Newberry Volcano EGS Demonstration Project

Response to Comments

The BLM received 11 comment letters on the EA. These letters were from the Klamath Tribe, Region 10 of the Environmental Protection Agency, the Northwest Environmental Defense Center, Oregon Wild, Central Oregon Land Watch, Blue Mountain Biodiversity Project, Leaning Pine Ranch, and four individuals during the 30-day notice and comment period. BLM reviewed and evaluated each letter for comment content. Many of the letters had similar comments around three topic areas: Groundwater Quality, Groundwater Quantity, and Induced Seismicity. The Response to Comments is organized around these three areas and also includes a section labeled Other Comments to address those comments that did not fall into one of the three categories listed above. In instances where comments from different letters were essentially the same, they were combined and answered in one response.

Comments Concerning Potential Effects to Groundwater Quality

Comment 1

A number of comments were received concerning the potential effects to groundwater quality in the project area. The primary concern of these comments was the composition and potential toxicity of the diverters and tracers that would be used during the stimulation, and the potential for these compounds to enter into the groundwater. The Newberry Volcano EGS Demonstration Project Environmental Assessment EA analyzes the potential effects to groundwater quality in detail in Chapter 4 (p. 121), and in the independent hydrologist review attached as Appendix B of the EA.

The tracers selected for the project are environmentally benign and are commonly used in groundwater and surface water studies as well as for geothermal studies. The tracers will be injected in concentrations of 10 to 100 parts per thousand in the injected pulse, and will be diluted to concentrations of approximately 0.1 to 100 parts per billion when flowed back at the wellhead. These tracers are typically detectable at the part per trillion levels. The EA lists 18 tracers that have been selected for potential use during the Project. None of these are toxic, especially in the very low quantities planned for use in the project (EA page 122-123).

The following discussion on tracers is from a review of tracer use by Stephen Wheatcraft, Ph.D. Dr. Wheatcraft is a Professor Emeritus of Hydrologic Sciences, University of Nevada, Reno (UNR) and President of Wheatcraft & Associates. His area of expertise is in groundwater hydrology, specializing in groundwater contamination. The tracers that are planned for use in the Project fall into three categories: naphthalene sulfonates, fluorescent dyes and salts. These are discussed below.

Napthalene Sulfonates

Napthalene Sulfonates were developed in the 1990s to provide a safe and non-toxic tracer for high-temperature geothermal applications. Toxicity studies in a peer-reviewed journal showed that this class of chemicals are neither carcinogenic nor mutagenic (Greim et al, 1994). They have been used in the field in actual geothermal tracer tests many times over the past twenty years. While they are non-toxic enough to use in high concentrations, they will be used in very low concentrations during the project. Napthalene Sulfonates have clearly been shown to be environmentally safe and will not pose any threat to the geothermal waters, nor to any potable water source.

Fluorescent Dyes

This category includes Rhodamine WT and fluorescein. Both of these fluorescent dyes are extremely common tracers, used in groundwater and surface water tracer studies. Both of these chemicals are so safe and non-toxic that they are often used in concentrations high enough that the dye color is visible to the unaided eye. They are also detectable in very low concentrations by fluorescent detection methods. The Project intends to use them in very low concentrations (less than 100 parts per billion).

Salts

This category includes lithium iodide, cesium iodide and rubidium iodide. All three of these compounds are common groundwater tracers that the Project plans to use in very low concentrations. Lithium iodide has an LD50 of 1,800 mg/kg. At Newberry this tracer will be injected at a concentration that will produce concentrations in the 100 µg/kg, which is more than 10,000 lower than the LD50 concentration. Cesium iodide has an LD50 of 2,386 mg/kg. Planned production concentrations are in the 100 µg/kg, similar to lithium bromide, and also more than 10,000 times lower than the LD50. Similarly, rubidium iodide has an LD50 of 4,708 mg/kg with planned production concentrations in the 100 µg/kg range, also more than 10,000 times lower than the LD50. In summary, all three of these tracers are commonly used in groundwater studies and the planned production concentrations are thousands of times lower than any toxicity concerns.

Safranin T

Since the EA was completed, Safranin T has been further tested in the field and determined that it will not survive at the temperatures present at Newberry. Therefore, Safanin T will not be used at Newberry.

Diverters

The following discussion on diverters is from a memo from Allen Apblett, Ph.D. Dr. Apblett is an Associate Professor of Chemistry at Oklahoma State University. His expertise and research interests include industrial, materials, and environmental chemistry.

The diverters were designed with both functionality and the prevention of environmental hazards in mind. Diverter materials include substances used in the biomedical field, food storage, and even clothing. It is believed that the relatively small amount of material planned for use, the benign nature of them, the fact that they will dissolve into the well water as non-toxic compounds make them part of an environmentally friendly system. The AltaRock diverters are from two classes of materials: biodegradable plastics and naturally occurring minerals. Biodegradable plastics are plastics that will decompose in natural aerobic (composting) and anaerobic (landfill) environments. They may be composed of either bioplastics, which are plastics with components derived from renewable raw materials, or petroleum---based plastics, which utilize an additive that makes them biodegradable. The plastic diverters used by AltaRock fall mainly into the first category – they are polymers derived from natural products from plants. These polymers will hydrolyze in the hot well water, releasing the same natural, non-toxic plant-derived products that are the building blocks of the polymer. Notably, bacteria and other organisms easily metabolize the released small components if they reach the biosphere. For example, one of the diverter materials made from renewable biologic raw materials that AltaRock has used is BioVertTM, a polymer of lactic acid known as polylactic acid or PLA. This material is a hard plastic that is available as grains that can be sorted by size. When heated, the chains in the polymer break down to lactic acid, a soluble substance found in human and animal tissue as a normal product of metabolism and exercise. Polylactic acid is used as absorbable sutures for surgery and wound stitching and is clearly non-toxic. Three of the other biodegradable plastics that could be used are also made from biologic materials (AltaVert 100,101, 151). Three other potential plastic diverter materials are derived from petroleum, but break down into small components that are bioactive and can be metabolized in the environment (AltaVert 150, 154, 251). These were chosen because they are benign materials used extensively in clothing and food packaging; they have a very long history of safety (both human and environmental) and the polymer break down in hot water to non-toxic building-blocks that are readily further biodegraded. Biodegradable plastics will be selected based on the temperature at which they melt and then the temperature at which they dissociate. The choice will be predicated on the temperature of the well at which the diverters will be used. The first zone stimulated may not be cooled enough to make it possible to use a biodegradable plastic as a diverter. If this were the case, a mineral diverter will be selected for that zone. The mineral diverters that may be used are all naturally occurring minerals containing common rock forming elements: Aluminum, Calcium, Magnesium, Chlorine, Silica, Carbon, Oxygen and Hydrogen. These minerals will be ground to a specific particle size and mixed with clean groundwater to pump into the well. A

variety of diverters have been selected for varying solubility over a wide range of temperature. One possible mineral that has been tested is calcium carbonate (calcite). Because any natural mineral material can have contaminants that are toxic, AltaRock uses materials that have been quality controlled and tested to have very low contaminants. For example, the calcite selected for use as a diverter is very pure, with greater than 99% calcium carbonate and less than 0.3% quartz. This is the same material that is found in calcium supplements and many antacids. Similarly, the other mineral diverters that might be used also have common uses in consumer products in which they have displayed no toxicity or health problems. Dr. Apblett has reviewed the MSDS sheets of the diverters which were provided to the BLM as well as the breakdown products. He believes at the concentrations expected in the water injected and flowed-back from the demonstration well, the diverter materials will definitely not pose a toxicity risk to the environment, wildlife or people. Not only will the injected materials be non-toxic, but their breakdown products will also be innocuous and the dilution in large amounts of water will ensure the absence of an impact that might be caused by supplying nutrients to bacteria and algae.

