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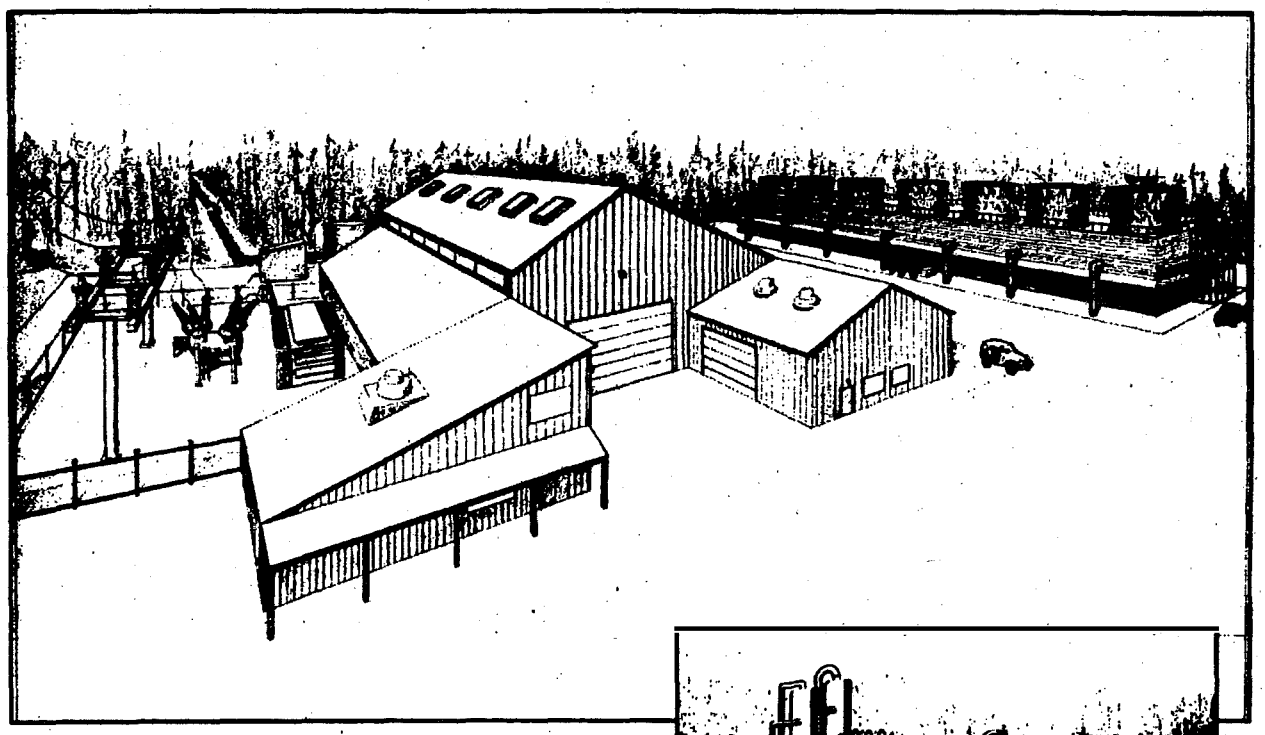
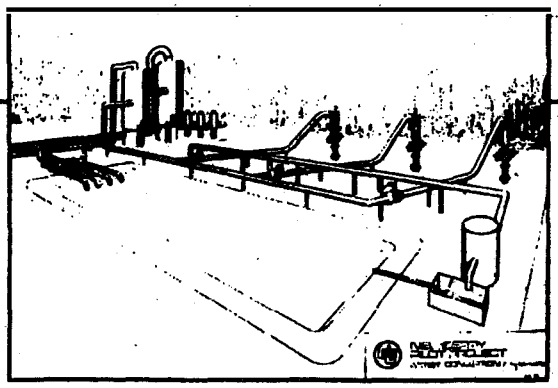
Executive Summary:
Newberry Geothermal Pilot Project
Final Environmental Impact Statement





CE Exploration Company of Portland, Oregon has submitted a proposal to build and operate a 33-megawatt geothermal power plant in the Deschutes National Forest in Central Oregon. This is the draft version of the environmental analysis of the proposed project, prepared by the U.S. Forest Service, the U.S. Bureau of Land Management, and Bonneville Power Administration.

U.S. Forest Service

Bonneville
POWER ADMINISTRATION

U.S. Bureau
of Land Management

EXECUTIVE SUMMARY OF THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED NEWBERRY GEOTHERMAL PILOT PROJECT

Deschutes National Forest
Deschutes County, Oregon
July 1994

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Abstract

CEE Exploration Company of Portland, Oregon proposes to build and operate a geothermal pilot project and supporting facilities capable of generating 33 megawatts of electric power in the Deschutes National Forest in central Oregon. The facilities would include a power plant, access roads, exploration and production wells, a power transmission line, and a switchyard. The project would consist of four distinct phases: exploration, development, utilization, and decommissioning. The project would be located on the west flank of Newberry Volcano on Federal geothermal leases.

This Environmental Impact Statement analyzes three alternatives for this proposed geothermal pilot project. Each alternative responds differently to the issues and concerns identified in the EIS process.

Alternative A is the proposal submitted by CEE. It includes a single power plant site, 14 well pads for drilling exploration and development wells, a transmission line, access roads and steam pipelines to bring the steam to the power plant.

Alternative B was developed to respond to the issues and provide siting flexibility to make the most efficient use of the geothermal resources while minimizing environmental effects. Many components are similar to those in Alternative A. Major differences are that it proposes different siting locations, a different transmission line route and design, and additional mitigation measures. Alternative B is the agencies' Preferred Alternative.

Alternative C is the No Action Alternative.

This document is a summary of the Environmental Impact Statement for the Proposed Newberry Geothermal Pilot Project, and contains an abbreviated description of the full analysis.

Location and General Description

CE Exploration Co., (CEE) of Portland, Oregon, has submitted a proposal to the U.S. Forest Service and the Bureau of Land Management (BLM) for geothermal exploration, development, utilization, and decommissioning as part of Bonneville Power Administration's (BPA's) Geothermal Pilot Program. The proposed project includes construction and operation of a geothermal power plant, 14 well pads, pipelines, access roads, and a transmission line. The power plant would generate 33 megawatts (MW) of electric energy, and would be located on the west flank of Newberry Volcano, within the Deschutes National Forest in central Oregon. The proposed project would be located on Federal geothermal leases designated as suitable for geothermal development outside the Newberry National Volcanic Monument (NNVM). Figures S-1 and S-2 show a vicinity map and project area map of the proposed geothermal pilot project.

