

Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities

Chapters 5 through 12
and Appendices A through F

Draft Report for Comment

Office of Federal and State Materials and
Environmental Management Programs

Wyoming Department of Environmental Quality
Land Quality Division

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Appendices C, D, and F are provided. Some pages of these appendices inadvertently were not printed in the original printing of Volume 2 of NUREG-1910.





United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-1910, Vol. 2
Errata

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**U.S. Nuclear Regulatory Commission
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**Wyoming Department of Environmental Quality
Land Quality Division**

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APPENDIX C

1
2
3

SUMMARY OF CONVENTIONAL URANIUM MILLING TECHNOLOGIES

1 **C. SUMMARY OF CONVENTIONAL URANIUM**
2 **MILLING TECHNOLOGIES**

3
4 **C1.1 Conventional Mills**

5
6 Uranium milling techniques have evolved over the years, but the basic requirements are similar
7 to those described in NUREG-0706 (NRC, 1980, Appendix B). Although located in an
8 Agreement State and not regulated by the U.S. Nuclear Regulatory Commission (NRC), recent
9 licensing actions related to conventional mill sites in Utah (White Mesa near Blanding and
10 Shootaring Canyon near Ticaboo) can also provide some updated information [Denison Mines
11 (USA) Corporation, 2007; Plateau Resources, Ltd., 2006]. These facilities have a maximum
12 capacity of about 900–1,800 metric tons [1,000–2,000 short tons] of ore per day. Many of the
13 chemical processes are similar to those used to process ISL solutions; unlike ISL uranium
14 processing, however, additional steps are necessary to prepare the solid uranium ore for
15 recovery and manage solid waste disposal.

16
17 In traditional conventional milling operations, the uranium ore is mined from a deposit by surface
18 or underground mining techniques and transported to the mill site for processing
19 (Figure C1.1-1). Depending on economic conditions and license requirements, a conventional
20 mill may also process alternate materials such as contaminated soils for their uranium content
21 [Denison Mines (USA) Corporation, 2007]. The conventional uranium milling process involves
22 several basic steps (Figure C1.1-2).

23
24 **C1.1.1 Ore Handling and Preparation**

25
26 This stage of the milling process includes ore blending to ensure uniform physical and chemical
27 characteristics, crushing and grinding, and possibly drying or roasting to improve ore handling
28 and solubility properties.

29
30 Ore is trucked to the processing facility. The incoming ore is weighed and analyzed for moisture
31 and uranium content. The ore may be stockpiled to manage the feed into the circuit. Ore is
32 initially screened through a large mesh grizzly and transported by conveyer belt into the grinding
33 stage, usually by discharge into a semiautogenous grinding mill. Water is added to the ore to
34 produce a slurry containing approximately 70 percent solids. The slurry is then pumped through
35 screens into large surge tanks to maintain feed into the leach circuit. Oversize material is
36 recycled back into the semiautogenous grinding mill, and undersize material flows to a
37 storage sump.

38
39 **C1.1.2 Mill Concentration**

40
41 This stage of the milling processing includes physical (e.g., washing) or chemical techniques to
42 leach uranium from the slurry, followed by further uranium concentration using techniques such
43 as ion exchange or solvent recovery.

44
45 The leaching circuit dissolves uranium minerals from sandstone grains. A two-stage leaching
46 circuit is typically used (Plateau Resources, Ltd., 2006). The ore slurry is pumped from the
47 surge tanks to the first-stage leach circuit where the ore is mixed and agitated with a sulfuric
48 acid or alkaline leach solution, and an oxidant and passed through a series of leach tanks in

Summary of Conventional Uranium Milling Technologies

1

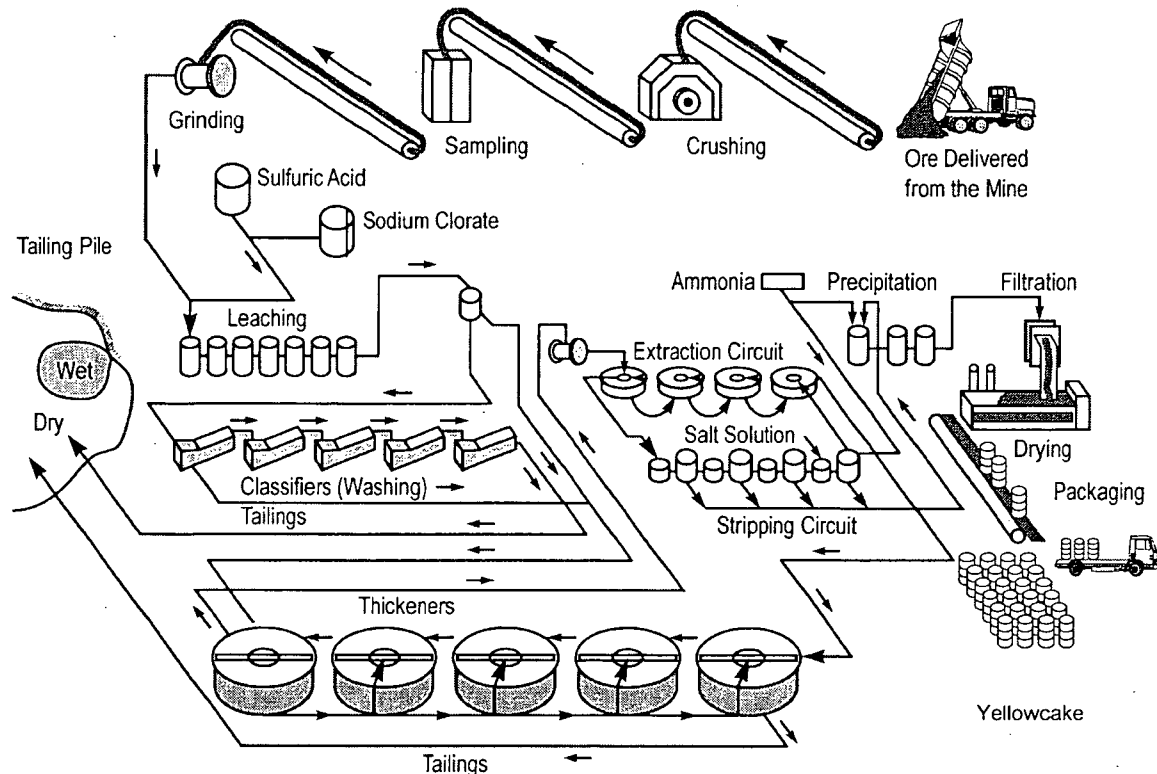


Figure C1.1-1. Schematic of a Conventional Uranium Milling Operation (Energy Information Administration, 1995)

2

3 series. Following the first-stage leach, the slurry is transferred to the decant thickener. The
4 decanted liquid from the thickener is enriched in dissolved uranium and is pumped to the
5 solvent recovery unit for further concentration. The solids from the thickener are pumped to a
6 series of tanks for a second leaching stage and further uranium recovery using sulfuric acid with
7 oxidant. Each tank in the second stage is agitated to keep the sand grains in suspension. The
8 output from the second leach stage is a slurry of solids and sulfuric acid solution with
9 dissolved uranium.

