Appendix B

LOCATABLE MINERAL RESOURCES— REASONABLY FORESEEABLE DEVELOPMENT SCENARIOS

B.1 INTRODUCTION

B.1.1 Purpose

The purpose of the reasonably foreseeable development (RFD) scenarios presented in this appendix is to provide a prediction of the level and type of reasonably foreseeable future locatable mineral exploration and development that could occur in the proposed withdrawal area. A predicted level of activity is first prepared for the No Action Alternative (Alternative A, Section B.8.1). The resulting development scenario is then adjusted based on the constraints of each alternative (Sections B.8.2 through B.8.4) and provides a uniform set of assumptions about reasonably foreseeable future locatable mineral exploration and development. These activity assumptions, in conjunction with existing conditions, serve as the basis for the impact assessment of each alternative as presented in Chapter 4 of the environmental impact statement (EIS). The RFD is by its nature speculative in attempting to predict future types and levels of locatable mineral exploration and development. The important feature of the RFD is not its numeric accuracy when it comes to the number of drill holes, ore tonnage, mines, or acres, but rather that it uses consistent assumptions to portray the relative levels of reasonably foreseeable future actions across the alternatives.

The RFD analysis is organized first with a discussion of provisions contained in the General Mining Law of 1872 (Mining Law), the legal framework under which mineral exploration and development occur in the study area (Section B.2). This is followed by an outline of the steps involved in developing a mineral deposit, beginning with the existing regulatory framework (Sections B.3 and B.4). Current activity levels are profiled (Section B.5), followed by an assessment of development potential (Section B.6) and future trends and assumptions for commodity markets, technology, and legal frameworks (Section B.7). Finally, predictions regarding the anticipated mineral exploration and development are presented, along with likely variation by EIS alternative (Section B.8). A summary of the RFD analysis for each alternative is included in Section B.9, along with a summary of all assumptions used to develop this analysis.

B.1.2 Scope

An RFD scenario is a prediction based on the known or inferred locatable mineral resource capabilities of the lands in the proposed withdrawal area using a set of assumed future economic, regulatory, and legal conditions. As such, it is subject to change as additional mineral resource data become available or as the economic, regulatory, and/or legal circumstances change. While historic mine development can give some idea of future development, there are other factors that affect the pace of future development. The pace of future development may not mimic that of the past because of changing prices or markets (see the subsection under B.8.1 on uncertainty factors), changing technologies that may improve exploration success, or the possibility of being able to improve mining success by building on information collected through exploration in years past. These factors contribute to a different assumed future development pattern than was experienced in the past.

The scope of this RFD analysis incorporates only locatable minerals; salable and leasable resources are not considered because they would not be subject to the proposed withdrawal. The mineral development

scenarios presented within this analysis address only locatable minerals. The mineral commodity dominating activity is uranium, specifically uranium that occurs within breccia pipe deposits. Other precious metals and rare earth metals could be recovered from breccia pipe deposits concurrent with uranium mining, including gold, silver, copper, and vanadium. However, recovery of these additional metals has historically been secondary to uranium recovery, and the economic value from recovery of these metals is assumed to not be sufficient to drive mine development. Therefore, uranium resources are used in this analysis as the major indicator of mining activity.

The types of land included in the RFD scenarios are focused on federal surface and federal minerals administered by the Bureau of Land Management (BLM) and U.S. Forest Service (Forest Service), as well as split-estate lands. Activities on private or state lands are discussed where applicable.

B.1.3 Study Area

A complete description of the proposed withdrawal area boundaries, geology, and mining history can be found in Chapter 3 of the EIS. The proposed withdrawal area consists of three parcels: the North Parcel, which consists of 549,995 acres on the Kanab Plateau; the East Parcel, which consists of 134,454 acres in the House Rock Valley; and the South Parcel, which consists of 322,096 acres of the Kaibab National Forest south of the Grand Canyon.

Uranium mineralization was first discovered in the breccia pipes of northern Arizona in 1947. The uranium occurred in association with copper mineralization at the Orphan mine 2 miles west of the visitor's center on the South Rim of the Grand Canyon (not within the proposed withdrawal area). The first uranium ore was shipped by the Golden Crown Mining Company in 1956 to a buying station in Tuba City, Arizona. Before closing in 1969, the Orphan operation produced a reported total of 2,200 tons processed uranium (U_3O_8).

Since the discovery of uranium in the Orphan Mine, extensive fieldwork has been conducted by government and private concerns to define the spatial extent of the breccia pipes in northern Arizona. This work has included ground and airborne geophysical surveys, mapping of rock exposures in the deep canyons of the area, mapping on aerial photos, shallow and deep drilling, electric logging in drill holes, laboratory analysis of drill core, and 2- and 3-dimensional computer modeling. In addition, subsurface data have been obtained from observations and measurements taken in the historic underground mines.

The recognition of a relationship between uranium and copper mineralization sparked an investigation of several small copper deposits in the region. Uranium was identified in the Hack Canyon copper mine on the Arizona Strip in the 1950s but it was not until 1974, when Western Nuclear discovered uranium ore bodies in the Hack 1 and Hack 2 breccia pipes, that industry began to focus attention on the emerging district. Energy Fuels Nuclear Inc. (Energy Fuels Nuclear) acquired the Hack Canyon ore bodies in 1980 and initiated an intense campaign of land acquisition and exploration that uncovered seven ore bodies over the next 10 years. With the entrance of Pathfinder Mines and Union Pacific Resources, at least three additional mineralized breccia pipes were added to the discoveries in northern Arizona.

From the 1950s through the 1990s, 10 breccia pipes were developed or mined for uranium ore within the proposed withdrawal area. The history of development for these mines is shown in Table B-1. Until the 1980s, the only mine producing uranium within the proposed withdrawal area was the original Hack Canyon Mine, which had ceased production in 1964. Additional pipes were discovered in Hack Canyon in the 1970s, and production from these breccia pipes began in 1981. Exploration uncovered six other breccia pipes with minable uranium ore during the early and mid-1980s, and production from these mines began with the Pigeon mine in 1984. By the end of 1990, all uranium production from the proposed withdrawal area had ceased. Six mines were considered mined out and were closed or reclaimed (the four

Hack Complex pipes, Pigeon, and Hermit). Four other mines were placed under interim management; two of these had been partially mined (Kanab North and Pinenut), while the other two had never been put into production (Canyon and Arizona 1). Arizona 1 remained under interim management until resuming production in late 2009.

Table B-1. Historical Mine Development within the Proposed Withdrawal Area

	Discovered	Development	Production	Interim Management	Reclamation	Reactivated
Pigeon	1980	1982–1984	1984–1989	N/A	1989	N/A
Kanab North	1981	1984–1987	1988–1990	1992	N/A	
Hack Complex (Original pipe)	1900s	N/A	For uranium: 1950–1954, 1964	N/A	1987–1988	N/A
Hack Complex (Hack 1)	Mid-1970s	unknown	1981–1987	N/A	1987–1988	N/A
Hack Complex (Hack 2)	Late 1970s	unknown	1981–1987	N/A	1987–1988	N/A
Hack Complex (Hack 3)	Late 1970s	unknown	1982–1987	N/A	1987–1988	N/A
Hermit	1986	1987–1988	1989	N/A	1990	N/A
Pinenut	1982	1984–1986	1987–1989	1989	N/A	N/A
Canyon	1982	1984–1986	N/A	early 1990s	N/A	N/A
Arizona 1	Unknown	unknown	N/A	early 1990s	N/A	2009

During the 1980s, it appears to have taken from three to seven years following discovery of a breccia pipe to begin production of uranium. From 1981 through 1989, between three and five mines appear to have been active at any one time, with peak production appearing to be in 1987, as shown in Table B-2.

Table B-2. Historical Number of Mines Concurrently in Production in the Proposed Withdrawal Area

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Pigeon				×	×	×	×	×	×	
Kanab North								×	×	×
Hack 1	×	×	×	×	×	×	×			
Hack 2	×	×	×	×	×	×	×			
Hack 3		×	×	×	×	×	×			
Hermit									×	
Pinenut							×	×	×	
Number of Mines in Production	2	3	3	4	4	4	5	3	4	1
Approximate Price of Uranium ($/lb)*	$23	$20	$21	$18	$17	$18	$18	$15	$10	$10

* Available at: <http://www.mongabay.com/commodities/price-charts/price-of-uranium.html>.

While other types of uranium deposits occur within northern Arizona and southern Utah, no other geological type of uranium deposit is known to be located within the proposed withdrawal area. Therefore, the RFD scenarios focus on the exploration and mining of breccia pipe uranium deposits.

B.2 MINING LAW OF 1872

The General Mining Law of 1872 [30 United States Code (USC) 22–54] authorizes citizens to stake or "locate" mining claims on federal lands. Only minerals considered "locatable" are subject to appropriation under the Mining Law. Locatable minerals include metallic minerals (gold, silver, lead, uranium, etc.), nonmetallic minerals (fluorspar, asbestos, mica, gemstones, etc.), and certain "uncommon variety" minerals.

There are two types of mining claims: lode and placer. Lode claims are generally located on indurated bedrock, whereas placer claims are usually located on loosely consolidated materials, such as mineral-bearing sands and gravels. Mining claims associated with uranium-bearing breccia pipe deposits are lode claims.

Mining claimants establish valid mining claims by making a "discovery" of a valuable mineral deposit and complying with all other applicable statutory and regulatory requirements, such as posting a notice of location at the discovery point and marking the claim on the ground to ensure that the claim boundaries are readily identifiable. A valid mining claim gives the claimant the right to possess and develop the mineral deposit. This right has to be exercised consistent with all applicable state and federal environmental protection requirements.

Only lands that are open to mineral entry are available for the location of new mining claims. This means that no new mining claims may be located after lands are segregated or withdrawn from location and entry under the Mining Law. A segregation or withdrawal is made "subject to valid existing rights." Mining claimants may continue to hold and develop valid mining claims that predate the segregation or withdrawal, subject to all applicable statutes and regulations.

B.3 REGULATORY FRAMEWORK

The BLM and the Forest Service have promulgated surface management regulations governing mining operations conducted under the Mining Law, including exploration and development related to the breccia pipe uranium deposits in the proposed withdrawal area. Operators on BLM lands must comply with the regulations at 43 Code of Federal Regulations (CFR) 3809, as well as the use and occupancy regulations at 43 CFR 3715. Operators on National Forest System lands must comply with the regulations at 36 CFR 228A. In addition, operators must comply with all other federal, state, and local laws and regulations.

B.3.1 Federal Surface Management Regulations

BLM classifies operations on public lands in one of three categories:

- casual use, involving non-mechanized activity for which an operator need not notify the BLM;
- Notice-level exploration operations, for which an operator must submit a Notice; and
- plan-level operations, for which an operator must submit a plan of operations and obtain BLM's approval before undertaking any activity.

Exploration activities typically can occur under a Notice, provided that surface disturbance totals less than 5 acres, activities involve removal of less than 1,000 tons of presumed ore, and activities do not fall within certain special management areas, including Areas of Critical Environmental Concern, Wilderness Areas, areas closed to off-road use, and habitat for proposed or listed threatened and endangered species. The BLM does not approve a Notice, although the operator is still required to comply with the performance standards and the bonding requirements described in the following section.

Mining and mine development activities, regardless of size, require that a plan of operations be submitted to the BLM and approved before any activity can be undertaken. Plans of operation provide detailed information on the operator, a description of the operations, a reclamation plan, a monitoring plan, and an interim management plan in the event that operations are halted temporarily.

The Forest Service has a similar classification; however, the distinction between a Notice of Intent and a plan of operations is at the discretion of the District Ranger. Under Forest Service regulations a Notice of Intent is submitted to the District Ranger, who then determines whether the proposed operations would cause significant disturbance of surface resources. The Forest Service then notifies the operator whether a plan of operations is required before the proposed activity can be undertaken.

The Forest Service and BLM permitting processes do not negate or supersede other state or federal permitting processes. Applicants must comply with all other federal and state laws and regulations prior to development of any mine. These additional permits are described in detail later in this section. In addition, the federal permitting agencies themselves are required to comply with the National Environmental Policy Act (NEPA), and the required environmental analysis is part of the overall BLM or Forest Service permitting process. Both agencies also require validity exams before approving plans of operation on withdrawn lands.

Performance Standards

The BLM performance standards are divided into two types—general and specific performance standards. These performance standards apply to casual use activities, Notices, and plans of operation. The basic performance standard is the prevention of unnecessary or undue degradation. Operators must prevent unnecessary or undue degradation while conducting operations on public lands by operating in accordance with the requirements in 43 CFR 3809.415(a–c). As defined in 43 CFR 3809.5, unnecessary or undue degradation means conditions, activities, or practices that

- fail to comply with one or more of the performance standards in 43 CFR 3809.420, the terms and conditions of an approved plan of operations, operations described in a complete Notice, and other federal and state laws related to environmental protection and protection of cultural resources;
- are not "reasonably incident" to prospecting, mining, or processing operations as defined in 43 CFR 3715.0–5; or
- fail to attain a stated level of protection or reclamation required by specific laws in areas such as the California Desert Conservation Area, Wild and Scenic Rivers, BLM-administered portions of the National Wilderness System, and BLM-administered National Monuments and National Conservation Areas.

To prevent unnecessary or undue degradation, operators must comply with the performance standards in 43 CFR 3809.420; follow their accepted Notice or approved plan of operations; and comply with other federal and state laws related to environmental protection and protection of cultural resources.

The regulations [43 CFR 3809.420] establish procedures and standards to ensure that operators and mining claimants meet their responsibility to prevent unnecessary or undue degradation of the land and reclaim disturbed areas. The standards are generally outcome-based and do not contain specific design or operational requirements for operations. The general performance standards require that operators

- use appropriate technology and practices,
- undertake activities in a logical sequence,
- comply with the applicable BLM land use plan,
- take any mitigation measures as specified by BLM,

- conduct proper and appropriate reclamation activities, and
- comply with all pertinent state and federal laws.

The specific performance standards address issues related to

- the planning, construction, and use of access routes;
- disposal of mining wastes;
- reclamation;
- disposal of solid wastes;
- prevention of adverse impacts to fisheries, wildlife, and related habitat;
- prevention of disturbance, alteration, or destruction of cultural and paleontological resources;
- protection of survey monuments;
- fire prevention and suppression;
- the handling and treatment of acid-forming and toxic materials;
- the operation, design, and construction of leaching operations; and
- the maintenance and safety of structures and equipment.

In addition to meeting the performance standards, all activity conducted under a Notice or plan of operations must be reasonably incident to prospecting, mining, or processing operations and uses, as defined in 43 CFR 3715.0–5. This means that even the best-managed activity cannot be conducted under the 3809 regulations if the activity is not related to mineral exploration or development.

Forest Service regulations [36 CFR 228.8] require that all operations, where feasible, shall be conducted to minimize adverse environmental impacts on National Forest System surface resources, including the following:

- Air quality, including compliance with applicable federal and state air quality standards, including the requirements of the Clean Air Act.
- Water quality, including compliance with applicable federal and state water quality standards, including regulations issued pursuant to the federal Water Pollution Control Act.
- Solid wastes, including compliance with federal and state standards for the disposal and treatment of solid wastes. All garbage, refuse, or waste shall either be removed from National Forest System lands or disposed of or treated to minimize its impact on the environment and the forest surface resources. All tailings, dumpage, deleterious materials, or substances and other waste shall be deployed, arranged, disposed of, or treated to minimize adverse impacts on the environment and forest surface resources.
- Scenic values. The operator shall harmonize operations with scenic values through such measures as the design and location of operating facilities, including roads and other means of access, vegetative screening of operations, and construction of structures and improvements that blend in with the landscape.
- Fish and wildlife habitat. In addition to compliance with water quality and solid waste disposal standards required by this section, the operator shall take all practicable measures to maintain and protect fish and wildlife habitat that may be affected by the operations.
- Roads. Operator shall construct and maintain all roads to ensure adequate drainage and to minimize or, where possible, eliminate damage to soil, water, and other resource values.
- Reclamation. Upon exhaustion of the mineral deposit or at the earliest practicable time during operations, or within 1 year of the conclusion of operations, unless a longer time is allowed by the authorized officer, the operator shall, where practicable, reclaim the surface disturbed in

> operations by taking measures that will prevent or control on- and off-site damage to the environment and forest surface resources.

Monitoring Plan

Among other things, the plan of operations pursuant to 43 CFR 3809 must include a monitoring plan. The purpose of monitoring is to

- demonstrate compliance with the plan of operations and other federal or state laws and regulations,
- provide early detection of potential problems, and
- supply information to assist in directing corrective actions.

For each resource to be monitored, the respective monitoring plan must describe the following:

- Type and location of monitoring devices,
- Sampling parameters and frequency,
- Analytical methods,
- Reporting procedures, and
- Procedures for responding to adverse monitoring results.

Reclamation Requirements

All operators on BLM administered lands are required to reclaim disturbed areas in accordance with the performance standards and their reclamation plans. Reclamation is defined in 43 CFR 3809.5 as follows:

> Reclamation means taking measures required by this subpart following disturbance of public lands caused by operations to meet applicable performance standards and achieve conditions required by BLM at the conclusion of operations. For a definition of "reclamation" applicable to operations conducted under the mining laws on Stock Raising Homestead Act lands, see part 3810, subpart 3814 of this title. Components of reclamation include, where applicable:
>
> 1) Isolation, control, or removal of acid-forming, toxic, or deleterious substances;
> 2) Regrading and reshaping to conform to adjacent landforms, facilitate revegetation, control drainage, and minimize erosion;
> 3) Rehabilitation of fish or wildlife habitat;
> 4) Placement of growth medium and establishment of self-sustaining revegetation;
> 5) Removal or stabilization of buildings, structures, or other support facilities;
> 6) Plugging of drill holes and closure of underground workings; and
> 7) Providing for post-mining monitoring, maintenance, or treatment.

On Forest Service lands, reclamation specifically requires the following [36 CFR 228.8]:

- Control of erosion and landslides;
- Control of water runoff;
- Isolation, removal, or control of toxic materials;
- Reshaping and revegetation of disturbed areas, where reasonably practicable; and
- Rehabilitation of fish and wildlife habitat.

Enforcement Provisions

At any time, the BLM may inspect operations on BLM lands. An inspection may include any physical aspect of the operation, including all structures, equipment, and workings located on public lands. An inspection may also include an examination of any pertinent files the operator may have related to the permitting of the operation and the storage of chemicals and supplies. Permits, approvals, and authorizations that are subject to verification include any documents issued or required by local, state, or federal authorities that are, or may be, required for lawful operation.

The BLM can issue various types of enforcement orders if an operator does not meet the requirements of the surface management regulations. The BLM may issue enforcement orders under either 43 CFR 3809 (noncompliance, or suspension) and/or 43CFR 3715 (immediate suspension, cessation, or notice of noncompliance).

On Forest Service lands, forest officers shall periodically inspect operations to determine whether the operator is complying with the regulations and an approved plan of operations [36 CFR 228.7]. If an operator fails to comply with the regulations or the approved plan of operations, the authorized officer shall serve a notice of noncompliance on the operator or his or her agent in person. Such notice shall describe the noncompliance and shall specify the action with which to comply and the time within which such action is to be completed, generally not to exceed 30 days.

B.3.2 Arizona State and Other Requirements

The following additional permits may be required for the mine site:

- Air Quality Permit from the Arizona Department of Environmental Quality (ADEQ);
- Aquifer Protection Permit (APP) from ADEQ;
- U.S. Army Corps of Engineers Section 404 Permit;
- Arizona Pollutant Discharge Elimination System (AZPDES) Permit from ADEQ;
- Compliance with National Emissions Standards for Hazardous Air Pollutants, in accordance with the U.S. Environmental Protection Agency (EPA) Region 9;
- Arizona Department of Water Resources (ADWR) well permit for production wells and most exploratory boreholes;
- Septic system permit from ADEQ; and
- Right-of-way or road maintenance permit from Mohave County or Coconino County.

ADEQ and ADWR regulate many activities associated with locatable minerals mining, including many activities associated with breccia pipe uranium mining operations. ADEQ has authority related to the potential discharge of contaminants to the vadose zone and aquifer, administered under the APP program. ADEQ also has authority over potential migration of contaminants by stormwater, administered under the AZPDES program. ADEQ, along with EPA, also is responsible for issuance of air quality permits related to mining activities that may discharge contaminants to the air.

ADWR has authority over the drilling and proper abandonment of most exploration holes, the drilling and construction of wells, and the use of groundwater; however, in the proposed withdrawal area there are no specific state requirements for obtaining groundwater rights, other than that the groundwater be put to beneficial use.

The state permitting process typically occurs on a separate yet concurrent track from approval of the plan of operations by the BLM or Forest Service. Both the BLM and Forest Service require that operators

comply with all applicable federal, state, and local environmental protection requirements as a condition of maintaining the approved plan of operations.

A full list of the federal, state, and local permits typically required in order to develop a uranium mine is included in Attachment B-1.

B.3.3 Notice and Notice of Intent Review Process

Within 15 days of receiving a Notice, the BLM will advise the operator either that the Notice is complete or what information is required to complete the Notice. The BLM will advise the operator of any measures that must be incorporated into the Notice in order to prevent unnecessary or undue degradation. The operator may not begin operations until the required reclamation financial guarantee is received and accepted by the BLM.

Similarly, upon receipt the Forest Service will review a Notice of Intent and notify the operator whether a plan of operations is required to be filed or whether the activity can proceed under the Notice of Intent.

B.3.4 Plan of Operations Approval Process

The plan of operations approval process is summarized in Figure B-1. Upon receipt, the plan of operations is reviewed for completeness. A completeness review involves identifying any additional data that the operator must provide to allow assessment of impacts or any commitments that must be made by the operator to minimize adverse environmental impacts on National Forest System surface resources and eliminate unnecessary or undue degradation on BLM administered lands. Guidance and authorities used during the completeness review process include the Federal Land Policy Management Act, conformance with the appropriate resource management plan or forest plan, surface management regulations [43 CFR 3809 and 36 CFR 228A], and internal agency guidance documents. The deficiencies identified during a completeness review are enumerated to the proponent, who then revises the plan of operations as appropriate and resubmits it to the agency for another completeness review. The cycle of completeness review by the agency, with subsequent modification of the plan of operations by the applicant, continues until the application is declared “complete.”

After a complete application is received, the environmental analysis is prepared, in accordance with NEPA requirements. Depending on the anticipated impacts of the proposal, this may be either an environmental assessment (EA) or an EIS.

BLM regulations provide a minimum 30-day public comment period on all plans of operation. This is usually done at the same time as public review of the environmental analysis.

After the environmental analysis is complete and the public comments have been considered, the agency issues its decision. Any operating or reclamation requirements determined necessary to prevent unnecessary or undue degradation and to comply with the performance standards are required as conditions of approval. A reclamation bond amount is calculated based on an engineering evaluation of what it would cost the agency to reclaim the operation as described in the approved reclamation plan. The bond must be posted before ground-disturbing activity can begin. Amendments to existing plans of operation are processed in a similar manner.