CEE entered into a joint development agreement with the Eugene Water & Electric Board (EWEB) for the development and marketing of geothermal electrical power from the CEE leases. Under this agreement, EWEB would purchase 10 MW of power produced from the project. BPA would purchase 20 MW under a power purchase agreement. About 3 MW would be consumed in operation of the plant and on the ransmission line.

Purpose and Need

The need for the Federal action is to decide whether to enable the development of the proposal for a geothermal power project at Newberry Volcano. This project would indicate the availability of geothermal power to help meet the region's future energy needs. The U.S. Forest Service, BLM, and BPA have determined this to be a major Federal action requiring an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). The agencies will determine whether the project, or alternatives to the project, should be permitted to proceed. Agency decisions will be documented in Records of Decision (ROD) for the final EIS. If an action alternative is chosen, additional mitigation measures, conditions, and stipulations may be included as part of the decision. Any subsequent actions taken by the agencies to implement the decision must be consistent with the RODs.

Because the proposed project would occur on National Forest lands subject to the legislation that established the NNVM (PL-101-522, November 5, 1990), the agencies agree that the U.S. Forest Service is the lead agency for the analysis and EIS, and the BLM and BPA are cooperating agencies. Each agency has its own specific purposes for involvement.

As lead agency as well as the agency responsible for surface management, the U.S. Forest Service's purpose is to decide whether to approve the proposed project and take action on subsequent approvals and authorizations for surface disturbing activities. BLM is the Federal agency responsible for management and administration of Federal geothermal leases and subsurface activities, pursuant to the Geothermal Steam Act of 1970. BLM's purpose is to decide whether to approve the proposed project and take action on subsequent approvals and authorizations for surface and subsurface activities. BPA is the Federal agency responsible for purchasing, developing, marketing, and transmitting electrical power to utility, industrial, and other customers in the Pacific Northwest, pursuant to the BPA Project Act of 1937 and the Northwest Power Planning and Conservation Act of 1980. To fulfill its statutory purposes and test the availability of geothermal energy to provide a reliable, economical, and environmentally acceptable alternative energy source to help meet the region's power needs, BPA will decide whether to take actions to purchase and transmit power from the power plant, if it is decided that the project will proceed.

The objective of the Newberry Geothermal Pilot Project is to demonstrate whether geothermal energy is a feasible alternative source of electricity in the Pacific Northwest to help meet growing regional power demands and needs. Newberry Volcano was proposed because its geothermal resource potential has been recognized in the past, and because the potential for geothermal development has been addressed in the 1990 Deschutes National Forest Land Management Plan, and in the NNVM legislation. This project is consistent with both documents.

Issues Summary

The issues addressed in the environmental analysis came from a variety of sources. A scoping process was used to identify concerns and environmental issues to be addressed in the EIS. Comments were gathered from citizens, government agencies, and public interest groups. Additionally, issues were raised by agency personnel and technical specialists involved with the analysis. Issues were categorized into the following topics:

Geology and Soils	Traffic and Transportation
Water Resources	Vegetation
Geothermal Resources	Wildlife
Climate and air Quality	Cultural Resources
Visual Resources	Human Health and Safety
Noise	Economic and Social Characteristics
Land Use	Cumulative Effects
Recreation	

Some of the issues were considered to be "key issues" and were used to generate the alternatives. For example, alternatives include different power plant, road or transmission line locations to respond to concerns about impacts on visual quality. Other issues were addressed through mitigation, monitoring, or in another manner in the EIS. For example, visual impacts of the power plant and pipelines might be mitigated by constructing them of materials colored to blend in with the background. Issues that can be addressed by monitoring include monitoring of air quality at the plant site and at other locations to insure that pollution is not a problem. Some issues raised were not within scope of this EIS, and could not be analyzed in this document.

Alternatives at a Glance

Three alternatives are analyzed in the EIS, including the "no action" alternative. The following description summarizes key elements of the alternatives.

The project area for proposed facilities, other than the transmission line, includes Federal geothermal lease areas which are bisected by Paulina Creek. The portion of the lease area which lies south of Paulina Creek would be for exploration purposes only, and would not have any pipelines or roads constructed to connect them with the power plant and other facilities located on the lease areas north of Paulina Creek.

The project in either Alternative A or Alternative B would include construction and operation of a power plant, wells, and supporting facilities, and would consist of four distinct phases. The first phase, "exploration," includes construction of new access roads, upgrading existing roads, and drilling and testing different types of wells on a total of 14 well pads, each up to 2.4 hectares (6 acres) in size. All drilling would be directional or slanted, to access drilling targets which lie deep below the adjacent "no surface occupancy" (NSO) lease areas.

Once evaluation of the exploration wells is complete, the "development" phase would begin, if the drilling program is successful and finds a developable geothermal resource. This phase consists of construction of the power plant, pipelines to transmit steam from the well pads to the power plant, access roads, a transmission line and switchyard, as well as continuing development

of production wells and well pads. Siting of facilities would make use of existing roads where possible. No facilities would cross Paulina Creek.

The power plant would generate 33 MW of electrical power using "flash" technology with a condensing steam turbine, and a wet cooling tower. With flash technology, electrical power is generated by using steam separated from the hot underground geothermal water to run a turbine. After the water has been used in the power plant and cooled in the cooling tower it will be injected into the geothermal reservoir at locations which will help recharge the underground resource, but not interfere with production or use of the reservoir. Figure S-3 illustrates this process in a simplified flow diagram.

The project would include construction of approximately 13.1 km (8.2 miles) of a 115-kilovolt transmission line from the power plant westward to an existing transmission line west of Highway 97. Construction of a new switchyard, located on BLM lands west of Highway 97, would also be included in the project.

The day-to-day operation of the power plant, well field, and other facilities is the "utilization" phase. This also includes appropriate disposal methods for solid waste, noncondensable gases, and excess geothermal fluids.

The "decommissioning" phase would occur and the end of the commercial life of the facility, which is expected to be approximately fifty years or more. During this phase, structures and equipment would be dismantled and removed, wells would be plugged and abandoned, and the environment would be returned to acceptable conditions.