10

11 The slurry is transferred to the first of a series of countercurrent decantation tanks for washing
12 and thickening. This countercurrent flow of liquid and solids washes the residual dissolved
13 uranium compounds from the solids. The uranium-rich acid solution decanted from the
14 countercurrent decantation is transferred to a clarifier, filtered, and pumped to the solvent
15 recovery circuit. Settled and filtered solids are recycled to the second stage leach circuit for
16 additional uranium recovery. The primary purpose of the solvent recovery circuit is to
17 concentrate and purify uranium. First, the uranium acid solution is mixed with an organic
18 solvent that is preferentially selective for uranium. The two solutions are then allowed to settle
19 and separate. After going through a series of mixing and settling tanks, almost all of the
20 uranium is removed from the acid solution.

21

22 The uranium-rich organic solvent is washed with acidified water and stripped of its uranium
23 content by mixing it in a series of mixer/settling tanks with an aqueous solution such as

Summary of Conventional Uranium Milling Technologies

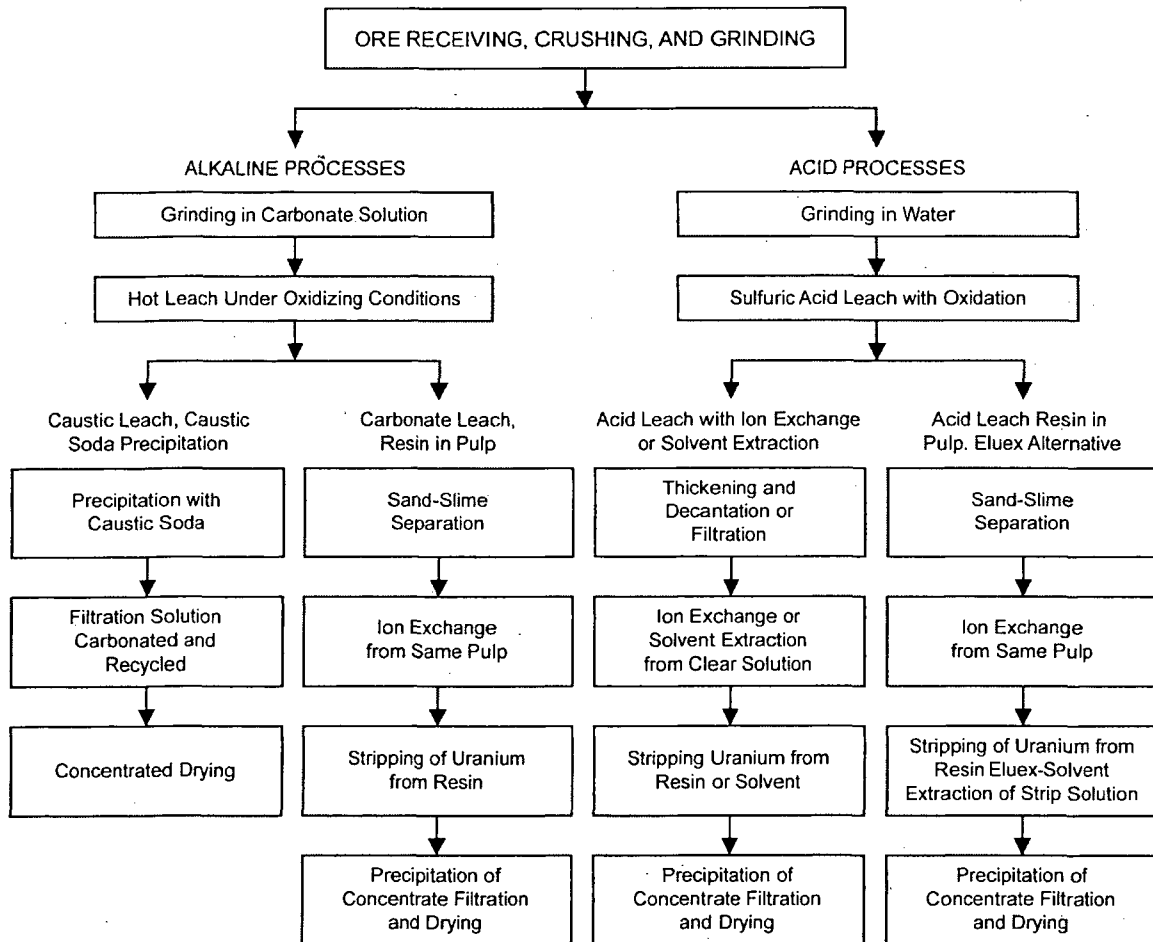


Figure C1.1.–2. Flow Diagram of the Conventional Uranium Milling Process (Energy Information Administration, 1995)

2
3 ammonium sulfate or sodium chloride [Denison Mines (USA) Corporation, 2007; Plateau
4 Resources, Ltd., 2006]. After stripping, the now barren organic solvent is recycled back into the
5 solvent recovery circuit. The uranium-rich (pregnant) solution then goes to the final stage for
6 purification, precipitation, drying, and packaging.

7 8 **C1.1.3 Product Recovery**

9
10 This is the final step in the milling process, where the product is recovered from solution by
11 filtration, purification, and chemical precipitation, followed by drying and packaging of the
12 yellowcake for shipment. This stage is similar to the ISL processing. The uranium-rich solution
13 from the solvent recovery circuit and stripping process is treated chemically to induce uranium
14 precipitation. The precipitated yellowcake is allowed to settle and thicken before filtration and
15 drying. The precipitate is then washed, dried, and packaged as described in Section 2.4.

C1.1.4 Tailings Management

The conventional milling techniques recover about 90 percent of the uranium content of the feed ore. Unlike ISL milling, each stage of the conventional milling process produces solid, liquid, and gaseous waste streams that require disposal. These wastes can be either radioactive or nonradioactive, depending on the specific process controls used for a facility. Typically, these waste streams are transferred to tailings piles and tailings ponds for disposal (Figure C1.1-3). The tailings represent the bulk of the wastes originating from the uranium mill, and with the exception of the recovered uranium and process losses, account for practically all of the ore solids and the process additives, including water (NRC, 1980, Appendix B). When discharged from the operating mill, the tailings will consist of a mixture of solids and solutions that vary in chemical and physical compositions, depending on the nature of the ore and the process used. The typical components of the tails include tailings sand, fine solids (called slimes), liquids composed of chemical solutions and dissolved ore solids, and water.

As part of the uranium mill licensing process, the NRC reviews the design and construction details associated with the applicant or licensee proposed tailings retention system to ensure safe disposal of tailings. The design review can include features such as geotechnical stability, surface water hydrology and erosion protection, groundwater protection (liners), and radiation protection (radon caps) (NRC, 2003). Surety estimates for aquifer restoration, decommissioning, and reclamation activities are conducted similarly to those described in Sections 2.5-2.6, although the scope of the effort will vary depending on the size of the conventional milling facility and the presence or absence of contamination at the end of operations.