A primary factor to consider when discussing the potential effects of tracers and diverters to humans is the likelihood of these materials coming into contact with humans. The most likely means of contact would come from drinking water derived from wells drilled into the local aquifer. The EA analysis shows that the risk of developing a hydraulic connection between the proposed EGS reservoir and the shallow (project site) aquifer is extremely low (EA page 121-122). This is due to the approximately 5,000 feet of low permeability receptor rock separating the top of the proposed EGS reservoir zone and the bottom of the project site aquifer. Further, the well bore which passes through the groundwater table is encased in multiple liners of steel and cement which serve to isolate the well from the surrounding rock and water table (EA page 126). The design and integrity of the casing has been reviewed, tested and approved by both the BLM and The Oregon Department of Geology and Mineral Industries (DOGAMI).

Comment 2:

Davenport/Altarock has not publicly announced that it will be pumping industrial chemicals (tracers, diverters, mud additives, friction reducers, etc) including naphthalene, safranin, rhodamine, lithium, cesium, rubidium, fluorescein, tobermorite, polymerized plastics, "secret" Altavert fluids, and other compounds into the wells. This has not been reported in public meetings, in written materials, or in news articles until the EA came out. More transparency and candor is called for. It is likely that the faulted, fractured and inter-bedded volcanic strata at Newberry will have some degree of leakage. This is especially true with the induced seismicity that is part of the project. Please provide safety data, toxicology reports, carcinogenicity evaluations, and a discussion of the potential health effects for all materials that will be pumped down the well. While it has been asserted that the proprietary Altavert materials are "harmless", the public deserves to know what they are and to make their own judgment. Secrecy does not belong in this EA.

Response:

The use of diverters and tracers have been fundamental parts of the project from the beginning and they were discussed in both the public meetings and the scoping letter. The tracers are used in very low concentrations and are commonly used in geothermal projects and groundwater studies. Altarock has disclosed the formula for Altavert to the BLM and DOE and the individual chemicals that make up Altavert are listed in the EA (pages 122-126). Since Altavert is a proprietary formula going through the patent process, the exact formula and associated Materials Safety Data Sheet (MSDS) are confidential. While the intention is not to hide this information from the public, it is necessary for the formula to remain confidential so as not to put Altarock at a competitive disadvantage. The MSDS for all the other chemicals are available upon request. Please see above general discussion on the independent review of the diverters and tracers that will be used during the project.

The volcanic stratum at the existing geothermal well NWG 55-29 is extremely dense and not fractured. Results from two deep geothermal wells and LIDAR topographic mapping show an absence of active faults within 3 km of the well (EA, Appendix A, p. 28). The proposed EGS reservoir would be created 6,500 to 11,000 feet below the ground surface, a vertical mile below the shallow groundwater aquifer in a thick section of impermeable rock. Thus, even if it were possible for the EGS stimulation zone to have some degree of leakage, this would occur over a mile *below* the groundwater aquifer.

Comment 3:

Please provide a plan for remediation if the fluids pumped down the well do get into the groundwater supply for La Pine and Sunriver. There is evidence that some of these are possibly carcinogenic, teratogenic, and/or toxic.

Response:

The EA analysis shows that the risk of development of a hydraulic connection between the proposed EGS reservoir and the shallow (project site) aquifer is extremely low (EA page 121-122). As discussed above, there is approximately 5,000 feet of low permeability receptor rock between the top of the proposed EGS reservoir zone and the bottom of the shallow (project site) aquifer. Further, the well bore which passes through the groundwater table is encased in multiple liners of steel and cement which serve to isolate the well from the surrounding rock and water table (EA page 126). The design and integrity of the casing has been reviewed, tested and approved by both the BLM and DOGAMI. There is no evidence that any of the diverters and tracers that would be injected as part of the stimulation are carcinogenic, teratogenic and/or toxic

at the concentrations in which they will be used. As a result, the BLM has determined that it is unnecessary to develop a specific remediation plan at this time.

Comment 4:
Please explain emergency plans in place if there is an accidental surface spill of these materials being pumped down the well including the "secret" but "safe" fluids. Please provide what the regulating agencies will require for cleanup of the spill. Where fracking has taken place in Pennsylvania, drinking water had to be trucked in for residents. Do you have arrangements to do this for Sunriver and Lapine if contamination occurs?

Response:

The BLM will hire a third party hazard material compliance company to prepare a surface spill plan and to monitor the storage and handling of chemicals used on site. In addition, the State of Oregon Department of Environmental Quality (DEQ) and DOGAMI will oversee storage of chemicals and handling of any spills. The well pad where the diverters and tracers will be used is graded such that any runoff is directed to a double-lined sump, which will prevent any fluids on site from running off the wellpad. These project design features, along with the knowledge that the diverters and tracers are non-toxic, suggest there is little risk of any injected material entering the aquifer. BLM therefore has determined that it is unnecessary at this time to arrange for alternative drinking water sources for residents of Sunriver and LaPine.

Comment 5:

Is this hydro-shearing really hydraulic fracturing?

Response:
Geothermal well stimulation via hydro-shearing is not fracking, and there are important differences between the two processes. Hydraulic fracturing, or "fracking," is a method sometimes used for extracting oil and natural gas in which water and chemicals are injected at very high pressures, up to 10,000 psi at the surface, into an oil or gas well. The water pressure causes the rocks to fracture or crack open, and then propping agents, carried by gels, are injected to keep the hydrofracture open so that oil and gas can be collected and piped to the surface. Some of the chemical additives used in fracking and the recovered hydrocarbons can be toxic.

The Newberry EGS Demonstration Project is based on the concept of hydroshearing not hydrofracturing. Hydroshearing occurs when friction within natural rock fractures is reduced by injecting cold water at much lower surface pressures (less than 1,600 psi) allowing the fracture walls to slip past each other slightly. Further, hydroshearing does not require gels or propping agents, because the small, hydrosheared fractures will remain slightly open, less than a tenth of an inch, due to the irregularities on the fracture walls. Lastly, the proposed project will not be

producing fossil fuels, but hot water and steam created through the heating up of injected water as it passes through the hydrosheared fractures created in the hot rock.

Comment 6:

Please provide testing results of the performance and safety of all compounds, including the "secret" ones, at the high levels of pressure and heat they will experience down the well. Please prove that they will not become reactive, gaseous, and/or more mobile or toxic.

Response:

Please see the general discussion above on ground water quality. The chemical makeup and MSDS sheets for all chemicals have been provided to the BLM and DOE. Dr. Wheatcraft and Dr. Apblett are consultants to the DOE's technical team and are considered experts in their field by the DOE. They conclude there is no evidence that any of the diverters and tracers that would be injected as part of the stimulation are carcinogenic, teratogenic and/or toxic at the concentrations in which they will be used.

Comment 7:

Please provide the details of the geology of the drill hole that might limit the escape of toxic fluids into the aquifer. This is unclear in the EA. Please provide the results of your tests that prove that there is no connection of proposed fracking areas with groundwater wells for Lapine/Sunriver area. Further, please direct us to your research that assures residents that the hundreds to thousands of induced earthquakes you will generate won't allow leakage of fluids that you inject into the wells to make their way into groundwater. This might be aided by the microfractures you will induce in order to force the water to go places it apparently didn't go before.