All activities throughout the life of this project will require approval and authorizations and must comply with all applicable laws, regulations, and the Federal Geothermal Resources Operational Orders. Additionally, a number of mitigation and monitoring elements are included in both Alternative A and Alternative B.

An artist's conception of the power plant is shown in Figure S-4. Table S-1 summarizes the features of Alternative A and B.

Alternative A

A map showing the proposed locations of the facilities can be seen in Figure S-5. Key features of Alternative A, as submitted by CEE, include:

- Access roads to the well pads, power plant, pipeline, and transmission line
- A network of steam pipelines constructed above-ground to connect wells to the power plant
- 14 well pad sites, each approximately 2.4 hectares (6 acres) in size, at specific locations
- Geothermal power plant at a specific location, on an approximately 7.3 hectare (18-acre) site
- 13.1-km (8.2-mile) transmission line located along the north side of Road 9735, with a corridor cleared to a width of 30.5 meters (100 feet) and using an H-frame wood pole design

Table S-1
Features of the Proposed Action Alternatives[1]

Project Element	Alternative A	Alternative B
WELL PADS		
[2]Pad size Temperature gradient hole/core hole	18.3 x 30.5 meters (60 x 100 feet)	18.3 x 30.5 meters (60 x 100 feet)
Production/exploration size	Up to 121.9 x 182.9 meters (400 x 600 feet) per pad or up to about 34 hectares (84 acres) total	121.9 x 182.9 meters (400 x 600 feet) per pad within a 16.2-hectare (40-acre) siting area; up to about 34 hectares (84 acres) total
[2]Sump	3,785,000 liter (1 million gallons)	3,785,000 liters (1 million gallons)
WELLS		
[2]Temperature gradient	4 temperature gradient wells	4 temperature gradient wells
Exploration	Up to 28 exploration wells[3] at 14 locations	Up to 28 exploration[3] wells at 14 of 20 locations
[2]Production	Initially 8 to 104 (plus additional wells over the life of the project)	Initially 8 to 104 (plus additional wells over the life of the project)
[2]Injection	3 to 5	3 to 5
[2]Testing	Up to 90 days per well	Up to 90 days per well
NEW ACCESS ROADS		
Access to power plant and well pads (excludes 1.9 kilometers [1.2 miles] of existing Road 9735)	Main access road to power plant: 18.3 meters x 3.3 kilometers (60 feet x 2.05 miles) (Includes part of transmission line ROW along power plant access road.) Well pad access roads: 6.7 meters x 4.8 to 6.4 kilometers (22 feet x 3 to 4 miles) Total surface disturbance for new access roads about 13.5 hectares (33.5 acres)	Main access road to power plant: 18.3 meters x 3.3 kilometers (60 feet x 2.05 miles) (Includes part of transmission line ROW along power plant access road.) Well pad access roads: 6.7 meters x 4.8 to 6.4 kilometers (22 feet x 3 to 4 miles) Total surface disturbance for new access roads about 13.5 hectares (33.5 acres)
PIPELINES		
Production and injection pipeline corridors	Main Pipelines: 36.6 meters x 6.1 kilometers (120 feet x 3.8 miles) = 22.7 hectares (56 acres)[5] Feeder Pipelines: 13.3 hectares (33 acres)	Main Pipelines: 36.6 meters x 6.1 kilometers (120 feet x 3.8 miles) = 22.7 hectares (56 acres)[5] Feeder Pipelines: 13.3 hectares (33 acres)
POWER PLANT SITE		
Siting location	7.5 hectares (18.5 acres) One possible location	7.5 hectares (18.5 acres) site within one of three 12.1-hectare (30-acre) siting areas

Table S-1
Features of the Proposed Action Alternatives[1] (Continued)

Project Element	Alternative A	Alternative B
POWER PLANT DESIGN		
[2]Cooling towers	7-cell wet cooling towers	7-cell wet cooling towers
[2]Water use	Local groundwater (up to 3.08 million m^3 [2,500 acre-feet]) per year and produced geothermal fluid (approximately 1.9 million m^3 [1580 acre-feet]) per year	Local groundwater (up to 3.08 million m^3 [2,500 acre-feet]) per year and produced geothermal fluid (approximately 1.9 million m^3 [1580 acre-feet]) per year
[2]H_2S removal	Liquid redox, iron catalyst or hydrogen peroxide	Liquid redox, iron catalyst or hydrogen peroxide
TRANSMISSION LINE		
Route	North and adjacent to Road 9735	South of Road 9735
Poles	Wood pole, H-frame	Single wood pole with underbuild
[2]Voltage	115 kV	115 kV
Disturbance	30.5 meters x 13.1 km (100 feet x 8.2 miles) = 40 hectares (99 acres) (with additional 25 to 50 feet feathered for 8.2 miles)	22.8 meter x 13.1 km (75 feet x 8.2 miles) = 30 hectares (75 acres) (with additional 50 feet x 8.2 miles feathered)
ROW clearing	30.5-meter (100-foot) width cleared 7.6 meters (25 foot) width feathered on one or both sides of ROW	22.9 meter (75 foot) width cleared 7.6 meters (25 foot) width feathered on both sides of ROW
[2]Laydown/construction areas	Existing log landings	Existing log landings

[1]Alternative C - No Action: None of these features would be built.
[2]Features that are the same in both alternatives.
[3]Some of these wells would be converted to production wells.
[4]Some of these wells would be converted from exploration wells to production wells.
[5]This is the width required for multiple expansion loops. A more typical width would be 27 m (90 ft) or less.

Alternative B

This has been identified by the cooperating agencies as the preferred alternative.

The size, number, and general type of facilities (power plant, wells, well pads, pipelines, access roads, and transmission line), as well as their operation, as proposed in Alternative B are comparable to those described in Alternative A.

Alternative B differs in that it includes different siting locations of some components and additional mitigation measures to address issues raised during the scoping and analysis processes. This alternative provides more flexibility in siting to make the most efficient use of the geothermal resource while minimizing environmental effects. Figure S-6 shows the proposed locations of the facilities for Alternative B. The major differences included in Alternative B are:

- There are 20 potential well pad siting areas, of which only 14 could be approved for well pad development. Each potential well pad would be located within its corresponding siting area, which range from 8 to 16 hectares (20 to 40 acres) in size.