C2 HEAP LEACH METHOD

Like conventional milling operations, the heap leaching process is a way of extracting uranium from uranium ore. Ore is either mined at the location or trucked into the site. The uranium ore is sized and stacked on a graded site in a series of lifts using heavy equipment. Leaching solutions (typically sulfuric acid) are applied to the top of the pile and percolate through the ore pile, dissolving uranium as they move. The uranium-rich solutions are collected at the bottom of

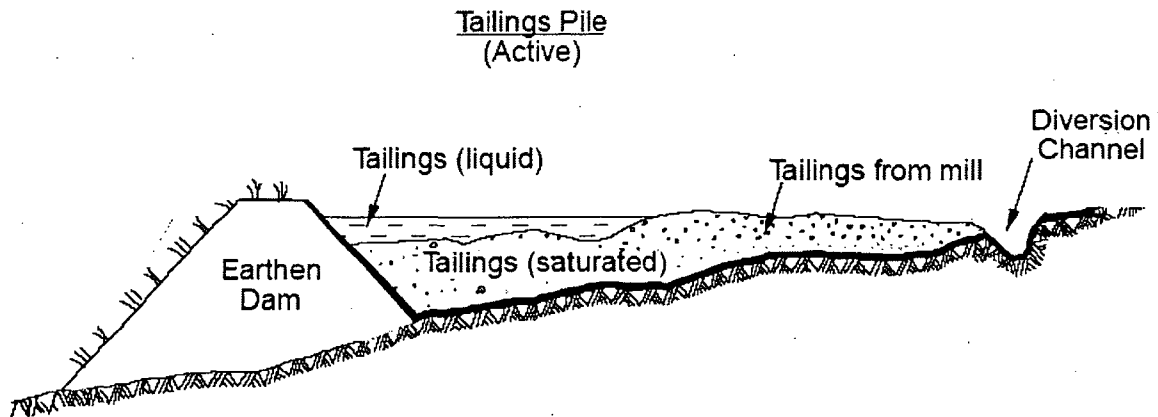


Figure C1.1-3. Schematic Cross Section of an Active Tailings Pile and Tailings Pond (Energy Information Administration, 1995)

1 the ore pile, typically by a series of perforated plastic pipes buried in a gravel layer underneath
2 the pile. Heap leach technology has largely been developed for gold and copper mining, but
3 many of the same features are relevant to uranium recovery.

4
5 The heap leach site is typically lined with a clay liner or geomembrane to prevent
6 ore constituents (uranium plus other metals) from infiltrating the groundwater (Figure C2.1-1).
7 The operator determines the type of and size of the leach pad based in part on the economics
8 of producing the uranium ore, the nature of the ore, geotechnical stability issues, site
9 topography, and reclamation costs (Chadwick, 2007). Brief descriptions of types of leach
10 pads follow:

- 11
- 12 • Conventional or flat pads are relatively flat, either graded smooth or terrain contoured on
13 gentle alluvial fans. Ore is generally stacked in thin lifts, on the order of 5–10 m
14 [16–33 ft] thick.
- 15
- 16 • Dump leach pads are similar to flat pads or can include slightly more rugged terrain.
17 The term “dump” usually means that the ore is stacked in much thicker lifts, perhaps as
18 much as 50 m [164 ft].
- 19
- 20 • Valley fills are used in rugged and steep topography. These heap leach pads are
21 designed to fill in natural valleys using either a buttress dam at the bottom of the valley
22 or a leveling fill within the valley. These can be very large pads, depending on the local
23 topography and the size of the ore deposit.
- 24
- 25 • On/off pads are hybrid heap leach systems. A relatively flat pad is built using a robust
26 liner and overliner system. Then, a single lift of ore from 4 m to 10 m [13 to 33 ft] thick is
27 loaded and leached. At the end of the leach cycle the spent ore is removed for disposal,
28 fresh ore is restacked on the pad, and the cycle is repeated.
- 29

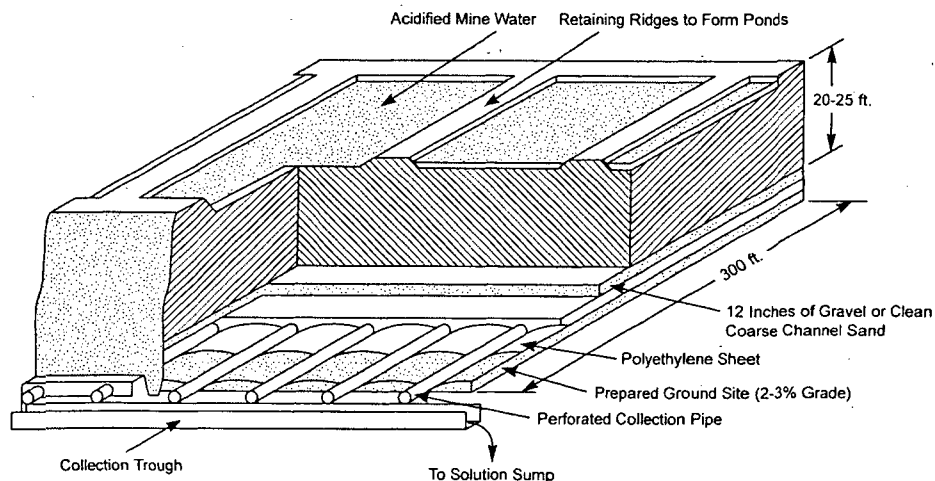


Figure C2.1-1. Schematic Diagram of Typical Heap Leach Pile (NRC, 1980)
[1 ft = 0.3048 m; 1 in = 0.39 cm]

Summary of Conventional Uranium Milling Technologies

1 The top of the heap leach pile is typically graded and divided into sections to induce leach
2 solution ponding. A pile is abandoned when the uranium recovery no longer justifies the
3 expense of pumping of leaching solution through it or when a specified low limit of solution
4 grade is reached. Collected enriched solutions can be processed at the leaching site by ion
5 exchange or solvent recovery and precipitated by chemical processing. The final precipitated
6 slurry product is then trucked to a processing facility. Groundwater restoration,
7 decommissioning, reclamation activities, and surety estimates would be conducted similarly as
8 those described previously in Sections 2.5–2.6, although the scope of the effort will vary
9 depending on the size of the heap leach operation and the presence or absence of
10 contamination at the end of operations.

11
12 Heap leaching is usually used to treat low-grade ores or when the ore body is small and situated
13 far from the milling facilities. Haulage costs dictate the choice of heap leaching at sites far from
14 the milling plant because the shipment of a high-grade pregnant solution or a crude bulk
15 precipitate from a point near the mine site is cheaper than hauling low grade ore to the mill
16 (NRC, 1980; Beahm, 2007). In cases where the heap leach pile is located reasonably near a
17 mill, acid solutions from the mill circuit are commonly used for the heap leach operation, with the
18 enriched solutions returned to the mill circuit for processing. Heap leaching for uranium
19 recovery was used on an experimental basis in the United States in the 1970s and 1980s, but
20 the process is not in use at a commercial scale today (EPA, 2007).