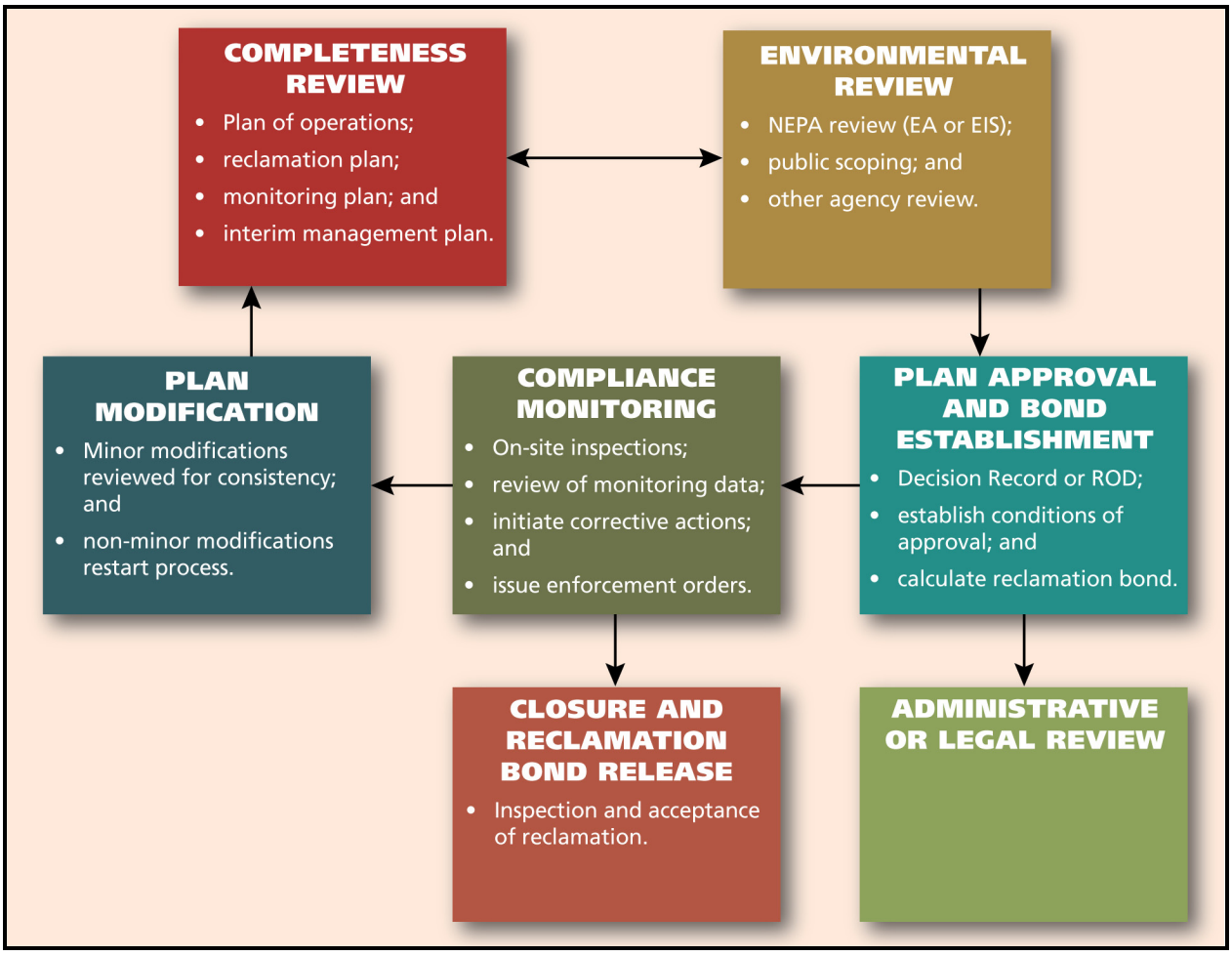

Figure B-1. Plan of operations approval process diagram.[1]

B.4 DEVELOPMENT OF A URANIUM MINE

The development of a breccia pipe uranium deposit from exploration to production can be divided into seven stages. Each stage requires the application of more discriminating (and more expensive) techniques over a successively smaller land area to identify, develop, and mine an economic mineral deposit. The full sequence of mine development involves the following stages:

- appraisal of a large region,
- reconnaissance of selected parts of the region,
- detailed surface investigation of a target area,
- three-dimensional physical sampling of the target area,
- development of the mine infrastructure,
- actual production, and
- mine reclamation.

[1] ROD = Record of Decision.

These can be grouped into five categories: reconnaissance, prospecting, exploration, mine development, and reclamation. A diagram showing the relationship between these various stages in the life of a uranium mine is shown in Figure B-2.

B.4.1 Reconnaissance

Reconnaissance-level activity is the first stage in exploring for a breccia pipe mineral deposit. This activity involves initial literature search of an area of interest using available references such as publications, reports, maps, aerial photographs, etc. The area of study can vary from hundreds to thousands of square miles.

Historically, the first breccia pipe deposits discovered by prospectors in northern Arizona were mainly identified as a result of their exposure by erosion along the walls of canyons incised into the Colorado Plateau and by the easily noticed presence of oxidized minerals within the breccia pipe. Later, geologists recognized that even where not exposed by erosion, breccia pipes often exhibit surface expression because of the collapse, deformation, or tilting of overlying sedimentary formations.

Reconnaissance activity that typically takes place in the present day includes large-scale mapping, regional geochemical and geophysical studies, and remote sensing with aerial photography or satellite imagery. The type of surface-disturbing activity typically associated with reconnaissance-level mineral inventory includes stream sediment, soil, or rock sampling. Minor off-road vehicle use may be involved, in accordance with local off-road travel restrictions. This activity would normally be considered casual use and not require a Notice, Notice of Intent, or plan of operations.

B.4.2 Prospecting

Through data uncovered during reconnaissance, stemming from anomalous geochemical or geophysical readings or unique geological structures or features, the occurrence of typical mineral-bearing formations, or a historical reference to past mineral occurrence, the prospecting area of interest is identified. Whereas with other locatable minerals, the area of prospecting could include large areas or even entire mountain ranges, for breccia pipes the prospecting area is typically limited to the suspected location of an individual breccia pipe, typically covering a few hundred acres.

Activities that take place in an effort to locate a breccia pipe include more detailed mapping, sampling, and geochemical and geophysical study programs. This is the time when most mining claims are located in order to establish primacy rights over any discovered breccia pipe uranium deposits against other potential operators.

A system of reconnaissance/prospecting specifically for breccia pipes is described in Wenrich (1992). The process typically starts with photogeological interpretation of color aerial photographs at a scale of 1:24,000. This step of the process focuses primarily on identifying circular features for further field investigation; however, aerial photographic interpretation is cautioned as not being adequate to identify the presence of a breccia pipe because of the large number of other geological features, such as karst-related depressions, that look similar. Based on the preliminary photographic interpretation, a low-level aerial survey is conducted to further refine the potential target list.

A final step in reconnaissance is field investigation of targets in order to specifically look for markers or indicators of a possible breccia pipe, including the presence of concentric, inward-dipping beds; bleached or limonite-stained rock; brecciated rock or mineralized rock; and circular or topographic anomalies. Types of surface-disturbing activity associated with prospecting involve more intense soil and rock chip sampling using mostly hand tools, frequent off-road vehicle use, and placement and maintenance of

Figure B-2. Mine life cycle diagram.

mining claim monuments. This activity is normally considered "casual use" and does not require BLM or Forest Service notification or approval unless it requires off-road travel in a closed area. Off-road travel may require a Notice, Notice of Intent, or plan of operations, depending on the specific circumstances.

Advances in remote-sensing technology have created new avenues for reconnaissance-level activities. In 2007, a survey was conducted by Quaterra Resources, Inc., using a technology known as Versatile Time Domain Electro-Magnetics (VTEM). VTEM is an aerial survey that identifies variations in the electrical conductance of geological formations; it is estimated that up to 70% of targets identified using this technique may be breccia pipes (personal communication, Spiering 2010c, 2010e).

B.4.3 Exploration

Upon location of a sufficiently anomalous mineral occurrence or favorable occurrence indicator, a mineral prospect is established and is subjected to more intense evaluation through exploration techniques. Activities that take place during exploration include those used during prospecting but at a more intense level in a smaller area. Typically for a breccia pipe deposit, activities include drilling of exploratory drill holes. For a prospective breccia pipe, exploratory drill holes (usually less than 600 feet deep) are drilled in order to identify the "throat" of the breccia pipe. Deeper boreholes (up to several thousand feet deep) are then advanced, and drill core samples obtained in order to determine the level and extent of mineralization at depth within the breccia pipe. Historically, drilling has been required to confirm the presence and mineralization of a breccia pipe; this may change in the future as new exploration and remote sensing techniques are perfected.

The disturbance associated with individual drill sites is typically limited to the area immediately surrounding the drill rig. Usually, access to drill sites can be accomplished by using existing roads and overland travel and does not involve road or drill pad construction or excavation. In some cases, construction of new temporary access roads is required, including blading and clearing of vegetation; these access roads are typically no greater than 12 feet wide. Overall, the surface disturbance associated with a typical exploration project amounts to less than 2 acres and can usually be accomplished under a BLM Notice or a Forest Service Notice of Intent, although in some cases, such as exploration in Areas of Critical Environmental Concern (BLM-administered lands), a plan of operations would be required instead. Upon completion of exploration activity, the drill holes are plugged and any surface disturbance is reclaimed. Reclamation for exploration sites is typically implemented within the same field season.

B.4.4 Mine Development

If exploration results show that an economically viable mineral deposit may be present, activity will intensify to obtain detailed knowledge regarding resources, possible mining methods, and mineral processing requirements. This involves applying all the previously used exploration tools in a more intense effort. Once enough information is acquired, a feasibility study would be conducted by the mine claimant to decide whether to proceed with mine development and which mining and ore processing methods would be used.

Once the decision to develop the property is made, the mine permitting process begins. Upon obtaining all necessary federal, state, and local permits, including the approval of a mining plan of operations, work begins on development of the mine infrastructure. All breccia pipes that have been historically mined within or near the proposed withdrawal area have used underground workings. The surface footprint of these mines is typically less than 25 acres. Further, all processing of uranium ore has historically occurred at a central processing facility, and this is expected to continue. No processing facilities would be located at the mine sites, and ore would be hauled off-site. Because of the decentralized nature of breccia pipe deposits, ore would be hauled by truck.

Waste rock may or may not be stockpiled at the surface during active mining activities. Waste rock is rock containing less than the minimum amount of uranium required for economical transport and processing. Auxiliary activities at the mine sites might include well construction, both for monitoring and as water for dust control, sanitation, and drilling blast holes for underground development. No water would be used for processing uranium ore on-site. Evaporation ponds would be constructed to contain any water produced by the mine, as well as to contain any rain water falling on the mine site from draining to the undisturbed land outside the mine's exterior boundaries. Off-site surface disturbance typically would be limited to the construction of haul roads. During the initial phases of construction, power would be provided by on-site generators and later by power lines.

As described in Section B.8.1.8, there are many uncertainty factors that could change the length of this phase of the life of a uranium mine, including permitting delays, a larger or smaller ore body, or an operator choosing to temporarily suspend production and operate under the interim management plan contained in the mine's approved plan of operations.

Interim Management

All approved mining plans of operation on BLM-administered lands contain an interim management plan that specifies the measures to be taken in the event of an extended period of non-operation before mining is completed. The actions to be taken under the interim management plan usually depend on the length of non-operation, which is typically categorized as short term (a few months to a year) or long term (more than a year). Actions to be taken are meant to stabilize the excavation and workings, isolate and contol toxic or deleterious materials, store or remove equipment, supplies, or structures, maintain the project area in a safe and clean condition, and monitor site conditions. Typical short-term and long-term interim management actions are described below.

TYPICAL SHORT-TERM INTERIM MANAGEMENT

A short shutdown of a few months to a year would require only limited action. In this case, a few employees may be kept at the mine site for repair and maintenance work, and a watchman may reside at the mine site. All inventory items that may deteriorate in a year's time, such as explosives, oil, gas and first-aid, supplies, would be used or removed from the mine site. Hardware, such as nuts, nails, and pipe fittings, would be secured in place. Hazardous materials at the mine site would be secured with locks in the shop building or warehouse. All equipment would be checked, and most of it would be stored in the shop building or in the mine working. Ventilation fans, electric lines, and transformers would be left in place. Steel gates on the mine shaft would be closed and locked.

All stockpiles above economic grade would be shipped to a mill for processing or maintained at the site. There would likely be some stockpiles of low-grade ore that would also be maintained at the mine site during short-term interim management. Measures would be taken to ensure that the development rock pile would be stabilized if necessary.

Monitoring would occur during the period of short-term interim management. The mine facilities area, buildings, mine shaft, vent holes, roads, evaporation ponds, and surrounding fencing would be inspected on a biannual basis. Maintenance of facilities and stabilization structures and controls would occur at the mine site following inspection activities and would be reported in annual reports. In addition, all permits would be maintained during closure and permit conditions would be adhered to.

TYPICAL LONG-TERM INTERIM MANAGEMENT

In the event of non-operation for more than a year, a different procedure would be followed. Nearly all mobile equipment and a portion of the fixed equipment would be removed from the mine site. Fans would

be removed and the ventilation shaft capped with perforated steel plates welded in place to allow natural ventilation but prevent access to the workings. The buildings, headframe, and hoist would be left in place but secured and maintained in the same manner as for short-term interim management. All hazardous materials would be removed from the site and disposed of in accordance with state and federal regulations.

Like with short-term interim management, all stockpiles above economic grade would be shipped to a mill for processing or maintained at the site. There would likely be some stockpiles of low-grade ore that would also be maintained at the mine site during long-term interim management. Measures would be taken to ensure that the development rock pile would be stabilized if necessary.

Similar monitoring would occur during the period of long-term interim management. The mine facilities area, buildings, mine shaft, vent holes, roads, evaporation ponds, and surrounding fencing would be inspected on a biannual basis. Maintenance of facilities and stabilization structures and controls would occur at the mine site following inspection activities and would be reported in annual reports. In addition, all permits would be maintained during closure and permit conditions would be adhered to.

If operations are inactive for 5 consecutive years, the BLM will review the operations and determine whether the BLM should terminate the existing plan of operations and direct final reclamation and closure. If the BLM determines that operations are abandoned, they may initiate forfeiture under 43 CFR 3809.505. If the amount of the financial guarantee is inadequate to cover the costs of reclamation, BLM may complete the reclamation, and the operator and all other responsible persons are liable for the costs of such reclamation.

B.4.5 Mine Closure and Reclamation

Upon completion of, or concurrent with, mining, the property will be reclaimed. Permanent reclamation typically involves the backfilling of waste rock into the mine, sealing of the mine to re-establish subsurface hydraulic gradients and prevent mine drainage, dismantling and removal of infrastructure or equipment, revegetation of the mine site and haul roads, and long-term monitoring of reclamation success (Denison 2010). Once monitoring shows that the reclamation criteria established for a particular operation have been met, the reclamation financial guarantee may be reduced or released following a public comment period. Reclamation success typically takes several seasons to confirm after seeding or planting. Although time frames can be longer for mines under standby mode and operating under interm plans of operation, a typical mine site may be disturbed for 5 to 7 years. Under interim plans of operation, some interim seeding and reclamation could be required.

Several mines that operated in the 1980s have completed reclamation: the Hermit, Pigeon, and Hack Canyon mines. These mines were reclaimed in accordance with the reclamation critieria established in their respective plans of operation. Since then, recent U.S. Geological Survey (USGS) studies (USGS 2010) have identified levels of uranium in remnants of ore or waste rock on the reclaimed surface that exceed background levels.

B.5 CURRENT EXPLORATION AND MINING ACTIVITIES

Hundreds, if not thousands, of breccia pipes are likely to exist within the proposed withdrawal area; the majority of these are undiscovered. Historically, the presence of a breccia pipe can only be confirmed by actual drilling and usually only by drilling deep enough to identify the presence of breccia below the lower horizon of the Toroweap Formation. Within the proposed withdrawal area, to date, only about 45

breccia pipes have met this level of demonstration. These known breccia pipes fall into several categories, as summarized in Table B-3:

- Historic breccia pipes that have already been mined out,
- Historic breccia pipes with development and remaining uranium resources,
- Breccia pipes where no development has occurred but for which uranium resources have been estimated,
- Breccia pipes where some level of mineralization has been identified but for which uranium resources have not been documented, and
- Breccia pipes for which no sufficient data are available for determining the level of mineralization.

Many of the breccia pipes for which the presence of uranium resources have been confirmed were discovered and explored during the peak of northern Arizona uranium production in the 1980s, as described in Section B.1.3. With the exception of Arizona 1, these breccia pipes have remained undeveloped and unmined. A mining company's decision to develop or mine a breccia pipe is based on a number of factors, including uranium prices and the level of certainty about future conditions. As shown in Table B-2, part of the curtailment of mining by the end of the 1980s was due to a declining trend in commodity values. As prices have risen over the past decade, exploration activities have increased as well; however, with the exception of the resumption of mining in Arizona 1, no new breccia pipes have been developed or mined, partially as a result of the uncertainty of price and regulatory conditions.

Table B-3. Drill-confirmed Breccia Pipes within the Proposed Withdrawal Area

Breccia Pipe Name	Mined Out	Developed, with Resources Remaining	Mineralized and Unmined, with Resources Estimated	Mineralized and Unmined, with Resources Not Estimated	Undetermined
North Parcel					
A01				×	
A20				×	
Arizona 1		×			
Clearwater				×	
DB			×		
EZ-1			×		
EZ-2			×		
Findlay Tank NW			×		
Findlay Tank SE			×		
Gump				×	
Hack 1	×				
Hack 2	×				
Hack 3	×				
Hermit	×				
John				×	
June					×
Kanab North		×			
L. Robinson				×	
Lisa				×	
Lost Calf				×	
Ollie				×	
Peace				×	

Table B-3. Drill-Confirmed Breccia Pipes within the Proposed Withdrawal Area (Continued)

Breccia Pipe Name	Mined Out	Developed, with Resources Remaining	Mineralized and Unmined, with Resources Estimated	Mineralized and Unmined, with Resources Not Estimated	Undetermined
North Parcel, continued					
Pigeon	×				
Pinenut		×			
Rim			×		
Smuggler					×
Sunshine					×
UPR					×
Weap					×
What			×		
Subtotal	*5*	*3*	*7*	*10*	*5*
South Parcel					
Airport				×	
Auto				×	
Bank					×
Bank East					×
Black Box				×	
Butte NE				×	
Canyon		×			
New Year				×	
Otto 4				×	
Peterson Flat					×
Sayer					×
Shale				×	
Tap 2					×
Tap East				×	
Subtotal	*0*	*1*	*0*	*8*	*5*
East Parcel					
House Rock				×	
Subtotal	*0*	*0*	*0*	*1*	*0*
Total All Parcels	**5**	**4**	**8**	**19**	**10**

Source: personal communication, Spiering (2010a).

Located mining claims do not necessarily have any association with an actual breccia pipe, and even if they do correspond to an actual breccia pipe, only a fraction of the breccia pipes are mineralized (and even fewer to an extent that is economically viable for mining). Approximately 3,350 mining claims (as of August 2011) exist within the three proposed withdrawal parcels. Many times, mining claims are filed based on indirect evidence of locatable minerals; exploration, being more expensive, typically proceeds only for mining claims for which there is reasonable evidence that a breccia pipe exists.

It should be noted that the information presented in Table B-3 does not reflect any ongoing analysis of a specific mining claim's valid existing rights, nor does the use of these data for the purposes of this analysis presume or supersede any determination of valid existing rights through the normal administrative process, which occurs independent of the RFD analysis and the EIS. The data presented here should in no way be construed to infer valid existing rights for any specific claim. Rather, the purpose of presenting these data is to give an idea, based solely on the overall composition of mining

claims and using professional judgment and knowledge, of breccia pipes that may represent targets for future mining proposals.

B.6 MINERAL POTENTIAL

Two factors are assessed in order to determine the mineral potential of an area: occurrence potential and development potential. Occurrence potential is the likelihood of the presence of locatable minerals, regardless of administrative, geographic, or economic constraints on development. Development potential is the ability to physically access and mine those deposits. In the proposed withdrawal area, there are few geographic constraints on the development of breccia pipes. Even where geographically unfavorable (i.e., canyons or steep slopes), the mine site can be located elsewhere and the ore bodies can be developed by lateral techniques.

Occurrence potential for uranium within the proposed withdrawal area has been detailed previously by Finch et al. (1990). The entire proposed withdrawal area is included in "Favorable Area A," which is the area that has the highest level of development potential for uranium. Similarly, based on the criteria set forth in the BLM Manual 3031, the mineral potential classification for uranium is high occurrence with high level of certainty throughout the entire proposed withdrawal area. The geological environment, reported mineral occurrences and/or geochemical/geophysical anomaly, and known mines/deposits indicate a high potential for uranium resources. Available data provide abundant direct and indirect evidence to support the possible existence of mineral resources.

Based on historic discoveries and mine development, the North Parcel is considered to be the most prospective, followed by the South Parcel and then the East Parcel (BLM 2010). Thirty confirmed breccia pipes occur on the North Parcel; five of these have already been mined out, and three have been developed or are currently being mined. Fourteen confirmed breccia pipes occur on the South Parcel; none of these have been mined, and only one has been developed. The East Parcel contains only a single confirmed breccia pipe.

Development potential is also tied to the regulatory process. Development of a breccia pipe requires compliance with all federal, state, and local laws and regulation, which includes obtaining BLM or Forest Service approval on federal lands and agency completion of environmental analysis under NEPA. Some permitting, such as permitting for dredge and fill under Section 404 of the Clean Water Act, is highly site-specific and may increase the difficulty of developing a specific breccia pipe. A full list of required permits for mine development is included in Attachment B-1.

B.7 FUTURE TRENDS AND ASSUMPTIONS

B.7.1 Commodities of Interest

The scope of this RFD analysis incorporates only locatable minerals; salable and leasable resources are not considered because they would not be subject to the proposed withdrawal. The primary mineral commodity of interest in the area will continue to be uranium. Other precious metals and rare earth metals could be recovered from breccia pipe deposits concurrent with uranium mining, including gold, silver, copper, and vanadium. However, values from recovery of these metals are assumed to not be sufficient to drive mine development.

B.7.2 Commodity Markets

The economics of mining in the proposed withdrawal area will continue to be driven by the relationship between uranium production costs and market price. While production costs can be controlled or anticipated through management and technology, the significant unknown factor will continue to be the price of uranium. The overall profitability of an operation, and hence the level of activity at the prospecting, exploration, and mining phases, for development of breccia pipes will be closely related to the price of uranium.