Response:

Details of the geology surrounding the site are discussed in the EA and its appendices (See Appendix A-ISMP for details). A general schematic of the well bore and casing profile are shown in Figure 28 on page 127 of the EA. A detailed drilling plan and well design were reviewed, approved and tested by both the BLM and DOGAMI as part of the 2007 EA for Geothermal Exploration and as part of the BLM Geothermal Drilling Permit and DOGAMI Geothermal Drilling Permit to assure the well bore and casing are sufficient to protect groundwater where the well intersects the water table. As a comparison, the Geysers project in California has had ongoing seismic activity at higher magnitudes than predicted for this project

associated with their geothermal fields. To date no well casing integrity has been jeopardized by seismic activity.

The independent hydrologist review (Appendix B in the EA) concluded there is no hydraulic connection between the wells in the La Pine sub-basin and the shallow aquifer present at the project site. (EA pages 120-121). Please also see the general discussion on induced seismicity addressed in Comment 24.

Comment 8:

The project requires "a reserve pit for the storage of waste drilling mud and fluid". EA at 89. These pits are also referred to as a "mud tanks". EA at 112. The EA does not discuss potential hazards associated with these pits. The potential environmental impacts of these mud pits needs to be studied further in an EIS because the EA contains very little information about the hazards associated with the listed additives. Are these pits open? Will these pits be accessible to wildlife? Will these pits be accessible to humans? How dangerous is the waste drilling mud and fluid? What exactly does the waste drilling mud and fluid consist of? How will the dangers associated with this waste be mitigated? Is there a plan to properly dispose of this waste? If so, what is the plan?

Response:

The project will use, if necessary, two existing double-lined sumps for temporary storage of run-off, water and drilling mud (EA 44, 58-59, 70). These sumps are surrounded by fences to keep humans and wildlife from entering. The sumps were constructed for the 2007 Newberry Geothermal Exploratory Project. The construction of the sumps, and the management of wastes in them, were evaluated in the EA and DR for that project, which have been incorporated by reference in the EA for the EGS project (EA 22). The EA and DR for the exploratory project prescribe measures to ensure proper storage and disposal of the contents of the sumps, including protection of wildlife. *See* 2007 Newberry Geothermal Exploration Project EA at 14, 29-30, 36, 37, 38 (NEPA Register #DOI-BLM-OR-P000-2007-0075-EA posted to internet August 2007, available on the Prineville BLM webpage under "Plans & Projects, NEPA Analysis" at http://www.blm.gov/or/districts/prineville/index.php#); and the Decision Record at 4, 7, 9 (DR posted to internet October 2007). The drilling muds would be very similar to those used in drilling the two previous geothermal wells drilled in 2008. These drilling muds were sampled and tested by BLM and reviewed by the Oregon Department of Environmental Quality (DEQ). DEQ determined the muds were substantially the same as "clean fill" (DEQ letter dated September 6, 2011 Re: Solid Waste Permit Exemption Determination). The "mud tank" referenced at page 112 of the EA for the EGS project is a free-standing tank for storage of mud and cuttings at the sites of the boreholes for the microseismic array. EA at 34. All stored

drilling mud is required to be disposed of offsite and in an approved facility in accordance with BLM requirements (EA page 34).

Comment 9:

Are the diverters petroleum based?

Response:

Yes, as described on p.40 of the EA, some of the biodegradable plastics used in the diverters may be composed of petroleum-based plastics. While petroleum based, they will break down into small components that are bioactive and can be metabolized in the environment (EA p. 41). The BLM and DOE have reviewed MSDS sheets for the diverters and there is no indication they are toxic at the concentrations and manner in which they will be used. (Dr. Apblett memo). Please see the response to comment #1 for a fuller description of the properties of the diverters.

Comment 10:

What prevents diverters from piling up at the bottom of the well?

Response:

As explained in the EA (p. 38) after the diverter material has finished closing off stimulation zones, the well bore is allowed to reheat to the original well temperature. This causes the diverter material to dissolve. The dissolved diverter material will then either disperse throughout the stimulation network or be returned to the lined sumps at the surface during the test pumping.

Comment 11:

Material Safety Data Sheets (MSDS) are only for toxic materials.

Response

MSDS are a widely used system for cataloging information on chemicals and chemical compounds. They are not limited to toxic materials but also cover the storage, handling and firefighting measures for a wide range of materials. For example, there are MSDS for common cleaning products including laundry soap and window cleaners.

Comment 12:

Don’t want any of the diverters to get into the soil or water.

Response:

By design, the diverter material will be injected into the well and come in contact with rock, and during stimulation, with the water injected into the well. Response to comment 1 describes the chemical nature and toxicity of the diverter material. Handling and storage of diverter materials is discussed on p. 125 of the EA. Material will be stored in a designated area on the well pad. The pad has been designed to direct any runoff to the double lined sump. An independent contractor that is licensed to do so will review all storage and handling of the chemicals for this project under the direction of the BLM. Also, please see response to comments 7 and 8 for more specific information on the use of diverters and design measures that will prevent diverter material from coming in contact with surface soil and ground water.

Comment 13:

What is the potential for toxic fluids to migrate vertically during the hydroshearing and enter the groundwater? What are the upper limits allowed for this vertical movement?

Response:

The upper limit for unwanted vertical growth of the reservoir is specified on P. 63 of the EA. The EA and mitigation measures in the decision also address the potential for vertical migration. Any seismic event with M>1.0 or that is picked up on six or more stations of the micro seismic array (MSA) that is located shallower than 6000 feet (1.8 km) below the ground surface at NWG 55-29 will result in use of diverter to shift stimulation to another zone. Any planned increase in flow rate will be postponed until after the diverter is applied. None of the fluids used in this project are considered toxic in the dilutions they will be applied. Additional information is provided in the response to Comment #1 regarding the toxicity of fluids proposed for use.

Comment 14:

Please describe the safety of the diverter chemistry via journal articles.

Response:

Please see the general discussion on diverter chemistry provided in response to comments # 1. For more information, the following references are available.

Toxicity References: (full reports are in the administrative record)

http://www.medicalservices.com.br/atualizacao/pesqclinicas/files/2004.pdf

http://www.deepdyve.com/lp/wiley/drug-plastic-interactions-ii-sorption-of-p-hydroxybenzoic-acid-esters-Drv0F3alYP?key=wiley

http://pubs.acs.org/doi/abs/10.1021/es803315v

Comment 15:

Has fluid from the soon to be stimulated zone been geochemically tested for Sr/Th isotopes or CFCs? This would show whether there is comingling with surface/shallower waters.

Response:

NWG 55-29 was a dry hole, meaning that there were no appreciable amounts of native geothermal fluid in the well to sample. Hence, it was not possible to test the well for Sr/Th isotopes or CFCs. The only source of water that could be sampled at this time would be from the groundwater well. Since the ground water tapped by this well has no geological connection with the geothermal well, it would be inconclusive in showing whether there is any comingling of shallower waters and the stimulated zone and defeat the purpose of such a test. As the stimulation proceeds, the Proponents will be sampling and performing chemical analysis of groundwater drawn from the water well on the pad and the microseismic array borehole NN-17, 1 km down-gradient from the sump and the NWG 55-29 well. The results of the testing will be reviewed by the BLM and the Oregon Department of Environmental Quality (DEQ).