- There are 3 potential power plant locations, only 1 of which would be approved. Each potential plant site is located within a 12-hectare (30-acre) siting area.

- The transmission line route from the power plant would be located south of the Alternative A route, and would be an average of 122 to 152 meters (400 to 500 feet) south of Road 9735. The cleared corridor would be 23 meters (75 feet) wide, and have a feathered edge of an additional 7.6 meters (25 feet) on each side. Additionally, the transmission line would use a single-pole structure with a lower-voltage underbuild.

Alternative C

Alternative C is the "no action" alternative. Under Alternative C, no facilities would be developed and this geothermal proposal would not be implemented.

AFFECTED ENVIRONMENT

The Newberry Volcano is a broad, gently-sloping, shield-like, forested landform that rises approximately 1,100 meters (3,600 feet) above the surrounding terrain. The proposed Newberry Geothermal Pilot Project is located on the west flank of Newberry Volcano, on Deschutes National Forest land, adjacent to (but not within) the NNVM. The proposed project facilities would be located on undeveloped Federal land used mainly for timber production. Elevation ranges from 1,280 meters (4,200 feet) on the western end of the project area, just west of Highway 97 where the proposed transmission line would connect to an existing Midstate Electric transmission line, to 2,133 meters (7,000 feet) at the northeast portion of the lease area. The northeast portion of the surface occupancy (SO) lease area is currently roadless.

Principal access is provided to the project area by U.S. Highway 97, which runs north/south and then by County Road 21 or Forest Road 9735. Refer to Figure S-2.

The range of nearly 914 meters (3,000 feet) in elevation and 9.6 km (6 miles) between the eastern and western ends of the project area accounts for differences in weather, vegetation, and wildlife. Soils and rocks in the project area and vicinity are derived from volcanic materials and are generally very permeable. Most rain and snowmelt percolates directly into the ground. There are no surface drainages, permanent waters, or wetlands within the project area. Paulina Creek, a perennial stream eligible for Wild and Scenic River status, flows between (but is not included in) the northern and southern portions of the SO lease areas (Figure S-2). The SO lease area is thought to be located above a fresh groundwater aquifer separated from and underlain by a deep hydrothermal system which this proposed pilot project has been designed to utilize. The exact boundaries and distribution of the underground geothermal resources are not known; however, exploration and information at Newberry indicate that a considerable resource may exist below the surface.

Air quality in the project vicinity is affected by wind-blown dust, pollen, and fires, but is in attainment of state and Federal air quality standards. The climate is typical of the semi-arid high desert environment east of the Cascades. Precipitation comes mostly during the winter and summers tend to be warm and dry. The western end of the project area is lower, warmer, and drier than the eastern end which is comparatively higher, colder, and wetter. This difference is reflected in the vegetation. The western end of the project area is mostly ponderosa pine and lodgepole pine forest, and the eastern and higher elevation end within the SO lease area is lodgepole pine-dominated, with the highest elevation areas of the NSO lease area dominated by lodgepole pine, fir, hemlock, and western white pine. Prolonged drought and beetle infestation have combined with a history of fire suppression to create stands of mature lodgepole pine with

abundant standing and down woody material. Much of the timber in the project area has been or will be harvested in the next few years. Wildlife species composition and populations are typical of those found in the pine forests of the High Lava Plains Province of central Oregon. No threatened or endangered species of plants of animals are known to exist within the project area.

The project area is visible from the top of Paulina Peak as well as other sites, including La Pine, Highway 97, and Bend. The vegetation and terrain reduce the visibility or screen some parts of the project area from these viewpoints. Ambient noise levels are relatively low. Recreational use of the project area is low, but increasing nearby within the NNVM. Traffic in the project area is currently low.

There are a relatively small number of prehistoric and historic cultural resources sites within the project area; most are either scattered obsidian flakes left from tool-making or artifacts related to the historic logging railroad grade within the area. Aside from wildfires, there are no existing hazards to human health and safety in the project area. There are few existing residences located at the extreme western end of the project area, but none of these will be the site of any proposed project facilities.

ENVIRONMENTAL EFFECTS OF EACH ALTERNATIVE

Potential environmental effects of each alternative were analyzed by resource type (i.e., geology and soils, vegetation, wildlife, etc.,) and are briefly described in this section. A comparison of effects of Alternatives A and B are summarized in Table S-2.

Effects Common to Alternatives A and B

Grading and soil disturbance would be necessary for the construction of facilities in Alternative A or B. There are no known geologic features or mineral resources (other than the geothermal resources) that could be affected by the proposal. The facilities would be analyzed and properly designed so that any potential impact from seismic activity would be low. To avoid adverse impacts to water quality from wastewater produced during drilling or power plant production, the wastewater would be routed to a sump before disposal by injection into the geothermal reservoir. The same would be done for storm water after oil is removed, so that an increase in runoff is not anticipated. Some groundwater would be withdrawn for use during the project.

Over time, a small percentage of fluid loss is expected to occur from the geothermal reservoir. Effects on the hot springs in Newberry Caldera are expected to be long-delayed and slight, if they occur at all, and would likely not be distinguishable from natural fluctuations.

Air pollution control measures would be built into the project to reduce potential air quality impacts. However, it is expected that hydrogen sulfide may be smelled in the area at times, and that a steam cloud will be visible at times. Visual impact of the facility itself would be minimized through effective site planning. The facilities could be partially visible from a few local high points, such as Paulina Peak and the Rim Trail.

In general, noise levels from the proposed complex of power producing equipment would be expected to be low at all receptor locations and also at a distance of 0.5 mile (0.8 km) and is expected to be in compliance with both Federal and state regulations. Impacts on people and wildlife from noise are anticipated to be minor.

The proposed project would bring industrial development to an area of Forest Service land currently used for forestry, fuelwood gathering, and dispersed recreation. It would bring access roads and facilities to a portion of the North Paulina Roadless Area. This land use, however, would be consistent with existing land use plans and policies. Changes to recreation would also be consistent with designations assigned to the area.

Local community traffic is expected to increase only slightly, with the largest amount to occur during the construction phase. New road construction and upgrading of existing roads would occur.