Uranium has been subject to constant variations in price, supply, and demand over the past half-century as a result of several factors, including the amount of uranium supplies worldwide, dollar value, and energy demand. Figure B-3 illustrates the relationship between uranium requirements (or demand, represented by the blue line) and uranium production (or supply, represented by the red line). The peak production of uranium occurred around 1979–1980.

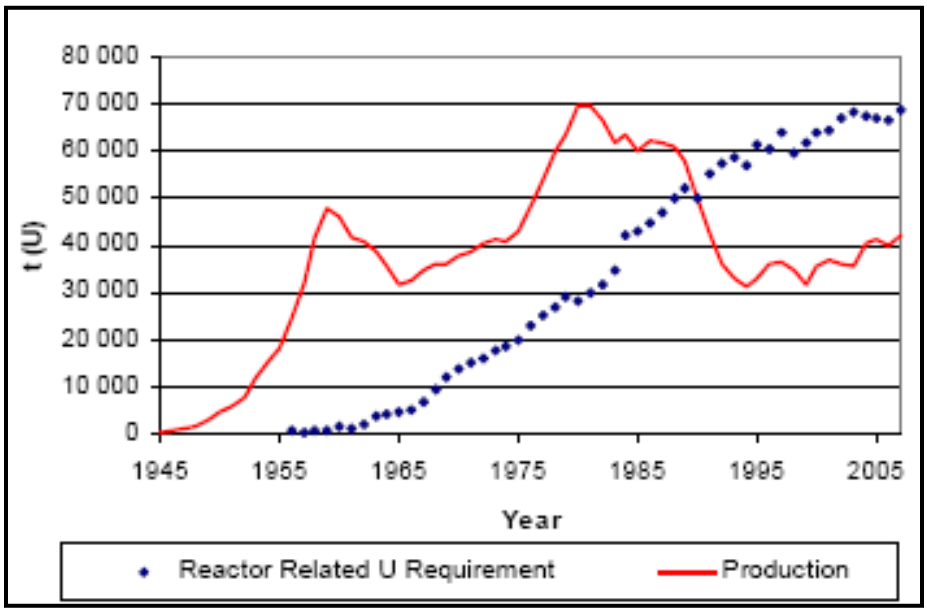

Figure B-3. Worldwide annual production and reactor-related requirements (1945–2005) (Source: International Atomic Energy Agency 2009).[2]

Worldwide uranium demand has climbed steadily since the 1950s, more recently leveling off at approximately 70,000 tons of uranium per year. Annual uranium production far exceeded uranium demand until about 1990. Since 1990, driven by a collapse of uranium commodity prices (see Figure B-3), production has been significantly less than demand; worldwide, uranium stockpiles produced before 1990, rather than current production, are being used to fully meet uranium demand.

Figure B-4 displays uranium prices (U.S. dollars per pound [$/lb]) on the spot market over the past 15 years. Uranium prices throughout the 1990s remained low, less than $20/lb, following the collapse of uranium commodity prices in the 1980s and the influx of various stockpiled sources of uranium into the marketplace, including weapons-grade enriched uranium from the former Soviet Union and U.S.-held government stockpiles. Only since 2003 have uranium prices risen. The peak in 2007 was driven largely by global speculation, and prices have since settled to approximately $40/lb.

[2] U = uranium.

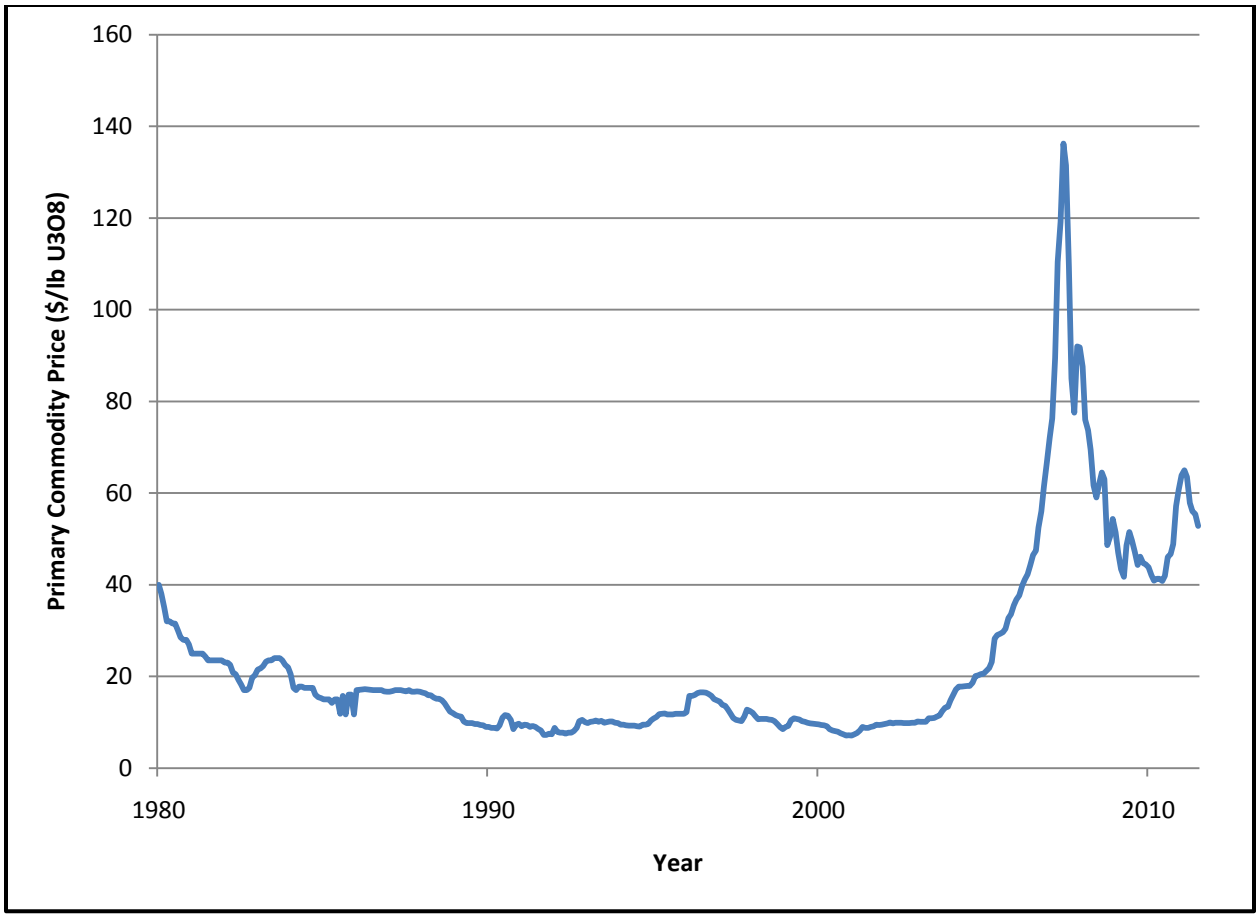

Figure B-4. Historical uranium market prices (U.S. dollars per pound) (Source: International Monetary Fund 2011).

It should be noted that the spot market may not be an accurate indicator of long-term contract prices for uranium, which are what determine the economics of mining specific breccia pipe ore bodies. For the purposes of the RFD scenarios, it is assumed that uranium prices will remain above this level. Historically, price changes have been the primary reason for mining companies to operate under interim management; therefore, based on the assumption that prices will remain above this level, the mines considered in the RFD are not likely to operate under interim management.

The approach of assuming a floor for uranium commodity prices equal to current levels was considered appropriate because this price level is relatively conservative and therefore does not overestimate the economic impacts of mining based on short-term price spikes, and because at this price it is known that mining uranium in breccia pipe deposits is economically viable. While the exact dollar amount for uranium is not expected to remain constant over the next 20 years, the assumption is that prices would generally remain sufficient to support mining operations. Given potential changes in demand, supply, and unforeseen world events, exact price changes simply cannot be predicted with any degree of accuracy.

In the past, uranium prices have been subject to wide fluctuations, as seen during the speculative period that peaked in 2007, when spot prices reached $140/lb and long-term prices approached $100/lb. During the previous 20 years, long-term and spot prices were around $10/lb. The RFD assumes that prices will remain constant at current levels for the next 20 years. Prices play a critical role in the extent to which uranium deposits are developed in the United States and in other parts of the world. Relatively higher prices would be anticipated to stimulate additional mining, from both new and existing mines. Additional

production would be expected to act as a moderating force on additional price increases. Deviations from this assumption could affect several parts of the RFD, such as the total number of mines and the total uranium mined, which would then carry through to the evaluation of impacts. This in turn would drive greater differences in development between alternatives.

One of the drivers of uranium prices is world supply, both from producing uranium mines and secondary stockpiles. The top five uranium producers (Kazakhstan, Canada, Australia, Namibia, and Russia) accounted for 75% of world supply in 2008 and 85% in 2009 (World Nuclear Association 2010a). The United States produces about 3% of world supply. An increase in production by the top producers would be expected to put downward pressure on prices. These changes would affect the other impacts described in the EIS. For example, reduced mining activity may lead to reduced impacts under the No Action Alternative, such as fewer particulate matter emissions, less disturbance of habitat and cultural, historical, or Indian resources, and less displacement of recreation activity. This in turn reduces the differences between the No Action Alternative and any of the action alternatives (B, C, or D).

Total world uranium production met 68% of demand in 2008, and 76% in 2009 (World Nuclear Association 2010a); demand in excess of supply can be expected to bid up prices. Plans for new reactors could also increase demand and bid up prices. As of October 2010, the United States had 104 operable reactors, with one more reactor under construction, and nine planned and 22 proposed over the next 20 years. Worldwide, there were 441 reactors operable in October 2010, with 58 more under construction, and 152 planned and 337 proposed over the next 20 years (World Nuclear Association 2010b). This increase in demand may be met by current supply, or it may outstrip supply and bid up prices.

B.7.3 Technology

In general, advances in technology can improve mineral exploration and development success. With respect to exploration, advances in geophysical and geochemical survey methods, tools, and procedures will continue as more and better equipment is made available. The effect of these advances will be a more accurate and rapid evaluation of regional and local areas, with better discrimination of target areas and a more accurate assessment of a deposit's potential. With respect to mining and mineral processing efficiency, improvements in technology, coupled with experience, can decrease costs, partially offsetting declines in commodity markets or allowing for lower cutoff grades when identifying potential ore deposits.

With respect to breccia pipe uranium deposits, such changes may not be a major factor in identifying new deposits since northern Arizona breccia pipe deposits are not marginal in terms of percent uranium, being already higher in grade than 85% of uranium deposits worldwide. Where uranium mineralized deposits exist, they can be classified as either minable or not, without having to rely on anticipated improvements in technology.

B.7.4 Industry Mining and Milling Capacity

Underground mining of uranium requires a high degree of specialized expertise, a large capital investment in equipment and infrastructure, and available mill capacity for processing of ore. Although multiple companies are actively pursuing exploration associated with breccia pipe uranium deposits in the proposed withdrawal area, only a single company is currently engaged in actual mining activities. Because of the high degree of specialization and overhead, there is unlikely to be a large number of companies actively engaged in mining activities at any one time.

Furthermore, the average life span of a breccia pipe uranium mine is relatively short, generally lasting only about 5 years from development through operations and reclamation. Investing large amounts of

capital in redundant equipment is not economically viable when existing equipment can be effectively moved from mine to mine after only a few years of operation. The inherent economic limitations in the uranium industry will tend to limit the concurrent development of mines. This limitation is discussed in more detail under Alternative A.

B.7.5 Legislative Changes

There are several areas of legislative change that may affect how the hardrock mineral resources in the proposed withdrawal area are developed. The first is the ongoing effort to amend, repeal, or reform the Mining Law. This could result in anything from simply leaving it as is to a complete restructuring into a leasing royalty system similar to what is now used for coal or oil and gas. The effect of major changes in the Mining Law on mineral activity in the proposed withdrawal area, while uncertain, would likely be a decrease in the amount of exploration activity and hence mine development, at least in the short term, as operators adjust to the new requirements. A perhaps more extensive effect would be a decrease in the ultimate number and size of mines that could be developed if a royalty on mineral production created a corresponding increase in operating costs, raising the cut-off ore grade. For the purposes of this analysis, it is assumed that the Mining Law would not be changed significantly, the right of self-initiation would be maintained, and there would be no federal royalty system imposed. It is also assumed that while the exploration and mine review and approval process would continue to receive greater scrutiny and legal challenge, claimants or operators would still be able to obtain the necessary approvals.

Changes in the way mining property and production are taxed could also have a substantial effect on the viability of individual operations. No changes in state tax schedules are anticipated. In this analysis, it is assumed that there will be no federal royalty.

Changes in state environmental permitting through ADEQ, ADWR, and EPA could also have a substantial effect on the viability of individual operations. No major change to the present state regulatory framework is anticipated.

B.8 FUTURE LOCATABLE MINERAL EXPLORATION AND DEVELOPMENT

Estimates of reasonably foreseeable future locatable mineral exploration and development are presented below for each alternative, starting with the No Action Alternative. These projections include estimates of the following:

- Number of mines,
- Amount of exploration activity,
- Miles of new roads,
- Miles of power lines,
- Number of haul trips,
- Acreage of surface disturbance, and
- Water use.

The time frame used for the projection of future mineral activity is 20 years. This is for several reasons: first, the Proposed Action (Alternative B) is for a 20-year withdrawal (the limit of the Secretary's withdrawal authority), and using this time period allows for a direct comparison between alternatives; and second, the longer the time frame used for analysis purposes, the more speculative and less reliable the

projections of future activity. However, it should be noted that activity of the same type and rate may proceed beyond the 20-year time frame.

B.8.1 Alternative A: No Action (No Withdrawal)

The notice of proposed withdrawal segregated the locatable minerals in the study area, preventing the location and entry of any new mining claims for a period of 2 years (July 21, 2009 to July 21, 2011); the subsequent emergency withdrawal extended this for an additional 6 months, to January 20, 2012. Under Alternative A, the No Action Alternative, the lands would again be open to location of new mining claim upon termination of the emergency withdrawal. Mineral exploration and development on any existing or new mining claims would proceed under the applicable BLM or Forest Service regulatory requirements.

Future Locatable Mineral Exploration and Development

The number of potential mines can be grouped into five categories, similar to those shown in Table B-1:

- Mines that are currently operating under approved plans of operation;
- Mines that may be developed from known mineralized breccia pipes with reliable estimated uranium resources,
- Mines that may be developed from known mineralized breccia pipes where uranium resources have yet to be estimated,
- Mines that may be developed from known breccia pipes for which the level of mineralization has yet to be determined, and
- Mines that may be developed from breccia pipes that are currently undiscovered.

Currently Approved Mines

Three mines within the proposed withdrawal area (Pinenut, Kanab North, and Canyon) were approved in the late 1980s. These mines still contain uranium resources but are operating under the interim management plans contained in their approved mining plans of operation and are not currently producing uranium ore. An additional mine, Arizona 1, was approved and developed in 1988, but no ore was mined until late 2009. Pinenut, Kanab North, and Arizona 1 are located within the North Parcel, while Canyon is located within the South Parcel. The Kanab North mine holds an approved plan of operations, with some remaining uranium resources. For purposes of this RFD scenario, it is assumed that the Kanab North mine would resume ore production. Development work at the Canyon mine included sinking of the main shaft approximately 50 feet before the operator decided to begin operating under the interim management plan contained in its approved mining plan of operations.

- Assumption: All four mines with approved plans of operation will resume production under the proposed withdrawal.

Known Mineralized Breccia Pipes with Estimated Uranium Resources

A further 26 confirmed breccia pipes within the proposed withdrawal area are known to have some level of mineralization (see Table B-3). Of these, seven have been confirmed to have uranium resources. Uranium reserve estimates have been officially published for the EZ-1 and EZ-2 breccia pipes (Scott Wilson Mining 2009); uranium reserve estimates for the remaining five breccia pipes (DB, Findley NW, Findley SE, Rim, and What) were reportedly conducted internally by Energy Fuels Nuclear and are considered preliminary (personal communication, Spiering 2010a). For the purposes of this analysis, it is

assumed that under Alternative A, these breccia pipes would be mined. All seven breccia pipes with estimated uranium resources are located within the North Parcel.

- Assumption: The seven breccia pipes with estimated uranium resources will be mined under the proposed withdrawal.

Known Mineralized Breccia Pipes with No Estimate of Uranium Resources

Uranium resources have reportedly not been calculated for the remaining 19 confirmed mineralized breccia pipes shown in Table B-3 (personal communication, Spiering 2010a). The presence of mineralization is not a guarantee of significant uranium resources (typically considered to be resources with more than 50 tons U_3O_8). Previous research suggests that less than 10% of mineralized breccia pipes might be economically viable (Weinrich and Sutphin 1988); further discussions with industry experts (personal communication, Hefton 2010; personal communication, Pillmore 2010a; personal communication, Spiering 2010b; personal communication, Turner 2010) did not lead to a refinement of this assumption.

For the purposes of this analysis, it is assumed that 15% of these known mineralized breccia pipes could be economical to mine; a discussion of the use of this assumption is included later in this section under Undiscovered Uranium Reserves. This yields an additional three breccia pipes (i.e., 15% of the 19 mineralized breccia pipes) that probably would be mined. It is assumed that of the three breccia pipes, two would be located in the North Parcel and one would be located in the South Parcel.

- Assumption: An additional 19 breccia pipes are confirmed to be mineralized.
- Assumption: An estimated 15% of mineralized breccia pipes contain minable amounts of uranium, yielding a total of three mines resulting from the 19 confirmed mineralized breccia pipes under the proposed withdrawal.

Known Breccia Pipes with Undetermined Mineralization

Only a fraction of breccia pipes contain significant levels of mineralization, and only a fraction of these mineralized breccia pipes contain economically viable quantities of uranium ore; however, a reasonable percentage for this assumption is difficult to obtain. In addition to a review of available literature, discussions were undertaken with industry experts in an attempt to ascertain a reasonable value. Three possible values are presented below; it should be noted that the industry experts consulted believe that this is a difficult number to know with any accuracy.

- Previous research has suggested that perhaps only 8% of breccia pipes contain mineralization, and, as previously noted, that perhaps only 10% of mineralized breccia pipes might be economically viable (Weinrich and Sutphin 1988). This suggests that approximately 1 out of every 100 undetermined breccia pipes might eventually be suitable for mining.
- One industry expert suggested a range: perhaps 1 to 5 out of every 100 breccia pipes might yield an economic ore body (personal communication, Hefton 2010).
- A third approach was suggested that used published data to estimate percentages. Different estimates of the number of breccia pipes have been published for various portions of northern Arizona. The most comprehensive inventory of breccia pipes across the northern Arizona region comes from Wenrich and Sutphin (1989). Wenrich and Sutphin (1989) mapped 1,296 breccia pipes across much of northern Arizona, inclusive of the proposed withdrawal area. Historically, in this same area there have been 14 breccia pipes mined (or developed with plans to be mined). These include, from 1951–1969, the Orphan, Hack Canyon, Ridenour, Chapel, and Riverview mines, and during the 1980s, the Hack 1, Hack 2, Hack 3, Hermit, Pinenut, Kanab North, Arizona

1, Pigeon, and Canyon mines. These data suggest that there is approximately 1 productive mine for every 100 identified breccia pipes.

Based on these estimates, for the purposes of the RFD scenarios, it assumed that 1 out of every 100 discovered breccia pipes could eventually be mined; however, as with any such predictive approach, there is considerable uncertainty. This estimate may not be indicative of future conditions should other variables change, such as a drastic up- or downturn in the uranium market.

In the case of the 10 confirmed breccia pipes within the proposed withdrawal area whose level of mineralization has yet to be determined (see Table B-3), for the purposes of the RFD analysis, it is unlikely that any of these breccia pipes would be mined.

- Assumption: An additional 10 breccia pipes are confirmed within the proposed withdrawal area, but it is not known whether they are mineralized or not.
- Assumption: An estimated 1% of all breccia pipes contain minable amounts of uranium, yielding no mines resulting from the 10 confirmed breccia pipes under the proposed withdrawal.

Undiscovered Uranium Resources

Numerous estimates of the amount of uranium resources have been calculated for portions of northern Arizona over the past three decades. The most recent of these studies was conducted by the USGS specifically for the proposed withdrawal area in order to support the analysis of a potential withdrawal (USGS 2010).

The 2010 USGS estimate focused on the undiscovered uranium endowment; the term uranium endowment is defined as the uranium occurring in rock that exceeds 0.01 percent grade U_3O_8. Note that uranium amounts are typically referred to as "tons U_3O_8," which refers to the amount of processed uranium a mine can yield. The actual ore that must be removed from the mine and taken to the mill is much greater; for northern Arizona breccia pipes, the amount of ore that must be removed is typically 100 to 200 times the amount of processed uranium, depending on the ore grade. The 2010 USGS estimate is primarily based on a USGS study completed in 1990 (Finch et al. 1990). The 1990 study ranked various areas within northern Arizona for favorability for breccia pipe uranium deposits; the entire proposed withdrawal area is within the zone termed "Favorable Area A," which is the area of highest favorability for uranium deposits.

The 1990 estimate of uranium endowment was based on a well-studied control area of 141 square miles termed the "Hack-Pinenut" control area (located within the North Parcel of the proposed withdrawal area). The USGS reviewed borehole data collected during drilling and development, as well as uranium reserve estimates from Energy Fuels Nuclear, the sole company producing uranium in the area during the 1980s. Based on an understanding of the Hack-Pinenut control area, probabilities of breccia pipe size, density, and ore grade were extrapolated to the rest of the northern Arizona study area. The 1990 USGS report estimated 112.4 tons U_3O_8 existed per square mile. The 2010 USGS report adjusted this number based on discrepancies in area calculations, with a result of 96.6 tons U_3O_8 per square mile.

Applied to the 1,689 square miles of the proposed withdrawal area, this yields an estimated undiscovered uranium endowment of 163,380 tons U_3O_8 (USGS 2010). This estimate was further divided by USGS into undiscovered uranium endowment under existing claims and undiscovered uranium endowment not under existing claims; this subdivision was arrived at solely by applying the percentage of the proposed withdrawal surface area covered by existing claims. The 2010 USGS estimated undiscovered uranium endowment is shown in Table B-4.

The 1990 estimate of resources within the Hack-Pinenut control area included a statistical assessment of the likely uranium endowment within the area; the estimate of 96.6 tons U_3O_8 per square mile (and thus the estimate of 163,380 tons U_3O_8 for the proposed withdrawal area as well) is based on the statistical average of estimated uranium endowment within the Hack-Pinenut control area. A statistical range was also calculated during the 1990 estimate in order to provide the bounds of the 90% confidence interval. In other words, there is a 90% probability that the real-world uranium endowment will be within this range. Applied to the proposed withdrawal area, there is a 90% probability that the undiscovered uranium endowment will be between 42,900 tons U_3O_8 and 339,000 tons U_3O_8 (personal communication, Otton 2010a). The average value of 163,380 tons U_3O_8 reflects the statistically most likely value for the undiscovered uranium endowment, based on the available data. This relatively large range reflects the inherent uncertainty involved in estimating the undiscovered uranium endowment.

