequences for this alternative would be similar to those described for the proposed action alternative. No adverse health effects would be expected to occur from the water treatment system and spray atomizers.

3.5.2.4 No Action Alternative

Because no further remedial action would take place under this alternative, there would be no further risk to workers. The vent wells would be closed, so they would not present any risk from air borne contamination. The nearest water supply well is completed in a deeper aquifer and has not shown evidence of contamination. Therefore, no risk would be associated with groundwater contamination.

3.6 NOISE

3.6.1 Existing Environment

Current noise at or near the site is generated by traffic on County Road 6041, and by quarterly groundwater monitoring activities. Noise from the monitoring activities consists of vehicles driving to and from the site during sampling sessions and the noise caused by a portable gasoline-powered generator.

3.6.2 Environmental Consequences

A major effect from noise is defined as a change in ambient noise levels that would interfere with normal lifestyles of residents near the project site.

3.6.2.1 Proposed Action

All noise effects would be direct and short term. The primary noise sources for the proposed action would be from vehicles transporting materials and personnel to the site, construction equipment used during the remediation phase, and operation of compressors, blowers, and pumps. The equipment evaluated for noise production during the construction and remediation phase included drill rigs for installation of air sparging wells and monitor wells for the proposed action, and electric blowers or pumps that are part of the air sparging system. Once remediation was complete, noise would be generated by equipment removing the air sparging system and buildings and equipment moving stockpiled soil.

The site is located in a remote area and there is only one nearby residence. Noise associated with the air sparging alternatives would be similar to the noise produced during the air sparging demonstration conducted by EG&G between 1995 and 1996 (U.S. Army Corps of Engineers, 1997). During this demonstration, the nearby residents did not express any problems with noise originating from the site.

There would be some daytime noise due to drill rigs and heavy equipment during the construction phase. During the remediation phase, most noise would be from the compressors and pumps associated with the project. Noise levels from this equipment would be very low, since the equipment would be electrically powered and enclosed in buildings. The use of generators is not anticipated. No major effect would be anticipated.

3.6.2.2 Excavation Alternative

All noise effects would be direct and short term. Noise associated with the excavation alternative would be caused by earth moving equipment operating for two shifts per day for 2 years. Other noise would be from rock crushers during the remediation phase, and from vehicles transporting workers and equipment during the 4-year life of the project.

The earth moving and rock crushing noise could affect residents of the house 1,500 ft (460 m) from the project site. It would not be likely to affect other residents of the area. This alternative would have a major effect because operating heavy equipment for two shifts per day within 1,500 ft (460 m) of the residence could interfere with daily activity patterns.

3.6.2.3 Pump and Treat Alternative

All noise effects would be direct and short term. Noise from the pump and treat alternative would be similar to the noise generated during the pump and treat activities conducted between 1986 and 1994 (U.S. Department of Energy, 1992). During the construction phase, there would be noise from drill rigs and equipment used for well rehabilitation. During the remediation phase, the main noise source would be from vehicles transporting workers to and from the site. There would be no noise from generators because the equipment would be powered by electricity. The pumps would be located inside the well casings and should not generate audible sound. Once remediation is complete, noise would be generated by equipment removing the wells and buildings and equipment moving stockpiled soil. No major effect would be anticipated.

3.6.2.4 No Action Alternative

All noise effects would be direct and short term. Noise from the no action alternative would be similar to the existing situation. There would be noise from vehicles during periodic groundwater sampling and from a portable gas-powered generator used to operate pumps away from the existing electric supply. There would be a short-term effect from equipment used to revegetate the site. No major effect would be anticipated.

3.7 SOILS

3.7.1 Existing Environment

The soils in the project area consist of sandy loams to clay loams that have formed from residuum and alluvium from interbedded sandstone and shales. The soils are moderately deep, have moderate permeability, and are moderately susceptible to water and wind erosion. None of the soils were identified as highly erodible. The preliminary assessment report (U.S. Department of Energy, 1992) did not identify any surface contamination at the site, and the risk assessment concluded that there were no contaminant pathways for soils (Dames & Moore, Inc., 1996a).

3.7.2 Environmental Consequences

A major effect to soils would occur if the action resulted in the loss of topsoil from the areas disturbed during construction, or if disturbance of the land caused a loss of soil productivity.

3.7.2.1 Proposed Action

All soil effects would be direct and short term. Soil disturbance would occur on approximately 2.0 ac (0.8 ha) of land that would be affected by the air sparging wells, new compressor building, and soil stockpile area. Soil productivity would temporarily decrease on these lands during remediation, but would be restored by post-project reclamation.

Salvage of the topsoil from disturbed areas would be essential for successful reclamation. Therefore, prior to construction, the topsoil on these areas would be stripped and stockpiled. The topsoil piles would be marked and protected from wind and water erosion by establishing a temporary vegetative cover. This could include both seeding and moisture addition. The stockpiles would be monitored for erosion and, if required, protective measures such as silt fences or straw bales would be used to prevent loss of topsoil.

During reclamation, the topsoil would be spread on the disturbed areas, reseeded, and protected with straw mulch until a vegetative cover was established. Retopsoiled areas would be tested for available nutrients, and fertilizer applied as needed. No long-term loss of topsoil or soil productivity would occur.

3.7.2.2 Excavation Alternative

This alternative would disturb approximately 40 ac (16 ha) of land for excavation of the pits, stockpile areas, and remediation facilities. All soil effects would be direct and short term.

The topsoil would be stripped, stockpiled, maintained, and used in reclamation as described in Section 3.7.2.1. A short-term productivity loss would be expected during the construction, but would be restored by post-project reclamation.

3.7.2.3 Pump and Treat Alternative

The pump and treat alternative would not result in any new areas of disturbance except for the installation of four new dewatering wells. Topsoil stripped from these areas would be added to the topsoil stockpile already on the site from the pump and treat operation in 1989 and 1992. No loss of soil productivity is expected to occur if the topsoil is protected from wind and water erosion, and is used in reclamation as described in Section 3.7.2.1.

3.7.2.4 No Action Alternative

Areas previously disturbed would be topsoiled and reclaimed as described in Section 3.7.2.1. No short-term, long-term, or indirect effects to the soil resource would be expected.

3.8 SOLID AND HAZARDOUS WASTE

3.8.1 Existing Environment

Currently, the only potential solid wastes projected to be on the site would be well refuse and general rubbish, both of which would be disposed of at the Campbell County landfill. The only hazardous waste known to occur on the site would be granulated activated carbon

(GAC), which was used to treat discharge water during the previous pump and treat and air sparging activities.