Comment 16:

How can you verify that the sump is not leaking? Are wells going to be installed to monitor potential sump leakage?

Response:

The sump is double-lined and meets or exceeds all regulatory standards. The sump was tested by the proponents in November of 2011 by filling it with water and measuring the water level. The water level remains constant, showing that the sump does not leak. BLM observed this test and concurs with this finding. The Proponents will be sampling and performing chemical analysis of groundwater drawn from the water well on the pad and the microseismic array borehole NN-17, 1 km down-gradient from the sump and the NWG 55-29 well. The results of the testing will be reviewed by the BLM and the Oregon Department of Environmental Quality (DEQ).

Comment 17:

Is it conceivable that water from the stimulated zone can comingle with the shallower aquifers?

Response:

Independent, expert hydrologists at Kleinfelder Associates could not propose any conceivable way that the 5,000 feet of impermeable rock between the shallow aquifer and the stimulated zone will allow the injected water and shallow water to comingle (Appendix B of the EA). Impermeable or impervious is a term used for earth materials with permeability less than 1 millidarcy, which is appropriate for the volcanic rocks below the water table at Newberry. Please see general discussion above.

Comment 18:

What is the probability that the casing will collapse while pressured up during the stimulation causing drinking water aquifer contamination?

Response:

The pressure used during the stimulation will be below the rated limit of the steel casing. The geothermal well was drilled in 2008 and the casing was installed to exceed all state and federal regulatory requirements with two or three layers of casing and cement across the ground water aquifer zone. Since well completion, casing integrity tests have been performed which show the casing to be in excellent condition. During the entire stimulation the temperature will be monitored along the full length of the wellbore using a fiber optic distributed temperature sensing system. This measurement will show if there are any leaks during the stimulation.

Comment 19:

How will you flow test the stimulated well and how will you deal with the tracer and diverter chemicals?

Response:

The valve on the geothermal well will be opened, allowing the hot water and steam pressure built up at depth to flow to the surface. The hot water will be flowed through piping and instrumentation systems for measurement of flow rate, temperature and pressure and then into a muffler to quiet the sound and reduce the energy in the water before flowing to the sump. The water will be sampled and tested as it flows through the piping and after it enters the sump. The degradation products of the diverter will not be detectable above the natural background levels. The tracers will, hopefully, be detectable, but are not toxic, by design. Therefore, the tracer and degraded diverter chemicals will create no disposal problem. If the chemicals are detectable above background levels and are considered unacceptable by the State of OR DEQ – the sump fluids will either be injected back into the EGS or the fluids and residue will be pumped into tanker trucks and disposed of offsite in accordance with State of Oregon DEQ regulations.

Comments Concerning Potential Effects to Groundwater Quantity

A number of comments were received concerning the potential effects to groundwater quantity in the project area. These comments and responses are discussed below.

Comment 20:
Please explain how pumping at least 142 million gallons of water down the well over two years won't have any effect on the water table. Please provide details of the induced seismicity that deep wells caused at the Rocky Mountain Arsenal in the 1960's (see appendix A) that led to stopping of pumping. Please explain why this is not possible at Newberry.

Response:
Potential effects to groundwater from the Project are discussed in detail on pages 116-121 of the EA and in the Independent Hydrologist Review (Kleinfelder, 2011) attached as Appendix B of the EA. As explained on p. 120 of the EA, the maximum water use proposed by the project (435 acre-feet over a two year period) represents approximately three-tenths of one percent (0.003) of the estimated annual recharge (73 billion gallons or 224,000 acre-feet) to the Deschutes Basin from the west flank of Newberry volcano (Kleinfelder 2011, p. 15). Groundwater mitigation credits will be purchased by the proponent from the Deschutes Groundwater Mitigation Bank, operated by the Deschutes River Conservancy in accordance with the OWRD permit. Sufficient credits will be purchased to ensure there would be no net loss of water to the Deschutes river basin.

Geoscientists involved in the Project have studied the history of injection-induced seismicity, starting with Rocky Mountain Arsenal in 1967 through the present. Much has been learned since then and the experiences and relevant lessons from these projects were analyzed in the preparation of the Induced Seismicity Mitigation Plan (ISMP). The detailed ISMP, attached as Appendix A of the EA, is based on current science and addresses the issue of induced seismicity and details a specific plan along with mitigation measures to prevent the type of problems encountered at the Rocky Mountain Arsenal in 1967.

Comment 21:

On page 80 under heading Paulina Creek: Water rights are from 1899, there are only two owners to the water rights and many water certificates to these two owners. The creek supplies all the water to the two ranches and there is no excess after meeting the requirements of those water certificates.

Response:

The references in the EA to water rights on Paulina Creek were taken from the Independent Hydrologist Review (Kleinfelder Report, included as Appendix B to the EA). A subsequent search of the OWRD online database does show water rights dating back to 1899, not 1911 and

1918 as the EA stated (EA p. 80). However, because the project will not be using water from Paulina Lake or creek, nor will it impact these water rights, this error does not materially impact the analysis or conclusions of the EA.

Comment 22:

On page 119 of the EA -Unless I was ill informed, there was a draw down of a few inches in an adjacent well (1/2 mile) not 1.8 miles for that very short duration. The draw down was short lived. This is a concern because a huge pull from the well might take some time to recharge itself and may affect other Aquifers.

Response:

As stated in the EA and referenced in the Aquifer Pumping Test Report Pad S-29 Water Well Newberry EGS Demonstration Project, Wallace Group, 2011, P. 8-9, only slight water level variations (less than 0.1 feet) were recorded in the observation wells (Pad S-16, approximately 1.8 miles away and WW#2, approximately 1 mile away) during the step-drawdown test conducted in August 2011. The independent hydrologists conducting the test concluded that these variations do not appear to be related to groundwater pumping at the Pad S-29 well, but rather reflect normal, barometric pressure changes over the monitoring period. Furthermore, as required in the limited license issued by OWRD, water levels will be monitored in the nearby WW#2 continuously with a data logger and transducer that meet Department standards and the data will be reported on a monthly schedule while pumping is occurring.

Comment 23:

EA page 120 -I think it could affect the Paulina Creek water flow if there are large draw on the lower aquifer for a long period of time. This in turn would reduce the amount of water that eventually gets to the ranches. If you draw down this lower aquifer it will over time pull water from the upper aquifer and the creek. Please refer to how the water wells S-16 & S-29 are recharged on page 78 & 79. This says there is vertical recharge flow within Caldera to regional and local aquifer

Response

The independent hydrologist report ((Kleinfelder Report, included as Appendix B to the EA)) reviewed numerous professional papers regarding the hydrologic model on and around the western flank of Newberry volcano and concluded that the pumping of the well a Pad 29 will not impact flows in Paulina Creek. At the location of the water well on Pad 29, Paulina Creek loses approximately 0.75 cgs/mile to groundwater; it does not receive recharge from groundwater (EA Appendix B, p. 12). Furthermore, as required in the limited license issued by OWRD, water levels will be monitored in the nearby WW#2 continuously with a data logger and transducer

that meet Department standards and the data will be reported on a monthly schedule while pumping is occurring. Finally, any water withdrawn from the aquifer will be offset by groundwater mitigation credits purchased from the Deschutes River Conservancy and as a result there would be no net loss of water to the Deschutes river basin (EA p. 116).

Comments Concerning Potential Effects from Induced Seismicity

Comment 24:

A number of general comments were received concerning the potential effects from induced seismicity. The following response provides some background information relating to the proposed induced seismicity.