Table B-4. Estimated Undiscovered Uranium Endowment*

Proposed Withdrawal Parcel	Undiscovered Uranium Endowment under Existing Claims (tons U_3O_8)	Undiscovered Uranium Endowment Not under Existing Claims (tons U_3O_8)	Total Undiscovered Uranium Endowment (tons U_3O_8)
North	45,808	46,136	91,944
East	425	21,832	22,257
South	14,403	34,776	49,179
Total	**60,636**	**102,774**	**163,380**

Source: USGS (2010:Chapter A, Table 8).

* It should be noted that since the 2010 USGS report was prepared, the number of claims in the proposed withdrawal area has decreased considerably and the distinction between claimed and unclaimed lands is no longer applicable.

As noted above, the 2010 USGS estimate of uranium resources within the proposed withdrawal area focuses specifically on the uranium "endowment," a term explicitly defined as the uranium occurring in rock that exceeds 0.01 percent grade U_3O_8. The uranium endowment would consist of mineralized breccia pipes, but these are not necessarily breccia pipes with uranium grades that are economical for mining. Historically, the percent grade of uranium from ore bodies that have been or could be mined ranges from 0.53% to 1.08%, as shown in Table B-5.

Table B-5. Percent Ore Grade for Existing and Historic Mines

Proposed Withdrawal Parcel	Mine	% Uranium of Ore
North	Arizona 1	0.68
	Pigeon	0.643
	Hack 1	0.530
	Hack 2	0.704
	Hack 3	0.504
	Hermit	0.760
	Kanab North	0.53
	Pinenut	1.02
South	Canyon	1.08

Source: personal communication, Spiering (2010a).

As mentioned previously, research suggests that less than 10% of mineralized breccia pipes might be economically viable (Weinrich and Sutphin 1988); further discussions with industry experts (personal communication, Hefton 2010; personal communication, Pillmore 2010a; personal communication, Spiering 2010b; personal communication, Turner 2010) did not lead to a refinement of this assumption.

Whereas historically, ore grades mined from the proposed withdrawal area have been greater than 0.5% U_3O_8, this is not necessarily the case for future uranium mines. Based on estimates of ore grade for the mines with currently approved plans of operation and other known mineralized breccia pipes, ore grades as low as 0.23% U_3O_8 are expected to be mined. The 10% estimate referenced above was increased to 15% to account for the lower grades of uranium that might be economically mined today, compared with those mined in 1988. A 2009 industry report by the American Clean Energy Resources Trust (ACERT) estimated that the average size of a typical breccia pipe uranium deposit is 3 million pounds U_3O_8 (ACERT 2009; personal communication, Spiering 2010b). Five mines in the proposed withdrawal area have been fully depleted of their uranium ore, or at least to the extent to which mining is economically feasible: Hack 1, Hack 2, Hack 3, Hermit, and Pigeon. The uranium ore bodies in these mines ranged from approximately 552,000 pounds U_3O_8 (Hermit) to approximately 7 million pounds U_3O_8 (Hack 1), with an average of approximately 3.1 million pounds (personal communication, Spiering 2010a). Based on these historic data, it appears that the 2009 ACERT estimate of 3 million pounds U_3O_8 (1,500 tons U_3O_8) for a typical breccia pipe ore body is reasonable. The number of mines that could be proposed to extract the entire estimated undiscovered economically viable uranium resource (i.e., 15% of the endowment) is shown in Table B-6.

Table B-6. Estimated Number of Mines Required to Extract Undiscovered Uranium Endowment

Proposed Withdrawal Parcel	Total Undiscovered Economically Viable Uranium Resource* (tons U_3O_8)	Number of Mines†
North	13,792	9
East	3,339	2
South	7,377	5
Total	**24,508**	**16**

* Assumed to be 15% of the undiscovered uranium endowment.

† Based on average of 1,500 tons U_3O_8 per typical breccia pipe ore body, rounded.

- Assumption: The USGS has estimated that the statistical average uranium endowment (greater than 0.01 percent ore grade) within the proposed withdrawal area is 163,380 tons U_3O_8.
- Assumption: Only a portion of the uranium endowment would be economical to mine. This portion has been estimated in the past at 10%, but was increased to 15% to account for likely lower ore grades being economical to mine than was the case historically. This yields 24,508 tons U_3O_8 as yet undiscovered within the proposed withdrawal area.
- Assumption: Based on the historical average amount mined per breccia pipe, a typical breccia pipe mine would yield 1,500 tons U_3O_8.
- Assumption: Based on these conditions, the undiscovered uranium endowment would yield 16 mines.

Industry Limitations on Active Mines

Given an unlimited time frame and favorable economic conditions, it could be assumed that almost all economically viable uranium could eventually be mined from the proposed withdrawal area. However, the large number of mines needed to do so could not occur all at once, nor would they all occur over the 20-year time frame of the present analysis. Rather, the normal industrial cycle would tend to restrict the number of mines in production at any one time, based on market economics, available equipment, personnel, and expertise.

The mining industry has prepared an estimate of the economic impacts of mines within the proposed withdrawal area (ACERT 2009). The 2009 ACERT report proposes that a typical mine has a 5-year life cycle: planning and permitting (1 year), development (1 year), production (2 years), and reclamation (1 year).

The 2009 ACERT report estimated the number of mines likely to occur within northern Arizona over a 42-year period, based on a 5-year life cycle and the assumption that no more than six mines would ever be in production at any one time. Several industry experts were contacted regarding this assumption, including two who had consulted on the ACERT analysis. It was determined that the ACERT assumption of a maximum of six mines in simultaneous production was made based on economic considerations, including required cash flow and the local economic repercussions of multiple mining operations (personal communication, Hefton 2010; personal communication, Pillmore 2010a; personal communication, Spiering 2010b). Discovery rate of breccia pipes and mill capacity were not considered to be limiting factors. The White Mesa Mill, located in Blanding, Utah, licensed to handle 2,000 tons of uranium ore per day, was considered likely to handle increased production from northern Arizona, and additional capacity is expected when the Piñon Ridge facility (located in Montrose County, Colorado) comes on line, potentially in 2012. The Piñon Ridge facility is expected to eventually process up to 1,000 tons of uranium ore per day (Energy Fuels Resources 2010). For the purposes of analysis, it is assumed that ore will be shipped to and processed at the White Mesa Mill; however, other mills may also see changes in activity based on specific contracts and business relationships made with uranium mines within the proposed withdrawal area. The transport of ore to mills other than White Mesa is not expected to result in significantly different resource impacts or substantially change the analysis of impacts.
The assumption that six breccia pipes might be in production at any one time was compared with the historic operations during the 1980s and the current number of breccia pipes that are likely to move toward development. Historically, seven breccia pipes were developed during the 1980s: three breccia pipes at the Hack Complex, along with the Hermit, Pinenut, Kanab North, and Pigeon breccia pipes. Based on known production schedules, it is likely that at several periods up to five of these breccia pipes were being mined at any one time. Currently, there are four breccia pipes with approved plans of operation and an additional three breccia pipes (EZ-1, EZ-2, What) for which plans have been filed. Based on these historic and current observations, it is reasonable to estimate an industrial capacity of four to seven breccia pipes being mined at any one time. For the purposes of the RFD, the assumption that six breccia pipes could be mined at any one time was used.

A schedule was constructed for the next 20 years, with six mines being in production at any one time; this includes the existing Arizona 1, Pinenut, Kanab North, and Canyon mines, as well as yet-unidentified new mines. This schedule suggests that 61 mines could be in production over the next 20 years, as shown in Figure B-5. However, based on additional limitations, this estimate of new mines was considered a maximum and was further reduced, as described in the next section.

Uncertainty Factors and Estimate of Mine Life Cycle

COMMODITY PRICES

Commodity prices drive mineral exploration and mine development, and historically the mining of breccia pipes in northern Arizona has been no exception. As shown in Table B-2, the 1980s were characterized by anywhere from three to five mines producing uranium at any one time, with the peak occurring in 1987. However, commodity prices for uranium were also steadily eroding throughout the 1980s. There is not necessarily an immediate and direct relationship between spot commodity prices and mine activity; long-term prices and contract prices play a much more important role in mine development. However, the halving of uranium prices from $23/lb in 1981 to $10/lb by the 1990s took its toll, and four mines with approved plans of operation ceased or suspended ore extraction or development and interim management plans were implemented.

	AZ-1	Pinenut	Kanab North	Canyon	New Mine 1	New Mine 2	New Mine 3	New Mine 4	New Mine 5	New Mine 6	New Mine 7	New Mine 8	New Mine 9	New Mine 10	New Mine 11	New Mine 12	New Mine 13	New Mine 14	New Mine 15	New Mine 16	New Mine 17	New Mine 18	New Mine 19	New Mine 20	New Mine 21	New Mine 22	New Mine 23	New Mine 24	New Mine 25	New Mine 26	New Mine 27	New Mine 28	New Mine 29	New Mine 30	New Mine 31	New Mine 32	New Mine 33	New Mine 34	New Mine 35	New Mine 36	New Mine 37	New Mine 38	New Mine 39	New Mine 40	New Mine 41	New Mine 42	New Mine 43	New Mine 44	New Mine 45	New Mine 46	New Mine 47	New Mine 48	New Mine 49	New Mine 50	New Mine 51	New Mine 52	New Mine 53	New Mine 54	New Mine 55	New Mine 56	New Mine 57
Year 1	P	P	P	P	P	P	D	I	I	I	I	I																																																	
Year 2	R	P	P	P	P	P	P	D	D	D	D	D	I																																															
Year 3		R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I																																											
Year 4							R	P	P	P	P	P	P	D	D	D	D	D	I																																											
Year 5								R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I																																							
Year 6													R	P	P	P	P	P	P	D	D	D	D	D	I																																					
Year 7														R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I																																	
Year 8																			R	P	P	P	P	P	P	D	D	D	D	D	I																															
Year 9																				R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I																										
Year 10																									R	P	P	P	P	P	P	D	D	D	D	D	I																									
Year 11																										R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I																			
Year 12																															R	P	P	P	P	P	P	D	D	D	D	D	I																	
Year 13																																R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I										
Year 14																																				R	P	P	P	P	P	P	D	D	D	D	D	I									
Year 15																																					R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I				
Year 16																																									R	P	P	P	P	P	P	D	D	D	D	D	I				
Year 17																																										R	R	R	R	R	P	P	P	P	P	P	D	I	I	I	I	I	
Year 18																																															R	P	P	P	P	P	P	D	D	D	D	D	I
Year 19																																																R	R	R	R	R	P	P	P	P	P	P	D
Year 20																																																				R	P	P	P	P	P	P

Assumes six mines in production at any given time
I = Initial permitting and planning
D = Development of mine site
P = Production
P = Production
R = Reclamation

Figure B-5. Estimated number of mines able to be supported by industry based on ACERT study.

As shown in Figure B-4, uranium prices began to recover at the end of the 1990s. The past decade has been characterized by a peak in uranium prices driven in part from speculation, with prices peaking near $140/lb in 2007 and settling near current price levels at $40/lb. The effect of uranium price recovery has been a resurgence in exploration in the proposed withdrawal area as well as the resumption of mining in the Arizona 1 Mine, although no new breccia pipes have been developed to date. The historical response to price fluctuations in the 1980s and during the past decade both illustrate how important uranium prices are to driving exploration, mine development, and production. The historical data also show how much variability can occur in commodity prices even over several years. Future commodity prices and price fluctuations are a source of uncertainty in this analysis. The spot price of $40/lb is representative of a level sufficient to support economically viable mine operations. While the exact dollar amount is not expected to remain constant, the RFD activity estimate is based on the assumption that prices would generally remain sufficient to support mining operations. To do otherwise would require speculation not only on future economic conditions but on other global events that could affect price but simply cannot be predicted with any degree of accuracy. Similarly, the estimate of the industrial capacity to maintain six mines in production at any one time is assumed to be primarily driven by uranium commodity prices and will remain similar over the 20-year period of analysis.

NATIONAL ENVIRONMENTAL POLICY ACT REVIEW

The BLM and Forest Service will likely authorize most uranium exploration activities under a notice or notice of intent, neither of which is considered major federal actions subject to NEPA review. However, the surface managing agency may under some circumstances require the filing of a plan of operations for such activities. In such instances, the overall permitting time for the mine would increase because NEPA analysis would take place before both the exploration and the mining phases. The approval of a plan of operations is a major federal action requiring analysis under NEPA. Preparation of an EA takes on average 1 year. If the surface managing agency determines as a result of preparing the EA that the activities under the plan will significantly affect the quality of the human environment, or if the agency anticipates at the outset that the potential effects of mining will be significant, the agency will prepare an EIS. Preparation of an EIS generally takes on average 2 to 3 years. In addition, there are concurrent state permitting processes that may also take 1 or more years to complete, such as under the Individual APP program. Because of these uncertainties, this RFD analysis assumes a 2-year permitting/planning time frame for future mines.

PRODUCTION TIME FRAME

The production time frame of 2 years used in the 2009 ACERT report was based on analysis of the historic Pigeon mine (personal communication, Spiering 2010b). The Pigeon mine produced approximately 2,800 tons U_3O_8 between 1984 and 1989 (personal communication, Otton 2010b; personal communication, Spiering 2010a). The average mine would produce a little more than one-half the amount produced from Pigeon; therefore, it was assumed that 2 years would be a likely production time frame for the average mine. Several factors suggest a slightly longer production time frame.

Based on the proposed plan of operations for the EZ-1, EZ-2, and What breccia pipes, the production time frame is estimated at 10 years for these three breccia pipes (Denison Mines (USA) Corporation [Denison] 2010). Furthermore, both the proposed EZ-1/EZ-2/What mine and the currently active Arizona 1 mine indicate that approximately 300 to 400 tons of ore per day would be hauled from each mine. The average mine production of 1,500 tons U_3O_8 would likely require 278,000 tons of ore to be removed for processing (based on estimated ore grades for known breccia pipes, discussed further below).
This suggests that 2 to 3 years of production would be required to remove and haul ore for the average mine. Therefore, for the purposes of this analysis, the production time frame for future mines is assumed to be 3 years. In total, the mine life cycle used for the RFD is 7 years: 2 years for planning/permitting, 1 year for mine development, 3 years for production, and 1 year for reclamation.

Based on the modified mine life cycle, it is estimated that industry could sustain up to 37 mines in some stage of production over a 20-year time frame as shown in Figure B-6; this includes the existing Arizona 1, Pinenut, Kanab North, and Canyon mines, as well as 33 as-yet-unidentified new mines.

However, this number of mines is unlikely to be reached, as it exceeds the estimated number of mines (30) that could be sustained by all known and undiscovered uranium resources. As such, the limitation driving the RFD scenario is the available uranium, not the economic or logistical capability of industry to mine ore bodies; for this reason, industrial limitations are not discussed further under the other alternatives.

VALID EXISTING RIGHTS PROCESS

As discussed previously, the assumptions used to develop the RFD scenarios do not reflect any ongoing analysis of a specific mining claim's valid existing rights, nor does the use of these data for the purposes of this analysis presume or supersede any determination of valid existing rights through the normal administrative process, which occurs independent of the RFD analysis and the EIS. The assumption stated above—that the typical mine would require a 2-year permitting/planning time frame—does not incorporate any part of the administrative process to verify or establish valid existing rights that is required by BLM and USFS before authorizing surface disturbing activities on withdrawn lands.This process could significantly lengthen the planning/permitting time frame for mining operations under any of the action alternatives and represents a factor of uncertainty in the mine life cycle used for this RFD analysis.

INTERIM MANAGEMENT

All approved mining plans of operation on BLM-administered land contain an interim management plan, in the event an operator chooses to temporarily suspend production. Three mines in the proposed withdrawal area are currently operating under interim management plans, primarily as the result of historic declines in uranium prices. As discussed previously, an assumption is made in this RFD that uranium prices will remain at or above current levels over the period of analysis, and therefore there will be a continued interest in uranium mining. Therefore, interim management of mines with approved plans of operation is not considered as part of RFD analysis, but it does represent a factor of uncertainty in the proposed mine life cycle.

- Assumption: Industry reports indicate that up to six breccia pipes might be mined at any one time, based on economics and cash flow. In the 1980s, up to five mines were producing at any one time. Based on current conditions, seven breccia pipes are being mined or are being developed. Considering all sources, it was assumed that six breccia pipes might be mined at any one time.
- Assumption: The average mine life cycle will consist of 7 years: 2 years for planning/permitting, 1 year for mine development, 3 years for production, and 1 year for reclamation. Reclamation success could take several additional seasons.
- Assumption: Based on these conditions, industry has the capacity to support up to 37 mines over the next 20 years.

	AZ-1	Pinenut	Kanab North	Canyon	New Mine 1	New Mine 2	New Mine 3	New Mine 4	New Mine 5	New Mine 6	New Mine 7	New Mine 8	New Mine 9	New Mine 10	New Mine 11	New Mine 12	New Mine 13	New Mine 14	New Mine 15	New Mine 16	New Mine 17	New Mine 18	New Mine 19	New Mine 20	New Mine 21	New Mine 22	New Mine 23	New Mine 24	New Mine 25	New Mine 26	New Mine 27	New Mine 28	New Mine 29	New Mine 30	New Mine 31	New Mine 32	New Mine 33	New Mine 34	New Mine 35	New Mine 36	New Mine 37	New Mine 38	New Mine 39	New Mine 40	New Mine 41	New Mine 42	New Mine 43	New Mine 44	New Mine 45	New Mine 46	New Mine 47
Year 1	P	I	I	I	I	I	I																																												
Year 2	R	I	I	I	I	I	I																																												
Year 3		D	D	D	D	D	D																																												
Year 4		P	P	P	P	P	P	I	I	I	I	I	I																																						
Year 5		P	P	P	P	P	P	I	I	I	I	I	I																																						
Year 6		P	P	P	P	P	P	D	D	D	D	D	D																																						
Year 7		R	R	R	R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																																
Year 8								P	P	P	P	P	P	I	I	I	I	I	I																																
Year 9								P	P	P	P	P	P	D	D	D	D	D	D																																
Year 10								R	R	R	R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																										
Year 11														P	P	P	P	P	P	I	I	I	I	I	I																										
Year 12														P	P	P	P	P	P	D	D	D	D	D	D																										
Year 13														R	R	R	R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																				
Year 14																				P	P	P	P	P	P	I	I	I	I	I	I																				
Year 15																				P	P	P	P	P	P	D	D	D	D	D	D																				
Year 16																				R	R	R	R	R	R	P	P	P	P	P	P	I	I	I	I	I	I														
Year 17																										P	P	P	P	P	P	I	I	I	I	I	I														
Year 18																										P	P	P	P	P	P	D	D	D	D	D	D														
Year 19																										R	R	R	R	R	R	P	P	P	P	P	P														
Year 20																																P	P	P	P	P	P														

Assumes six mines in production at any given time
I = Initial permitting and planning (assumes two years)
D = Development of mine site (assumes one year)
P = Production (assumes three years)
R = Reclamation (assumes one year)

Figure B-6. Estimated number of mines able to be supported by industry.

Reasonably Foreseeable Development under Alternative A—Number of Mines

The various estimates presented above are summarized in Table B-7. Under Alternative A, reasonably foreseeable uranium mining would occur not only from existing approved mines (four mines) and from confirmed mineralized breccia pipes (10 mines) but also from further exploration and development of the undiscovered uranium endowment within the proposed withdrawal area (potentially 16 mines) over an unlimited time frame. Based on the available information and assumptions, it appears that the amount of available uranium resource is the limiting factor for the number of mines that might be developed. As such, the RFD scenario for the potential number of plans of operation that could be proposed over the next 20 years is 30: 21 in the North Parcel, two in the East Parcel, and seven in the South Parcel.

Table B-7. Alternative A—No Withdrawal, Estimated Number of Mines (20-Year Time Frame)

	North Parcel	East Parcel	South Parcel	Total
A) Existing Mines	3	0	1	**4**
B) Mines Associated with Mineralized Breccia Pipes with Estimated Uranium Resources	7	0	0	**7**
C) Mines Associated with Mineralized Breccia Pipes with No Estimated Uranium Resources	2	0	1	**3**
D) Mines Associated with Breccia Pipes with Undetermined Mineralization	0	0	0	**0**
E) Number of Mines Anticipated to Extract Estimated Undiscovered Uranium Resources	9	2	5	**16**
F) Reasonably Foreseeable Development under Alternative A	21	2	7	**30**

A) Pinenut, Kanab North, Arizona 1, and Canyon.

B) Assumes that all mineralized breccia pipes with estimated uranium resources could be developed.

C) Assumes that 15% of the mineralized breccia pipes without uranium reserve estimates could be developed.

D) Assumes that 1% of the breccia pipes with undetermined mineralization could be developed.

E) Based on 15% of the USGS (2010) undiscovered uranium endowment estimate and an average 1,500 tons U_3O_8 per mine.

F) RFD scenario is assumed to be the sum of existing mines and likely mines associated with known and unknown breccia pipes [A + B + C + D + E].

It is recognized that future proposed mines in the proposed withdrawal area may actually exploit multiple breccia pipes (e.g., EZ-1, EZ-2, What) from a single mine footprint. For the purposes of this analysis, the terms "mine" is understood to refer to the operations needed to develop a single breccia pipe.

- Assumption: The industry capacity to mine uranium over the next 20 years (37 mines) is greater than the amount of mines associated with known breccia pipes and undiscovered uranium resources (30 mines) and therefore is not a limitation.
- Assumption: While in the future, a single mine site might exploit multiple breccia pipes, for the RFD analysis, a "mine" is understood to consist of a single breccia pipe.

Reasonably Foreseeable Development under Alternative A—Exploration Activities

Field investigations associated with new and existing mining claims would continue. Identifying a possible ore body consists of three stages: reconnaissance, prospecting, and exploration. Reconnaissance and prospecting have little surface disturbance, typically consisting of the use of aerial and remote sensing techniques, followed by on-the-ground mapping and surface sampling. Exploration using drill holes and sampling then proceeds where reconnaissance and prospecting results are favorable.

Exploration drilling includes advancing several shallow drill holes (less than 600 feet deep) in order to confirm the presence of a breccia pipe and establish its boundaries. This would be followed by deeper drilling (up to several thousand feet) to confirm the presence of mineralization and the presence and grade of uranium ore. As it is difficult to fully define the extent of an ore body from the surface solely through drilling, exploration or development might also include sinking a shaft in order to directly intercept the ore for further drilling or sampling. Data on the historic drilling conducted by Energy Fuels Nuclear indicate that between 1981 and 1994, there were 683 deep and 1,672 shallow stratigraphic holes drilled across the northern Arizona region, or approximately two to three shallow holes for every deep hole (personal communication, Pillmore 2010b).