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APPENDIX D

CULTURAL AND HISTORICAL RESOURCE MANAGEMENT PROCESSES

1
2
3
4

1 **D. CULTURAL AND HISTORICAL RESOURCE MANAGEMENT PROCESSES**

2
3 **D1.1 CULTURAL RESOURCES**

4
5 Cultural resources are historic properties that include archaeological sites and historical-period
6 structures and features protected under the NHPA of 1966, as amended (16 U.S.C. 470).

7 Cultural resources further include traditional cultural properties that significantly define
8 community practices and beliefs that are important to maintaining community identity.

9 According to Section 106 of the NHPA, federal agencies must account for effects to historic
10 properties that may result from the agencies' undertakings. 36 CFR Part 800 defines the
11 process by which federal agencies comply with the NHPA, as amended. The National Register
12 of Historic Places (NRHP) is a register of historic buildings, objects, sites, and districts as well
13 as archaeological resources. Archaeological resources consist of prehistoric and
14 historical-period sites that contain evidence of past human lifeways and adaptations. Traditional
15 cultural properties, cultural landscapes, ethnographic landscapes, rural historic landscapes, and
16 historic mining landscapes can also be evaluated for listing in the NRHP.

17
18 The federal government established the NRHP and devised the way historic properties are
19 eligible and can be nominated to be listed in the NRHP; this process preserves significant
20 historic properties. The listing of a historic property in the NRHP ensures that a property is
21 protected under provisions of the NHPA. In addition, properties deemed potentially eligible for
22 inclusion in the NRHP are given this same protection.

23
24 In the context of a federal undertaking, the significance of a cultural resource is judged
25 according to NRHP eligibility criteria. These criteria are defined in Title 36, Part 60, of the Code
26 of Federal Regulations (36 CFR Part 60), which states that

27
28 "The quality of significance in American history, architecture, archeology,
29 engineering, and culture is present in districts, sites, buildings, structures, and
30 objects that possess integrity of location, design, setting, materials,
31 workmanship, feeling, and association, and;

32
33 (a) that are associated with events that have made a significant contribution to
34 the broad patterns of our history; or

35
36 (b) that are associated with the lives of persons significant in our past; or

37
38 (c) that embody the distinctive characteristics of a type, period, or method of
39 construction, or that represent the work of a master, or that possess high artistic
40 values, or that represent a significant and distinguishable entity whose
41 components may lack individual distinction; or

42
43 (d) that have yielded, or may be likely to yield, information important in
44 pre-history or history."

45
46 In addition to these four criteria, there is a general stipulation that the property be 50 or more
47 years old (for exceptions, see 36 CFR 60.4, Criteria Considerations a–g). The importance of
48 this historic information is measured by its relevance to identified research questions that can be
49 addressed through the analysis of particular types (National Park Service, 1991). In addition to
50 research potential, both Native American and Euroamerican cultural resources may possess

1 public and ethnic values. Cultural resources may also have broader public significance, such as
2 serving to educate the public about important aspects of national, state, or local history and
3 pre-history. In this way, the cultural properties are evaluated in terms of the NRHP criteria with a
4 focus on integrity and information potential.

5
6 The eligibility of a cultural resource nominated for an NRHP listing may be based upon any of
7 the four criteria. Some criteria are best addressed through archival or architectural research,
8 but criterion (d) is typically documented by archaeological evidence. However, historical-period
9 properties in particular may also be eligible under other criteria, typically criteria (a)–(c).

10
11 Eligibility for listing in the NRHP under criterion (d) requires that the importance or “significance”
12 of the cultural resources in question be evaluated. There is no formula for making a NRHP
13 eligibility determination that will satisfy every possible cultural resource that needs to be
14 evaluated. NRHP eligibility, therefore, must occur within a theoretical or substantive context
15 referred to as a Historic Context.

16 17 **D2.1 HISTORIC RESOURCES**

18
19 Historic contexts (or research themes) are the framework within which the federal historic
20 preservation process is structured. A historic context is a body of information about properties
21 organized by its basic elements—theme, place, and time. Together, the historic contexts of a
22 particular geographic area make up the history or pre-history of the area broken down into a
23 series of historically meaningful segments; each segment is a single historic context. Grouped
24 together, the various historic contexts of an area form a comprehensive summary of all aspects
25 of the area’s history and pre-history.

26
27 A region has an indefinite number of historic contexts or research themes. Because these
28 contexts or themes reflect contemporary theoretical concerns in archaeology, historic contexts
29 are dynamic and constantly need to be evaluated, rethought, and refined. Historic contexts are
30 hierarchical frameworks of general concepts or categories. Topics are developed within each
31 historic context that address specific areas of research. Research questions within topics focus
32 discussion on particular issues and guide the archaeologist or historian with the initial questions
33 they can use to evaluate a cultural resource.

34
35 A key determination regarding site significance involves the concept of integrity—the physical
36 condition of a cultural resource. If the physical condition of a site can potentially provide
37 important information about history or pre-history, then it has integrity. If various processes of
38 disturbance—environmental or cultural, intentional or unintentional—have affected the property
39 so that its cultural essence is lost or severely damaged, then the property is said to lack
40 integrity. In general, properties that lack integrity lack the potential to provide important
41 information about pre-history or history and are therefore considered ineligible for listing in
42 the NRHP.

43
44 In summary, the protection of archaeological, historical period, and traditional cultural resources
45 and landscapes within and in the vicinity of proposed projects and alternatives must be carefully
46 considered under the statutory requirements of both the National Environmental Protection Act
47 and Section 106 of the NHPA, as amended. A facility’s construction, operation, or
48 decommissioning can adversely impact historic properties either directly through construction

1 and maintenance activities or indirectly through increased access to historic properties that
2 could potentially lead to vandalism.

4 **D2.1 Native American Consultation**

5
6 Native American groups that have ties to the region or locality in which a project is proposed
7 should be consulted during the early stages of a project. Discussions should be included with
8 any THPO or other tribal cultural organization about the presence of traditional cultural
9 properties, traditional use areas, plant and animal procurement areas, springs, shrines, sacred
10 sites, ethnographic landscapes, and other cultural resources of concern that might be present in
11 the project area.

13 **D2.2 Area of Potential Impacts to Historic and Cultural Resources**

14
15 The general area of potential impacts to cultural and historic resources encompasses the
16 project area and its alternatives, all its structures and facilities, and related infrastructure
17 developments. That area is wherever direct or indirect impacts adversely affect or have the
18 potential to adversely affect historic and cultural resources, traditional cultural properties, and
19 landscapes that are or have the potential to be listed in the NRHP. Determining effects to
20 historic and cultural resources, traditional cultural properties, and landscapes will coincide with
21 the site-specific review and development of a supplemental EIS, as required.

23 **D2.3 General Historic Contexts**

24
25 Developing Historic Contexts is critical in evaluating archaeological resources for listing in the
26 NRHP as part of the NEPA and NHPA Section 106 processes. These overarching themes are
27 the framework on which specific historic contexts will need to be developed for the specific
28 regions and localities in which ISL mining projects are proposed.