Response:

Induced seismicity is created by inducing shear slip on existing fractures by injecting water at high pressure ("hydroshearing") into a rock formation in order to create an Enhanced Geothermal System. The International Energy Agency developed a protocol for addressing induced seismicity during geothermal projects that was adopted by the U.S. Department of Energy (DOE) for EGS demonstration projects. As part of this protocol, a number of studies were conducted and an Induced Seismicity Mitigation Plan (ISMP) was developed. The EA analyses the potential effects of induced seismicity in detail (Ch. 4, p.128) and draws on these studies. The ISMP and the related studies are attached as Appendix A to the EA. The combined conclusions indicated that:

- The probable upper-bound maximum magnitude of an induced seismic event at Newberry is M 3.5 to 4.0.
- The probability of a seismic event with a magnitude between M 3.0 and M 4.0 is less than 1%.
- There is no difference in seismic hazard between the natural seismicity and the hazard introduced by EGS induced seismicity.
- Mitigation measures outlined in detail in the ISMP (Appendix A) and Section 4.4, decrease flow at detection of events M 2.7 to 3.4 and then stop injection and flow the well to the surface to relieve pressure at detection of events equal to or higher than M 3.4.
- If an M 3.5 seismic event did occur, the potential for damage at the nearest structures within the NNVM would be light, corresponding to a MM Intensity level of VI.

Comment 25:

An EIS is required because of the technology's likelihood of inducing earthquakes. While there are plans in place to monitor induced seismic activity, the EGS process is new worldwide, and therefore an understanding of all possible environmental impacts cannot be known at this time. An EIS should further explore uncertainty surrounding potential seismic risks of the EGS project. The EA acknowledges that "the development of a below-ground EGS reservoir by hydroshearing has the potential to produce induced seismicity and increased seismic risk that could affect historic structures, resorts, and other recreation sites within the NNVM, could increase avalanche risk, could increase risk to above and below ground geologic features, and could result in property damage in nearby population centers" (EA, 128). Even though the likelihood of these events is slight, the mere fact that they could occur as a direct result of the project indicates that an EIS should be prepared.

Response:

The EA displays technical and scientific analyses of the potential seismic hazards of the area and the increased seismic risk from hydro-shearing activity (EA, 82). Those studies "concluded there would be no increased earthquake or seismic hazard over existing baseline conditions as a result of the EGS stimulation." (EA, 130). The assumptions from the URS report (part of appendix A) are supported by the DOE assembled technical team. The mere possibility of an adverse effect does not create sufficient uncertainty to warrant an EIS. Further, the mitigation measures to address such unlikely effects also make the potential impacts environmentally insignificant (EA, 140).

Comment 26:

The risk to below-ground geological features is especially alarming and is not adequately addressed in the EA. An EIS should further address this issue because the effects of hydroshearing near a volcano are largely unknown. Will this induced seismic activity have any impact on the Newberry Volcano? If yes, what will the impact be? While the EA does show that induced seismic activity is unlikely to have a substantial impact on property and above-ground geological features (such as landslides and avalanches), it does not offer the same insight into how this project will impact below-ground geological features. For this reason, NEDC insists that the BLM study the impacts of induced seismic activity near an active volcano more thoroughly in an EIS.

Response:

The EA contains technical and scientific analyses of the potential seismic hazards of the area and the increased seismic risk from hydroshearing activity (EA, 82). Those studies "concluded there would be no increased earthquake or seismic hazard over existing baseline conditions as a result of the EGS stimulation" (EA, 130). Please see discussion above on induced seismicity. The

commenter did not present information that challenged these conclusions. Further, the EA relied on the conclusions of those analyses in combination with the mitigation plan measures to conclude that "the 500 m buffer will protect rocks under the Monument from being affected." EA at 56-57. Some of the most productive geothermal power plants in the world are located in volcanic regions such as the Philippines, Indonesia, Iceland, and Hawaii. In these geothermal fields, no eruptions have been caused by geothermal drilling or production. Newberry volcano is not considered an active volcano but one that is dormant.

Comment 27:

I am concerned about the long term effects the ground shaking will have on the concrete dam and who is liable. The EA has minimal details about the dam's status and minimal analysis of the probability of its rupture.

Response:

As discussed in the EA on pages 136-137, geotechnical engineers conducted a geotechnical engineering evaluation of the dam which is referenced and included in Appendix I of the ISMP, attached as Appendix A of the EA. They concluded the probability of additional damage to the dam is low. Furthermore, as part of the ISMP, the proponents will be required to monitor cracks on the dam and bridge. As part of AltaRock's risk management practices, it has obtained both general liability and umbrella liability insurance under which a third party may collect if AltaRock is found liable for damage caused by induced seismicity (EA, 67). Draft Instructions & Guidelines for Damage claims resulting from any induced seismicity from the project are described in Appendix J of the ISMP, attached as Appendix A of the EA. The EA contains analyses of the potential seismic hazards of the area and the increased seismic risk from hydroshearing activity (EA, 82). The engineering study concluded that the likelihood of damage is none for Peak Ground Acceleration (PGA) values of 0.014g and 0.028g and only very light to light damage, which could consist of minor cracking for PGA values of 0.05g and 0.10g. Considering these low levels of acceleration and the previous performance of concrete dams, the probability of additional damage to the dam is low and the probability of failure of the dam is extremely remote (EA, 137). The engineering study further states on p. 4 in Appendix I of the ISMP that according to the Federal Guidelines for Dam Safety: Earthquake Analyses and Design of Dams (May 2005) no major concrete dam is known to have failed as a result of earthquake-induced ground motion. The BLM has not found or been provided with a scientific basis for speculating that the dam would be breached as a result of seismicity induced by the project; therefore impacts associated with a failure of the dam were not analyzed in the EA.

Comment 28:

Will rocks under the monument be affected? –How does backflowing reduce seismicity?

Response:

As discussed in the EA, the goal of the stimulation is to create an EGS reservoir with a horizontal extent of 1000 m (3280 ft.) While the goal is to have this centered on the well (500 m in each direction), it is possible the EGS reservoir will grow primarily in one direction, in which case it could extend 1000 m towards the NNVM. The boundary of the NNVM is about 2.3 km (1.4 mi) from the wellhead and 1.8 km from the bottom of the well. Thus, there is 800 m (0.5 mi) between the closest edge of the nearest possible EGS reservoir and the monument (EA, 56). The ISMP specifies that any confirmed outlying seismic event within 500 m (1640 ft) of the NNVM boundary will result in the use of diverter to shift stimulation to another zone and any planned increase in flow rate will be postponed until after the diverter is applied. Thus, due to the limited planned extent of the EGS stimulation zone and the mitigation actions outlined in the ISMP to prevent unwanted horizontal growth, rocks beneath the NNVM are not expected to be affected by the project. Induced seismicity in EGS projects is a result of the injection of pressurized water into the deep underlying rock formation. By flowing back the water and/or steam immediately after hydroshearing is completed, excess reservoir pressure will be reduced. Reducing reservoir pressure is expected to decrease the fluid pressure in the EGS reservoir and reduce post-hydroshearing induced seismicity (ISMP p. 43).

Comment 29:

Seismicity will drive away tourists to the monument.

Response:

As stated on page 130 of the EA, "The relatively low rate of $M \geq 4.0$ induced earthquakes and associated low ground motions will result in no differences in the hazard (over natural occurrence of seismic events) when EGS events are included" (URS 2010). There will thus be no increased danger to visitors that would justify choosing not to visit the NNVM.