During project design, an attempt would be made to locate facilities in previously disturbed areas. Some lodgepole pine-dominated communities that are common in this region will be impacted as some vegetation will be removed. This removal would also constitute a minor loss of wildlife habitat. No threatened or endangered plants or animals are known to occur in the project area and no adverse effects on such species are expected.

Activities associated with transmission lines have the potential to impact existing cultural resources. Careful placement would avoid impacts on significant sites. Probabilities of accidents and fires have been calculated during a 50-year project life. The presence of personnel in the area on a 24-hour basis would be a benefit in reporting and extinguishing fires that may start in the project area or on adjacent National Forest lands.

Likely socioeconomic impacts include a small increase in jobs (about 25 permanent), and a slight impact on local schools. In addition, Deschutes County will receive about $1 million in property taxes and about $250,000 in federal royalties annually.

Environmental Effects of Alternative C

Under Alternative C, the effects associated with construction and operation of the proposed project would not occur, and the viability of the geothermal resource at Newberry would not be tested with this project. However, other proposals in the future could be submitted and considered.

Issues to be Resolved

The findings and data collection during the exploration stage will shape plans for construction and utilization more specifically and would verify or modify assumptions about the geothermal resource used for this analysis. If it is found that assumptions about the resources, types of facilities needed, or environmental effects differ significantly from information used in this analysis, the project or elements of the project will be re-evaluated.

Other Considerations

BPA's Resource Programs EIS showed that geothermal resources are believed to have a high potential for being a cost-effective and renewable energy source. The Newberry Geothermal Pilot project includes features that would minimize impacts to natural resources. The proposal would have some short-term impacts during construction, but would be unlikely to damage the long-term productivity of the environment.

Project construction would require commitment of building materials. Materials that could be reused or recycled would be salvaged during the decommissioning stage. Construction and utilization would also require the use of water, electrical energy, some fossil fuels, and other resources over the life of the proposed project. The amounts of these resources to be consumed cannot be accurately determined at this time and are considered irretrievable and irreversibly committed to the project.

This project is expected to be a major step in identifying, developing, and utilizing an alternative source of energy in Oregon. The project would provide environmental advantages over traditional power generation such as reduced emission of air pollutants, reduced land-use requirements, no impacts to rivers or fish habitat, and potential for renewability.

TABLE S-2
Comparison of Effects of Action Alternatives

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Geology and Soils	Grading on gentle slopes during construction over 91 hectares (225 acres) for plant site, well pads, pipeline and roads; and 28.1 hectares (69.5 acres) for the transmission line area.	Grading area may be larger for gathering system, if well pads chosen are more distant than those under Alternative A, or less if pads are closer.
	Soil disturbance is minimized along transmission line owing to proximity of Road 9735 for much of its length.	Larger soil disturbance along transmission line for access where existing roads do not cross the line, and for new access to Plant Site 3.
Water Resources	Withdrawal of up to 3.08 million cubic meters (2,500 acre-feet) per year from shallow groundwater aquifers, representing approximately 1 percent of total groundwater recharge on the west slope of Newberry Volcano.	Same as A, except that potential changes in water quality and hydrologic patterns could be more widely distributed, depending on choices for power plant and well locations.
Geothermal Resources	Effects on hot springs in the caldera should be slight, subtle, and long delayed, if they occur at all. Maximum net fluid loss from reservoir estimated to be 1 to 2 percent per year, which should be at least partially made up by natural recharge.	Siting flexibility would improve efficient use of the geothermal resource. Other effects same as A.
	No siting flexibility. If test drilling results indicate that proposed well pads and/or other facilities are at inappropriate locations, additional environmental review and consequent potential delays could occur to the development process.	Additional power plant and well pad sites provide more flexibility in siting facilities to avoid sensitive areas, and based on the results of the test drilling, reducing chances of additional delays owing to the need for additional environmental review of new facilities locations.
Climate and Air Quality	Emissions for all regulated pollutants during the worst-case scenario and typical operations are expected to be well below applicable state and Federal standards set to protect human health and welfare.	Same as A, except that impacts at the NNVM boundary would be greater for Plant Site 3, which is closer than Plant Sites 1 and 2.

TABLE S-2
Comparison of Effects of Action Alternatives (Continued)

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Visual Resources	Except for the power plant steam plume and well venting, facilities will not be visible from any key observation point (KOP), except for Paulina Peak and the Rim Trail. Plume will draw visual attention from Paulina Peak and Rim Trail. From more distant KOPs, plume will be visually subordinate to surrounding landscape and not generally noticed.	Steam plume, well venting, pads south of Road 21 effects similar. Power Plant Site 2 is slightly more visible from Paulina Peak (KOP 3) due to lack of visual screening in logged areas; this site is 0.8 km (0.5 miles) farther from the KOP, which compensates some for lack of screening. Power Plant Site 3 is less visible from Paulina Peak than Plant Sites 1 or 2.
	Well pads located south of Paulina Creek would be partially visible from Road 21.	The six additional well pads would have visual impacts similar to the 14 in Alternative A.
	Transmission line would be visible in clearcuts along Road 9735 and briefly from Highway 97. Night glow of power plant would be visible from Paulina Peak and its access road; dim night glow may be visible from more distant KOPs.	Transmission line corridor will not be as visible from Forest Road 9735, reducing potential impacts to a road corridor that may receive increased use in the future. Night glow would be less than Alternative A.
Noise	Impacts from slightly elevated noise levels and occasional sounds associated with drilling.	Lower power plant noise at potential noise receptors owing to more distant location of Plant Sites 2 and 3. Other differences imperceptible.
Land Use	Reduction of North Paulina Roadless Area by 6 percent.	Same as A, except that Plant Site 3 would also be in roadless area.
	Removal of 119 hectares (295 acres) from the timber base in the Project Area.	Removal of approximately 123 hectares (303 acres) from the timber base depending on plant site and well pad selection.
Recreation	Changes to recreation experience to hunting and snowmobiling would be consistent with the Roaded Modified or Semi-Primitive Motorized (winter only) ROS designations assigned to the Project Area. Recreation experience could be affected at times when elements of the proposed project would be (infrequently) seen, heard, and/or smelled.	Same as A, except that Plant Site 3 would intrude into the currently roadless area.