29
30 For pre-history, the key themes might include the following: Chronology, Subsistence,
31 Subsistence Technology and Methods, Land Use and Settlement Patterns, Community
32 Development and Organization, and Cultural Affiliation and Boundaries are considered to be the
33 major prehistoric and protohistoric themes related to prehistoric cultural resources of the
34 western United States and are applicable to Nebraska. For the Historic period, the key themes
35 include: Farming and Ranching, Mining, Military Presence, Formation of Indian Reservations,
36 Transportation and Communication, Water Control, and Power Generation are considered to be
37 the major historical period themes related to the settlement and development of the western
38 United States.

40 **D3 HISTORIC AND CULTURAL RESOURCE INVENTORY METHODS**

41
42 Documentation of historic and cultural resources, traditional cultural properties, and traditional
43 landscapes required for the NEPA and NHPA Section 106 evaluative processes for
44 development of a supplemental environmental assessment/EIS as project-specific localities are
45 identified occurs as ISL milling projects are identified. The inventory methods are discussed on
46 a general level in the following section. The actual documentation process and level of
47 documentation will coincide with the site-specific review and development of a supplemental
48 EIS as required.

1 **D3.1 Class I Inventory**
2

3 Class I inventory consists of reviewing existing cultural resources files (existing literature, other
4 documents, maps, files, and photographs) at the relevant federal, tribal, state, and local
5 repositories. Previous cultural resources inventories in the proposed project areas and
6 alternatives that will be incorporated into project-specific cultural resources inventories and
7 evaluations will be described and documented as part of the Class I records search process.
8 The Class I inventory includes the background research needed to develop regional and locally
9 specific historic contexts. The resulting Class I inventory report forms the foundation for later
10 historical and cultural resources field inventories. The inventory evaluates cultural resources for
11 their eligibility for listing in the NRHP and how they are treated before construction begins.
12

13 As part of the Class I inventory, an attempt should be made to identify and contact
14 knowledgeable individuals to, insofar as possible, obtain information about the location of
15 historical and cultural resources. This should include consultation and ethnographic interviews
16 with Native American individuals or groups (Tribal Historic Preservation Officers or tribal cultural
17 and historic preservation offices) to document traditional cultural properties, sacred places, and
18 ethnographic and historic landscapes.
19

20 **D3.2 Class II Inventory**
21

22 The Class II inventory consists of a nonintensive cultural resources field inventory. The Class II
23 inventory typically surveys a portion of a project area rather than conducting a complete
24 inventory (see following information on Class III inventory). The sample that is selected is
25 considered to represent the kind and density of resources in the entire project area. Therefore, it
26 predicts the historical and cultural resources that are expected to be found in the entire project
27 area. Resources that are found during the Class II inventory are fully documented to federal,
28 state, and tribal standards, and a technical report describing the inventory results is created.
29

30 **D3.3 Class III Inventory**
31

32 A Class III inventory consists of an intensive on-the-ground cultural resources inventory of the
33 entire project area. All cultural resources that are found are fully recorded and documented to
34 meet federal, state, and tribal inventory requirements. A technical report meeting SHPO and/or
35 land managing agency reporting standards that describes the results of the cultural resources
36 inventory is created.
37

1

APPENDIX F

2

**DESCRIPTION OF PROCESSES FOR REVIEW
OF CUMULATIVE EFFECTS**

3

4

Description of Processes for Review of Cumulative Effects

1 to both public scoping meetings and impact study team scoping that identifies
2 cumulative effects issues. Steps 1 and 4 are particularly relevant and resulted in the
3 four identified resources areas. Resource capacity and response to change
4 (e.g., groundwater usage) need to be identified for local and regional groundwater
5 resources. The types, locations, and sizes of wetlands near the proposed ISL facility
6 should be described. Federal and state-listed threatened or endangered species in both
7 local and regional areas must be identified along with fundamental scientific information
8 on the “ecology” of the species, the reasons for the original species listing and any
9 subsequent changes (e.g., from a “threatened” status to an “endangered” status), and
10 the availability of specific recovery plans. For nearby cultural resources, those listed or
11 eligible for listing on the National Register of Historic Places (NRHP) should be
12 identified. State listings should also be included.

- 13
14 • Steps 6 and 7: Characterize the stresses affecting these resources, ecosystems, and
15 human communities and their relation to regulatory thresholds; define a baseline
16 condition for the resources, ecosystems, and human communities. These two steps can
17 be addressed together for each of the four resource areas of concern—groundwater
18 resources, wetlands, threatened and endangered species, and historic and cultural
19 resources. Historical and current laws, regulations, ordinances, and programs that
20 contain policies related to the specific resource area should be identified. Then,
21 historical reference point and trend information, along with current conditions, should be
22 summarized for the indicators representing the resource areas. Many information
23 sources will need to be reviewed during the characterizations called for in Steps 6 and 7.
24 Further, the institutional information, environmental conditions, and compliance with
25 regulations can serve as the basis to categorize past and present sustainability
26 conditions for the resource areas.

- 27
28 • Step 8: Identify the important cause-and-effect relationships between human activities
29 and specific resource areas. This step can largely be accomplished by relating past,
30 present, and RFFAs to the four pertinent resource areas. These connections can be
31 based on peer-reviewed literature, various governmental studies and reports, and
32 impact-study-related and resource-management-related sources. Such references will
33 aid in the documentation of relationships. As noted above, Step 8 is also related to
34 Step 4, and combining these steps will help establish the “action boundaries.”

- 35
36 • Step 9: Determine the magnitude and significance of cumulative effects. To determine
37 the magnitude of the cumulative effects, incremental impacts of the proposed action on
38 each selected resource area and related impacts from past, present, and RFFAs actions
39 should be analyzed. Quantitative models might be available for some topics, such as
40 evaluating the impacts of groundwater restoration. For other topics such as cumulative
41 effects on wetlands, impact information might be developed by considering the changes
42 in wetland sizes and their functions. Various functionality indices are available for
43 wetlands, and they could be used to determine the magnitude of the cumulative effects.
44 For both threatened and endangered species and cultural resources, a combination of
45 regulatory criteria and information related to the proposed ISL facility could be used.