Comment 30:

Will Drilling cause avalanches?

Response:

The EA did analyze the potential to trigger avalanches from induced seismicity which has the potential to cause higher ground shaking than drilling. The EA acknowledged that an induced seismic event could potentially serve as a trigger to an avalanche, but the potential for an avalanche would be affected by natural risk factors unrelated to human activity such as snow pack conditions, weather, and temperature (EA, 137). Given that drilling does not cause substantial ground shaking and there are no steep slopes within immediate vicinity of the project site, the risk of drilling triggering an avalanche is non-significant.

Comment 31:

Talus slopes and avalanches could all cause a death – what are the effects of a magnitude 3.5 or 4.0 event? How do you know these won't happen even with low probability?

Response:

While the possibility for fatal avalanche or a rockslide on a talus slope can never be ruled out completely for either naturally occurring or human-induced events, the EA does disclose this possibility on p. 137-138. The independent engineering study concluded all geologic units have a low to very low risk of a deep seated landslide during static and minor earthquake loading with PGA's up to 0.1g. Additionally, the EA on p. 130 discusses the increased seismic hazard of induced seismicity from the project and concludes there is essentially no contribution to the probabilistic hazard at La Pine, Sunriver, or at Well NWG 55-29 from EGS seismicity. The relatively low rate of $M \geq 4.0$ induced earthquakes and associated low ground motions result in no differences in the hazard when EGS events are included. Thus, while the possibility of a fatal landslide cannot be entirely ruled out, the increased risk of this occurring as a result of the project is very slight and the decision includes project design features (EA, 66) to minimize the risk.

Comment 32:

This project seems to depend on mitigations and not prevention of seismic events – won't damage occur before the mitigations are in place?

Response:

For the project to succeed, micro-seismic events must be created at low levels, so it is not possible to prevent micro-seismic events altogether. The ISMP is designed to monitor these events and take actions to reduce the likelihood of larger damaging events occurring. This is discussed in the EA starting on p. 60 and in the ISMP as Appendix A to the EA. The ISMP was reviewed by a DOE contracted technical team that found the mitigations to be adequate.

Comment 33:

Who wrote the seismic mitigation plan?

Response

The ISMP was written by AltaRock Energy Inc, one of the proponents, and was reviewed and approved by the Department of Energy (DOE). The DOE has assembled a technical team from experts throughout the US, to review all aspects of this project including the ISMP. Among the members of the technical review team is a representative of the Lawrence Berkeley Lab, who has expertise in induced seismicity based on his work at the Geysers Geothermal field in California.

The National Renewable Energy Lab and Sandia National Lab are also represented on the DOE technical team.

Comment 34:

Wouldn't it be prudent to shut off all flow rather than to gradually decrease flow with events greater than 2.7 why not do it with events that are 2.0? Why wait until an event of 3.5 is detected to stop injection?

Response:

The mitigation actions and trigger levels in the ISMP were designed specifically to allow creation of the EGS reservoir while keeping ground motion below levels that may cause damage to the nearest structures in the NNVM. These levels were analyzed in the EA and Induced Seismic Mitigation Plan and reviewed and approved as part of the ISMP by the DOE and a technical review team of experts throughout the U.S.

Comment 35:

Signs will not stop injury or deaths from falling rocks on the road up to the overlook.

Response:

Appropriate signage will inform people of the potential for rocks on the road or falling rocks so they can drive more cautiously or avoid using the road to the overlook. In any event, as the EA concluded, the risk of landslides or falling rocks from induced seismicity generated by the project is very low (EA, 137).

Comment 36:

Could an induced seismic event in one location trigger a chain reaction through existing faults lines that could spread beyond predicted parameters or even trigger a volcanic eruption?

Response:

Existing friction, imposed by the weight of rock, will prevent the fractures from growing and extending in an uncontrolled way. Only where water pressure is increased by injection at the well will friction be reduced enough to cause fracture stimulation.

Starting at the well, a zone of increased water pressure will relieve the frictional forces on fractures and allow for small slip events, creating an EGS reservoir marked by a cloud of microseismicity. The increased water pressure zone and microseismic cloud will grow as the

stimulation progresses until the EGS reservoir extends 1,500 feet from the injection well. Outside this zone of excess water pressure, the fractures will not slip. When the increased pressure is relieved at the end of the 30 day stimulation, the induced microseismicity in the EGS reservoir will stop.

Monitoring the locations of microseismicity with the seismic network will allow the proponents to map where the fractures have been stimulated. If microseismicity occurs outside the volume approved for stimulation, corrective measures as outlined in the ISMP will be taken (ISMP, Appendix A of the EA).

Other Comments

Comment 37:
The proposal to have weed monitoring visits in June and August for two years is inadequate. Much of the area will not show plant development in June when snow is still likely at many areas. The monitoring should start in June and go thru October. This should go on for 5 years rather than two years. Rehabilitation should be prompt. In the past, the operators have been negligent in this area.

Response:

With further consideration, the Decision will be changed to address this concern by increasing monitoring from three to five years and by including the following language:

Drill rigs, tanker trucks, trailers and any other heavy equipment will be pressure washed in La Pine prior to their first entrance into the project area, and prior to any subsequent entrance after leaving the project area.

The Proponents would be responsible for conducting annual weed monitoring visits to ensure that weeds do not become established on the drilling or MSA sites. If weeds are found, the Proponents would hand-pull them and bag them if flowers or seeds are present. The Proponent would provide the District Botanist and Special Uses Coordinator of the FS a brief annual report that shows compliance with this mitigation.

The Proponents would be responsible for monitoring the area for five growing seasons after the work is done. Weed monitoring would begin the first growing season after the project has been completed; it is strongly encouraged that the monitoring occurs by July 30 rather than later in the summer because the weeds would still be small and not flowering or producing seed, while still being able to find those species that tend to emerge later, such as Russian thistle. The

Proponents would be released from further responsibility for weeds within the project area after the fifth year of monitoring/treatment is concluded.

The annual weed monitoring report will be due no later than September 30, will include descriptions of when they monitored, what weed species, if any, were found, and that they were treated. The report would be submitted to BLM and FS. Hand-pulling will be the treatment. Herbicide application will not be an option for this area, as herbicides have not been approved for use.

Comment 38:

There is no mention of the effects of the Davenport/Altarock project on Mountain goats and wolves which are found in the area. Please provide your analysis of how the activities proposed at Newberry will affect these wildlife species and what mitigation is needed.

Response:

The proposed activities are approximately three miles away from the last known place a mountain goat has been observed and therefore out of the zone of influence. In addition, the mountain goat is not on any of the Regional Sensitive species list or any other wildlife species listings. While wolves have been recently added to the Region 6 sensitive species list, no management direction has been developed to date by the responsible agency which is Oregon Department of Fish and Wildlife. Wolves are limited to a single breeding population in NE Oregon, and the rest of the state is considered dispersal habitat for wolves seeking new territories. Any wolf presence in the project area would be considered transitory and temporary. The project would have no effect on the wolf's ability to pass through the area (Memo from Ben Herndez, Wildlife biologist Bend/Fort Rock District USFS).

Comment 39:

An EIS is needed to fully evaluate the potential cumulative impacts to wildlife that may be caused by roads, sound disturbances, clearing of vegetation, and seismic activity.