3.8.2 Environmental Consequences

A major effect with regard to solid and hazardous waste is defined as a change that would cause a violation of hazardous waste laws.

3.8.2.1 Proposed Action

No major effect would be anticipated from the proposed action, and all effects to solid and hazardous waste would be short term. Potential hazardous wastes resulting from the proposed action would include GAC from the existing pump and treat system; GAC used to treat monitoring well purge water; and oil, lubricant, fuel, and antifreeze generated during maintenance of construction vehicles and equipment. The GAC would be sent to a recycler in accordance with all applicable regulations for handling, transporting, and disposing of the material. The contractor would be required to properly dispose of vehicular wastes according to WDEQ regulations.

3.8.2.2 Excavation Alternative

No major effect would be anticipated from the excavation alternative. Similar types of waste as generated by the proposed action would be produced. However, greater amounts of GAC and vehicular wastes would be generated. Disposal of these materials would be the same as for the proposed action.

3.8.2.3 Pump and Treat Alternative

No major effect would be anticipated from the pump and treat alternative. Solid and hazardous wastes would be similar to those for the proposed action.

3.8.2.4 No Action Alternative

No major effect would be anticipated from the no action alternative. Except for general rubbish, no solid waste would be generated. Some GAC may be used to clean purge water from the monitoring wells. It would be disposed of as described under the proposed action alternative.

3.9 THREATENED AND ENDANGERED SPECIES

3.9.1 Existing Environment

The Endangered Species Act requires that Federal agencies consult with the USFWS to determine whether species listed as threatened or endangered, species proposed for listing, or designated critical habitat for listed species, occur on or near a proposed Federal project site. The DOE consulted with the USFWS, Wyoming Game and Fish Department, and Nature Conservancy's Wyoming Natural Diversity Database (WNDD) to determine which species of concern might be affected by the proposed remediation and reclamation. The agencies indicated there are no records of federally listed threatened or endangered species occurring on the project site and there is no designated critical habitat in the area. No concern was expressed regarding state-listed species in the consultation letters. (Ramirez, 1997; Collins, 1997; Gianakos, 1997).

- The USFWS indicated concern for the endangered black-footed ferret and two candidate species, mountain plover and swift fox. Candidate species are species for which the USFWS has sufficient data to propose for listing, but has not done so.
- The Wyoming Game and Fish Department indicated a concern for the threatened bald eagle, but deferred judgment on this species to the USFWS, which indicated bald eagle is not a concern.
- The WNDD indicated it had no records of threatened, endangered, or candidate plant or animal species occurring in the project vicinity. However, the WNDD indicated that no recent surveys have been performed there. The WNDD did not identify any specific species that may occur in the area.

This section addresses the four species specifically identified in the consultation with the agencies.

Bald eagles would be most likely to be found in the project area during the winter and during spring and fall migrations. Eagles perch in large trees at all times of the year. During the winter, they use communal roost trees on a regular basis to spend the night and to escape from

severe weather. Because there are no trees on the project site, it does not provide perching or roosting opportunities. There are power poles that could be used for perching adjacent to the site, and bald eagles may occasionally hunt on the project site.

Black-footed ferrets reside in prairie dog colonies where the burrows are used for dens. The ferrets feed almost exclusively on prairie dogs (Fagerstone, 1987). No prairie dog colonies are found on or near the site. Therefore, the black-footed ferret is unlikely to occur on the site. No black-footed ferrets have been observed at the site.

Mountain plovers prefer to nest on bare ground in heavily grazed grassland sites with sparse vegetation (Ryder, 1980). They may be associated with prairie dog colonies (Knowles *et al.*, 1982). The project site is within the mountain plover's range. Based on an April 1997 site reconnaissance, the project site and most of the surrounding area is in fair to good range condition with sparse vegetation and a fair amount of bare ground present. Therefore, the area can be considered potentially suitable mountain plover habitat. A mountain plover survey was conducted in August 1997, on and adjacent to the project site. No mountain plovers were observed during the survey or have been sighted at the site or in its immediate vicinity.

Swift foxes occupy a wide variety of grassland communities, including those in the Powder River Basin (Scott-Brown *et al.*, 1987). The project site and surrounding area are potentially suitable swift fox habitat. However, no swift fox sightings have been reported from the area. The Wyoming Game and Fish Department have not observed any denning areas in the vicinity of the Hoe Creek site (Spears, 1997).

3.9.2 Environmental Consequences

A major effect to threatened and endangered species would result in a determination that the project may affect a population of a listed, proposed, or candidate species or affect a designated critical habitat.

3.9.2.1 Proposed Action

The USFWS determined that the proposed action would not adversely affect Federally threatened and endangered species or any designated critical habitats (Ramirez, 1997). Additionally no major effects to candidate species would be anticipated from the proposed action.

There would be no effects to black-footed ferret because suitable habitat is lacking on the site.

There are no bald eagle perch or roost trees on the property. However, bald eagles may occasionally perch on power poles that border the site. Human activity on the site during project construction may inhibit bald eagles from using the site during the construction period. However, wintering bald eagles hunt over very large areas and may be found foraging over 10 mi (16 km) from overnight roost sites (Northern States Bald Eagle Recovery Team, 1983). The temporary loss of this small amount of eagle foraging area is unlikely to affect bald eagles using the project vicinity.

No mountain plovers have been reported from the project vicinity (Gianakos, 1997; Spears, 1997). However, if mountain plovers nest in the area, disturbance resulting from project development could cause an indirect, short-term effect from the loss of about 12 ac (5 ha) of potentially suitable habitat. Because there is abundant suitable habitat on the remainder of the project site and surrounding lands and because no mountain plovers have been observed at the site, these possible effects would not be considered important to site or regional mountain plover populations.

No swift foxes have been reported from the project vicinity (Gianakos, 1997; Spears, 1997). However, if swift foxes do occur in the area, the 12 ac (5 ha) that would be occupied by the air sparging system is less than 6 per cent of a swift fox's home range, which varies from 212 ac (86 ha) to more than 7,000 ac (2,880 ha) (Scott-Brown *et al.*, 1987). Construction activities could cause swift fox use of the area to decrease during the construction period. However, after construction and reclamation were complete, swift fox use of the area would return to pre-project levels. Additionally, significantly abundant similar habitat exists throughout the project vicinity. The short-term reduction in potentially suitable swift fox habitat and possible swift fox use of the site would not affect swift fox populations that may occur in the project vicinity.

3.9.2.2 Excavation Alternative

There would be no major effects to threatened, endangered, or candidate species or to designated critical habitat due to the excavation alternative. The short-term, indirect effects resulting from this alternative would result from the temporary loss of 40 ac (16 ha) of habitat potentially used by bald eagles, mountain plover, and swift fox. There would be no effects to regional populations for the same reasons as described for the proposed action.