46
47 The significance of cumulative effects refers to “NEPA significance” as defined in
48 40 CFR 1508.27. The criteria in 40 CFR 1508.27 note that the requirements of
49 pertinent laws and regulations need to be considered along with numerical

1 standards and criteria, if they exist. A key issue regarding significance is how the
2 combined cumulative effects influence the resource's stability. An alternative
3 approach could include considering relative magnitudes (or contributions) to
4 cumulative effects. These magnitudes could be divided into major, intermediate,
5 and minor contributions from the proposed and other actions. Finally, note that
6 the "magnitude" feature of Step 9 requires scientific and technical approaches,
7 while the "significance" feature involves both scientific and policy considerations.
8

- 9 • Step 10: Modify or add alternatives to avoid, minimize, or mitigate significant cumulative
10 effects. This step can be addressed by identifying generic mitigation measures for many
11 of the actions associated with the analyzed actions. Measures that could be included as
12 a license condition and thus become the responsibility of the ISL licensee are especially
13 important. In addition, various regulatory programs that have facilitated, or are expected
14 to emphasize, generic mitigation measures for numerous actions should also be
15 identified and incorporated, as appropriate.
16
- 17 • Step 11: Monitor the cumulative effects of the selected alternative and adapt
18 management. This step is systematically identified for each selected resource area.
19 The key criteria that could be used to trigger Step 11 are the past, present, and future
20 sustainability conditions for the areas. If the conditions of the resource area are
21 currently sustainable and this is expected to continue into the future, only targeted
22 additional monitoring beyond that which is currently being done might be considered.
23 For resource areas that are currently considered to be not sustainable or marginally
24 sustainable, specific collaborative monitoring with pertinent governmental agencies may
25 be recommended.
26

27 **F2 WYOMING INTERNET INFORMATION SOURCES**

28
29 The following list of websites contains information on environmental conditions in the State of
30 Wyoming, and/or information on past, present, and reasonably foreseeable future actions within
31 the State. (These websites generally provide information at the state level, and the reviewer
32 may consider them as a starting point for a more region-specific analysis.)
33

- 34 • U.S. Forest Service—National Forests—<<http://www.fs.fed.us/r2/mbr/>>. This
35 website includes information on national forests, their history, management
36 plans, projects, and NEPA compliance documents such as environmental
37 assessments and environmental impact statements (EISs).
38
- 39 • U.S. Bureau of Land Management—Wyoming—<[http://www.blm.gov/wy/](http://www.blm.gov/wy/st/en/info)
40 [st/en/info](http://www.blm.gov/wy/st/en/info)>. This website includes resource management plans, land usage
41 information on BLM lands, and various recent and current NEPA compliance
42 documents such as environmental assessments and EISs.
43
- 44 • Uranium-related website—<<http://www.wise-uranium.org>>. This website
45 includes both general and specific information on uranium recovery projects.
46
- 47 • Coal mine-related website—<[http://www.rootsweb.com/](http://www.rootsweb.com/~wymining/1898coalmines.html)
48 [~wymining/1898coalmines.html](http://www.rootsweb.com/~wymining/1898coalmines.html)>. This website includes historical and
49 current information on coal mining in Wyoming.

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- 1
2 • General website—<www.all-llc.com>. This website includes information on
3 coal bed methane projects in Wyoming.
4
- 5 • General website—<<http://www.wma-minelife.com/uranium/mining/pits.html>>.
6 This Wyoming Mining Association website includes useful information on
7 uranium, coal, and other minerals mining activities.
8
- 9 The following list of State of Wyoming websites includes information on state agencies listed at:
10 <<http://wyoming.gov/government.asp>>. Some of the web sites have limited information, but many
11 (e.g., State Geological Survey) have links to numerous applicable publications.
12
- 13 • Wyoming Department of Agriculture—<<http://wyagric.state.wy.us/links.htm>>.
14 Links to Rural Development Councils and Conservation Districts.
15
- 16 • Wyoming State Climatologist—<<http://www.wrds.uwyo.edu/wrds/wsc/wsc.html>>. Link to Wyoming drought monitoring.
17
18
- 19 • Wyoming Business Council—<<http://www.wyomingbusiness.org>>. Link to
20 state Energy Program, including the quarterly newsletter, Wyoming Energy
21 Notes, and viability analyses of underground coal gasification in the Powder
22 River Basin and similar documents and link to the Wyoming Oil & Gas
23 Conservation Commission.
24
- 25 • Wyoming Department of Environmental Quality—<<http://deq.state.wy.us/>>.
26 Links to all divisions, including Water Quality, Air Quality and Abandoned
27 Mine Lands.
28
- 29 • Wyoming Game & Fish Department—<<http://gf.state.wy.us/>>. Final 2007
30 Gray Wolf Management Plan and document on Current & Future Energy
31 uses in Wyoming, also link to Recommendations for Development of Oil and
32 Gas Resources within Crucial and Important Wildlife Habitats (2004)—A
33 Strategy for Managing Energy Development Consistently with the Federal
34 Land Planning and Management Act Principles of Multiple Use and
35 Sustained Yield.
36
- 37 • Wyoming GIS Coordination Structure—<<http://wgiac2.state.wy.us/html/index.asp>>. GIS databases and online maps, including coalbed
38 methane map.
39
40
- 41 • Wyoming State Geological Survey—<<http://w.wsgs.uwyo.edu/>>. Online
42 publications include pamphlets on coalbeds, earthquakes, and natural gas in
43 Wyoming; Wyoming Mineral Updates (through January 2008) and link to the
44 Industrial Minerals and Uranium Section.
45
- 46 • Office of Homeland Security—<<http://wyohomelandsecurity.state.wy.us/>>.
47 Includes the 2008 State Mitigation Plan addressing various natural and
48 human-induced disasters. The plan includes many RFFAs applicable to
49 Wyoming and other western states.

- 1
- 2 • Wyoming Department of Health—<http://wdh.state.wy.us/>. Has
- 3 environmental health page with links to limited information on such topics as
- 4 mercury in fish, chemical hazards, etc.
- 5
- 6 • Oil & Gas Conservation Commission—<http://wogcc.state.wy.us/>. Includes
- 7 updates of several large projects, as well as geological reports and resources
- 8 analyses. Home page lists several potential RFFAs.
- 9
- 10 • Wyoming Board of Outfitters—<http://outfitters.state.wy.us/>. Includes link to
- 11 39-page memorandum of understanding between the outfitters and several
- 12 state and federal agencies.
- 13
- 14 • State Parks & Cultural Resources—<http://wyospcr.state.wy.us/>. Has links
- 15 to all state parks, various planning documents, and park visitor statistics.
- 16
- 17 • Department of Transportation—<http://dot.state.wy.us/>. Information Central
- 18 icon has information on public meetings, manuals, and other publications.
- 19
- 20 • Wyoming Travel & Tourism—<http://www.wyomingtourism.org>. Includes
- 21 interactive map and travel regions.
- 22
- 23 • Wyoming Water Development Commission—<http://wwdc.state.wy.us/>.
- 24 Includes legislative reports, history of Wyoming water law, water basin plans
- 25 for the two Regions, as well as links to water resources data system and
- 26 water library.
- 27
- 28 • Wyoming Wildlife and Natural Resource Trust—<http://wwnrt.state.wy.us/>.
- 29 Funded by interest earned on a permanent account, donations, and
- 30 legislative appropriation, the purpose of the program is to enhance and
- 31 conserve wildlife habitat and natural resource values throughout the state.
- 32

33 F3 NEBRASKA AND SOUTH DAKOTA INFORMATION SOURCES

34

35 The following list of websites contains information on environmental conditions in the states

36 of South Dakota and Nebraska, and/or information on past, present, and RFFAs within each

37 state. (These websites generally provide information at the state level, and the reviewer may

38 consider them as a starting point for a more region-specific analysis.)