The amount of exploration likely to occur in order to lead to the expected number of mines can be estimated from historic data. During the peak exploration period from 1980 to 1988, 528 exploration Notices were submitted to the BLM Arizona Strip District Office. Of these, 384 projects experienced some manner of activity, and 237 projects included exploration drilling (BLM 1990:Table III-6). This exploration accounted for the drilling of 1,211 drill holes (BLM 1990:Table III-6). During this same period, Notices of Intent submitted to the Kaibab National Forest accounted for the drilling of about 900 drill holes, as shown in Table B-8 (personal communication, Schwab 2010).

Table B-8. Amount and Success of Historic Exploration*

Jurisdiction	Historic Exploration Statistic	Amount
BLM – Arizona Strip District Office	Number of exploration projects with drilling	237
	Drill holes	1,211
	Acres disturbed	415.1
Kaibab National Forest	Number of exploration projects†	180
	Number of drill holes	900
Northern Arizona	Ore bodies discovered	11
Statistics Used in RFD Analysis	Average drill holes per project	5
	Average active projects per ore body discovered	38
	Acres disturbed per active project	1.1

* Approximate time range 1980–1988.

† Actual number unavailable; estimate based on BLM data.

During this period (the 1980s and early 1990s), nine ore bodies were discovered and either mined or developed with plans to be mined (Hack 1, Hack 2, Hack 3, Pigeon, Pinenut, Canyon, Arizona 1, Kanab North, and Hermit). In addition, two other breccia pipes were discovered that only recently have published estimates of uranium resources (EZ-1 and EZ-2). In total, 11 ore bodies were discovered as a result of the approximately 400 exploration projects using 2,100 drill holes on lands administered by the Arizona Strip District Office and Kaibab National Forest. Based on these historic data, for every ore body that is economically developed and mined, approximately 40 exploration projects are undertaken, with an average of five drill holes per project.

It should be noted that, for several reasons, historic exploration activity is not necessarily a valid predictor of future exploration activity. Not only are commodity prices fundamentally different, but the technology for remote sensing techniques to identify breccia pipes prior to drilling has improved dramatically since the 1980s. According to industry documents, a recent survey in 2007 consisting of airborne remote sensing followed by exploratory drilling yielded a success rate of 71% for identifying breccia pipes, with many of these breccia pipes actually being mineralized (personal communication, Spiering 2010c, 2010e). Based on these improvements in reconnaissance technology, it is likely that less exploration would be required in the future to locate a minable deposit than is suggested by the historic data. Therefore, it is assumed that for every productive mine, an average of 28 exploration projects might be submitted to the

BLM and Kaibab National Forest, resulting in an average of 140 drill holes. Using this average, the amount of exploration that could be needed to support the expected number of mines in production is shown in Table B-9.

Table B-9. Alternative A—No Withdrawal, Estimated Exploratory Activity Needed to Support Uranium Production (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines*	Number of Exploration Projects†	Number of Drill Holes‡
North	18	504	2,520
East	2	56	280
South	6	168	840
Total	**26**	**728**	**3,640**

* Excludes existing mines (Pinenut, Kanab North, Arizona 1, and Canyon).

† Based on average of 28 exploration projects per ore body discovered.

‡ Based on average of five drill holes per exploration project.

Historic data show that a typical exploration project results in an average of 1.1 acres of surface disturbance (i.e., blading or vegetation clearing). Note that this figure includes any surface disturbance resulting from temporary access road construction. Active clearing and drilling at a typical site is expected to last between 30 and 60 days, although delays are often encountered as a result of weather conditions or drill rig availability. Vehicles present might include a mounted rotary drill rig, drill pipe truck, water trucks, passenger trucks, back hoe, and a geophysical logging truck.

All surface disturbances (i.e., roads, drill pads) are required to be reclaimed prior to release of reclamation bonds. Reclamation at an exploration site typically includes plugging of all drill holes, spreading of any stockpiled cuttings or soil, scarifying and reseeding of disturbed areas, and cleanup of any accidental spills of hazardous materials or petroleum products.

- Assumption: In the 1980s, 417 uranium exploration projects on BLM and Forest Service lands yielded a discovery of 11 minable ore bodies, or 38 exploration projects per future mine.
- Assumption: Based on historic data, there is an average of 5 drill holes per exploration project.
- Assumption: Based on historic data, 1.1 acres of surface disturbance occur per exploration project.

Reasonably Foreseeable Development under Alternative A—Miles of New Roads and Number of Haul Trips

There are two components to be considered for the transportation of ore: the miles of new roads required for new mines and the number of haul trips needed. The miles of new roads were estimated using the following approach. First, it was assumed that the existing road network would be used to the extent possible, with the understanding that some upgrades to existing roads would be required. Next, a series of theoretical mines were placed within the parcels using a random location algorithm within a geographic information system (GIS) database. Once randomly placed, the linear distance from each mine to the nearest existing road was calculated. The average of these linear road segments represents an estimate of the required new road network to support any given mine. An additional factor of 50% was added to this number to account for the sinuosity of roads, under the assumption that in most cases they would not be perfectly linear. On average, the following road lengths were calculated to connect a randomly placed mine to the nearest road: 0.9 mile on the North Parcel, 1.2 miles on the East Parcel, and 0.6 mile on the South Parcel. The estimates are shown in Table B-10; note that only new mines are considered, as the four existing mines (Pinenut, Kanab North, Arizona 1, and Canyon) already have road access.

Table B-10. Alternative A—No Withdrawal, Estimated Miles of New Roads (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines*	New Miles of Road
North	18	16.4
East	2	2.4
South	6	3.6
Total	**26**	**22.4**

* Excludes existing mines (Pinenut, Kanab North, Arizona 1, and Canyon).

No road building was estimated for exploratory drilling since construction of new roads is generally not required to support exploration. Access to exploration sites can usually be accomplished by overland travel, which requires little to no mechanical excavation of the surface route. In cases where new roads are required for exploratory activities, these impacts are already incorporated into the average of 1.1 acres of surface disturbance per exploration project.

The number of ore haul trips is based on the existing operation at the Arizona 1 mine and the proposed mine operations at the EZ-1, EZ-2, and What breccia pipes (Denison 2010). For these mines, approximately 300 to 400 tons of ore are hauled or planned to be hauled per day, with each haul truck capable of handling 25 tons of ore. For the average mine, 1,500 tons U_3O_8 would be produced. The percent grade of ore in known breccia pipes within the proposed withdrawal area is shown in Table B-11. The average grade of ore is 0.54%, which would result in the need to remove approximately 278,000 tons of ore per mine, for a total of 11,120 haul trips for the average mine. The expected number of haul trips under Alternative A is summarized in Table B-12.

- Assumption: Based on GIS analysis of the existing road network, the average distance to the nearest existing road is 0.9 mile for the North Parcel, 1.2 miles for the East Parcel, and 0.6 mile for the South Parcel.
- Assumption: An average mine will produce 1,500 tons U_3O_8.
- Assumption: The average ore grade in unmined breccia pipes is 0.54%, which indicates that 278,000 tons of ore would be removed per mine.
- Assumption: The average capacity of a haul truck is 25 tons, yielding 11,120 haul trips per mine.

Table B-11. Ore Grade for Existing Mines

Proposed Withdrawal Parcel	Existing Breccia Pipe or Mine	% Uranium of Ore
North	Arizona 1	0.68
	DB	0.44
	EZ-1	0.51
	EZ-2	0.43
	Findlay Tank NW	0.40
	Findlay Tank SE	0.23
	Kanab North	0.53
	Pinenut	1.02
	Rim	0.35
	What	0.25
South	Canyon	1.08
Average		**0.54**

Source: personal communication, Spiering (2010a).

Table B-12. Alternative A—No Withdrawal, Estimated Number of Haul Trips (20-Year Time Frame)

Proposed Withdrawal Parcel	Ore Tonnage for Existing Mines*	Number of Haul Trips for Existing Mines†	Number of New Mines	Number of Haul Trips for New Mines‡
North	528,449	21,138	18	221,298
East	0	0	2	22,240
South	181,185	7,247	6	73,967
Total	**709,634**	**28,385**	**26**	**317,505**

* Ore tonnage for existing mines (from personal communication, Spiering 2010a): Arizona 1 (180,671), Kanab North (92,834), Pinenut (254,944), and Canyon (181,185). Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 to account for this discrepancy.

† Based on 25 tons per haul trip.

‡ Based on 11,120 haul trips needed per average mine.

Reasonably Foreseeable Development under Alternative A—Miles of Power Lines

The existing and future proposed mines within the proposed withdrawal area probably would obtain all power from off-site; construction of power lines is a necessary surface disturbance for mine development. Power lines typically would be constructed using 40-foot wooden poles, with a 300-foot span between poles and a 12-foot-wide access road (Denison 2010). For the purposes of the RFD scenarios, power lines are assumed to approximately parallel haul roads and to not require construction of a separate access road. The estimates are shown in Table B-13.

- Assumption: Power lines will follow haul roads and will be the same length as the new roads.

Reasonably Foreseeable Development under Alternative A—Acreage of Surface Disturbance

Acreage disturbed includes the footprint of the mines themselves and the acreage disturbed by new roads, new power lines, and exploration activities. Estimates of the acreage disturbed by each mine footprint vary from 3 to 4 acres per mine (Wenrich 2009) to approximately 15 to 20 acres per mine (personal communication, Spiering 2010d) to more than 40 acres per mine (Denison 2010). It is important to note, with respect to the high end of this range, that the proposed mines would actually exploit multiple breccia pipes (EZ-1, EZ-2, What) from a single mine footprint and, as such, have greater surface disturbance. For the purposes of this analysis, an estimate of 20 acres of surface disturbance per mine is assumed. For roads, a width of 14 feet has been used, for a disturbance of 1.7 acres per mile (Denison 2010). For power lines, as there would be no separate access road, surface disturbance is assumed to be 10% of road disturbance, to account for the minimal permanent surface disturbance around poles and the temporary surface disturbance during construction. For exploratory activities, as shown in Table B-8, an estimate of 1.1 acres per exploration project has been used. Total acreage of disturbance is summarized in Table B-14 (rounded to the nearest acre).

Table B-13. Alternative A—No Withdrawal, Estimated Miles of New Power Lines (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines*	New Miles of Power Lines
North	18	16.4
East	2	2.4
South	6	3.6
Total	**26**	**22.4**

* Excludes existing mines (Pinenut, Kanab North, Arizona 1, and Canyon).

Table B-14. Alternative A—No Withdrawal, Estimated Surface Disturbance (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road	New Miles of Power Lines	Number of Exploration Projects	Mine* Temporary Surface Disturbance (acres)	Road† Temporary Surface Disturbance (acres)	Power Lines‡ Temporary Surface Disturbance (acres)	Exploration§ Temporary Surface Disturbance (acres)
North	18	16.4	16.4	504	360	28	3	554
East	2	2.4	2.4	56	40	4	1	62
South	6	3.6	3.6	168	120	6	1	185
Total	**26**	**22.4**	**22.4**	**728**	**520**	**38**	**5**	**801**
Approximate Duration of Disturbance¶					**5–7 Years**	**5–7 Years**	**5–7 Years**	**1 Month**

* Assumes 20-acre footprint per mine.

† Assumes 14-foot width, for a disturbance of 1.7 acres per mile (Denison 2010).

‡ Assumes disturbance of 0.17 acre per mile from poles (10% of road disturbance).

§ Assumes disturbance of 1.1 acres per exploration project (BLM 1990:Table III-6).

- Assumption: There will be no additional surface disturbance from mines with approved plans of operation.
- Assumption: The surface disturbance for new mines will be 20 acres.
- Assumption: The surface disturbance for exploration activities will be 1.1 acres per exploration project.
- Assumption: The surface disturbance for haul roads will be 1.7 acres per mile, based on a road width of 14 feet.
- Assumption: The surface disturbance for power lines will be 0.17 acre per mile, which is 10% of road disturbance in order to account for temporary construction disturbance and permanent pole footprints.

Reasonably Foreseeable Development under Alternative A—Mine Water Use

Based on the existing mines in the area, each mine would likely have a deep production well to withdraw operational water from the Redwall Aquifer. Water use by mines for dust control, equipment washdown, underground drilling, and sanitation is estimated to average a continual 5 gallons per minute (gpm) over the 4-year operating life of the mine. Water is typically trucked in for any exploration activities, and it is assumed that reclamation will not require active watering after initial establishment of vegetation. Over the 4-year life span of a mine (development and production), this equals 10,512,000 gallons, or 32.3 acre-feet. Total water use volume and averaged water use rate are summarized in Table B-15. Table B-16 summarizes the activity associated with Alternative A.

Table B-15. Alternative A—No Withdrawal, Estimated Water Use (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines	Total Combined Water Use Volume for All Mines (million gallons)*	Total Combined Water Use Volume for All Mines (acre-feet)*	Approximate Rate of Water Use for All Mines (gpm)†
North	21	221	678	21
East	2	21	65	2
South	7	74	226	7
Total	**30**	**316**	**969**	**30**

* Based on mine use of 5 gpm over 4 years, for 10,512,000 gallons or 32.3 acre-feet per mine.

† Combined water use from all mines evenly spaced over the 20-year time frame.

- Assumption: There will be one well per mine.
- Assumption: Mines will use an estimated average of 5 gpm of water, which includes 2 gpm for sanitation and underground drilling and 3 gpm for dust suppression.
- Assumption: Water use will be limited to development and production periods (4 years), yielding a total water use per mine of 10,512,000 gallons.

Summary of Activity Associated with Alternative A—No Withdrawal (20-Year Time Frame)

Table B-16. Summary of Activity Associated with Alternative A—No Withdrawal (20-Year Time Frame)

Activity	North Parcel	East Parcel	South Parcel
Total Number of Mines	21	2	7
Number of Exploration Projects	504	56	168
Miles of New Road	16.4	2.4	3.6
Number of Haul Trips	221,298	22,240	73,967
Miles of New Power Lines	16.4	2.4	3.6
Acreage of New Mine Footprint (5- to 7-year duration)	360	40	120
Acreage of New Roads (5- to 7-year duration)	28	4	6
Acreage of New Power Lines (5- to 7-year duration)	3	1	1
Acreage of Exploration (1-month duration)	554	62	185
Total Acreage Disturbed	945	107	312
Combined Water Use Volume for All Mines (million gallons)	221	21	74
Averaged Rate of Water Use from All Mines (gpm)	21	2	7

B.8.2 Alternative B: Proposed Action (~1 Million Acres, 20-Year Withdrawal)

The proposed withdrawal area currently contains approximately 3,350 mining claims (as of August 2011) that predate the Secretary's publication of the Notice of Proposed Withdrawal, subject to valid existing rights, on July 21, 2009. Mineral development could still occur under the Proposed Action, Alternative B. However, neither the BLM nor the Forest Service would allow new mines to be developed unless and until a mineral examination determined that the mining claims involved contained a discovery and were held by valid existing rights.Determining the validity of a mining claim is a complex and time-consuming legal, geological, and economic evaluation that is done on a claim-by-claim basis. Discovery can occur before or after location of a mining claim, but in any case discovery is based on the actual physical exposure of the mineral deposit within the claim boundaries. For the locatable minerals associated with breccia pipe deposits, unless erosion has exposed mineralization in a canyon, this would probably require exploratory drilling and sampling. The discovery would need to have taken place as of the date of segregation, July 21, 2009, and have been maintained until the time of the mineral examination. None of the assumptions in this analysis, even if referring to specific breccia pipes, should be construed as a determination or indication that certain mining claims may contain a discovery.

Future Locatable Minerals Activity

As with Alternative A, the number of potential future mines can be grouped into five categories, similar to those shown in Table B-1:

- Mines that are currently operating under approved plans of operation,
- Mines that may be developed from known mineralized breccia pipes with reliable estimated uranium resources,
- Mines that may be developed from known mineralized breccia pipes where uranium resources have yet to be estimated,
- Mines that may be developed from known breccia pipes for which the level of mineralization has yet to be determined, and
- Mines that may be developed from breccia pipes that are currently undiscovered.

Currently Approved Mines

As previously described, three mines within the proposed withdrawal area (Pinenut, Kanab North, and Canyon) were approved in the late 1980s, are operating under the interim management plans contained in their approved mining plans of operation, and are not currently producing uranium ore. An additional mine, Arizona 1, was developed, but no ore was removed until late 2009. Pinenut, Kanab North, and Arizona 1 are located within the North Parcel, while Canyon is located within the South Parcel. For the purposes of this analysis, it is assumed that all four of these mines will continue operations.

- Assumption: All four mines with approved plans of operation will resume production under Alternative B.

Known Mineralized Breccia Pipes with Estimated Uranium Resources

A further 26 confirmed breccia pipes within the proposed withdrawal area are known to have some level of mineralization (see Table B-3). Of these, seven have been confirmed to have uranium resources, and those uranium resources have been estimated. For the purposes of the RFD scenario, it is assumed that these breccia pipes have valid existing rights and would be mined. All seven breccia pipes with estimated uranium resources are located within the North Parcel.

- Assumption: The seven breccia pipes with estimated uranium resources will be mined under Alternative B.

Known Mineralized Breccia Pipes with No Estimate of Uranium Resources

Uranium resources have not been calculated for the remaining 19 confirmed mineralized breccia pipes (see Table B-3). Under Alternative A, it was assumed that 10% of these breccia pipes might contain uranium ore bodies and ultimately could be mined. While this is still true under Alternative B, it is assumed that if uranium resources have not yet been estimated, then it is likely that insufficient information is available to show discovery and be considered a valid existing right under the withdrawal. Therefore, for any mineralized breccia pipes lacking an estimate of uranium resources, it is assumed they would not be developed under this alternative.

- Assumption: If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. None of the 19 confirmed mineralized breccia pipes without resource estimates will be developed.

Known Breccia Pipes with Undetermined Mineralization

As with the known mineralized breccia pipes without estimates of uranium resources, it is assumed that the remaining 10 confirmed breccia pipes within the proposed withdrawal area whose level of mineralization has yet to be determined (see Table B-3) would lack the necessary discovery to establish valid existing rights; it is therefore assumed these breccia pipes would not be mined under Alternative B.

- Assumption: If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. None of the 10 confirmed breccia pipes with undetermined mineralization will be developed.

Undiscovered Uranium Resources

Under Alternative B, it is assumed that none of the estimated undiscovered uranium endowment would be mined, as no further exploration would take place to discover these deposits or to determine the extent of any potential uranium ore bodies.

- Assumption: If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. No undiscovered uranium endowment would be mined.

Reasonably Foreseeable Development under Alternative B—Number of Mines

The estimates presented above are summarized in Table B-17. Under Alternative B, reasonably foreseeable uranium mining activity could occur only at the four existing mines and at the seven mines that have confirmed mineralized breccia pipes with estimated uranium resources. Mines would not develop from any of the other confirmed breccia pipes, nor would mines develop from further exploration and development of the undiscovered uranium endowment within the proposed withdrawal area.
As shown in Table B-17, under Alternative B, the limiting factor for the number of mines that could be developed is the number of claims for which valid existing rights could presumably exist. The RFD scenario for the number of plans of operation that might be submitted to the BLM and Kaibab National Forest, in addition to those plans of operation already approved, under Alternative B is 11: 10 in the North Parcel, none in the East Parcel, and one in the South Parcel.

Table B-17. Alternative B—Proposed Withdrawal, Estimated Number of Mines (20-Year Time Frame)

	North Parcel	East Parcel	South Parcel	Total
A) Existing Mines	3	0	1	**4**
B) Mines Associated with Mineralized Breccia Pipes with Estimated Uranium Resources	7	0	0	**7**
C) Mines Associated with Mineralized Breccia Pipes with No Estimated Uranium Resources	0	0	0	**0**
D) Mines Associated with Breccia Pipes with Undetermined Mineralization	0	0	0	**0**
E) Number of Mines Anticipated to Extract Estimated Undiscovered Uranium Resources	0	0	0	**0**
F) Reasonably Foreseeable Development under Alternative B	10	0	1	**11**

A) Pinenut, Kanab North, Arizona 1, and Canyon.
B) Assumes that all mineralized breccia pipes with estimated uranium resources will be developed.
C) Assumes that insufficient information is available to show valid existing rights.
D) Assumes that insufficient information is available to show valid existing rights.
E) Assumes that insufficient information is available to show valid existing rights.
F) RFD scenario is assumed to be the sum of existing mines and likely mines associated with known and unknown breccia pipes [A + B + C + D + E].

Reasonably Foreseeable Development under Alternative B—Exploration Activities

As described above, it is assumed that only existing mines and the breccia pipes with already identified deposits would be likely to be able to proceed to mine development and that further exploration on other claims would not be allowed under a mineral withdrawal. Therefore, exploration activities would likely cease under Alternative B.

However, it is possible that in certain areas, a minor level of exploration might continue. In several cases, multiple breccia pipes have been shown to occur in close proximity (e.g., Hack 1, 2, and 3; EZ-1, EZ-2, and What). Exploration for additional breccia pipes could take place within the boundaries of mining claims already held by valid existing rights. For the purposes of the RFD scenario, it is assumed that no more than 11 such exploration projects might be submitted to the BLM and Kaibab National Forest over the 20-year time frame (Table B-18).

Table B-18. Alternative B—Proposed Withdrawal, Estimated Exploratory Activity (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines	Number of Exploration Projects	Number of Drill Holes*
North	10	10	50
East	0	0	0
South	1	1	5
Total	**11**	**11**	**55**

* Based on average of five drill holes per exploration project.

Reasonably Foreseeable Development under Alternative B—Miles of New Roads and Number of Haul Trips

No additional road-building activity would take place to support the four existing mines. However, roads would likely need to be built for the seven confirmed breccia pipes with estimated uranium resources. The analysis follows an approach similar to what was used under Alternative A to estimate the necessary miles of new roads. The estimates are shown in Table B-19.

As previously described, a total of 11,120 haul trips would be required for the average mine. The expected number of haul trips under Alternative B is summarized in Table B-20.

Table B-19. Alternative B—Proposed Withdrawal, Estimated Miles of New Roads (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road
North	7	6.4
East	0	0
South	0	0
Total	**7**	**6.4**

Reasonably Foreseeable Development under Alternative B—Miles of Power Lines

No additional power lines would be built for the four existing mines. However, power lines would likely need to be built for the seven confirmed breccia pipes with estimated uranium resources. The analysis

follows an approach similar to what was used under Alternative A to estimate the necessary miles of new power lines. The estimates are shown in Table B-21.