3.9.2.3 Pump and Treat Alternative

There would be no major effects to threatened, endangered, or candidate species or to designated critical habitat as a result of the annual pump and treat alternative. The effects would be similar to those for the proposed action.

3.9.2.4 No Action Alternative

There would be no major effects to threatened, endangered, or candidate species or to designated critical habitat as a result of the no action alternative. About 12 ac (5 ha) of habitat potentially used by bald eagles, mountain plovers, and swift foxes would be temporarily unavailable due to revegetation activities. This would not cause any effects to populations in the project vicinity.

3.10.2.3 Pump and Treat Alternative

A short-term, direct loss of vegetation would occur during the construction and remediation period on about 2 acres (0.6 ha) of land. The associated short-term forage loss would be approximately 0.1 AUM.

This alternative would have a short-term, indirect beneficial effect on the vegetation in the area where the treated groundwater would be spray-evaporated into the air. Some of the water would be available for plant growth, and may result in more lush growth and a temporary change in the species composition. However, after cleanup was completed and spray atomization of the treated effluent was halted, vegetation would return to conditions similar to those currently at the site. Some of the treated water would also be discharged to Hoe Creek, which would have a short-term, indirect, beneficial effect on the vegetation as described in Section 3.10.2.2.

Upon completion of the pump and treat alternative, the disturbed areas would be reclaimed as described under the proposed action. No long-term effects are expected from this action.

3.10 VEGETATION

3.10.1 Existing Environment

The predominant vegetation throughout most of the Hoe Creek site is representative of a grassland-sagebrush plant community. The principal plant species are big sagebrush, western wheatgrass, blue grama, sideoats grama, and needle-and-thread grass. No trees are present on the site.

The areas around the Hoe Creek 1, 2, and 3 test sites have been disturbed by previous UCG activities. In these areas, the vegetation consists of native perennial grasses, crested wheatgrass, cheat grass, and some weedy plant species. Sagebrush is sparse to nonexistent around the test sites, but is abundant in the area where groundwater has been sprayed into the air to volatilize benzene.

Prior to DOE's activities, the BLM managed the land for livestock and wildlife grazing. The property is currently leased to a local rancher who grazes sheep on the native vegetation during a portion of the summer.

3.10.2 Environmental Consequences

A change in vegetation would be considered a major effect if the proposed action resulted in land that could not be revegetated, or a change to vegetation that would not be suitable for livestock and wildlife grazing.

3.10.2.1 Proposed Action

A short-term, direct loss of vegetation would occur during the construction and remediation period on about 2 acres (0.6 ha) of land. In addition, fencing would be installed to preclude livestock and wildlife from about 12 ac (5 ha) occupied by the air sparging system. This would result in an indirect loss of livestock and wildlife forage. As discussed in Section 3.2, approximately 15 to 20 ac (6 to 8 ha) of land at the site are required per AUM. Therefore, the short-term forage loss would be less than 1 AUM.

Upon completion of remediation, the disturbed areas would be restored as described in Section 3.7. The seed mixture of native grasses would be suitable for livestock and wildlife grazing and would be approved by the WDEQ. Therefore, no long-term adverse effects to vegetation or grazing are anticipated.

3.10.2.2 Excavation Alternative

Excavation would result in a direct, short-term loss of about 40 ac (16 ha) of vegetation for approximately 4 years during construction and for 2 to 3 years after excavation until the grasses on the reclaimed areas became established. This would result in a short-term loss of forage of two to three AUM per year.

Upon completion of remediation, the disturbed areas would be restored as described in Section 3.7. The seed mixture of native grasses would be suitable for livestock and wildlife grazing and would be approved by the WDEQ. Therefore, no long-term adverse effects to vegetation or grazing are anticipated.

Groundwater from the dewatering of the Hoe Creek 2 and 3 sites would be treated and discharged to Hoe Creek. Hoe Creek is an intermittent stream that does not normally carry water except after heavy rains or spring snowmelt. A continuous flow of 30 to 40 gpm (115 to 150 liters per minute) would promote increased vegetative growth along the stream channel. This would result in a direct, short-term, positive effect on the vegetation growth, and the amount of forage available for livestock and wildlife downstream from the discharge point in Hoe Creek. The increase in forage along Hoe Creek may be greater than the amount lost due to the disturbance of the 40 ac (16 ha).

As a short-term, indirect effect, the increased water flow may also create a temporary wetland. Such a wetland would not invoke any regulatory requirements, since the additional water would be a result of man's activities. Once the dewatering stopped, the vegetation would revert back to its present grassland-sagebrush community type.

3.10.2.4 No Action Alternative

All disturbed areas would be topsoiled and seeded with a mixture of native grass species. The reclaimed areas may take 2 or 3 years for the vegetation to become established. Once established, the forage production of the reclaimed acres would be similar to pre-test conditions. No long-term effects would be expected from this alternative.

3.11 WATER RESOURCES

3.11.1 Existing Environment

3.11.1.1 Surface Water

Surface waters at the Hoe Creek site would be almost entirely derived from precipitation events. Surface waters generally flow to the southeast as sheet flow and in intermittent drainages, eventually flowing into Hoe Creek, which drains to the east.

Hoe Creek is intermittent and flows in response to snowmelt and rainstorms. A spring or seep with seasonal flow is located south of the site in the Hoe Creek drainage.

No hydraulic connection between the spring at Hoe Creek and the contaminated aquifers has been established. Contaminants of concern have not been detected in spring or creek surface waters.

The dry, poorly developed soil profile is sparsely vegetated. Therefore, high suspended sediment loads are associated with surface water in the Hoe Creek area. Natural water quality varies inversely with discharge. Surface water from Hoe Creek and the off-site spring are collected in ponds for watering livestock when it is available (Breckenridge *et al.*, 1974; Dames & Moore, Inc., 1996a and 1996b). Within these ponds, water quality for livestock use degrades as water volume decreases.

Contaminants of concern have not been detected in surface waters on, or adjacent to, the Hoe Creek property. However, natural surface water quality in this area is unsuitable for drinking and of good to very poor quality for livestock use, depending on the flow rate, which is tied to frequency and magnitude of precipitation events (Breckenridge *et al.*, 1974; Gilbert/Commonwealth, Inc., and J.M. Montgomery, 1991a; Dames & Moore, Inc., 1996a and 1996b).