TABLE S-2
Comparison of Effects of Action Alternatives (Continued)

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Traffic and Transportation	Rebuild main entrance to project area by following Forest Road 9735 to Spur 500, connecting Spur 500 to Spur 600 along proposed transmission line corridor; requiring 1.6 km (1 mi) of new road along transmission line, extensive rebuilding of Spur 600; widening of Spur 500; new roads for well pads, access road along entire length of transmission line provided by Forest Road 9735.	During development, Spur Road 500 would be resurfaced and become main access road to Plant Sites 1 or 2, requiring 1.6 km (1 mile) of new road along the transmission line and improving Spur 600 for exploration activities. Plant Site 3 would require about 3 km (2 miles) of new road construction along exploration roads. Additional length of road may be required if more distant well pads are chosen. Separate transmission corridor from Forest Road 9735 would be constructed, possibly needing additional access from Road 9735 at intervals along eastern portion of line via short spurs across existing logging units.
Vegetation	Removal of 7.5 hectares (18.5 acres) of lodgepole pine regeneration habitat at Plant Site 1.	Plant Site 1 is same as Alternative A. Removal of 7.5 hectares (18.5 acres) of lodgepole pine and lodgepole pine regeneration habitat for Plant Site 2. Removal of 7.5 hectares (18.5 acres) of lodgepole pine for Plant Site 3.
	For gathering system, removal of 36 hectares (89 acres) of vegetation, including 5.5 hectares (13.7 acres) of lodgepole-mixed conifer, 3.2 hectares (7.8 acres) of lodgepole/clearcut, 26.7 hectares (65.9 acres) of lodgepole, and 0.53 hectares (1.4 acres) of mixed conifer.	Approximately the same as Alternative A, depending on which well pad and plant site combination is used.
	For access roads, loss of lodgepole-dominated areas with portions of open ponderosa pine and mixed conifer habitats.	For access roads, removal of potentially slightly more vegetated area for access to the transmission line corridor if existing roads are not present.

TABLE S-2
Comparison of Effects of Action Alternatives (Continued)

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Vegetation	For the transmission line area, removal of 28.1 hectares (69.5 acres) of vegetation, including 1.2 hectares (3 acres) of lodgepole/clearcut, 0.2 hectares (0.5 acres) of lodgepole pine, 8.1 hectares (20 acres) of mixed conifer habitat, 13.7 hectares (34 acres) of open ponderosa pine, 3.2 hectares (8 acres) of lodgepole pine regeneration, and 1.6 hectare (4 acres) of mixed conifer partial cut habitat. Partial removal (feathering) would affect approximately 9.4 hectares (23.2 acres) of vegetation, including 0.45hectares (1.1acres) of lodgepole/clearcut, 0.08 hectares (0.2 acres) of lodgepole pine, 2.5 hectares (6 acres) of mixed conifer habitat, 4.7 hectares (11.8 acres) of open ponderosa pine, 1.1 hectares (2.8 acres) of lodgepole pine regeneration, and 0.53 hectare (1.3 acres) of mixed conifer partial cut habitat.	For the transmission line, removal of 29.8 hectares (78.2 acres) of vegetation, including 1.5 hectare (3.6 acres) of lodgepole/clearcut, 2.2 hectare (5.5 acre) of lodgepole pine, 5.5 hectares (13.7 acres) of mixed conifer, 17.3 hectares (47.2 acres) of open ponderosa pine, and 3.3 hectares (8.2 acres) of lodgepole pine regeneration. Partial removal (feathering) would affect approximately 19.9 hectares (49 acres) of vegetation, including 0.97 hectare (2.4 acres) of lodgepole/clearcut, 1.5 hectare (3.6 acre) of lodgepole pine, 3.7 hectares (9 acres) of mixed conifer, 11.5 hectares (28.5 acres) of open ponderosa pine, and 2.2 hectares (5.5 acres) of lodgepole pine regeneration.
	For well pads, removal of 34 hectares (84 acres) of habitat, including 3.7 hectares (9.2 acres) of lodgepole/mixed conifer, 1.4 hectares (3.5 acres) of lodgepole/clearcut, 24.6 hectares (60.8 acres) of lodgepole, 0.2 hectare (0.4 acre) of mixed conifer, and 4.1 hectares (10.1 acres) of clearcut.	Removal at well pads could be of different vegetation composition, depending on pad sites chosen. Some shrub and mixed conifer habitat could be avoided.
	No discernible effects on vegetation beyond 500 meters (1600 feet) of the power plant except for the areas immediately adjacent to wells.	Same as A. Better avoidance of sensitive areas and mixed conifer vegetation through project design and siting flexibility.

TABLE S-2
Comparison of Effects of Action Alternatives (Continued)

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Wildlife	Total 119 hectares (295 acres) of direct habitat loss or modification due to facility placement. (Well pads, plant, and roads equal habitat loss. Transmission line and pipeline equal habitat modification.)	Habitat losses and modification similar to A; but more or less could occur in mixed conifer type under this alternative, depending on well pads chosen. Impacts from development of well pad O-14 could result in an additional loss of up to 2.4 hectares (1 acre) of deer/elk high use area, not including access road. Clearing width of transmission line is 7.6 meters (25 feet) narrower than Alternative A. Loss of approximately 7.5 hectares (18.5 acres) potentially suitable habitat for black-backed woodpecker (MIS) at Plant Sites 2 and 3.
Cultural Resources	Known resources can be avoided.	Same as A.
Human Health and Safety	Probability of accidents during transport of hazardous materials during exploration estimated at 0.238 percent. During utilization over 50-year project life, approximately 1 accident during transportation of hazardous materials estimated. Probability of project personnel-caused fires over 50-year life of project conservatively estimated at 8; this would be offset by benefits of personnel present 24 hours a day to spot, report, and assist in extinguishing fires.	Same as A.