Table B-20. Alternative B—Proposed Withdrawal, Estimated Number of Haul Trips (20-Year Time Frame)

Proposed Withdrawal Parcel	Ore Tonnage for Existing Mines*	Number of Haul Trips for Existing Mines†	Number of New Mines	Number of Haul Trips for New Mines‡
North	528,449	21,138	7	98,978
East	0	0	0	0
South	181,185	7,247	0	7,247
Total	**709,634**	**28,385**	**7**	**106,225**

* Ore tonnage for existing mines (from personal communication, Spiering 2010a): Arizona 1 (180,671), Kanab North (92,834), Pinenut (254,944), and Canyon (181,185). Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 to account for this discrepancy.

† Based on 25 tons per haul trip.

‡ Based on 11,120 haul trips needed per average mine.

Table B-21. Alternative B—Proposed Withdrawal, Estimated Miles of New Power Lines (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Power Lines
North	7	6.4
East	0	0
South	0	0
Total	**7**	**6.4**

Reasonably Foreseeable Development under Alternative B—Acreage of Surface Disturbance

Acreage disturbed would include the footprint of the mines themselves and the acreage disturbed by new roads, new power lines, and exploration activities. As with Alternative A, mine footprints are assumed to be 20 acres, new roads are assumed to have a disturbance of 1.7 acres per mile, new power lines are assumed to have a disturbance of 0.17 acre per mile, and exploratory activities are assumed to have a disturbance of 1.1 acres per project. Total acreage of disturbance is summarized in Table B-22 (rounded to the nearest acre).

Table B-22. Alternative B—Proposed Withdrawal, Estimated Surface Disturbance (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road	New Miles of Power Lines	Number of Exploration Projects	Mine* Temporary Surface Disturbance (acres)	Road† Temporary Surface Disturbance (acres)	Power Lines‡ Temporary Surface Disturbance (acres)	Exploration§ Temporary Surface Disturbance (acres)
North	7	6.4	6.4	10	140	11	1	11
East	0	0	0	0	0	0	0	0
South	0	0	0	1	0	0	0	1
Total	**7**	**6.4**	**6.4**	**11**	**140**	**11**	**1**	**12**
Approximate Duration of Activity					**5–7 Years**	**5–7 Years**	**5–7 Years**	**1 Month**

* Assumes 20-acre footprint per mine.

† Assumes 14-foot width, for a disturbance of 1.7 acres per mile (Denison 2010).

‡ Assumes disturbance of 0.17 acre per mile from poles (10% of road disturbance).

§ Assumes disturbance of 1.1 acres per exploration project (BLM 1990:Table III-6).

Reasonably Foreseeable Development under Alternative B—Mine Water Use

Water use is estimated to average a continual 5 gpm over the 4-year operating life of the mine. Over the 4-year life span of a mine (development and production), this totals 10,512,000 gallons, or 32.3 acre-feet. Total water use volume and average water use rate are summarized in Table B-23. Table B-24 summarizes the impacts under Alternative B.

Table B-23. Alternative B—Proposed Withdrawal Estimated Water Use (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines	Total Combined Water Use Volume for All Mines (million gallons)*	Total Combined Water Use Volume for All Mines (acre-feet)*	Approximate Water Use Rate for All Mines (gpm)†
North	10	105	323	10
East	0	0	0	0
South	1	11	32	1
Total	**11**	**116**	**355**	**11**

* Based on mine use of 5 gpm over 4 years, for 10,512,000 gallons or 32.3 acre-feet per mine.

† Combined water use from all mines, evenly spaced over the 20-year time frame.

Summary of Activity Associated with Alternative B—Proposed Withdrawal (20-Year Time Frame)

Table B-24. Summary of Activity Associated with Alternative B—Proposed Withdrawal (20-Year Time Frame)

Activity	North Parcel	East Parcel	South Parcel
Total Number of Mines	10	0	1
Number of Exploration Projects	10	0	1
Miles of New Road	6.4	0	0
Number of Haul Trips	98,978	0	7,247
Miles of New Power Lines	6.4	0	0
Acreage of New Mine Footprint (5- to 7-year disturbance)	140	0	0
Acreage of New Roads (5- to 7-year disturbance)	11	0	0
Acreage of New Power Lines (5- to 7-year disturbance)	1	0	0
Acreage of Exploration (1-month disturbance)	11	0	1
Total Disturbed Acreage	163	0	1
Combined Water Use Volume for All Mines (million gallons)	105	0	11
Average Rate of Water Use from All Mines (gpm)	10	0	1

B.8.3 Alternative C: Partial Withdrawal (~650,000 Acres)

The potential withdrawal under Alternative C is similar to that described for Alternative B, except that it would apply to a smaller area: 648,805 acres of federal lands, compared with approximately 1 million acres under Alternative B. Mining and exploration in areas outside the withdrawal boundary would take place as usual.

Future Locatable Mineral Exploration and Development

As with Alternatives A and B, the number of potential future mines can be grouped into five categories, similar to those shown in Table B-1:

- Mines that are currently operating under approved plans of operation,
- Mines that may be developed from known mineralized breccia pipes with reliable estimated uranium resources,
- Mines that may be developed from known mineralized breccia pipes where uranium resources have yet to be estimated,
- Mines that may be developed from known breccia pipes for which the level of mineralization has yet to be determined, and
- Mines that may be developed from breccia pipes that are currently undiscovered.

Currently Approved Mines

As previously described, three mines within the proposed withdrawal area (Pinenut, Kanab North, and Canyon) were approved in the late 1980s, are operating under the interim management plans contained in their approved mining plans of operation, and are not currently producing uranium ore. An additional mine, Arizona 1, was developed, but no ore was removed until late 2009. Pinenut, Kanab North, and Arizona 1 are located within the North Parcel and are within the partial withdrawal area proposed under Alternative C. Canyon is located within the South Parcel and is not within the partial withdrawal area proposed under Alternative C. For the purposes of the analysis of Alternative C, it is assumed that all four of these mines would continue operations.

- Assumption: All four mines with approved plans of operation will resume production under Alternative C.

Known Mineralized Breccia Pipes with Estimated Uranium Resources

A further 26 confirmed breccia pipes within the proposed withdrawal area are known to have some level of mineralization (see Table B-3). Of these, seven have been confirmed to have uranium resources, and those uranium resources have been estimated. All seven breccia pipes are located within the North Parcel and are within the partial withdrawal area proposed under Alternative C. For the purposes of the RFD scenario, it is assumed that under Alternative C, these breccia pipes are likely to have valid existing rights and would be mined.

- Assumption: The seven breccia pipes with estimated uranium resources will be mined under Alternative C.

Known Mineralized Breccia Pipes with No Estimate of Uranium Resources

Uranium resources have not been calculated for the remaining 19 confirmed mineralized breccia pipes (see Table B-3); only 14 of these confirmed mineralized breccia pipes are located within the partial withdrawal area proposed under Alternative C.

Under Alternative A, it was assumed that 15% of these breccia pipes might contain uranium ore bodies and ultimately be mined. For the 14 mineralized breccia pipes located within the partial withdrawal area proposed under Alternative C, it is assumed that if uranium resources have not yet been estimated, then insufficient information is available to show discovery and be considered a valid existing right. Therefore,

under Alternative C, the mineralized breccia pipes lacking an estimate of uranium resources are not assumed to have valid existing rights and are not likely to be mined.

However, under Alternative C, five of these mineralized breccia pipes are located outside the proposed partial withdrawal area and could be subject to additional exploration and possibly mine development. It is estimated that because an estimated 15% of mineralized breccia pipes might be economically mined, one of these breccia pipes might yield a viable ore body on the South Parcel.

- Assumption: An additional 14 breccia pipes are confirmed to be mineralized and are located within the partial withdrawal area. If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. None of the 14 confirmed mineralized breccia pipes without resource estimates within the proposed partial withdrawal area under Alternative C will be developed.
- Assumption: An additional five breccia pipes confirmed to be mineralized are located outside the proposed partial withdrawal area under Alternative C, and these can be developed.
- Assumption: An estimated 15% of mineralized breccia pipes contain minable amounts of uranium, yielding a total of one mine resulting from the five confirmed mineralized breccia pipes under Alternative C.

Known Breccia Pipes with Undetermined Mineralization

Of the remaining 10 confirmed breccia pipes with an undetermined extent of mineralization (see Table B-3), only four are within the partial withdrawal area proposed under Alternative C. For the four undetermined breccia pipes located within the partial withdrawal area proposed under Alternative C, it is assumed that if uranium resources have not yet been estimated, then insufficient information is likely available to show discovery and be considered a valid existing right. Therefore, under Alternative C, none of these breccia pipes are likely to be mined.

The six remaining breccia pipes are located outside the partial withdrawal area proposed under Alternative C and could potentially be mined; however, the probability of a given breccia pipe yielding a viable ore body is perhaps 1 in 100. Therefore, it is unlikely that any of these particular breccia pipes would be developed under Alternative C.

- Assumption: An additional four breccia pipes are confirmed within the Alternative C proposed partial withdrawal area, but it is not known whether they are mineralized or not. If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. None of the four confirmed breccia pipes within the Alternative C proposed partial withdrawal area with undetermined mineralization will be developed.
- Assumption: An additional six breccia pipes of undetermined mineralization are located outside the Alternative C proposed partial withdrawal area, and these can be developed.
- Assumption: An estimated 1% of all breccia pipes contain minable amounts of uranium, yielding no mines resulting from the six confirmed breccia pipes under Alternative C.

Undiscovered Uranium Resources

In contrast to Alternative B, a portion of the undiscovered uranium resources could potentially be extracted from outside the Alternative C proposed partial withdrawal area. The amount of undiscovered uranium resources has been extrapolated based on the percentage of the entire proposed withdrawal area that will remain open to location and entry under the Mining Law under Alternative C, as shown in Table B-25.

Table B-25. Estimated Undiscovered Uranium Endowment Available under Alternative C

Proposed Withdrawal Parcel	Total Undiscovered Uranium Endowment (tons U_3O_8) in Entire Proposed Withdrawal Area*	Percentage of Proposed Withdrawal Area Not Withdrawn under Alternative C	Estimated Undiscovered Uranium Endowment (tons U_3O_8) Available under Alternative C	Estimated Number of Mines†
North	91,944	36%	33,100	3
East	22,257	34%	7,567	1
South	49,179	36%	17,704	2
Total	**163,380**		**58,371**	**6**

* USGS (2010:Chapter A, Table 8).

† Based on 15% of undiscovered uranium endowment and an average of 1,500 tons U_3O_8 per typical breccia pipe ore body.

- Assumption: An estimated 24,508 tons U_3O_8 is as yet undiscovered and minable within the entire proposed withdrawal area.
- Assumption: Only uranium endowment outside the Alternative C proposed partial withdrawal area would be mined. Based on the percentage of area not withdrawn under Alternative C, the undiscovered uranium endowment is 8,756 tons U_3O_8, yielding six mines.

Reasonably Foreseeable Development under Alternative C—Number of Mines

The estimates presented above are summarized in Table B-26. Under Alternative C, reasonably foreseeable uranium mining could occur from four existing mines and from confirmed mineralized breccia pipes with estimated uranium resources at seven mines. Mines would not develop from any of the other confirmed breccia pipes within the Alternative C proposed partial withdrawal area, nor would mines develop from further exploration and development of the undiscovered uranium endowment within the Alternative C proposed partial withdrawal area. However, of the five confirmed mineralized breccia pipes outside the Alternative C proposed partial withdrawal area, perhaps one would be mined on the South Parcel. In addition, a portion of the undiscovered uranium resources that are located outside the Alternative C proposed partial withdrawal area could be developed, resulting in an estimated six new mines.

As shown in Table B-26, the number of potential mines in Alternative C is less than the limitations of the industry to find, develop, and exploit ore bodies. As such, the RFD scenario for the number of plans of operation that could be submitted to BLM and the Forest Service under Alternative C is 18: 13 in the North Parcel, one in the East Parcel, and four in the South Parcel.

Reasonably Foreseeable Development under Alternative C—Exploration Activities

Under Alternative C, further exploration on mining claims with the proposed partial withdrawal area would not occur. For the most part, exploration activities would cease under Alternative C within the proposed partial withdrawal area. However, it is feasible that in certain areas, minor levels of exploration might continue. For the purposes of the RFD scenario, it is assumed that no more than 11 exploration projects might be submitted to the BLM and Kaibab National Forest over the 20-year time frame of the withdrawal.

Unlike under Alternative B, exploration could still continue outside the partial withdrawal area proposed under Alternative C, yielding an estimated seven new mines, as shown in Table B-27.

Table B-26. Alternative C—Partial Withdrawal, Estimated Number of Mines (20-Year Time Frame)

	North Parcel	East Parcel	South Parcel	Total
A) Existing Mines	3	0	1	**4**
B) Mines Associated with Mineralized Breccia Pipes with Estimated Uranium Resources	7	0	0	**7**
C) Mines Associated with Mineralized Breccia Pipes with No Estimated Uranium Resources	0	0	1	**1**
D) Mines Associated with Breccia Pipes with Undetermined Mineralization	0	0	0	**0**
E) Number of Mines Anticipated to Be Needed to Extract Estimated Undiscovered Uranium Resources	3	1	2	**6**
F) Reasonably Foreseeable Development under Alternative C	13	1	4	**18**

A) Pinenut, Kanab North, Arizona 1, and Canyon.

B) Assumes that all mineralized breccia pipes with estimated uranium resources will be developed.

C) Assumes that insufficient information is available to show valid existing rights for those within withdrawal area; assumes 15% of the five breccia pipes outside the withdrawal area might be mined.

D) Assumes that insufficient information is available to show valid existing rights for withdrawal area and that these are unlikely to be mined outside the withdrawal area.

E) Assumes that insufficient information is available to establish valid existing rights in the withdrawal area but that resources could be mined outside the withdrawal area, with the number of mines being based on 15% of the USGS (2010) undiscovered uranium endowment estimate and an average 1,500 tons U_3O_8 per mine.

F) RFD scenario is assumed to be the sum of existing mines and likely mines associated with known and unknown breccia pipes [A + B + C + D + E].

Table B-27. Alternative C—Partial Withdrawal, Estimated Exploratory Activity Needed to Support Uranium Production (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Exploration Projects within Proposed Withdrawal Area	Number of New Mines Outside Proposed Withdrawal Area	Number of Exploration Projects Outside Proposed Withdrawal Area*	Total Number of Exploration Projects	Number of Drill Holes†
North	10	3	84	94	470
East	0	1	28	28	140
South	1	3	84	85	425
Total	**11**	**7**	**196**	**207**	**1,035**

* Based on average of 28 exploration projects per ore body discovered.

† Based on average of five drill holes per exploration project.

Reasonably Foreseeable Development under Alternative C—Miles of New Roads and Number of Haul Trips

No additional road-building activity would take place to support the four existing mines. However, roads would likely need to be built for the new mines both inside and outside the Alternative C proposed partial withdrawal area. The analysis follows an approach similar to what was used under Alternative A to estimate the necessary miles of new roads. The estimates are shown in Table B-28.

As previously described, a total of 11,120 haul trips would be required for the average mine. The expected number of haul trips under Alternative C is summarized in Table B-29.

Table B-28. Alternative C—Partial Withdrawal, Estimated Miles of New Roads (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road
North	10	9.1
East	1	1.2
South	3	1.8
Total	**14**	**12.1**

Table B-29. Alternative C—Partial Withdrawal, Estimated Number of Haul Trips (20-Year Time Frame)

Proposed Withdrawal Parcel	Ore Tonnage for Existing Mines*	Number of Haul Trips for Existing Mines†	Number of New Mines	Number of Haul Trips for New Mines‡
North	528,449	132,338	10	111,200
East	0	11,120	1	11,120
South	181,185	40,607	3	33,360
Total	**709,634**	**184,065**	**14**	**155,680**

* Ore tonnage for existing mines (from personal communication, Spiering 2010a): Arizona 1 (180,671), Kanab North (92,834), Pinenut (254,944), and Canyon (181,185). Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 to account for this discrepancy.

† Based on 25 tons per haul trip.

‡ Based on 11,120 haul trips needed per average mine tonnage.

Reasonably Foreseeable Development under Alternative C—Miles of Power Lines

No additional power lines would be built for the four existing mines. However, power lines would likely need to be built for the new mines both within and outside the Alternative C proposed partial withdrawal area. The analysis follows an approach similar to what was used under Alternative A to estimate the necessary miles of new power lines. The estimates are shown in Table B-30.

Table B-30. Alternative C—Partial Withdrawal, Estimated Miles of New Power Lines (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Power Lines
North	10	9.1
East	1	1.2
South	3	1.8
Total	**14**	**12.1**

Reasonably Foreseeable Development under Alternative C—Acreage of Surface Disturbance

Acreage disturbed could include the footprint of the mines themselves and the acreage disturbed by new roads, new power lines, and exploration activities. As with Alternative A, mine footprints are assumed to be 20 acres, new roads are assumed to have a disturbance of 1.7 acres per mile, new power lines are assumed to have a disturbance of 0.17 acre per mile, and exploratory activities are assumed to have a disturbance of 1.1 acres per project. Total acreage of disturbance is summarized in Table B-31 (rounded to the nearest acre).

Table B-31. Alternative C—Partial Withdrawal, Estimated Surface Disturbance (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road	New Miles of Power Lines	Number of Exploration Projects	Mine* Temporary Surface Disturbance (acres)	Road† Temporary Surface Disturbance (acres)	Power lines‡ Temporary Surface Disturbance (acres)	Exploration§ Temporary Surface Disturbance (acres)
North	10	9.1	9.1	94	200	15	2	103
East	1	1.2	1.2	28	20	2	1	31
South	3	1.8	1.8	85	60	3	1	94
Total	**14**	**12.1**	**12.1**	**207**	**280**	**20**	**4**	**228**
Approximate Duration of Disturbance					**5–7 Years**	**5–7 Years**	**5–7 Years**	**1 Month**

* Assumes 20-acre footprint per mine.

† Assumes 14-foot width, for a disturbance of 1.7 acres per mile (Denison 2010).

‡ Assumes disturbance of 0.17 acre per mile from poles (10% of road disturbance).

§ Assumes disturbance of 1.1 acres per exploration project (BLM 1990:Table III-6).

Reasonably Foreseeable Development under Alternative C—Mine Water Use

Water use is estimated to average a continual 5 gpm over the 4-year operating life of the mine. Over the 4-year life span of a mine (development and production), this totals 10,512,000 gallons, or 32.3 acre-feet. Total water use volume and average water use rate are summarized in Table B-32. Table B-33 summarizes the impacts associated with Alternative C.

Table B-32. Alternative C—Partial Withdrawal, Estimated Water Use (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines	Total Combined Water Use Volume for All Mines (million gallons)*	Total Combined Water Use Volume for All Mines (acre-feet)*	Approximate Water Use Rate (gpm)†
North	13	137	420	13
East	1	11	32	1
South	4	42	129	4
Total	**18**	**190**	**581**	**18**

* Based on mine use of 5 gpm over 4 years, for 10,512,000 gallons or 32.3 acre-feet per mine.

† Combined water use from all mines, evenly spaced over the 20-year time frame, rounded.

Summary of Activity Associated with Alternative C—Partial Withdrawal (20-Year Time Frame)

Table B-33. Summary of Activity Associated with Alternative C—Partial Withdrawal (20-Year Time Frame)

Activity	North Parcel	East Parcel	South Parcel
Total Number of Mines	13	1	4
Number of Exploration Projects	94	28	85
Miles of New Road	9.1	1.2	1.8
Number of Haul Trips	132,338	11,120	40,607
Miles of New Power Lines	9.1	1.2	1.8

Table B-33. Summary of Activity Associated with Alternative C—Partial Withdrawal (20-Year Time Frame), Continued

Activity	North Parcel	East Parcel	South Parcel
Acreage of New Mine Footprint (5- to 7-year duration)	200	20	60
Acreage of New Roads (5- to 7-year duration)	15	2	3
Acreage of New Power Lines (5- to 7-year duration)	2	1	1
Acreage of Exploration (1-month duration)	103	31	94
Total Disturbed Acreage	320	54	158
Combined Water Use All Mines (million gallons)	137	11	42
Average Rate of Water Use from All Mines (gpm)	13	1	4

B.8.4 Alternative D: Partial Withdrawal (~300,000 Acres)

The area to be withdrawn under Alternative D would apply to approximately 292,088 acres of federal lands. As with Alternative B, the Alternative D proposed partial withdrawal would occur for a period of 20 years; no new mining claims could be located within the Alternative D proposed partial withdrawal area, nor could further exploration or development occur on existing mining claims within the Alternative D proposed partial withdrawal area unless valid existing rights were first established. Mineral exploration and development on mining claims with valid existing rights would continue under the respective BLM or Forest Service surface management regulations. Mining and exploration in areas outside the Alternative D proposed partial withdrawal boundary would take place as usual.

Future Locatable Mineral Exploration and Development

The number of potential future mines can be grouped into five categories, similar to those shown in Table B-1:

- Mines that are currently operating under approved plans of operation,
- Mines that may be developed from known mineralized breccia pipes with reliable estimated uranium resources,
- Mines that may be developed from known mineralized breccia pipes where uranium resources have yet to be estimated,
- Mines that may be developed from known breccia pipes for which the level of mineralization has yet to be determined, and
- Mines that may be developed from breccia pipes that are currently undiscovered.

Currently Approved Mines

As previously described, three mines within the proposed withdrawal area (Pinenut, Kanab North, and Canyon) were approved in the late 1980s, are operating under the interim management plans in their approved mining plans of operation, are not currently producing uranium ore. An additional mine, Arizona 1, was developed, but no ore was removed until late 2009. Pinenut, Kanab North, and Arizona 1 are located within the North Parcel; Pinenut and Kanab North are located within the Alternative D proposed partial withdrawal area, but Arizona 1 is located outside the Alternative D proposed partial withdrawal area. The Canyon mine is located within the South Parcel but is not within the Alternative D

proposed partial withdrawal area. For the purposes of analysis of Alternative D, it is assumed that all four of these mines would continue operations.

- Assumption: All four mines with approved plans of operation will resume production under Alternative D.

Known Mineralized Breccia Pipes with Estimated Uranium Resources

There are a further 26 confirmed breccia pipes within the proposed withdrawal area known to have some level of mineralization (see Table B-3). Of these, seven have been confirmed to have uranium resources, and those uranium resources have been estimated. All seven breccia pipes are located within the North Parcel. Six of these breccia pipes are outside the boundary of the Alternative D proposed partial withdrawal area; only the Rim breccia pipe lies within the Alternative D proposed partial withdrawal area. For the purposes of the RFD scenario, it is assumed that under Alternative D, all seven of these breccia pipes with confirmed uranium resources are likely to have valid existing rights and could be mined.

- Assumption: The seven breccia pipes with estimated uranium resources will be mined under Alternative D.

Known Mineralized Breccia Pipes with No Estimate of Uranium Resources

Uranium resources have not been calculated for the remaining 19 confirmed mineralized breccia pipes (see Table B-3); only two of these confirmed mineralized breccia pipes (Clearwater, Lost Calf) are located within the Alternative D proposed partial withdrawal area.