3.11.1.2 Hydrogeology

Groundwater in the upper Hoe Creek aquifer flows generally from north to south across the site, primarily through the Felix 1 and 2 coal seams and in the lower portion of the channel sand. Dames & Moore, Inc. (1996a) simulated the steady-state groundwater flow at Hoe Creek with a model calibrated to groundwater levels measured at the site. The volumetric budget which best simulated inflow conditions showed that 50% of the groundwater originates as infiltration and 50% comes from groundwater underflow. The model also showed that 30% of the groundwater outflow would be discharged to Hoe Creek.

The depth to the upper water table aquifer is variable across the site due to irregular and sloping surface topography, undulating and incised hydrostratigraphic unit surfaces, and the density of changes in hydraulic gradient across the site. The water table drops in elevation from approximately 4,673 ft (1,424 m) above mean sea level (msl) in the northwestern portion of the Hoe Creek site, to approximately 4,650 ft (1,417 m) above msl in the southeastern portion of the site. Depths to water vary from less than 50 ft (15 m) bgs to more than 100 ft (30 m) bgs, depending on well location.

Groundwater flows through the channel sand unit at rates of less than 1 ft per day (fpd) (0.3 m per day [mpd]). Groundwater flow rates through the Felix 1 coal seam are more variable but are generally less than 10 fpd (3 mpd) near the burn cavities. However, flow rates greater than 10 fpd (3 mpd) were measured primarily in areas down-gradient of the burn cavities near the site perimeter or outside of the fenced area.

Groundwater flow rates through the Felix 2 coal seam are generally less than 5 fpd (1.5 mpd). However, like the Felix 1 coal seam, areas with slightly higher flow rates occur down-gradient of the burn cavities. The one exception to this distribution in the Felix 2 coal seam is in an area northwest and up-gradient of the Hoe Creek 2 burn cavity, near well NF2-08 (Dames & Moore, Inc., 1996b).

As described by Dames & Moore, Inc., (1996b), the process used for gasification at the Hoe Creek 2 and 3 sites resulted in more volatile compounds being dispersed a distance from the burn cavities, in a manner controlled primarily by geologic structure. This hypothesis is supported by the presence of contaminants in areas where they could not have been transported by groundwater flow, including well NF1-08, which is up-gradient of the Hoe Creek 2 site. Contaminants of concern also have been detected in areas more nearly structurally up-dip than hydraulically down-gradient at the Hoe Creek 3 site.

Concentrations of contaminants of concern near the Hoe Creek 2 and 3 sites have remained constant for several years, at levels well below the solubility limit. These stable concentrations indicate that a non-aqueous phase of the contaminants exists at these sites, and the contaminant leaching rate appears to have reached a steady state with the surrounding aquifer.

3.11.1.3 Groundwater Quality

The Felix coal hydrostratigraphic units form the upper portion of the regional Wasatch aquifer. This aquifer has been designated as Class III, or suitable for livestock use only, because of its generally poor grade and purity. Groundwater from the Wasatch aquifer commonly contains sodium sulfate and bicarbonate in the range of 500 to 1,500 mg/L. Groundwater of this quality is undesirable for drinking and many industrial uses. It is classified as A good@ to A fair@ for livestock use (Breckenridge et al., 1974).

The quality and distribution of contaminants of concern in groundwater at the Hoe Creek site have been documented in several reports describing the numerous investigations at the Hoe Creek site. They include:

- Gilbert/Commonwealth, Inc. and James M. Montgomery Consulting Engineers, Inc., 1991;
- U.S. Department of Energy, 1992;
- Dames & Moore, Inc., 1996a and 1996b; and
- U.S. Army Corps of Engineers, 1997.

Recent investigations (Dames & Moore, Inc., 1996a) found no contaminants at concentrations of concern to the public or livestock in water from a private well located northwest of the site (screened below the Felix 2 coal seam in the deep Wasatch Formation), or in water from the spring located near Hoe Creek.

The source areas for the contaminant groundwater plumes are the burn cavities and proximal areas. The UCG experiments at the Hoe Creek 2 and 3 sites included the use of artificially induced high pressures in the burn cavities to restrict groundwater inflow and to maintain the burn and pyrolysis reaction. Induced burn cavity pressures were at least three times atmospheric pressure, and may have been higher after the end of the experiments when test wells were sealed and groundwater invaded the hot burn cavities and produced steam. These pressures were high enough to eject gases hundreds of feet laterally, up and down both structural dip and hydraulic gradient, into the surrounding stratigraphic units (Dames & Moore, Inc., 1996a). Induced pressures were not used at the Hoe Creek 1 site and elevated levels of contaminants of concern have not been encountered there.

Contaminants of concern were measured in two offsite monitoring wells, FIR-01, screened in the Felix 1 coal seam; and DOE 17, screened in the Felix 2 coal seam. Both wells are located east of the Hoe Creek 2 site (Dames & Moore, Inc., 1996b).

The onsite contaminant distribution was found to be around (up and down both hydraulic gradient and dip) the Hoe Creek 2 and 3 sites.

- Contaminants of concern were detected in seven wells screened in the Felix 1 coal seam. Four of these wells, including two at each site, had contaminants of concern at concentrations above 50 Fg/L.
- Contaminants of concern were detected in four wells screened in the Felix 2 coal seam. Two of these wells, both at the Hoe Creek 2 site, had contaminants of concern concentrations above 50 Fg/L.
- Contaminants of concern were detected in one well screened in the channel sand unit at the Hoe Creek 2 site. Contaminant concentrations measured in samples from this well were below 25 Fg/L.

3.11.2 Environmental Consequences

A major negative effect to water resources would include either of the following:

- An increase in the concentration of a contaminant that would cause a water quality standard for a designated use to be exceeded.
- A decrease in the quantity of surface water or groundwater that is available to downstream or downgradient users, compared to their current use of the resource.

3.11.2.1 Proposed Action

This alternative would not change the site topography, and would result in an estimated discharge of 268,000 gal (1,013,040 L) of purge water to Hoe Creek each year. Therefore, it would not have any substantial effect on surface drainage or surface waters quantities in Hoe Creek.

If this alternative were implemented, contaminants of concern would be degraded by native aerobic bacteria into harmless by-products of carbon dioxide and water (U.S. Army Corps of Engineers, 1997). As a result, groundwater quality at the Hoe Creek site would improve. Within about 5 years, groundwater contaminants of concern would be reduced to concentrations that were acceptable to all involved Federal and state agencies for Class III (livestock use only) groundwater, in accordance with the August 1993 agreement between the State of Wyoming DEQ and DOE (Dames & Moore, Inc., 1996a). The source of off-site groundwater contamination would be remediated, and the migration of groundwater contamination offsite would be reduced and eventually eliminated. The Hoe Creek aquifer groundwater resource would be available for potential future livestock watering needs if the groundwater was pumped to the surface.