39

- 40 • U.S. Forest Service—National Forests—<http://www.fs.fed.us/r2/mbr/>. This
- 41 website includes information on national forests, their history, management
- 42 plans, projects, and NEPA compliance documents such as environmental
- 43 assessments and EISs.
- 44
- 45 • BLM—South Dakota and Nebraska—<http://www.blm.gov/sd/st/en/info> and
- 46 <http://www.blm.gov/ne/st/en/info>. These websites include resource
- 47 management plans, land usage information on BLM lands, and various recent
- 48 and current NEPA compliance documents such as environmental
- 49 assessments and EISs.

1
2 **F3.1 South Dakota State Agencies**
3

4 The following list of State of South Dakota websites includes information on agencies listed at:
5 http://sd.gov/state_agencies.aspx. Some of the web sites have limited information, but many
6 (e.g., State Geological Survey) have links to numerous applicable publications.
7

- 8 • South Dakota Department of Agriculture—<http://www.state.sd.us/doa/>.
9 Includes several divisions such as Resource Conservation and Forestry
10 (links to Conservation Districts, statewide conservation plans, range
11 management, forestry land enhancement, state statutes, etc.) and wildland
12 fire suppression (links to drought protection measures, burning regulations,
13 etc.).
14
- 15 • Department of Environment and Natural Resources—
16 <http://www.state.sd.us/denr/denr.html>. Excellent site with information on
17 2008 surface water quality, groundwater quality, oil and gas, geology,
18 Superfund Amendments and Reauthorization Act sites, air quality monitoring,
19 Pollution Prevention programs, stormwater management, NPDES permits,
20 water rights, permitting and reporting procedures, etc.
21
- 22 • South Dakota Game, Fish and Parks—<http://www.sdgifp.info/>. Information
23 on state parks, prairie dog management plan, state recreational fishing
24 surveys, and hunting and fishing regulations.
25
- 26 • Department of Health—<http://doh.sd.gov/>. Includes publications on state
27 health statistics and diseases such as hanta virus.
28
- 29 • Department of Public Safety—<http://www.state.sd.us/dps/>. Includes
30 homeland security information, burning ban maps, link to Governor's drought
31 task force, etc.
32
- 33 • Department of Revenue and Regulation—[http://www.state.sd.us/](http://www.state.sd.us/drr2/revenue.html)
34 [drr2/revenue.html](http://www.state.sd.us/drr2/revenue.html). Includes information on the Petroleum Release
35 Compensation Fund (cleanup fund).
36
- 37 • Department of Tourism and State Development—<http://www.tsd.sd.gov/>.
38 Includes six divisions—Tourism, History, Arts, Housing, Tribal Relations and
39 the Governor's Office of Economic Development. Has links to State Historic
40 Preservation Office (SHPO) and historic preservation regulations.
41
- 42 • Department of Transportation—<http://www.sddot.com/>. Includes county
43 maps, other maps of aviation facilities and construction areas, information on
44 railroad loading facilities, environmental programs, etc.
45
- 46 • School and Public Lands—<http://www.sdpubliclands.com/>. A brief review
47 indicated letting of a mineral lease for Fall River County and surface land
48 leases for Fall River and Pennington Counties.
49

- 1 • Public Utilities Commission—<<http://puc.sd.gov/>>. Includes statutes and
2 administrative law.
- 3 • South Dakota Geological Survey—<<http://www.sdgs.usd.edu/>>. Includes
4 interactive state geological map, online databases, link to Black Hills
5 hydrological study, and information on oil and gas wells in Fall River County.
6
- 7 • Cooperative Extension Service—<<http://sdces.sdstate.edu/>>. Includes
8 agriculture and weather information.
9

10 **F3.2 Nebraska State Agencies**

11
12 The following list of State of Nebraska websites includes information on state agencies listed at:
13 <http://www.nebraska.gov/agency_sites.phtml>. Some of the web sites have limited
14 information, but many have links to numerous applicable publications.
15

- 16 • Nebraska Department of Agriculture—<<http://www.agr.state.ne.us/>>.
17 Website has links to an interactive statistics map, as follows:
18 <http://www.nass.usda.gov/Statistics_by_State/Nebraska/SVG/index.asp>
19
- 20 • Nebraska Energy Office—<<http://www.neo.ne.gov/>>. Homepage has links to
21 wind and solar energy initiatives, the state energy program, Federal Energy
22 Policy Act of 2005, and publications such as the Nebraska Energy Quarterly.
23
- 24 • Nebraska Department of Environmental Quality—<www.deq.state.ne.us/>.
25 This is one of the better state sites. Has links to regulations, maps and data,
26 and publications on a wide variety of topics including RCRA monitoring,
27 wellhead protection, groundwater program, source water protection, NPDES
28 permits, etc.).
29
- 30 • Nebraska Environmental Trust—<<http://www.environmentaltrust.org/>>.
31 Established in 1992 to conserve, restore and enhance the natural
32 environments of Nebraska.
33
- 34 • Nebraska Forest Service—<<http://www.nfs.unl.edu/>>. Affiliated with
35 University of Nebraska Extension Service; has links to publications such as
36 the land cover inventory of the Niobrara watershed, which includes portions
37 of Dawes, Sioux and Box Butte Counties.
38
- 39 • Nebraska Game and Parks Commission—<<http://www.ngpc.state.ne.us/>>.
40 Has links to the three state parks in the study area: (1) Box Butte Reservoir
41 SWA—Dawes/Box Butte Co., (2) Chadron SP—Dawes Co., and
42 (3) Ft. Robinson SP—Sioux Co.
43
- 44 • Nebraska Department of Health and Human Services—
45 <<http://www.dhhs.ne.gov/>>. Environmental health section includes links
46 to section on hazardous wastes related to terrorism and also
47 radioactive substances.
48

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- 1 • Nebraska Emergency Management Agency—<<http://www.nema.ne.gov/>>.
2 Has links to division dealing with radiological emergencies.
3
- 4 • Nebraska Department of Natural Resources—<<http://www.dnr.state.ne.us/>>.
5 Has links to many water resources news releases and publications, including
6 Report on Hydrologically Connected Ground Water and Surface Water in the
7 Upper Niobrara-White Natural Resources District—Found at:
8 <[http://www.dnr.state.ne.us/Publications_Studies/UNWNRD_](http://www.dnr.state.ne.us/Publications_Studies/UNWNRD_Report_1004.pdf)
9 <[Report_1004.pdf](http://www.dnr.state.ne.us/Publications_Studies/UNWNRD_Report_1004.pdf)> Also at this site is information on groundwater flow
10 models, water policy, soils and GIS natural resources mapping.
11
- 12 • Nebraska Oil & Gas Conservation Commission—
13 <<http://www.nogcc.ne.gov/>>. Has links to well data and underground
14 injection information and to related websites in surrounding states.
15
- 16 • Nebraska Department of Roads—<<http://www.dor.state.ne.us/>>. Has
17 information on wetland mitigation, cultural resources, stormwater
18 management, sediment and erosion control, etc.
19 <<http://www.dor.state.ne.us/environment/>>.
20
- 21 • Nebraska Travel and Tourism—<http://www.visitnebraska.org/>. Regional
22 maps are online.
23
- 24 • University of Nebraska Institute for Agriculture and Natural Resources—
25 <<http://ianrhome.unl.edu/Home>>. Has links to Extension Service, Agriculture
26 schools, and School of Natural Resources, as well as drought information
27 and other influences on agriculture.
28