For the two mineralized breccia pipes located within the Alternative D proposed partial withdrawal area, it is assumed that if uranium resources have not yet been estimated, then insufficient information is likely available to establish valid existing rights. Therefore, mineralized breccia pipes that lack an estimate of uranium resources are presumed not to possess valid existing rights and to be unable to be mined.

However, under Alternative D, 17 of these mineralized breccia pipes are located outside the Alternative D proposed partial withdrawal area and could potentially be mined. It is estimated that perhaps three of these breccia pipes might yield a viable ore body (two on the North Parcel and one on the South Parcel).

- Assumption: An additional two breccia pipes are confirmed to be mineralized and are located within the Alternative D proposed partial withdrawal area. If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. Neither of the two confirmed mineralized breccia pipes without resource estimates within the Alternative D proposed partial withdrawal area will be developed.
- Assumption: An additional 17 breccia pipes confirmed to be mineralized are located outside the Alternative D proposed partial withdrawal area, and these can be developed.
- Assumption: An estimated 15% of mineralized breccia pipes contain minable amounts of uranium, yielding a total of three mines resulting from the 17 confirmed mineralized breccia pipes under Alternative D.

Known Breccia Pipes with Undetermined Mineralization

Of the remaining 10 confirmed breccia pipes with an undetermined extent of mineralization (see Table B-3), only one is within the Alternative D proposed partial withdrawal area. For the one undetermined breccia pipe located within the partial withdrawal area proposed under Alternative D, it is assumed that if uranium resources have not yet been estimated, then insufficient information is available to show

discovery and establish a valid existing right. Therefore, under Alternative D, this breccia pipe is not likely to be mined.

The nine remaining breccia pipes are located outside the Alternative D proposed partial withdrawal area and could potentially be mined; however, the probability of a given breccia pipe yielding a viable ore body is perhaps 1 in 100. Therefore, it is unlikely that any of these breccia pipes would be developed under Alternative D.

- Assumption: A single additional breccia pipe is confirmed within the Alternative D proposed partial withdrawal area, but it is not known whether it is mineralized or not. If no estimate of uranium resources has been made, it is unlikely that sufficient information exists to show a valid existing right. This confirmed breccia pipes with undetermined mineralization within the Alternative D proposed partial withdrawal area will not be developed.
- Assumption: An additional nine breccia pipes of undetermined mineralization are located outside the Alternative D proposed partial withdrawal area, and these can be developed.
- Assumption: An estimated 1% of all breccia pipes contain minable amounts of uranium, yielding no mines resulting from the nine confirmed breccia pipes under Alternative D.

Undiscovered Uranium Resources

In contrast to Alternative B, there are undiscovered uranium resources in the project area that are outside the Alternative D proposed partial withdrawal area, and these could potentially be developed under Alternative D. The amount of undiscovered uranium resources has been extrapolated based on the percentage of the Alternative D proposed partial withdrawal area that will remain open to location and entry under the Mining Law, as shown in Table B-34.

- Assumption: An estimated 24,508 tons U_3O_8 is as yet undiscovered and minable within the entire proposed withdrawal area.
- Assumption: Only uranium endowment outside the Alternative D proposed partial withdrawal area would be mined. Based on the percentage of area not withdrawn under Alternative D, the undiscovered uranium endowment is 17,506 tons U_3O_8, yielding 12 mines.

Table B-34. Estimated Undiscovered Uranium Endowment Available under Alternative D

Proposed Withdrawal Parcel	Total Undiscovered Uranium Endowment (tons U_3O_8) in Entire Proposed Withdrawal Area*	Percentage of Proposed Withdrawal Area Not Withdrawn under Alternative D	Estimated Undiscovered Uranium Endowment (tons U_3O_8) Available under Alternative D	Estimated Number of Mines†
North	91,944	81%	74,475	8
East	22,257	61%	13,577	1
South	49,179	59%	29,016	3
Total	**163,380**		**117,068**	**12**

* USGS (2010:Chapter A, Table 8).

† Based on 15% of undiscovered uranium endowment and an average of 1,500 tons U_3O_8 per typical breccia pipe ore body, rounded.

Reasonably Foreseeable Development under Alternative D—Number of Mines

The estimates presented above are summarized in Table B-35. Under Alternative D, reasonably foreseeable uranium mining would occur at the four existing mines and at the seven mines that have confirmed mineralized breccia pipes with estimated uranium resources. Mines would not develop from any of the other confirmed breccia pipes within the Alternative D proposed partial withdrawal area, nor

would mines develop from further exploration and development of the undiscovered uranium endowment within the Alternative D proposed partial withdrawal area. However, of the 17 confirmed mineralized breccia pipes outside the proposed partial withdrawal area, perhaps three could be mined on the North and South parcels. In addition, a portion of the undiscovered uranium resources that are located outside the Alternative D proposed partial withdrawal area could still be developed, resulting in an estimated 12 new mines.

Table B-35. Alternative D—Partial Withdrawal, Estimated Number of Mines (20-Year Time Frame)

	North Parcel	East Parcel	South Parcel	Total
A) Existing Mines	3	0	1	**4**
B) Mines Associated with Mineralized Breccia Pipes with Estimated Uranium Resources	7	0	0	**7**
C) Mines Associated with Mineralized Breccia Pipes with No Estimated Uranium Resources	2	0	1	**3**
D) Mines Associated with Breccia Pipes with Undetermined Mineralization	0	0	0	**0**
E) Number of Mines Anticipated to Extract Estimated Undiscovered Uranium Resources	8	1	3	**12**
F) Reasonably Foreseeable Development under Alternative D	20	1	5	**26**

A) Pinenut, Kanab North, Arizona 1, and Canyon.

B) Assumes that all mineralized breccia pipes with estimated uranium resources could be developed.

C) Assumes that insufficient information is available to establish valid existing rights for those deposits within withdrawal area; assumes that 15% of the 17 breccia pipes outside the withdrawal area might be mined.

D) Assumes that insufficient information is available to show valid existing rights for withdrawal area and that these resources are unlikely to be mined outside the withdrawal area.

E) Assumes that insufficient information is available to show valid existing rights for withdrawal area but that these resources could be mined outside the withdrawal area, with the number of mines based on 15% of the USGS (2010) undiscovered uranium endowment estimate and an average 1,500 tons U_3O_8 per mine.

F) RFD scenario is assumed to be the sum of existing mines and likely mines associated with known and unknown breccia pipes [A + B + C + D + E].

The number of potential mines in Alternative D is less than the limitations of the industry to find, develop, and exploit ore bodies. As such, the RFD scenario for the number of plans of operation that might be submitted to the BLM and Kaibab National Forest under Alternative D is 26 mines: 20 in the North Parcel, one in the East Parcel, and five in the South Parcel.

Reasonably Foreseeable Development under Alternative D—Exploration Activities

Exploration on existing mining claims within the Alternative D proposed partial withdrawal area for the most part would cease. However, it is possible that in certain areas, minor levels of exploration might continue. It is assumed that no more than 11 such exploration projects might be submitted to the BLM and Kaibab National Forest over the 20-year time frame of the Alternative D proposed partial withdrawal area.

Exploration could still continue outside the Alternative D proposed partial withdrawal area and could yield an estimated 15 new mines, as shown in Table B-36.

Reasonably Foreseeable Development under Alternative D—Miles of New Roads and Number of Haul Trips

No additional road-building activity would take place to support the four existing mines. However, roads would likely need to be built to service the new mines both inside and outside the Alternative D proposed

partial withdrawal area. The analysis follows an approach similar to what was used under Alternative A to estimate the necessary miles of new road construction. The estimates are shown in Table B-37.

Table B-36. Alternative D—Partial Withdrawal, Estimated Exploratory Activity Needed to Support Uranium Production (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Exploration Projects within Withdrawal Area	Number of New Mines Outside Withdrawal Area	Number of Exploration Projects Outside Withdrawal Area*	Total Number of Exploration Projects	Number of Drill Holes†
North	10	10	280	290	1,450
East	0	1	28	28	140
South	1	4	112	113	565
Total	**11**	**15**	**420**	**431**	**2,155**

* Based on average of 28 exploration projects per ore body discovered.

† Based on average of five drill holes per exploration project.

Table B-37. Alternative D—Partial Withdrawal, Estimated Miles of New Roads (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road
North	17	15.5
East	1	1.2
South	4	2.4
Total	**22**	**19.1**

As previously described, a total of 11,120 haul trips would be required for the average mine. The expected number of ore haul trips under Alternative D is summarized in Table B-38.

Table B-38. Alternative D—Partial Withdrawal, Estimated Number of Haul Trips (20-Year Time Frame)

Proposed Withdrawal Parcel	Ore Tonnage for Existing Mines*	Number of Haul Trips for Existing Mines†	Number of New Mines	Number of Haul Trips for New Mines‡
North	528,449	21,138	17	210,178
East	0	0	1	11,120
South	181,185	7,247	4	51,727
Total	**709,634**	**28,385**	**22**	**273,025**

* Ore tonnage for existing mines (from personal communication, Spiering 2010a): Arizona 1 (180,671), Kanab North (92,834), Pinenut (254,944), and Canyon (181,185). Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 to account for this discrepancy.

† Based on 25 tons per haul trip.

‡ Based on 11,120 haul trips needed per average mine.

Reasonably Foreseeable Development under Alternative D—Miles of Power Lines

No additional power lines would be built for the four existing mines. However, power lines would likely need to be built for the new mines both within and outside the proposed partial withdrawal area. The analysis follows an approach similar to what was used under Alternative A to estimate the necessary miles of new power lines. The estimates are shown in Table B-39.

Table B-39. Alternative D—Partial Withdrawal, Estimated Miles of New Power Lines (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Power Lines
North	17	15.5
East	1	1.2
South	4	2.4
Total	**22**	**19.1**

Reasonably Foreseeable Development under Alternative D—Acreage of Surface Disturbance

Acreage disturbed could include the footprint of the mines themselves and the acreage disturbed by new roads, new power lines, and exploration activities. Mine footprints are assumed to be 20 acres, new roads are assumed to have a disturbance of 1.7 acres per mile, new power lines are assumed to have a disturbance of 0.17 acre per mile, and exploratory activities are assumed to have a disturbance of 1.1 acres per project. Total acreage of disturbance is summarized in Table B-40 (rounded to the nearest acre).

Table B-40. Alternative D—Partial Withdrawal, Estimated Surface Disturbance (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of New Mines	New Miles of Road	New Miles of Power Lines	Number of Exploration Projects	Mine* Temporary Surface Disturbance (acres)	Road† Temporary Surface Disturbance (acres)	Power Lines‡ Temporary Surface Disturbance (acres)	Exploration§ Temporary Surface Disturbance (acres)
North	17	15.5	15.5	290	340	26	3	319
East	1	1.2	1.2	28	20	2	1	31
South	4	2.4	2.4	113	80	4	1	124
Total	**22**	**19.1**	**19.1**	**431**	**440**	**32**	**5**	**474**
Approximate Duration of Disturbance					**5–7 Years**	**5–7 Years**	**5–7 Years**	**1 Month**

* Assumes 20-acre footprint per mine.

† Assumes 14-foot width, for a disturbance of 1.7 acres per mile (Denison 2010).

‡ Assumes disturbance of 0.17 acre per mile from poles (10% of road disturbance).

§ Assumes disturbance of 1.1 acres per exploration project (BLM 1990:Table III-6).

Reasonably Foreseeable Development under Alternative D—Mine Water Use

Water use is estimated to average a continual 5 gpm over the 4-year operating life of the mine. Mine water use is estimated to be no more than 5 gpm. Over the 4-year operating life span of a mine (development and production), this totals 10,512,000 gallons, or 32.3 acre-feet. Total water use and average water use are summarized in Table B-41. Table B-42 summarizes impacts associated with Alternative D.

Table B-41. Alternative D—Partial Withdrawal Estimated Water Use (20-Year Time Frame)

Proposed Withdrawal Parcel	Number of Mines	Total Combined Water Use Volume for All Mines (million gallons)*	Total Combined Water Use Volume for All Mines (acre-feet)*	Approximate Water Use Rate (gpm)†
North	20	210	646	20
East	1	11	32	1
South	5	53	162	5
Total	**26**	**274**	**840**	**26**

* Based on mine use of 5 gpm over 4 years, for 10,512,000 gallons or 32.3 acre-feet per mine.

† Combined water use from all mines, evenly spaced over 20-year time span, rounded.

Summary of Activity Associated with Alternative D—Partial Withdrawal (20-Year Time Frame)

Table B-42. Summary of Activity Associated with Alternative D—Partial Withdrawal (20-Year Time Frame)

Activity	North Parcel	East Parcel	South Parcel
Total Number of Mines	20	1	5
Number of Exploration Projects	290	28	113
Miles of New Road	15.5	1.2	2.4
Number of Haul Trips	210,178	11,120	51,727
Miles of New Power Lines	15.5	1.2	2.4
Acreage of New Mine Footprint (5- to 7-year duration)	340	20	80
Acreage of New Roads (5- to 7-year duration)	26	2	4
Acreage of New Power Lines (5- to 7-year duration)	3	1	1
Acreage of Exploration (1-month duration)	319	31	124
Total Disturbed Acreage	688	54	209
Combined Water Use Volume for All Mines (million gallons)	210	11	53
Average Rate of Water Use for All Mines (gpm)	20	1	5

B.9 SUMMARY

This section provides a summary of the RFD scenario for each alternative (Table B-43), as well as a summary of the assumptions used to develop the analysis (Table B-44).

Table B-43. Reasonably Foreseeable Future Mineral Exploration and Development by Alternative (20-Year Time Frame)

Activity	Alternative A No Action Area Remains Open under the Mining Law	Alternative B Proposed Action 20 Years (~1 Million Acres Withdrawn)	Alternative C Partial Withdrawal 20 Years (~650,000 acres)	Alternative D Partial Withdrawal 20 Years (~300,000 acres)
Predicted exploration projects				
North Parcel	504	10	94	290
East Parcel	56	0	28	28
South Parcel	168	1	85	113
Subtotal	*728*	*11*	*207*	*431*

Table B-43. Reasonably Foreseeable Future Mineral Exploration and Development by Alternative (20-Year Time Frame), Continued

Activity	Alternative A No Action Area Remains Open under the Mining Law	Alternative B Proposed Action 20 Years (~1 Million Acres Withdrawn)	Alternative C Partial Withdrawal 20 Years (~650,000 acres)	Alternative D Partial Withdrawal 20 Years (~300,000 acres)
Acres disturbed for exploration				
North Parcel	554	11	103	319
East Parcel	62	0	31	31
South Parcel	185	1	94	124
Subtotal	*801*	*12*	*228*	*474*
Predicted mining projects				
North Parcel	21	10	13	20
East Parcel	2	0	1	1
South Parcel	7	1	4	5
Subtotal	*30*	*11*	*18*	*26*
Acres disturbed for mining				
North Parcel	360	140	200	340
East Parcel	40	0	20	20
South Parcel	120	0	60	80
Subtotal	*520*	*140*	*280*	*440*
Number of ore haul trips required				
North Parcel	221,298	98,978	132,338	210,178
East Parcel	22,240	0	11,120	11,120
South Parcel	73,967	7,247	40,607	51,727
Subtotal	*317,505*	*106,225*	*184,065*	*273,025*
Miles of new power lines				
North Parcel	16.4	6.4	9.1	15.5
East Parcel	2.4	0	1.2	1.2
South Parcel	3.6	0	1.8	2.4
Subtotal	*22.4*	*6.4*	*12.1*	*19.1*
Miles of new roads for mine access				
North Parcel	16.4	6.4	9.1	15.5
East Parcel	2.4	0	1.2	1.2
South Parcel	3.6	0	1.8	2.4
Subtotal	*22.4*	*6.4*	*12.1*	*19.1*
Total acres disturbed for exploration and mining over 20-year time frame				
North Parcel	945	163	320	688
East Parcel	107	0	54	54
South Parcel	312	1	158	209
Subtotal	*1,364*	*164*	*532*	*951*
Water usage (million gallons) over 20-year time frame				
North Parcel	221	105	137	210
East Parcel	21	0	11	11
South Parcel	74	11	42	53
Subtotal	*316*	*116*	*190*	*274*

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
General RFD Framework Assumptions			
1	Uranium is the sole commodity of interest in the RFD	–	Withdrawal limited to locatable minerals only. There are no other significant deposits in area (strata-bound or otherwise) except for breccia pipes. Some ancillary commodities are recovered from breccia pipes but are not sufficient to drive mine development.
2	Time frame of analysis is 20 years	–	Limit of initial withdrawal period; furthermore, extrapolating conditions past 20 years is speculative.
3	Uranium commodity prices will remain at or above levels similar to today	–	As seen historically, large swings in commodity prices can drastically affect mine development, but accurate prediction of such swings is not likely. Assuming a floor for commodity prices allows extrapolation of current conditions, which allows a reasonable grounding in reality.
4	No major changes to the Mining Law are being considered	–	Any such changes would be speculative.
5	No major changes in royalty or tax systems are being considered	–	Any such changes would be speculative.
6	No major changes in environmental laws or regulations are being considered	–	Any such changes would be speculative.
7	Advances in technology are unlikely to change mine development with respect to breccia pipes	–	Technology is constantly improving, potentially allowing lower ore grades to be recovered. However, the breccia pipe deposits in northern Arizona are not of marginal grade. Rather, they contain higher ore grades than 85% of the uranium deposits worldwide. Incremental changes in technology are unlikely to affect breccia pipe mining over the near future.
General Mining Scenario			
8	Each mine will consist of a single breccia pipe	–	In two cases, a single mine footprint has or is planned to access multiple pipes, but in most cases a mine accesses only a single breccia pipe. In cases where multiple pipes are accessed (i.e., EZ1/EZ2/What), the footprint is larger than for a single pipe, which results in a similar surface disturbance per breccia pipe, compared with one mine accessing one breccia pipe.
9	Once planning/permitting starts, mines will proceed through development, production, and reclamation and will not require interim management	–	Interim management historically has been caused primarily by commodity prices. For the purposes of the RFD, commodity prices are assumed to remain at or above current levels (see ID 3). Other reasons for entering interim management are considered speculative.

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Industrial Capacity to Mine Uranium			
10	Estimated number of mines industry can support over next 20 years is 37	Up to 6 mines could be concurrently in production at any one time	Based on the number of breccia pipes concurrently being mined in the 1980s, the number of breccia pipes currently in line for development, and similar assumptions used in ACERT (2009) report. Assumes no limitation in milling capacity; for the purposes fo analysis milling is assumed to occur at White Mesa Mill. However, other mills may also see changes in activity based on specific business relationships with mines.
11		Planning/permitting period of 2 years	Based on the expected time frame for NEPA compliance and Arizona permitting requirements (APP).
12		Development period of 1 year	Based on historical mine development periods.
13		Production period of 3 years	Based on historical mine production periods, expected volume or ore to be removed from a typical breccia pipe (278,000 tons), and haul capacity of 300 to 400 tons per day from the EZ1/EZ2 draft plan of operation.
14		Reclamation period of 1 year	Based on historical mine reclamation periods. Reclamation success is expected to take several seasons to occur.
Quantity of Uranium Available to Mine			
15	A typical breccia pipe contains 1,500 tons U_3O_8	–	Five breccia pipes in the proposed withdrawal area have been depleted of uranium (Hack 1, 2, 3, Hermit, Pigeon), yielding 7,873 tons U_3O_8, or an average of 1,575 tons U_3O_8 per mine. This was rounded to 1,500 tons U_3O_8, which was also the value selected for use in the ACERT (2009) analysis.
16	Amount of uranium in mines with approved plans of operation (4,587 tons U_3O_8)	–	Estimates of uranium quantity in mines with approved plans were obtained from personal communication (Spiering 2010a) and regulatory filings. Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 from the figure used in the DEIS to account for this discrepancy.
17	Amount of uranium in discovered mineralized breccia pipes for which reserve estimates exist (6,070 tons U_3O_8)	–	Estimates of uranium quantity in seven mineralized breccia pipes were obtained from personal communication (Spiering 2010a) and are based on regulatory filings and in-house reserve estimated conducted by Energy Fuels Nuclear. Historically, estimates of uranium reserves based on surface drilling only underestimate the amount of uranium eventually mined. Based on historical data, surface estimates were increased by a factor of 2.57 from the figure used in the DEIS to account for this discrepancy.
18	Amount of uranium in discovered mineralized breccia pipes without reserve estimates (4,500 tons U_3O_8)	Overall number of discovered mineralized breccia pipes without reserve estimates (19)	Inventory of breccia pipes and mineralization status was obtained from personal communication (Spiering 2010a).
19		Percent of mineralized breccia pipes economically viable to mine (15%)	See ID 26.
20		Number of likely economically viable breccia pipes (3)	15% of 19 discovered mineralized breccia pipes, rounded.

Table B-42. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Quantity of Uranium Available to Mine, continued			
21		Average of 1,500 tons U_3O_8 per mine	See ID 15.
22	Amount of uranium in discovered breccia pipes with unknown mineralization (0 tons U_3O_8)	Overall number of discovered mineralized breccia pipes without reserve estimates (10)	Inventory of breccia pipes and mineralization status was obtained from personal communication (Spiering 2010a).
23		Percent of mineralized breccia pipes economically viable to mine (1%)	Wenrich and Sutphin (1988) estimate that 8% of breccia pipes are mineralized, and 10% of mineralized breccia pipes could be economically viable, yielding 0.8% of breccia pipes that are economical to mine. This is supported by observation that approximately 1,296 breccia pipes have been identified in northern Arizona (Wenrich and Sutphin 1989), resulting in a total of 14 developed ore bodies, or 1.1%.
24		Number of likely economically viable breccia pipes (0)	1% of 10 discovered breccia pipes with unknown mineralization, rounded.
25	Amount of undiscovered uranium resources (24,507 tons U_3O_8)	Estimated undiscovered uranium endowment (163,380 tons U_3O_8)	Taken from the USGS (2010) estimate for the proposed withdrawal area. “Endowment” refers to ore with grades greater than 0.01% U_3O_8. Grades this low are unlikely to be mined; therefore, the entire undiscovered uranium endowment is unlikely to be mined.
26		Percentage of endowment likely to be mined (15%)	Wenrich and Sutphin (1988) estimated that perhaps 10% of mineralized breccia pipes could be economically mined. During this same period, the approximate ore grade for mined breccia pipes was no less than 0.5% U_3O_8.However, some known breccia pipes currently in line for development contain lower grades of ore, as low as 0.25% U_3O_8, which suggests that these lower grades are now considered economically viable to mine as well. This suggests that the minable percentage of the undiscovered uranium endowment should be larger in order to incorporate these lower grades. A similar increase by 50% places the percentage at 15%, which was judged reasonable to incorporate all estimated reserves in known breccia pipes.
27		Amount of minable uranium in undiscovered uranium endowment (24,507 tons U_3O_8)	15% of total endowment of 163,380 tons U_3O_8.
Exploration Activities			
28	Number of field exploration projects per developed mine	Approximate number of exploration projects occurring on BLM and National Forest System lands during 1980s (417)	Data obtained from BLM indicate that 237 exploration projects with drilling occurred during the period from 1980 to1988, resulting in about 5 drill holes per project. The Forest Service reported that 900 drill holes were advanced on National Forest System lands during the 1980s and early 1990s; based on the BLM data, this is estimated to involve about 180 exploration projects, for a total of approximately 417 exploration projects.
29		Number of ore bodies discovered during same period (11)	Based on closed mines (Pigeon, Hermit, Hack Complex), mines with approved plans of operation (Canyon, Kanab North, Pinenut, Arizona 1), and breccia pipes expected to be developed (EZ1, EZ2).