Response:

The EA analyzes the direct, indirect, and cumulative effects of all relevant aspects of the project on wildlife and the FONSI summarized that these effects were not expected to be significant (EA pages 92-106, 140-143). The effects to all threatened and endangered species and BLM sensitive species were analyzed and disclosed in the Biological Evaluation (BE). Table 5 summarizes the determinations – only the white-headed woodpecker (*Picoides albolarvatus)* & Lewis' woodpecker (*Melanerpes lewis)* received a MIIH (May impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species) determination, disclosing that resulting impacts could be from potential disturbance from human

presence, traffic, or noise". Impacts are disclosed as "potential" because there are no known nest sites within the vicinity of any of the monitoring or drill sites. In addition there are no known breeding sites and no habitat removal which was the rationale for a no adverse impacts determination. Non-endangered species were analyzed and disclosed in the wildlife report (page 15 for MIS & page 16 for migratory birds). In addition only significant effects trigger the need to prepare an EIS, not a need for additional information.

Comment 40:

The BE acknowledges there are areas near the project that could potentially be suitable habitat for wolverines or fishers, but dismisses them as uninhabitable due to the small size and the amount of recreational activity nearby (EA, 72). Nevertheless, there have been two sightings of fisher near one of the proposed sites. Though the EA further states that fisher are unlikely to inhabit these areas due to the high amount of recreational activity, it cites no sources to support this proposition. Because the fisher is endangered mainly due to loss and fragmentation of habitat from human development, any area that is potential habitat for fisher should be protected from further development. The potential fisher and wolverine presence should be further explored in an EIS because, based on sightings, these areas could be used as wolverine and fisher habitat in the future, and increased human activity could lead to a loss in potential habitat for the wildlife.

Response:

The EA relies on the Biological Evaluation (BE) prepared by the Forest Service that concludes that neither the wolverine nor the fisher is likely to inhabit the proposed site areas because of the high human use of the area and lack of suitable habitat vegetation for these species.

The BE was based on analysis of information regarding potential habitat, known sightings, and areas of habitat undisturbed by human use or activities. There is limited habitat for both species in the project area. That entire potential habitat occurs in areas that receive very high human use (snowmobiles and skiing) during the winter denning periods. As such, none of the habitat is deemed to be suitable. Any sightings of fisher or wolverine would likely be transient animals seeking suitable habitat.

Comment 41:

The increased volume and type of traffic on the roads should be further explored in an EIS because this could have a significant impact on wildlife and the environment. Although there is no need for construction of new roads, increased use of roads by large vehicles may lead to more frequent maintenance. If the roads fall into disrepair from higher traffic levels and are not maintained, there is an increased risk of erosion, landslides, and slope failure.

Response:

The EA identified two categories of activities that raised key issues for evaluating impacts on wildlife: (1) potential habitat loss from vegetation clearing, and (2) disturbance of nesting sites from drilling, testing and stimulation activities and the increase in human disturbance generally (EA, 29). The EA acknowledges that increased traffic could contribute to increased noise disturbance but concludes that such disturbance would have a minor impact on bird species (EA, 94-97). The EA also concluded that increased traffic will be minimal because of the limited scale and duration of the project (EA, 24-5). Forest Service road maintenance standards will apply in order to address any increased risks of erosion, landslides, or slope failure. An EIS is therefore not required to address the issues raised by this comment.

Comment 42:

The effect that "potential noise disturbance" may have on wildlife in the area should be studied further in an EIS because there is a chance that this disturbance could cause a significant impact. The EA does not propose steps to mitigate the noise disturbance issue; it only lists wildlife that may be disturbed by noise from the project (EA, 100-106).

Response:

The EA concluded that the sound level from drilling activities would be 45 dBA at 1/2 mile from the site, equivalent to sound levels in a library or quiet room in a residence (EA, 26). The EA further concluded that there would be no significant noise impacts to bird species of concern because there are no known nesting sites within 1/2 mile of the sites (EA, 94-97). The project design also incorporates seasonal restrictions on drilling if a raptor nest is found with 1/2 mile of any site (EA, 52, 96). An EIS is therefore not required to address this issue.

Comment 43:

While the EA addresses these issues that may affect wildlife separately, it fails to adequately consider the potential cumulative impact that these disturbances could have on wildlife. The EA also recognizes timber harvests and recreational use as additional factors that have an impact on wildlife habitat in the area. EA at 141. The EA summarizes this discussion of cumulative impacts on wildlife by claiming that the proposed project "would slightly decrease the number of acres of habitat without disturbance." EA at 142. This statement is vague and misleading. Exactly how many acres of wildlife habitat will be disturbed by this project?

Response:

The EA concludes that only 0.6 of an acre will be cleared, and that in light of the small loss of vegetation, lack of nesting sites in proximity of drilling sites, and the temporary duration of the project, the EGS project will "not contribute to cumulative impacts to resources in the area." Please see the cumulative effects section of the EA on 141, 143.

Comment 44:

What are the effects to migrating wildlife from the telemetry antennas? Are they the same as high voltage power lines or cell phone towers?

Response:

As described in the EA (p. 112), the antennas will be small, 3 ft. solar battery powered units. Given the low power, size, number and temporary use of the radio antennas, any impact to migrating wildlife would be minimal and no different to that of any other radio usage in the area including cell phones and Citizens' Band (CB) radios.

Comment 45:

The Ogden EA says this area has a high likely hood of Wolverine habitat and is not mentioned in this EA.

Response:

The Ogden EIS states that there is no denning habitat within the project area other than possibly within the Newberry Crater (Ogden EIS p. 166). It goes on to conclude that there would be no direct or indirect effects to wolverines or their habitat. Wolverine use of the area would continue to be limited by the high degree of human recreation use in the Ogden project area and Newberry Crater (Ogden EIS p. 167). This project will not take place within the Newberry Crater, where wolverine denning habitat may exist.

The BE for this project was based on GIS and database analysis of potential habitat, known sightings, and areas of habitat undisturbed by human use or activities. There is limited habitat for wolverines in the project area. That entire potential habitat occurs in areas that receive very high human use (snowmobiles and skiing) during the winter denning periods. As such, none of the habitat is deemed to be suitable. Any sightings of wolverines would likely be transient animals seeking suitable habitat.

Comment 46:

An EIS is required because the effects of geothermal hydroshearing on the environment are highly uncertain and largely unknown. An EIS is required because this project is one of the first of its kind and BLM's 2008 Programmatic EIS on geothermal development states that geothermal hydroshearing will probably not be technically or economically proven for at least twenty years.

Response:

This project is a demonstration project, intended to test the use of enhanced geothermal system (EGS) technology in the geologic conditions found at this site. It is one step in the process for establishing that such technology is technically and economically feasible. Although the project is the first one of its kind in this geographic area, the elements of the technology have been used in other similar demonstration projects. Independent scientists, engineers and experts in the EGS field, as well as specialists from national laboratories and universities have reviewed the proposed project. In addition the Department of Energy (DOE) has assembled a technical team from experts throughout the US, to review aspects of this project. Among the members of the technical review team is a representative of the Lawrence Berkeley National Laboratory, who has expertise in induced seismicity based on his work at the Geysers Geothermal field in California. The National Renewable Energy Laboratory and Sandia National Laboratory are also represented on the DOE technical team. These experts have identified no effects from the proposed project on the human environment that are likely to be scientifically controversial or highly uncertain. The potential environmental effects of the use of that technology at this site can be, and have been, analyzed and evaluated in the EA (EA Ch. 4). There are thus no highly uncertain or controversial effects from the project that would support the need to prepare an EIS.

Comment 47:

An EIS is required because the existence of presumably unknown elements, such as potential size of the fracture system and how much steam it would return, and at what temperature.