This alternative would not change the quantity of groundwater available for offsite users. The only groundwater removed from the Hoe Creek aquifers would be an estimated 268,000 gal (1,013,040 L) per year of monitoring wells purge waters. This represents less than seven percent of the annual site groundwater outflow. A large portion of this purge water could potentially return to the system by surface disposal and subsequent infiltration.

3.11.2.2 Excavation Alternative

A short-term, local change to surface runoff would be caused by the excavated pits. Diversion structures would route flows around the excavations so that little change in the quantity of surface water downslope from the excavations would occur.

Sedimentation from disturbed areas and the stockpiled material removed from the pits would be minimized by use of erosion control berms and sediment traps. Hoe Creek is located about 1,800 ft (550 m) from the nearest pit excavation and would not be affected by sediment runoff.

This alternative would result in a short-term surface discharge to Hoe Creek of about 18 MM gal (68 MM L) of treated water per year at a rate of approximately 30 to 40 gpm (115 to 150 liters per minute). The increased volume of surface water would be a short-term beneficial effect since it would provide additional water for livestock use. This treated water could improve the quality of water in the creek for the short term.

Groundwater quality would be improved and groundwater contaminants of concern would be reduced. However, if pockets of contaminants of concern occurred outside of the excavation footprint, they would not be remediated by excavation and would continue to serve as a contaminant source. Detection of these pockets of contaminants might not occur until excavation activities were completed.

The potential for increased levels of total dissolved solids in the Hoe Creek aquifer would be substantially increased. Replacing consolidated native bedrock with pulverized sandstone, claystone, and coal would most likely lead to at least a temporary degradation in the quality of the groundwater that flowed through the excavated areas. However, total dissolved solids concentrations in groundwater would not be expected to exceed the water quality standards for livestock use.

Throughout excavation, site dewatering would cause a substantial short-term reduction in the quantity of groundwater available for potential offsite use (Dames & Moore, Inc., 1996a). Even after the excavation phase ended, complete re-saturation and hydration of the excavated spoil materials could take several years. During this time, reduced volumes of groundwater would be available to potential offsite users. However, because this groundwater is not currently used, this change would not produce a major effect.

The aquifer being disturbed under this alternative is not the same aquifer in which the closest residential drinking water wells and livestock wells are located. Therefore, dewatering would not be expected to affect these wells.

3.11.2.3 Pump and Treat Alternative

With this alternative, groundwater quality would be improved, and offsite groundwater contamination would be reduced. However, unlike the proposed action and the excavation alternative, this alternative would not treat the source of contamination. Therefore, pump and treat would continue so long as offsite migration of contaminated groundwater off the site was an issue of concern with the WDEQ.

Throughout the implementation period, the quantity of groundwater available for potential offsite users would not be substantially reduced during the 4-month treatment period, and would not be affected at all during the rest of the year. About half of the water withdrawn and treated would percolate back into the soil and recharge the aquifer (U.S. Department of Energy, 1992). During system operation, overland flow of a portion of the treated water could also produce increased flows in Hoe Creek. Hydraulic modeling of the aquifer, based on information from previous pump and treat operations, showed that after steady-state drawdown conditions had been reached (pumping 1.5 gpm [5.7 L per minute] from each well), an estimated maximum drawdown of 2 to 7 ft (0.6 to 2.1 meters) would occur at the site boundaries. Because nearby water wells are completed in a lower aquifer, drawdown would not be expected to affect any nearby water wells.

3.11.2.4 No Action Alternative

This alternative would not change surface runoff, and would result in no change to surface waters in Hoe Creek. The annual surface discharge of about 8,400 gal (31,750 L) of purge water represents a minor increase compared to current conditions.

Under the no action alternative, groundwater transport modeling predicted that contaminants of concern would continue to migrate off the site from the Hoe Creek 2 and 3 sites for approximately 30 years (Dames & Moore, Inc. 1996b). Offsite migration would continue to occur in the channel sand, in the Felix 1 and 2 coal seams at the Hoe Creek 2 site; and in the Felix 2 coal seam at the Hoe Creek 3 site. Onsite contamination would slowly be reduced through natural attenuation. Recent monitoring results have confirmed that natural degradation processes are taking place, and that benzene is being attenuated at rates faster than originally assumed (Dames & Moore, Inc., 1996a; U.S. Army Corps of Engineers, 1997).

Under this alternative, onsite groundwater would continue to be of poor quality and would be locally unsuitable for livestock use. However, because this water is not currently used for livestock watering, this would not be a major impact. The quantity of groundwater available to offsite users would be unaffected during or after implementation of this alternative.

A condition of the DOE's research permit, granted by the State of Wyoming, required the DOE to contain all ecological impacts within site boundaries. If contaminated groundwater moves beyond the site boundary, the DOE may be subject to litigation and/or substantial fines under Section 401 of the Clean Water Act. The no action alternative may not meet the general purpose of the 1993 agreement signed between the State of Wyoming and the DOE in which the affected aquifers are to be restored to a quality of use consistent with the use for which water was suitable prior to initiation of research activities. If it is not feasible to restore the water quality, the DOE must take action to contain migration of contaminants to the smallest affected area practicable.

3.12 WILDLIFE

3.12.1 Existing Environment

The site is located in a rolling grassland-sagebrush community. The disturbed areas around the test sites are vegetated mostly with grasses. No trees are present on the site. There are no streams, ponds, wetlands, or other surface water sources on the site. There are no dramatic topographic features such as cliffs or cut banks.

The site is used by animals typical of grassland-sagebrush in the Powder River Basin. These include mammals such as northern pocket gopher, black-tailed jackrabbit, and pronghorn. Common birds in this vegetative cover-type include western meadowlark, horned lark, lark bunting, and sage grouse. Common reptiles include prairie rattlesnake, bullsnake, and western plains garter snake.

Species of concern from a regulatory standpoint include bald eagle, black-footed ferret, mountain plover, and swift fox (Collins, 1997; Ramirez, 1997). Mountain plover, swift fox, and black-footed ferret are addressed in Section 3.9.

No raptor nesting habitat occurs on the site. However, most local raptor species, including golden eagle, ferruginous hawk, red-tailed hawk and burrowing owl, may occasionally hunt over the site.

Other species are of concern from a project completion standpoint. Striped skunk and prairie rattlesnake pose a potential danger to workers. Pronghorn foraging could interfere with disturbed area reclamation.

3.12.2 Environmental Consequences

A major impact to wildlife would be a habitat change or contaminant exposure that causes a measurable population decline for a given species.