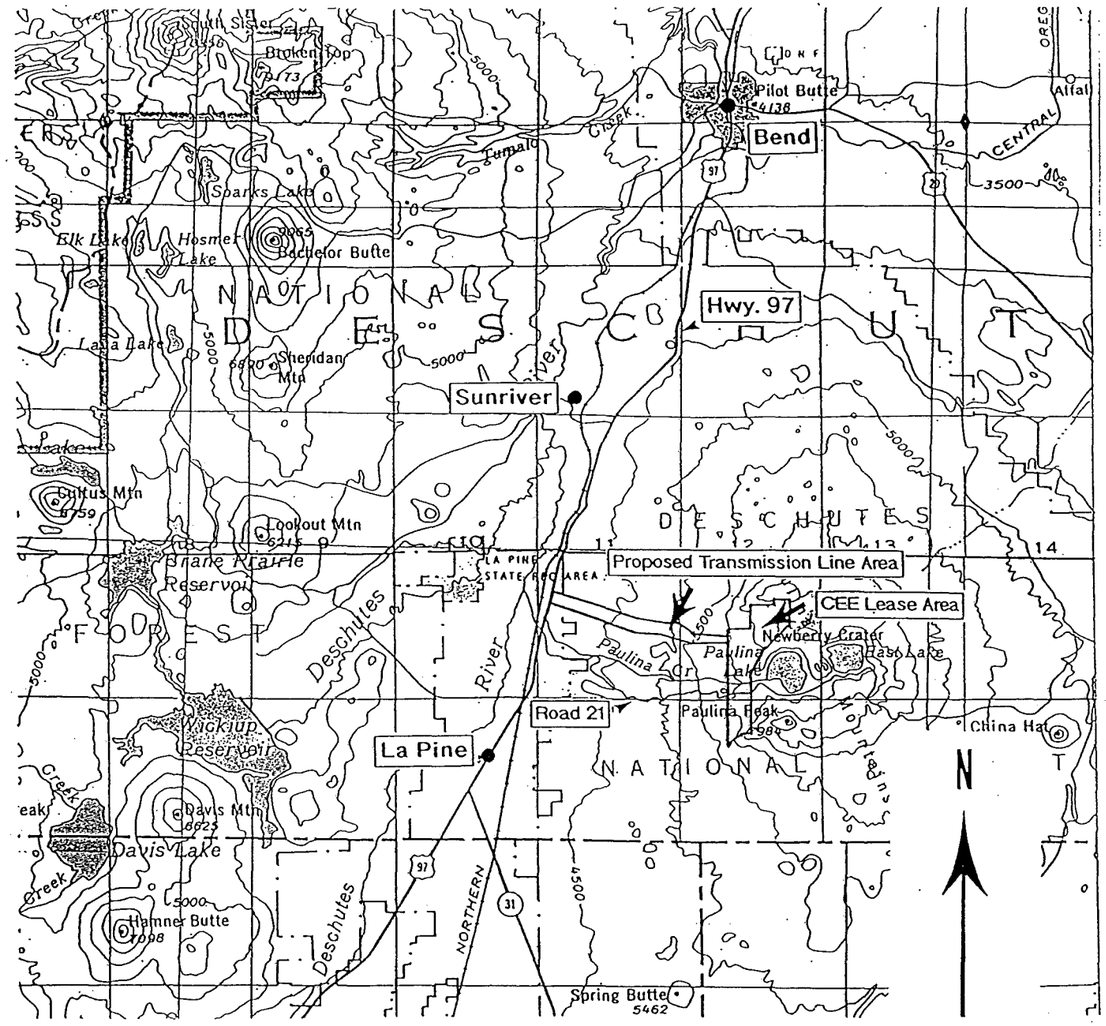
TABLE S-2
Comparison of Effects of Action Alternatives (Continued)

Discipline	Type and Magnitude of Alternative A Impacts	Type and Magnitude of Alternative B Impacts
Economic and Social Characteristics	Peak population increase of 447 persons during height of construction, and 50 persons during utilization. Construction jobs at peak would be 227 (60 local hires), during utilization 25 permanent jobs (12 local hires) would be created. Up to 60 additional students would be in Bend/La Pine School District during peak of construction. Royalties (approximately $240,000) and property taxes (approximately $1.2 million) would be raised annually.	Same as A.

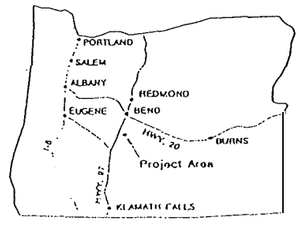
NEWBERRY GEOTHERMAL PILOT PROJECT
Deschutes National Forest, Oregon