Response:

The goal of the project is to create an EGS reservoir with a horizontal breadth of approximately 1,000 feet and at a depth of 6,000 feet in part to provide an adequate buffer for the potential effects of microseismicity at the reservoir site (EA, 55-56). The project design also includes growth, magnitude and shaking limits that, if exceeded, will trigger mitigation measures to address potential problems (EA, 60-64). The project will also follow an Induced Seismicity Mitigation Plan, based on the International Energy Agency's protocol for induced seismicity projects and on the unchallenged technical and scientific analysis of the seismic hazards of this project (EA, 128-129). These analyses and mitigation measures provide a system for managing any uncertainty regarding the potential size of the fracture system and for analyzing the likely environmental effects. Based on the analysis, BLM has found that there is no substantial question as to whether there the proposed project will result in significant effects. Therefore, an EIS is not required.

The amount and temperature of the steam and/or hot water returned from the EGS reservoir are some of the questions the demonstration project aims to answer and are primarily relevant to the economic viability of the technology. A range of temperature assumptions based on models produced from past EGS projects were made in designing the project and these assumptions were used in the analysis within the EA.

Comment 48:

The identification of two action alternatives and the no action alternative is far from the required reasonable range of alternatives. The single alternative proposed by the BLM is virtually identical to the preferred alternative and thus fails to fulfill the agency's duty to proposed and analyze a reasonable range of alternatives. 40 C.F.R. § 1502.14. The BLM states that this lone alternative was designed to address the specific issues of "water usage and the visual impact from the steam plume." EA, at 49. Thus, the BLM has admittedly failed to propose or consider alternatives that would "avoid or minimize adverse" the many other effects of the proposed project will have on the environment. BLM must develop an EIS that considers a reasonable range of alternatives accounting for the various impacts from the project including but not limited to lowering the water table, depleting groundwater supplies, inducing seismicity, and disturbing wildlife, in addition to the impacts on recreational and scenic values. This will require the development and study of alternatives proposing projects of different sizes, scopes and locations that will have different impacts.

Response:

The EA must evaluate a reasonable range of alternatives that respond to the purpose and need for the proposed project, including the no action alternative. The EA evaluated the no action alternative and two action alternatives: (1) Alternative A, the project as designed and proposed, and (2) Alternative B, a modified project using closed pressure vessels and air cooled condensers to reduce water usage and moisture content of the steam plume (EA, 33-52). The EA also identified one additional alternative (using Pad S-16 instead of Pad S-29), which was rejected as infeasible because the well at Pad S-16 was obstructed downhole indicating an unstable formation at depth and a compromised well bore (EA, 68). BLM is required to develop sufficient alternatives to address unresolved conflicts concerning the use of resources so as to provide a rational basis for its decision-making. The EA considered an alternative that provided options for addressing two key issues raised in the scoping process, water usage and scenic values. It was not possible to develop an alternative to address different levels of induced seismicity as a lesser amount of induced seismicity would not create the fractures necessary to meet the purpose and need for the Project. The wildlife concerns were addressed by project design features so it was not necessary to design an alternative around those concerns.

Comment 49:

BLM never analyzed the no action alternative.

Response:

The EA contains analysis of the no action alternative. The analysis noted that the no action alternative would require denial of approval of the project and presented a comparative chart of the relative impacts of each alternative with respect to the key issues that showed that the no

action alternative would not have any impacts (EA, 69). The EA also concluded that the no action alternative would not make "cumulatively considerable" contribution to cumulative impacts because the project would not go forward (EA, 146).

Comment 50:

What are the impacts from venting H2S (hydrogen sulfide) and other non-condensable gases?

Response:

On p. 27, the EA explains that because the vented steam would be heated groundwater injected from the surface and not naturally occurring geothermal steam traditionally found in conventional hydrothermal geothermal systems, it is anticipated H2S concentrations would be minimal (1 ppm or less) if detectable at all. Nonetheless, H2S monitoring and abatement equipment will be on site for use during well testing. Continuous abatement of H2S emissions would be applied if measured concentrations and flow rates were to indicate an emission rate greater than 5 lb. /hr., an industry standard H2S emission limit originally established by the Northern Sonoma County Air Pollution Control District (NSCAPCD) in 1980 to ensure emissions from geothermal power plants in the Geysers geothermal field in California did not violate ambient air quality standards[1]

Comment 51:

What are the effects of Paulina creek being listed as a wild and scenic river?

Response:

Paulina Creek would not be impacted by the project. An independent hydrologist review concluded the radius of influence (amount of water level drawdown as one moves away from the well) was small enough and the distance of the well to Paulina Creek far enough, that pumping of the project groundwater well would not impact the creek (EA, 120). The Forest Service felt the Outstanding Remarkable values for which Paulina Creek was nominated would not be diminished from this project.

Comment 52:

What are the carbon differences between the two alternatives – water versus diesel emissions?

Response:

The BLM routinely does not address carbon emissions in project level EA or EIS, carbon emissions are calculated at the RMP level. The EA indirectly address the difference in carbon

[1] Morris, W.F. and Stephens, F.B., Strategies for Steam Handling and H2S Abatement at Geothermal Power Plants in The Geysers Area of Northern California, Lawrence Livermore National Laboratory, 1981, p.11

emissions between the alternatives in noting Alternative B would use an additional 15,600 gallons of diesel fuel (EA, 50). Analysis of Alternative A—Proposed Action, determined there would be no net loss of water to the Deschutes river basin (EA, 120).

Comment 53:

The effects of noise would disturb recreational visitors.

Response

Effects from Noise Levels were analyzed in the EA (p.26). The EA concluded the project would have minimal noise effects due to the short-term nature of the activities and the remote location with respect to noise sensitive locations. This area of the Forest has unnatural noises generated thru thinning and other Forest management activities and is not within designated wilderness.

Comment 54:

Why wasn't recreation users abandonment analyzed for this project due to drill rigs and steam plumes?

Response

The most direct impact to recreation from the project will be the impact to winter recreation because of plowing the roads for winter access. This is discussed on p.53 of the EA. Proposed design features to minimize winter recreation impacts are discussed on p.54 of the EA. While it is possible that certain recreational users would choose a different area to visit as a result of the project, and the associated drill rigs and steam plumes the overall impact would be limited by the relatively small scope and short duration of the project.

Comment 55:

What is the methodology used for determining visual absorption?

Response

Visual Absorption Capability (VAC) is based on the capability of a landscape to accept alteration without losing its inherent visual character. A number of physical and perceptual factors affect the VAC of an area including landform diversity, aspect relative to the viewer, slope, aspect, potential soil color contrast, erosion hazard ratings and soil stability, vegetation type, vegetation height and density, and fire. The VAC inventory was refined by orthophoto interpretation. This is detailed on p. 6 of the Scenic Resources Inventory and Assessment conducted for the project referenced on p. 73 of the EA.

Comment 56:

How is it possible that this project is compliant with the Forest Plan direction and scenic management objectives? What is the analysis that supports this statement?

Response:

Conformance to Land Use Plans and the Deschutes National Forest Plan (LRMP) specifically is discussed in detail on p. 16 of the EA. Forest management goals reflect a vision for all Forest resources including a goal to "provide for exploration, development, and production of energy resources on the Forest while maintaining compatibility with other resource values." (LRMP p. 42). Additional sections of the plan relating to the project are cited on p. 16 and 17 of the EA. BLM also completed a visual resource report for the project.