3.12.2.1 Proposed Action

No major effects to wildlife resources would be expected to result from the proposed action.

The Wyoming Game and Fish Department (Collins, 1997) indicated that the only wildlife species that would potentially conflict with the project is the bald eagle. This species is addressed in Section 3.9, Threatened and Endangered Species.

Approximately 2 ac (0.8 ha) of ground would be disturbed by the air sparging wells. However, the entire portion of the site that would be occupied by the air sparging system (about 15 percent or 12 ac [5 ha]) would be fenced to exclude mule deer and pronghorn and would not be available for big game forage. The fenced area would not contain any critical or important habitat, and mule deer and pronghorn are wide ranging species. For these reasons, this short-term forage loss would have no measurable effect on the wildlife.

The risk assessment did not identify any potential pathways for water-borne contaminant exposure to wildlife (Dames & Moore, Inc., 1996a). No direct or indirect activities were identified for the proposed action that would cause a change in wildlife mortality.

Direct toxicity to wildlife from the ingestion of benzene in drinking water is not a concern at the concentrations occurring at the site. A review of more than 50 toxicological studies of benzene identified only three investigations of ingestion in non-human mammals, indicating that this exposure pathway is of low concern. Those three investigations found only sublethal effects with ingestion at concentrations exceeding 0.1 mg/kg of body weight. This is much higher than the concentrations that would be available to wildlife ingesting untreated purge waters at the site, which would have a maximum concentration of 50 Fg/L.

Although the project site is public land, access for hunting and other recreational activities has been restricted because of DOE=s activities. Land surrounding the site is privately owned and hunting opportunities are controlled by the landowners. This situation would not be changed by project implementation. Therefore, there would be no change in hunting opportunities during remediation. In the long term, the site would revert to BLM management and would be available for public recreational activities. This would result in a small increase in hunting opportunities compared to current conditions.

3.12.2.2 Excavation Alternative

No major effects to wildlife would occur from this alternative. The groundwater would be treated before discharge to Hoe Creek. Therefore the wildlife would not be exposed to any contaminated surface water produced by dewatering activities.

Excavation would remove 40 ac (16 ha) of forage from wildlife use for approximately 6 years. This short-term, indirect effect would be partially mitigated by wildlife habitat improvements associated with the discharge of treated groundwater from the dewatering of the excavation area. The water would provide an additional source for drinking water for wildlife and would increase the amount of forage around Hoe Creek, particularly during the hot, dry periods of the summer.

Wildlife use of the area surrounding the site also would be affected for 4 to 6 years during excavation and remediation. Human activity and presence would be greatly increased compared to current levels because of excavation, night-time operations, and increased road traffic. Wildlife use of the project site and an area about 0.25 mi. (0.4 km) around the site would decrease while these activities occurred.

Hunting opportunities during remediation would not change for the same reasons described for the proposed action. As with the proposed action, there could be a small increase in hunting opportunities in the long term compared to current conditions.

3.12.2.3 Pump and Treat Alternative

Approximately 16 ac (6.5 ha) of land would be temporarily irrigated by the spray of treated effluent. As described in Section 3.10.2.3, the increased water would produce a short-term indirect positive effect by increasing vegetative production, which would increase available wildlife forage. This effect would end with the completion of site remediation.

The groundwater and soils would be monitored to ensure that benzene as an indicator of contaminants did not exceed 5 ppb in surface water resulting from groundwater pumping. Therefore, exposure of wildlife to contaminants would not occur. The pump and treat alternative would have no major effect on wildlife.

Short-term hunting opportunities during remediation would not change for the same reasons described for the proposed action. In the long term, a small increase in hunting opportunities would be realized compared to current conditions.

3.12.2.4 No Action Alternative

Under the no action alternative, there would be a temporary decrease in wildlife use of the area due to human activities associated with revegetation of disturbed areas. This would not cause a major effect to wildlife resources.

A pathway for groundwater contaminants to wildlife has not been established. Water quality measurements of the monitor well at Hoe Creek, the livestock water well east of the property, and the residential well northwest of the site have not shown any detectable levels of the contaminants of concern. Therefore, no major effects to wildlife would occur from the no action alternative.

Under this alternative, current site access restrictions would remain in place. There would be no change in hunting opportunity from the existing situation.

3.13 CUMULATIVE ENVIRONMENTAL CONSEQUENCES

Cumulative effects are defined as environmental changes resulting from the combined effects of the current action with those of other past, present, and future actions by all Federal government, non-Federal government, and private entities. This section addresses the potential cumulative environmental consequences of the proposed action and the alternatives on environmental resources surrounding the Hoe Creek site. Hoe Creek is located in an undeveloped portion of Campbell County. The land uses within a 6-mile (9.6 km) radius of the site include agriculture, oil and gas production, mining for scoria, and recreational hunting for mule deer, antelope, and sage grouse. Land development is present at low density.

3.13.1 Air Sparging with Bioremediation

Activities associated with the proposed action would occur during the short construction phase of the project. Air sparging would disturb the soils and vegetation on about 2 ac (0.8 ha) of land. This would have no incremental effect on agriculture production and hunting opportunity on or around the site.

Less than seven percent of the groundwater volume would be removed during monitoring activities each year. The aquifer affected by the UCG tests and monitoring wells is located in a different aquifer than the one used for residential drinking water and livestock watering. Therefore, the proposed action would not cumulatively affect groundwater resources.

3.13.2 Excavation

Excavation would disturb approximately 40 ac (16 ha) of land for 4 years. Removal of this land from production would occur for a short term and would not affect agriculture production, or hunting opportunities around the site because of the site's relative small size compared to the surrounding area that supports the same uses. Fugitive dust would be produced from roads, and scoria mining in the surrounding area. The fugitive dust sources are widely separated, tend to generate low concentrations, and dust emissions are quickly dissipated. The nearest scoria deposits are 2 miles (3.2 kilometer) from the site. Cumulative effects of dust emissions from the scoria mine and the Hoe Creek site are not expected to affect any residents or exceed county air quality standards.

Excavation would produce localized changes in groundwater hydrology, but the incremental effects combined with existing or anticipated future activities would not create short or long-term cumulative effects. The Felix 1 and 2 coal seams are not economical to attract conventional mining. Other mineral deposits such as uranium and coal are present in the Powder River Basin, but no mines are located near the Hoe Creek site. Therefore, the potential for other mining operations to have a major cumulative effect on the same aquifer as the Hoe Creek test site would be unlikely.

3.13.3 Annual Pump and Treat

The annual pump and treat alternative would disturb about 2 ac (0.8 ha) of soils and vegetation. Removal of this land from production would occur for a short term and would not affect agricultural production or hunting opportunities around the site.