Vicinity Map and Proposed Project Area

Figure S-1



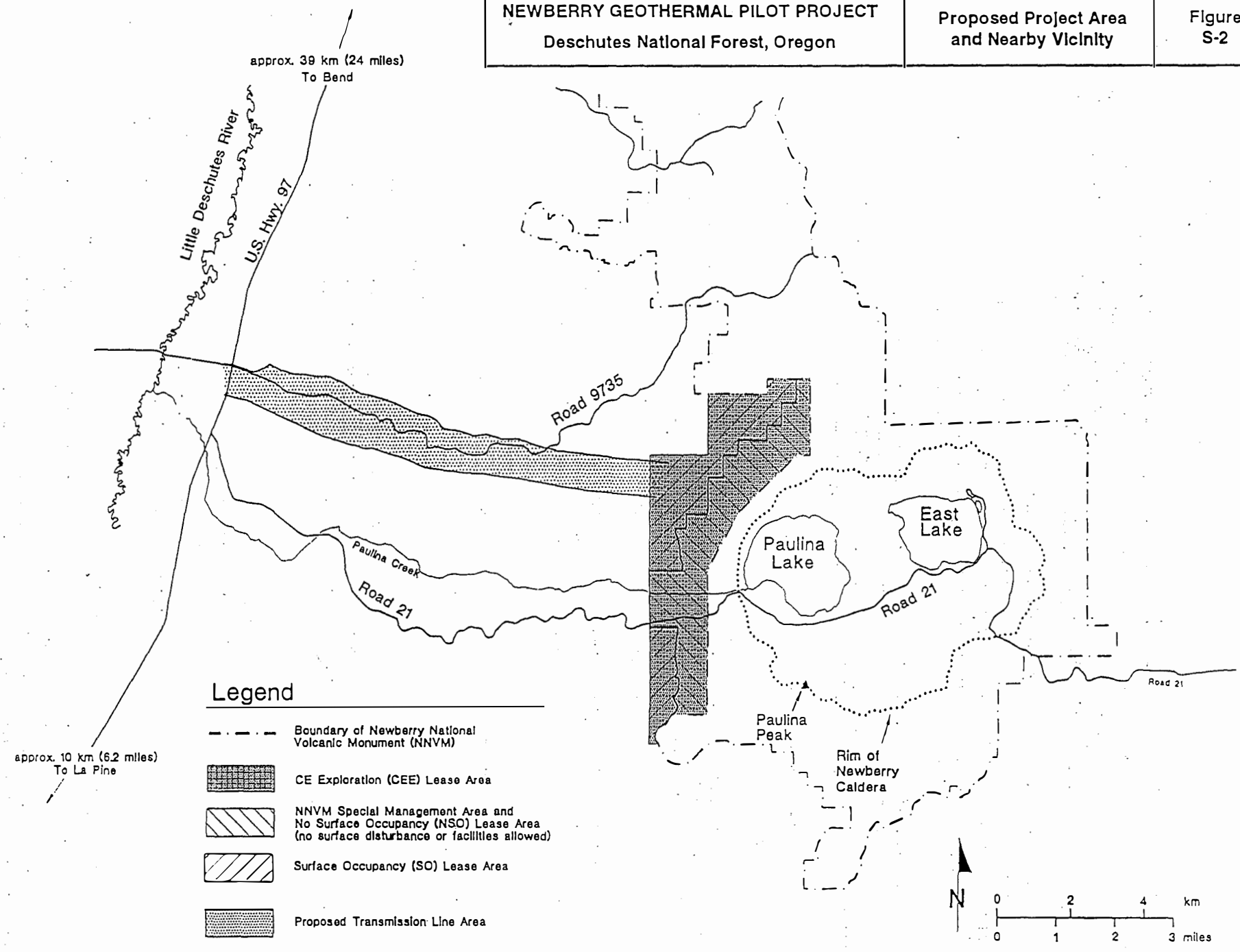
General Location Map
OREGON



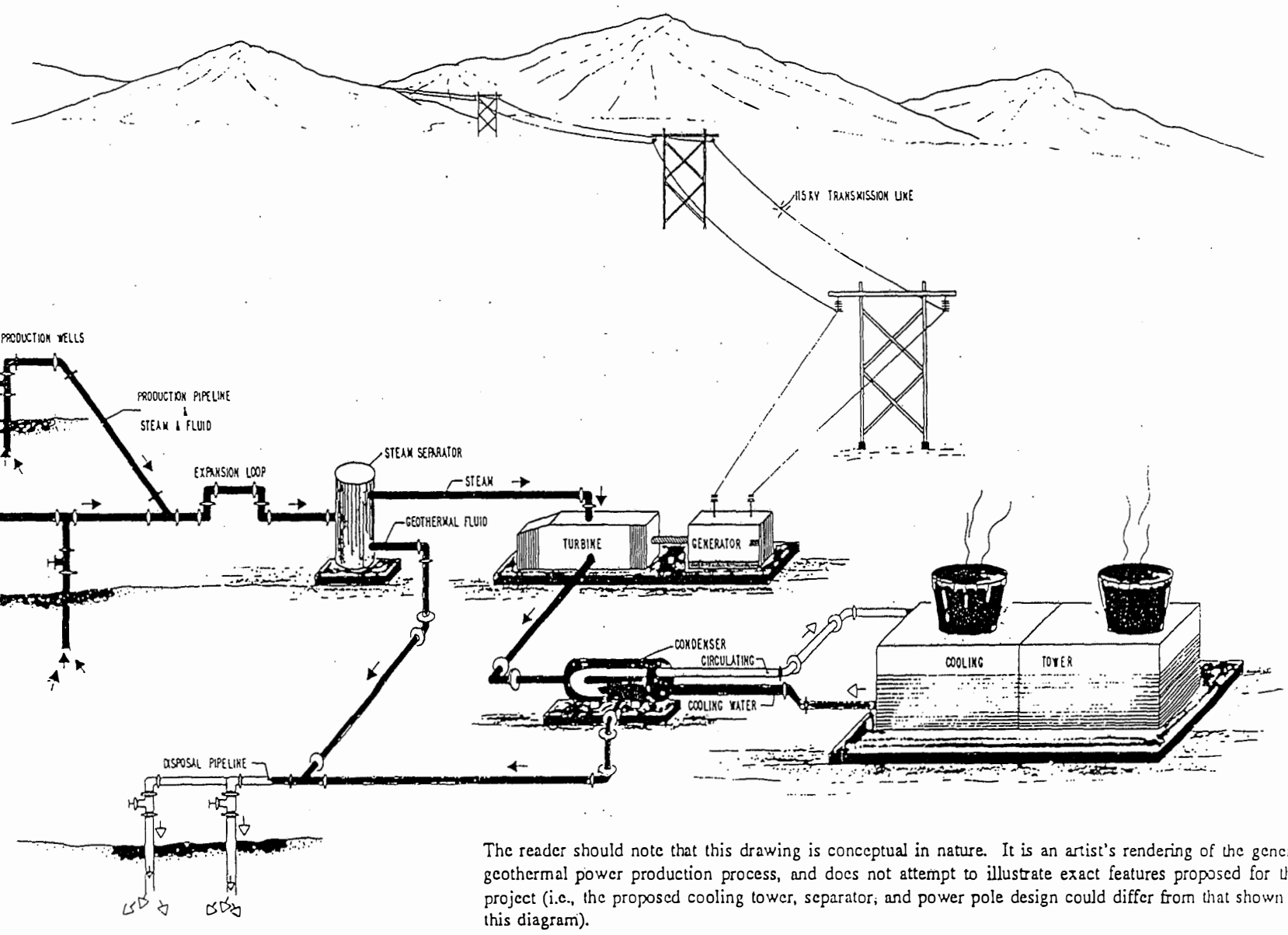
Note: The boundaries of the Lease Area and Transmission Line Area are approximate in nature.

Scale
0 6 12 18 km
0 6 12 miles

NEWBERRY GEOTHERMAL PILOT PROJECT Deschutes National Forest, Oregon	Proposed Project Area and Nearby Vicinity	Figure S-2



NEWBERRY GEOTHERMAL PILOT PROJECT Deschutes National Forest, Oregon	Conceptual Illustration of the Geothermal Power Production Process	Figure S-3



The reader should note that this drawing is conceptual in nature. It is an artist's rendering of the general geothermal power production process, and does not attempt to illustrate exact features proposed for this project (i.e., the proposed cooling tower, separator, and power pole design could differ from that shown in this diagram).

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GEOTHERMAL PILOT PROJECT
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Artist Conception of the Power Plant Site and Elevation of Plant Features

Figure S-4