F4 NEW MEXICO INFORMATION SOURCES

29
30
31 The following list of websites contains information on environmental conditions in the State of
32 New Mexico, and/or information on past, present, and RFFAs within the state. (These websites
33 generally provide information at the state level, and the reviewer may consider them as a starting
34 point for a more region-specific analysis.)
35

- 36 • U.S. Forest Service—National Forests—<<http://www.fs.fed.us/r2/mbr/>>. This
37 website includes information on national forests, their history, management
38 plans, projects, and NEPA compliance documents such as environmental
39 assessments and EISs.
40
- 41 • BLM—New Mexico—<<http://www.blm.gov/nm/st/en/info>>. This website
42 includes resource management plans, land usage information on BLM lands,
43 and various recent and current NEPA compliance documents such as
44 environmental assessments and EISs.
45

46 The following list of State of New Mexico websites includes information on state agencies listed
47 at: <<http://newmexico.gov/AtoZ.php>>. Some of the web sites have limited information, but many
48 have links to numerous applicable publications.
49

- 1 • Department of Agriculture—<<http://nmdaweb.nmsu.edu/>>. Has links to
2 information on Conservation Districts, watershed districts, wildlife
3 management (pests), rangeland and grazing programs, and water and
4 natural resources policy.
- 5 • Middle Rio Grande Conservancy District—<[http://www.mrgcd.com/
6 content.asp?CustComKey=226893&CategoryKey=266245&pn=Page&DomN
7 ame=mrgcd.com](http://www.mrgcd.com/content.asp?CustComKey=226893&CategoryKey=266245&pn=Page&DomName=mrgcd.com)>. Involved in a wide spectrum of water-related issues on
8 the Middle Rio Grande as far south as the Bosque del Apache National
9 Wildlife Refuge in Socorro County.
- 10
- 11 • Department of Cultural Affairs—<<http://www.newmexicoculture.org/>>. Has
12 links to prehistoric and historic sites and related issues; also, Historic
13 Preservation Division at <<http://www.nmhistoricpreservation.org/>>. Includes
14 sites listed on the state and federal historic and cultural registers.
- 15
- 16 • Demographics: Population Estimates and Projections—
17 <<http://www.unm.edu/~bber/demograp2.htm>>. Data by county.
- 18
- 19 • Department of Economic Development—<[http://www.edd.state.nm.us/
20 index.html](http://www.edd.state.nm.us/index.html)>. Maps of counties, railroads and major roads; also county
21 economic and population statistics.
- 22
- 23 • Energy, Minerals and Natural Resources Department—
24 <<http://www.emnrd.state.nm.us/main/index.htm>>. Divisions include mining
25 and minerals, oil conservation, forestry, and state parks. Information on mine
26 reclamation, abandoned mine land programs, timber harvesting
27 requirements, etc.
- 28
- 29 • Environment Department—<<http://www.nmenv.state.nm.us/>>. Includes
30 regulations and laws and programs for air quality, pollution prevention,
31 hazardous wastes, drinking water and groundwater quality (the latter includes
32 a section on Mining and Environmental Compliance).
- 33
- 34 • Department of Game and Fish—<<http://www.wildlife.state.nm.us/>>. Focuses
35 on hunting and fishing, but also has information on birding and small wildlife.
- 36
- 37 • Bureau of Geology and Mineral Resources—<<http://geoinfo.nmt.edu/>>.
38 Includes links to petroleum exploration maps for Catron, Cibola, McKinley
39 and Socorro Counties, geologic and hydrologic maps, and many
40 energy-related publications (e.g., Geology of the Uranium Region near
41 Grants in Cibola County).
- 42
- 43 • Department of Health—<<http://www.health.state.nm.us/>>. Has links to county
44 and tribal health departments/councils.
- 45
- 46 • Department of Homeland Security and Emergency Management—
47 <[http://www.nmdhsem.org/default.asp?CustComKey=270308&CategoryKey=
48 274276&pn=Page&DomName=nmdhsem.org](http://www.nmdhsem.org/default.asp?CustComKey=270308&CategoryKey=274276&pn=Page&DomName=nmdhsem.org)>. Includes emergency

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- 1 preparedness information similar to the Federal Emergency
2 Management Agency.
3
- 4 • Indian Affairs Department—<<http://www.iad.state.nm.us/>>. Includes state
5 map of tribal lands and links to tribal government sites.
6
 - 7 • New Mexico Resource GIS Program—<<http://rgis.unm.edu/>>. Resource GIS
8 provides access to data, training, and technical support for geographic
9 information users, as well as those who desire to incorporate geographic
10 information into their processes and applications; includes the Earth Data
11 Analysis Center.
12
 - 13 • State Land Office—<<http://www.nmstatelands.org/Default.aspx>>. Includes
14 information about oil and gas, mineral and agriculture leasing programs.
15
 - 16 • Tourism Department—<<http://www.newmexico.org/index3.php>>. Information
17 on all outdoor activities, including birding and wildlife watching areas.
18
 - 19 • Department of Transportation—<<http://www.nmshtd.state.nm.us/>>.
20 Information on construction areas, airports, maps, scenic byways and historic
21 and prehistoric sites along them.
22
 - 23 • New Mexico Natural Heritage—<<http://nhnm.unm.edu/>>. Dedicated to
24 information on rare species and ecosystems; has a user-friendly searchable
25 database for county information on state and federally listed species.
26

F5 REFERENCE

- 27
28
29 CEQ. "Considering Cumulative Effects Under the National Environmental Policy Act."
30 Washington, DC: Executive Office of the President. 1997.

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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122 West 25th Street, Herschler Building
Cheyenne, Wyoming 82002

10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This Draft Generic Environmental Impact Statement (Draft GEIS) was prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 and NRC regulations for implementing NEPA found at Title 10, "Energy," of the U.S. Code of Federal Regulations (CFR) Part 51 (10 CFR Part 51). This Draft GEIS evaluates on a programmatic basis, the potential environmental impacts associated with the construction, operation, ground water restoration, and decommissioning of uranium milling facilities employing the in-situ leach (ISL) process.

In the ISL process, a leaching agent, such as oxygen with sodium bicarbonate, is added to native ground water for injection through wells into the subsurface ore body to dissolve the uranium. The leach solution, containing the dissolved uranium, is pumped back to the surface and sent to the processing plant, where ion exchange is used to separate the uranium from the solution. The underground leaching of the uranium also frees other metals and minerals from the host rock. Operators of ISL facilities are required to restore the ground water affected by the leaching operations. The milling process concentrates the recovered uranium into the product known as "yellowcake" (U3O8). This yellowcake is then shipped to uranium conversion facilities for further processing in the overall uranium fuel cycle.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

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