Approximately 8.6 million gal (32.5 million L) of groundwater would be pumped from the Hoe Creek 2 and 3 sites each year. After treatment, about 50 percent of this water would be returned to the aquifer through percolation into the soil. As discussed in Section 3.11.1.3, the aquifer that would be dewatered is not the same one that supplies the closest private drinking water wells. No mining activities are located in the area that would affect the same aquifer. Thus, the potential for this alternative to contribute incremental effects to a groundwater problem would be considered to be low. New wells for livestock or residential use could not be completed in this aquifer until remediation was complete. Therefore, major cumulative effects would not be expected from this alternative.

3.13.4 No Action

A notice has been placed on the plat maps located in Cheyenne, Wyoming to notify other parties interested in the property that there is a potential for groundwater contamination at the site. It is unlikely that any new wells would be completed around the site with these warnings in place. The surface of the site would be reclaimed and the 2.0 ac (0.8 ha) of land previously unavailable to livestock and wildlife grazing would be made available for these uses.

3.14 SUMMARY

This EA considered four alternatives, including air sparging with bioremediation (the proposed action), excavation, annual pump and treat, and no action. The environmental effects of each alternative for each resource area are summarized in Table 3.1. Issues pertaining to site remediation were described in Section 1.5. The environmental effects from the proposed action and alternatives in regards to these issues are summarized in Table 3.2.

Based on these findings, no major effects were identified for the proposed action of air sparging with bioremediation.

No major environmental effects were identified for the excavation alternative. This alternative would have short-term effects on groundwater hydrology during dewatering and after the burn pits were backfilled. This condition would continue until groundwater flows re-established the water table. Site remediation may not remove all of the contaminant source from pockets in the overburden outside the area of excavation. A short-term, local, and indirect beneficial effect to wildlife species may occur from the addition of treated water to Hoe Creek during the dewatering period.

No major environmental effects were identified for the annual pump and treat alternative. A short-term indirect effect may be the creation of additional forage for livestock and wildlife on a 16-ac (6.5 ha) area where spray evaporation of treated groundwater would increase soil moisture and enhance vegetative growth. This alternative would be continued until natural processes remediated the groundwater contaminants and the potential for contaminant risk to humans, livestock, and wildlife reached acceptable conditions. The DOE and WDEQ would have to mutually agree to this decision.

No major environmental effects were identified for the no action. This alternative may not meet the intent of the agreement signed between the DOE and WDEQ. If contaminated groundwater moves off the site, the DOE may be subject to litigation or substantial fines.

TABLE 3.2
SUMMARY OF ENVIRONMENTAL ISSUES AND EXPECTED RESULTS
FOR HOE CREEK UCG TEST SITE REMEDIATION

Environmental Issue	Air Sparging with Bioremediation	Excavation	Continuation of Annual Pump and Treat	No Action
Whether groundwater would act as source for moving contaminants off the site.	Contaminants would be treated until there is no risk to human health. No contaminant movement off site.	Source of contaminants would be removed within burn areas. Potential exists for contaminants outside area of excavation. Transport of contaminants off site would be minimal.	Pump and treat would continue until there is no risk to human health or no longer required. Pump and treat would prevent movement of contaminants off site.	Best technology for treatment of contaminants would not be used. No action would be taken to prevent movement of contaminants off site.
Whether the workers= health would be adversely affected by exposure to air borne contaminants.	Fugitive dust would not affect human health. Benzene vapors would not affect human health.	Workers would not be exposed to contaminants in groundwater, but could be exposed to contaminants in excavated areas.	Benzene levels in groundwater that is treated and spray evaporated at the surface would have no effect on human health.	Residents and other persons who may conduct activities at the site would not be exposed to groundwater contaminants if institutional controls are enforced.
Whether groundwater supplies to downgradient users would be affected.	No effect to groundwater hydrology.	Groundwater depletion would occur for a short term in a localized area.	Groundwater depletion would occur for a short term in a localized area.	Institutional controls would limit use of groundwater in localized

		No effect to downgradient users.	No effect to downgradient users.	area.
Whether remediation activities would result in loss of wildlife, wildlife habitat, forage for grazing, and loss of hunting opportunities.	Short-term loss during construction. No long-term loss of wildlife habitat, or forage for grazing after site disturbance is reclaimed. No short-term or long-term loss of hunting opportunities.	Short-term loss during construction. No long-term loss of wildlife habitat, or forage for grazing after site disturbance is reclaimed. No short-term or long-term loss of hunting opportunities.	Short-term loss during construction. No long-term loss of wildlife habitat, or forage for grazing after site disturbance is reclaimed. No short-term or long-term loss of hunting opportunities.	Surface disturbance would be reclaimed. Any loss of wildlife habitat, forage for livestock and wildlife grazing would be restored to pre-test conditions. No short-term or long-term loss of hunting opportunities.
Whether remediation would result in a loss of valuable topsoil.	No loss of topsoil.	No loss of topsoil.	No loss of topsoil.	No loss of topsoil.
Whether surface disturbance can be returned to pretest conditions in terms of soil productivity, vegetation, and topography.	No long-term loss of soil productivity; vegetation would be established on disturbed areas.	No long-term loss of soil productivity, vegetation would be established on disturbed areas.	No long-term loss of soil productivity, vegetation would be established on disturbed areas.	No long-term loss of soil productivity, vegetation would be established on disturbed areas.

SECTION 4

REGULATORY REVIEW AND PERMIT REQUIREMENTS

This section lists the relevant laws that pertain to the proposed and alternative actions and addresses regulatory review and permit requirements.

4.1 RELEVANT FEDERAL, STATE, AND LOCAL STATUTES,

REGULATIONS, AND GUIDELINES

4.1.1 Federal Regulations

Regulations implementing NEPA are detailed in 40 CFR, Parts 1500-1508. In addition to the requirements of NEPA, other Federal requirements are considered in the preparation of an EA. Conforming with these regulations is an important aspect of complying with the NEPA process. Environmental laws with which the proposed action must comply are described below.

4.1.1.1 Endangered Species Act (16 USC 1531-1542)

The Endangered Species Act (ESA) of 1973, amended 1982 and 1987, is intended to prevent the further decline of endangered and threatened plant and animal species and to help restore populations of these species and their habitats. The Act, jointly administered by the Departments of Commerce and the Interior, requires that each Federal agency consult with the USFWS to determine whether endangered or threatened species are known to exist or have critical habitats on or in the vicinity of the site of a proposed action. Section 7(c) of the ESA authorizes the USFWS to review proposed major Federal actions to assess potential impacts on listed species.