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Exploration Activities, continued			
30		Approximate number of exploration projects yielding a minable ore body (38)	417 / 11.
31	Surface disturbance associated with an exploration project (1.1 acres per project)	–	Provided directly by BLM, based on historic exploration activities.
Haul Roads and Ore Hauling			
32	Miles of new roads for future mines	Average distance to existing road network for North Parcel (0.9 mile)	Average distance determined using GIS and coverage of existing road network; a number of theoretical mines were randomly placed throughout the parcel and the distance from each to the existing road network was calculated. This average distance was multiplied by the estimated number of mines under each alternative. An additional factor of 50% was added to account for the inability to build perfectly linear roads. The underlying assumption is that existing road network would be improved if needed, even if currently not adequate to handle haul traffic.
33		Average distance to existing road network for East Parcel (1.2 miles)	See ID 32.
34		Average distance to existing road network for South Parcel (0.6 mile)	See ID 32.
35	Number of haul trips needed per new mine (11,120)	Average of 1,500 tons U_3O_8 per mine	See ID 15.
36		Average ore grade of 0.54%	Based on known ore grades for 11 unmined breccia pipes in proposed withdrawal area.
37		Average amount of ore to be removed (278,000 tons)	1,500 tons U_3O_8 at 0.54% ore grade.
38		Average capacity of typical haul truck (25 tons)	Based on draft plan of operations for EZ1/EZ2 mine (Denison 2010).
Miles of New Power Lines			
39	Miles of power lines for future mines	–	Assumed power lines would follow road corridor and have be identical in length to new roads.

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Acreage of Surface Disturbance			
40	Surface disturbance from existing mines (0 acres)	–	Assumed surface disturbance for mines with approved plans of operation has already occurred. Acreage of surface disturbance therefore applies only to new mines.
41	Surface disturbance from new mine footprints (20 acres per mine)	–	Various estimates have ranged from 3–4 acres (Wenrich 2009) to 15–20 acres (personal communication, Spiering 2010d) to more than 40 acres (Denison 2010). The high end of this range refers to a mine accessing multiple pipes. Based on historic observations, footprints of existing mines with approved plans of operation, and draft plans of operation, a footprint of 20 acres was selected.
42	Surface disturbance from exploration activities (1.1 acres per exploration project)	–	See ID 31.
43	Surface disturbance from new roads (1.7 acres/mile)	–	Based on width of 14 feet, obtained from draft plan of operation for EZ1/EZ2 mine (Denison 2010).
44	Surface disturbance from power lines (0.17 acre/mile)	–	Calculated as 10% of new road disturbance. Based on impacts from temporary disturbance during construction and permanent pole footprints.
Mine Water Use			
45	Number of wells per mine (1 well)	–	Based on existing mines with approved plans of operation and draft plan of operations for EZ1/EZ2 mine (Denison 2010).
46	Water use (5 gpm)	Water use needed for sanitation and underground drilling (2 gpm)	Based on draft plan of operations for EZ1/EZ2 mine (Denison 2010). Note that these rates are averages over the entire duration and that actual pumping rates from the wells will likely be much higher but for much shorter duration. Mine sites will likely have 10,000- to 20,000-gallon storage capacity (Denison 2010).
47		Water use needed for dust suppression (3 gpm)	Based on approximate capacity of typical water haul truck of 4,000 gallons, assumed to be filled daily.
48	Duration of mine water use (4 years)	–	Assumes water use during development and production phases of mine life; assumes no watering during reclamation except initial establishment.
49	Total water use by each mine over lifetime (10,512,000 gallons)	–	Average water use (5 gpm) × 60 minutes × 24 hours × 365 days × 4 years.
Assumptions Specific to Alternative A (No Withdrawal)			
50	Number of deposits that can be developed under the alternative (30)	Mines with approved plans of operation – 4	All assumed to be developed under scenario.
51		Known mineralized breccia pipes with reserve estimates – 7	All assumed to be developed under scenario; for quantity see ID 17.
52		Known mineralized breccia pipes with no reserve estimates – 3	All assumed to be developed under scenario; for quantity see ID 20.

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Assumptions Specific to Alternative A (No Withdrawal), continued			
53		Breccia pipes with unknown mineralization – 0	All assumed to be developed under scenario, but none expected to yield a mine (see ID 24).
54		Undiscovered uranium resources – 16	All assumed to be developed under scenario; quantity based on available undiscovered uranium (see ID 27), divided by 1,500 tons U_3O_8 per mine (see ID 15).
Assumptions Specific to Alternative B (Proposed Withdrawal)			
55	Number of deposits that can be developed under the alternative (11)	Mines with approved plans of operation – 4	All assumed to be developed under scenario.
56		Known mineralized breccia pipes with reserve estimates – 7	All assumed to be developed under scenario; for quantity see ID 17.
57		Known mineralized breccia pipes with no reserve estimates – 0	Assumed to be unlikely to have valid existing rights.
58		Breccia pipes with unknown mineralization – 0	Assumed to be unlikely to have valid existing rights.
59		Undiscovered uranium resources – 0	Assumed to be unlikely to have valid existing rights.
Assumptions Specific to Alternative C (Partial Withdrawal)			
60	Number of deposits that can be developed under the alternative (18)	Mines with approved plans of operation – 4	All assumed to be developed under scenario.
61		Known mineralized breccia pipes with reserve estimates – 7	All assumed to be developed under scenario; for quantity see ID 17.
62		Known mineralized breccia pipes with no reserve estimates – 1	Of 19 breccia pipes, 5 are located outside the partial withdrawal area and 14 are located within it. Those without are assumed to be developed at a rate of 15% (see ID 20), yielding 1 mine; those within are assumed to be unlikely to have valid existing rights.
63		Breccia pipes with unknown mineralization – 0	Of 10 breccia pipes, 6 are located outside the partial withdrawal area and 4 are located within it. Those without could be developed, but based on assumptions typically only 1% might be economically viable, yielding no mines. Those within are assumed to be unlikely to have valid existing rights
64		Undiscovered uranium resources – 6	Undiscovered uranium endowment reduced based on percentage surface area of the partial withdrawal. See ID 54.

Table B-44. Assumptions Used to Develop Reasonably Foreseeable Development Scenarios, Continued

ID No.	Specific Assumption	Subcomponents of Assumption	Data Sources and Rationale
Assumptions Specific to Alternative D (Partial Withdrawal)			
60	Number of deposits that can be developed under the alternative (26)	Mines with approved plans of operation – 4	All assumed to be developed under scenario.
61		Known mineralized breccia pipes with reserve estimates – 7	All assumed to be developed under scenario; for quantity see ID 17.
62		Known mineralized breccia pipes with no reserve estimates – 3	Of 19 breccia pipes, 17 are located outside the partial withdrawal area and 2 are located within it. Those without are assumed to be developed at a rate of 15% (see ID 20), yielding 3 mines; those within are assumed to be unlikely to have valid existing rights.
63		Breccia pipes with unknown mineralization – 0	Of 10 breccia pipes, 9 are located outside the partial withdrawal area and 1 is located within it. Those without could be developed, but based on assumptions typically only 1% might be economically viable, yielding no mines. Those within are assumed to be unlikely to have valid existing rights.
64		Undiscovered uranium resources – 12	Undiscovered uranium endowment reduced based on percentage surface area of the partial withdrawal. See ID 54.

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Attachment B-1

FEDERAL, STATE, AND LOCAL PERMITS TYPICALLY REQUIRED PRIOR TO MINE DEVELOPMENT

Table B.1-1. Federal, State, and Local Permits Typically Required Prior to Mine Development

Environmental Concern	Permit Authorizations	Agency	Triggering Activity	Timing/Comment
Land Use	43 CFR 3715 and 43 CFR 3802, 3809 BLM Notices, Plans of Operation, and Occupancy (Mining Claims) *(BLM-administered lands)*	Federal Lands, BLM	Activities that ordinarily result in no or negligible disturbance of the public lands or resources are termed "casual use." In general, the operator may engage in casual use activities without consulting, notifying, or seeking approval from the BLM. For exploration activity greater than casual use and that causes surface disturbance of 5 acres or less of public lands, the operator must file a complete Notice with the responsible BLM Field Office 15 calendar days before commencing operations. A plan of operations is required for surface disturbance greater than casual use, unless the activity qualifies for a Notice filing. Surface disturbance greater than casual use on certain special category lands always requires the operator to file a plan of operations and receive BLM approval.	Within 15 calendar days of receipt of a Notice, the Field Office will review the filing to determine whether it is complete. If the Field Manager takes any of the following actions, operations may not begin until 15 calendar days after filing a complete Notice and providing BLM with an acceptable financial guarantee: • Notifies the operator that BLM needs additional time, not to exceed 15 calendar days, to complete its review; • Notifies the operator that he or she must modify the Notice to prevent unnecessary or undue degradation; • Requires the operator to consult with BLM about the location of existing or proposed access routes; • Determines that an on-site visit is necessary; or • BLM determines that the operator qualifies as a Notice-level operation. The amount of time required to review and approve a plan of operations will vary considerably, depending on the type and complexity of the activity being proposed, the resources potentially affected, the required level of NEPA analysis, the amount of interagency coordination needed, and the level of public controversy. A claimant or operator who is requesting to occupy a mining claim is subject to the same time constraints as a plan of operations.
	Plan of Operations 36 CFR 228 A, Plans of Operation (Mining Claims) *(Forest Service–administered lands)*	Forest Service	Proposals for activities to prospect, mine, or process locatable minerals that might cause significant disturbance of surface resources. A plan of operation is required for activity that uses mechanized earth moving equipment such as bulldozers and or backhoes or requires tree cutting or otherwise may cause significant disturbance of surface resources.	The length of time required to analyze and render a decision varies considerably, depending on the type of operation proposed, public issues, and potential environmental impacts. The process is largely influenced by the type of NEPA documentation that is required. If an EIS is required, the process to complete NEPA and approve a plan of operations may take up to 3 years.
Drilling and Water Use	Dry Well Registration	ADEQ	New dry wells.	Registration must be complete within 30 days of completion of the well. Review time for the registration varies with the complexity of the submittal.
	Notice of Intention to Drill and Abandon an Exploration/ Specialty Well Notice of Intention to Drill, Deepen, Replace, or Modify a Well Notice of Intent to Drill, Deepen, or Modify a Monitor/Piezometer/ Environmental Well Notice of Intent to Abandon a Well	ADWR	Required for any manmade openings in the earth through which water may be withdrawn or obtained from beneath the surface of the earth, including water wells, monitor wells, and piezometer wells. It also applies to all exploration wells and grounding or cathodic protection holes greater than 100 feet deep.	ADWR has a maximum of 15 days to process notices, except as follows: the Notice of Intent to Drill and Abandon an Exploration/Specialty Well and the Notice of Intent to Abandon a Well have 30 days. When a variance, or request to deviate from the minimum construction standards, is submitted, the review period increases to 50 days.
	Withdrawal and Use of Groundwater Well Construction Permit	ADWR	Use of groundwater. Water well completion.	15 to 100 days.
	Appropriations of Surface Water	ADWR	Use or store surface waters	A permit to appropriate water must be reviewed for completeness within 30 days, and a substantive review must be completed in 420 days, for a total overall time frame of 450 days. Permits for reservoir storage must be reviewed for completeness within 30 days and substantive review must be completed in420 days. Severance and transfer of water rights must be completed in an overall time frame of 420 days, including 30 days for completeness review and 390 days for substantive review.
Explosives, Fuel, and Oil	Used Oil Handlers – EPA Identification Number	ADEQ	Transporters/transfer facilities, processors/re-refiners, marketers, and burners of used oil, prior to activity.	Usual processing for the receipt of an EPA Identification Number is about 1 week.
	Permit to Transport Explosives	Bureau of Alcohol, Tobacco and Firearms	Transportation of explosives.	
	Magazine Construction	Bureau of Alcohol, Tobacco and Firearms	Storage of explosives.	
Air Quality	Air Quality Control Permit	ADEQ	Emitting air pollutants.	Depends on the size and complexity of the facility, but usually requires a minimum of 4 months to process.
	Operating Permit (?)	EPA	Release of radon from active underground uranium mines.	

Table B.1-1. Federal, State, and Local Permits Typically Required Prior to Mine Development (Continued)

Environmental Concern	Permit Authorizations	Agency	Triggering Activity	Timing/Comment
Water Quality	Clean Water Act [33 USC 1251 *et seq*., 1341] (Federal Water Pollution Control Act 401)	ADEQ	This certification is issued to ensure that federally permitted or licensed activities do not cause a violation of state water quality standards when an activity may result in a discharge to waters of the state.	Review time depends on the completeness of the information provided to ADEQ, the complexity and size of the proposed activity, and the sensitivity of the impacted watercourse. Typical processing time is 30 days; a complex project with changes may take longer.
	APP	ADEQ	Own or operate a facility that discharges either directly to an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer. In addition, the following facilities are categorized as discharging facilities: • Surface impoundments, pits, ponds, and lagoons; • Solid waste disposal facilities, except for mining overburden and wall rock that has not been subject to mine leaching operations; • Injection wells; • Land treatment facilities; • Facilities adding pollutants to a salt dome, salt beds, or salt formations, drywells, underground caves, or mines; • Mine tailings piles and ponds; • Mine leaching operations; • Underground water storage facilities (if reclaimed water is recharged); • Sewage treatment facilities, including on-site wastewater treatment facilities; and • Wetlands designed and constructed to treat wastewater for underground storage.	Individual permits are issued for the operational life of the facility. Individual permit review may take from 6 months to more than a year to complete, depending on the complexity of the project, the extent of public involvement, and the responsiveness of the applicant.
	208 Consistency Review	ADEQ	In conjunction with AZPDES or Individual APPs or modification of existing permits.	Consistency review can usually be completed within 1 month, if all necessary information is provided.
	Clean Water Act [33 USC 1251 *et seq*., 1341] (Federal Water Pollution Control Act 401)	ADEQ	When an activity may result in a discharge to waters of the state.	Review time depends on the completeness of the information provided to ADEQ, the complexity and size of the proposed activity, and the sensitivity of the impacted watercourse. Typical processing time is 30 days; a complex project with changes may take longer.
	AZPDES for Stormwater Discharges from Industrial Activities	ADEQ	Discharge from any conveyance that is used for collecting and conveying stormwater and that is directly related to manufacturing, processing, or raw material storage areas at an industrial plant.	For coverage under ADEQ's general stormwater permit, discharges are authorized 48 hours after Notice of Intent is postmarked, unless otherwise notified by ADEQ.
	AZPDES	ADEQ	Discharges of pollutants from point sources into waters of the U.S.	Once a complete AZPDES permit application is received, processing time is generally between 6 months to 1 year, depending on the complexity of the project.
	APP	ADEQ	Own or operate a facility that discharges either directly to an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer. In addition, the following facilities are categorized as discharging facilities: • Surface impoundments, pits, ponds, and lagoons • Solid waste disposal facilities, except for mining overburden and wall rock that has not been subject to mine leaching operations; • Injection wells; • Land treatment facilities; • Facilities adding pollutants to a salt dome, salt beds, or salt formations, drywells, underground caves, or mines; • Mine tailings piles and ponds; • Mine leaching operations; • Underground water storage facilities (if reclaimed water is recharged); • Sewage treatment facilities, including on-site wastewater treatment facilities; and • Wetlands designed and constructed to treat wastewater for underground storage.	Individual permit review may take from 6 months to more than 1 year to complete, depending on the complexity of the project, the extent of public involvement, and the responsiveness of the applicant.
	Section 404 Permit (also known as a "Dredge and Fill Permit")	U.S. Army Corps of Engineers	Projects that will result in a discharge of dredged or fill material into waters of the U.S., including wetlands.	It takes 30 to 60 days for most general permits and letters of permission. Individual permits typically require 180 days' processing time. Longer processing times may be expected for complex projects or instances where there are endangered species or cultural resource concerns.
	Section 10 Permit	U.S. Army Corps of Engineers	Construction activity in or near or altering any navigable water of the United States must obtain a Section 10 permit. In Arizona, Section 10 applies only to the Colorado River and its impoundments (i.e. Lake Havasu, Lake Mead and Lake Powell).	The individual permit review process typically takes 180 days. Longer processing times may be expected in more complex projects or instances where there are endangered species or cultural resource concerns.
Native Plants	Notice of Intent to Clear Land (Notice)	Arizona Department of Agriculture (ADA)	Arizona Revised Statutes 3-904 requires the property owner, when clearing undisturbed land, to submit a Notice, which notifies the ADA of the intended destruction of protected native plants.	Once submitted, the ADA will return a confirming copy of the Notice to the landowner. The landowner may not begin the destruction of protected native plants until he or she receives confirmation from the ADA and 20 days have elapsed for Notices of less than 1 acre, 30 days have elapsed for notices greater than 1 acre but less than 40 acres, or 60 days have elapsed for Notices involving more than 40 acres.

Table B.1-1. Federal, State, and Local Permits Typically Required Prior to Mine Development (Continued)

Environmental Concern	Permit Authorizations	Agency	Triggering Activity	Timing/Comment
Hazardous Materials	Hazardous Waste Permit	ADEQ	Facility that accepts hazardous waste from off-site for the purpose of treatment, storage, or disposal.	Permit processing time may take 24 months or more, based on the size and complexity of the project.
Solid Waste Disposal	Solid Waste Notification	ADEQ	Site owned, operated, or used for the storage, processing, treatment, or disposal of solid waste.	Notices must be submitted no later than 30 days prior to beginning operation.
Drinking and Wastewater Permits	Discharge Authorization for a Type 4 General APP	ADEQ	On-site wastewater treatment facility.	Regulations allow 73 to 136 business days, depending on the Type 4 General APP. Additional time may be added for more complex facilities.
	Approval to Operate water and/or Wastewater Facilities	ADEQ	New or modified water and/or wastewater facilities.	Typically from 2 to 8 weeks.
	Water and/or Wastewater Facilities – Approval to Construct	ADEQ Groundwater Section	Construction of new or modified water and/or wastewater facilities.	Routine projects are typically processed within 45 to 90 days.
	Reclaimed Water Permit	ADEQ	Wastewater treatment facilities supplying reclaimed water and sites where reclaimed water is applied or used.	Administrative completeness reviews for individual reclaimed water permits are 35 business days, and time frames for substantive reviews for standard and complex facilities range from 186 to 294 business days, depending on the complexity of the project and whether a public hearing is held.
Flood Control	Flood Control	County	Mines proposed for floodplains must be reviewed by the flood control district.	Varies from county to county.
Mine Health and Safety	License to Process Non-radioactive Material from Radioactive Tailings	Arizona Radiation Regulatory Agency (ARRA)	The ARRA is responsible for the conduct of a statewide radiological health and safety program and for the enforcement of state rules and regulations for the control of ionizing radiation. If the primary product is uranium or thorium, the processing of the material is licensed by the United States Nuclear Regulatory Commission. If the processing produces uranium, thorium, or other radioactive material as a secondary product, the licensing is by the ARRA.	120 days.
	Notice of Start-up, Move, or Stop for Portable Mining Equipment and Mine Operations	Arizona State Mine Inspector (ASMI)	Starting, moving, or stopping a mining operation. Use of underground diesel equipment. Elevators at mine property.	The ASMI will notify the mine operator by mail, email, or fax that the Notice has been received and provide the operator with an ASMI ID number. Diesel permits are issued within 30 to 45 days. Elevator permits are issued upon correction of any deficiencies found. If no deficiencies are found, permits are issued upon completion of the inspection.
Wildlife		U.S. Fish and Wildlife Service (USFWS)	The USFWS is not involved in the issuance of mining permits, nor does it authorize mining operations. However, the USFWS may become indirectly involved within the framework of Section 7 of the Endangered Species Act (ESA), as amended. This section of the ESA requires that federal agencies consult with the USFWS on any actions the agency authorizes, funds, or carries out that "may affect" a species listed as endangered or threatened under the ESA, or any designated critical habitat. Consultation is an interagency cooperative process that can either be carried out in conjunction with the permitting agency's NEPA review, or as a separate process. In this regard, permitting agency time lines for the issuance of permits and/or authorizations may be affected by their consultation with the USFWS. Although there is no direct permitting process, persons who "take" a threatened or endangered animal may be subject to civil or criminal penalties under Section 9 of the ESA. The term "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under federal jurisdiction or the destruction of endangered plants on non-federal areas in violation of state law or regulation or in the course of any violation of a state criminal trespass law.	The ESA requires that if formal consultation is initiated, the consultation be concluded within 90 days and thtat the USFWS's biological opinion be issued within 135 days. Deviations from the normal Section 7 schedules can result when interagency disagreement develops over the alternatives and/or measures needed for the protection of species and habitats in the affected area. These alternatives and/or measures are worked through using the Section 7 process.

Table B.1-1. Federal, State, and Local Permits Typically Required Prior to Mine Development (Continued)

Environmental Concern	Permit Authorizations	Agency	Triggering Activity	Timing/Comment
Cultural Resources	Cultural Resources Use Permit	BLM Forest Service	Compliance with Section 106 of the National Historic Preservation Act is necessary before the BLM/Forest Service approves a mining plan of operations.	A Cultural Resource Use Permit for archaeological survey is usually issued within 1 week of receiving a complete application. A Cultural Resource Use Permit for archaeological testing or excavation (data recovery) cannot be issued until any consultation that may be needed with the State Historic Preservation Officer, Advisory Council on Historic Preservation and the affected American Indian Tribe has been completed by the BLM/Forest Service. Once the BLM/Forest Service has completed the necessary consultation and approved the mitigation plan for cultural resources that will be affected by proposed operations, a Cultural Resource Use Permit for archaeological testing or excavation is usually issued within 1 week of receiving a completed application.
Taxes and Incorporation	Corporations Must File an Application for Authority and Articles of Incorporation	Arizona Corporation Commission	Required of all corporations established in Arizona.	6–8 weeks.
	Transaction Privilege Tax License	Arizona Department of Revenue	Receives gross proceeds from sales or gross income on which a privilege tax is imposed.	The length of time for the Department to issue a transaction privilege tax license and city privilege tax license can be between 10 and 30 business days.