The USFWS, Wyoming Game and Fish Department, and WNDD were consulted concerning threatened and endangered species. The results of the consultation are shown in Appendix A.

4.1.1.2 National Historic Preservation Act (16 USC

The National Historic Preservation Act (NHPA) of 1966, as amended, establishes historic preservation as a national policy and defines it as the protection, rehabilitation, restoration, and reconstruction of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, or engineering. It also expands the National Register of Historic Places (NRHP) (36 CFR 60) to include resources of state and local significance and establishes the Advisory Council on Historic Preservation (ACHP). NHPA Section 106, implemented by regulations issued by the ACHP (36 CFR 800), requires Federal agencies to consult with the SHPO regarding impacts that a proposed action may have on cultural resources.

Consultation with the SHPO was made regarding historic and cultural resources. Results of the consultation are shown in Appendix A.

4.1.1.3 Clean Water Act (33 USC 1251 *et seq.*)

The Federal Water Pollution Control Act (FWPCA) of 1972, as amended by the Clean Water Act (CWA) of 1977 and the Water Quality Act (WQA) of 1987, forms the legal framework to support maintenance and restoration of water quality and also addresses wetlands. The FWPCA established the National Pollutant Discharge Elimination System (NPDES) as the regulatory mechanism to achieve water quality goals by regulating pollutant discharge to navigable streams, rivers, and lakes.

An NPDES permit may be required for the discharge of water into Hoe Creek during dewatering activities for the excavation alternative.

4.1.1.4 Clean Air Act (42 USC 7401 *et seq.*)

The Clean Air Act (CAA) of 1970 establishes national ambient air quality standards and sets emission limits for certain air pollutants from specific sources. Two pertinent sections of the CAA are Section 109 and Section 176 (c). Section 109 allows the setting of standards for the following Acriteria@ pollutants: particulate matter less than or equal to 10 microns in diameter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 176(c) of the CAA establishes a conformity requirement for Federal agencies in which all environmental documents must address applicable conformity requirements and the status of compliance (40 CFR Part 93, Subpart B).

The Hoe Creek site is not located in an area designated for non-attainment. Emissions from fugitive dust, carbon monoxide, and benzene were evaluated as potential pollutants in the EA. The need for an air permit is discussed under the state regulations in Section 4.2.

4.1.1.5 Occupational Safety and Health Act (20 USG 333)

The Occupational Safety and Health Act (OSHA) forms the framework for a body of regulations (29 CFR 1910 and 29 CFR 1926) which, among other things, are intended to ensure worker safety and health through regulation of work practices and work environments. The Act specifically addresses construction projects, hazardous waste operations, emergency responses, toxic and hazardous substance operations, and communication of information concerning occupational hazards, specifying appropriate protective measures for all employees.

The proposed action was evaluated to determine if there was a change in work practices and the need for administrative actions other than normal compliance with OSHA=s standards.

4.1.1.6 Surface Mining Control And Reclamation Act (30 USC

1201 *et seq.*)

The Surface Mining Control and Reclamation Act of 1977 establishes standards for the operation and reclamation of surface coal mines and surface effects of underground mines. Section 1266 addresses surface effects of underground coal mining operations and requirements that need to be addressed in a permit. These issues are applicable for preventing surface effects from underground mining operations and include actions to prevent subsidence, protect offsite areas from damages which may result from underground mining operations, and minimize the disturbances to hydrologic resources during both mining and reclamation activities.

4.1.1.7 Comprehensive Environmental Response, Compensation,

and Liability Act (42 USC 9601 *et seq.*)

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or ASuperfund@ to provide funding and enforcement authority for cleaning up past hazardous waste activities. The Hoe Creek site is not a CERCLA waste site and is not on the National Priorities List. Procedures have been developed under CERCLA for conducting remedial investigations and feasibility studies. These procedures were used at the Hoe Creek site to characterize the nature and extent of contamination, to define the

risks posed by contaminants at the site, and to identify alternative treatment technologies for protection of human health and the environment.

4.1.2 Relevant State of Wyoming Regulations

Many of the relevant State of Wyoming regulations and guidelines appropriate to this project were written to comply with the Federal acts described above. The laws pertaining to the proposed action and alternatives at the Hoe Creek site would be subject to the Wyoming Environmental Quality Act promulgated in 1973. The WDEQ administers the state regulations through the AQD, LQD, and WQD. Article 4, WS 35-11-426 through 436 states that any person engaged in *in situ* mineral mining or research and development testing is required to comply with the Environmental Quality Act.

4.1.2.1 Wyoming Air Quality Standards and Regulations

In Section 22, the Wyoming AQD has incorporated by reference the EPA regulations on Standards of Performance for New Stationary Sources (40 CFR Part 60). Section 14 requires that emissions of fugitive dust shall be limited by all persons handling, transporting, or storing any material to prevent unnecessary amounts of particulate matter from becoming airborne. A list of control measures is provided that should be considered for such control. Section 21 establishes permit requirements for construction, modification, and operation of a site that may cause an increase in the issuance of air contaminants into the air before any actual work is begun on the site.

4.1.2.2 Wyoming Land Quality Rules and Regulations

Investigations at the Hoe Creek site were completed under a Research and Development Testing License for *In Situ* Mining. Performance requirements for *in situ* mining in Chapter 5, Section 4 of LQD regulations for coal mining require that all *in situ* processing activities be planned and conducted to minimize disturbance to the prevailing hydrologic balance. Compliance is necessary with all requirements under Section 4, Environmental Protection Standards for Surface Coal Mining; Section 7, Underground Coal Mining; and Section 18, *In Situ* Mining.

4.1.2.3 Wyoming Water Quality Rules and Regulations

Chapter II, Section 4, Appendix A of WQD regulations sets requirements for point source discharges. Chapter XI, Part G establishes minimum requirements for design, construction, and abandonment of wells. All wells that are no longer used must be plugged and properly abandoned to ensure that groundwater supply is protected and preserved for further use and to eliminate the potential physical hazard.

4.2 PERMIT REQUIREMENTS

The following permit requirements are anticipated for the actions described for the proposed action or alternatives. In some cases, the requirement for a permit has already been discussed with the state and determined not to be required.

- Permit from the State Engineer's Office for construction of new process or monitoring wells.
- Permit from the State Engineer's Office for abandoning wells (provides current status of wells proposed for abandonment).
- NPDES permit from WDEQ-WQD for discharge of water from dewatering activities.
- Air quality permit from the WDEQ-AQD has been waived for the spray atomization system as long as it meets the conditional requirements listed in Section 3.3.2.3.

SECTION 5

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