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United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1910
Supplement 4, Vol. 1

Environmental Impact Statement for the Dewey-Burdock Project in Custer and Fall River Counties, South Dakota

Supplement to the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities

Draft Report for Comment

Chapters 1 to 4

Office of Federal and State Materials and
Environmental Management Programs

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Manuscript Completed: October 2012
Date Published: November 2012

Office of Federal and State Materials and
Environmental Management Programs

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for the possession and use of source material provided that proposed facilities meet NRC regulatory requirements and will be operated in a manner that is protective of public health and safety and the environment. Under the NRC environmental protection regulations in 10 CFR Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), issuance of a license to possess and use source material for uranium milling, as defined in 10 CFR Part 40, requires an environmental impact statement (EIS) or a supplement to an EIS.

In May 2009, NRC issued NUREG–1910, the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Facilities (GEIS) (NRC, 2009). In the GEIS, NRC assessed the potential environmental impacts from the construction, operation, aquifer restoration, and decommissioning of an *in-situ* leach uranium recovery facility [also known as an *in-situ* recovery (ISR) facility] located in four specified geographic regions of the western United States. As part of this assessment, NRC determined which potential impacts will be essentially the same for all ISR facilities and which will result in varying levels of impact for different facilities, thus requiring further site-specific information to determine potential impacts. The GEIS provides a starting point for NRC NEPA analyses for site-specific license applications for new ISR facilities, as well as for applications to amend or renew existing ISR licenses.

By letter dated August 10, 2009, Powertech (USA), Inc. (Powertech, referred to herein as the applicant) submitted a license application to NRC for a new source and byproduct material license for the Dewey-Burdock ISR Project. The proposed Dewey-Burdock ISR Project will be located in Fall River and Custer Counties, South Dakota, which is in the Nebraska-South Dakota-Wyoming Uranium Milling Region identified in the GEIS. The NRC staff prepared this draft Supplemental Environmental Impact Statement (SEIS) to evaluate the potential environmental impacts from the applicant proposal to construct, operate, conduct aquifer restoration, and decommission an ISR uranium facility at the proposed Dewey-Burdock ISR Project. This draft SEIS describes the environment potentially affected by the proposed site activities, presents the potential environmental impacts resulting from reasonable alternatives to the proposed action, and describes the applicant environmental monitoring program and proposed mitigation measures. In conducting its analysis in this draft SEIS, the NRC staff evaluated site-specific data and information to determine whether the applicant’s proposed activities and site characteristics were consistent with those evaluated in the GEIS. NRC staff then determined relevant sections, findings, and conclusions in the GEIS that could be incorporated by reference and areas that required additional analysis. Based on its environmental review, the preliminary NRC staff recommendation is that a source and byproduct material license for the proposed action be issued as requested, unless safety issues mandate otherwise.

Paperwork Reduction Act Statement

This NUREG contains and references information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB), approval numbers 3150-0014, 3150-0020, 3150-0021, and 3150-0008.

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References

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40. "*Domestic Licensing of Source Material*." Washington, DC: U.S. Government Printing Office.

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51. "*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*." Washington, DC: U.S. Government Printing Office.

NRC. NUREG–1910, "Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC: NRC. May 2009.

CONTENTS

CONTENTS (continued)

Section | Page

CONTENTS (continued)

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

CONTENTS (continued)

Section Page

FIGURES

Figure Page

FIGURES (continued)

Figure Page

FIGURES (continued)

Figure Page

TABLES

TABLES (continued)

TABLES (continued)

TABLES (continued)

EXECUTIVE SUMMARY

BACKGROUND

By letter dated August 10, 2009, Powertech (USA), Inc. (Powertech) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new source and byproduct material license for the Dewey-Burdock *In-Situ* Uranium Recovery Project, located in Fall River and Custer Counties, South Dakota. The applicant is proposing to recover uranium using the *in-situ* leach (ISL) [also known as *in-situ* recovery (ISR)] process. The proposed Dewey-Burdock ISR Project would include processing facilities and sequentially developed wellfields sited in two contiguous areas, the Burdock area and the Dewey area. Proposed facilities include a central processing plant in the Burdock area, a satellite facility in the Dewey area, wellfields, Class V deep injection wells and/or land application areas for disposal of liquid wastes, and the attendant infrastructure (e.g., pipelines and surface impoundments).

The Atomic Energy Act of 1954 (AEA), as amended by the Uranium Mill Tailings Radiation Control Act of 1978, authorizes NRC to issue licenses for the possession and use of source material and byproduct material. These statutes require NRC to license facilities, including ISR operations, in accordance with NRC regulatory requirements to protect public health and safety from radiological hazards. Under the NRC environmental protection regulations in 10 CFR Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), preparation of an environmental impact statement (EIS) or supplement to an EIS is required for issuance of a license to possess and use source material for uranium milling [10 CFR 51.20(b)(8)].

In May 2009, the NRC staff issued NUREG–1910, the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities (herein referred to as the GEIS) (NRC, 2009). In the GEIS, NRC assessed the potential environmental impacts from the construction, operation, aquifer restoration, and decommissioning of an ISR facility located in four specified geographic regions of the western United States. The proposed Dewey-Burdock ISR Project is located within the Nebraska-South Dakota-Wyoming Uranium Milling Region identified in the GEIS. The GEIS provides a starting point for NRC NEPA analyses for site-specific license applications for new ISR facilities, as well as for applications that amend or renew existing ISR licenses. This Supplemental EIS (SEIS) incorporates by reference information from the GEIS and also uses information from the applicant's license application and other independent sources to fulfill the requirements set forth in 10 CFR 51.20(b)(8).

This draft SEIS includes the NRC staff analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures to either reduce or avoid adverse effects. It also includes the NRC staff's preliminary recommendation regarding the proposed action.

This draft SEIS was prepared in cooperation with the U.S. Bureau of Land Management (BLM). BLM has requested to be and is acting as a cooperating agency with NRC to evaluate the impacts of Powertech's Plan of Operations (POO) in accordance with the National Memorandum of Understanding with NRC. BLM manages 97 ha [240 ac] of land within the proposed Dewey-Burdock ISR Project area. Under 43 CFR Part 3809, BLM is required to review the environmental impacts of federal actions on surface lands to assure that there is no "unnecessary or undue degradation of public lands." To fulfill this requirement, the applicant submitted a POO to BLM for the Dewey-Burdock ISR Project on August 26, 2009. Powertech modified the POO and resubmitted it to BLM on January 28, 2011.

PURPOSE AND NEED FOR THE PROPOSED ACTION

NRC regulates uranium milling, as defined in 10 CFR 40.4, including the ISR process, under 10 CFR Part 40, "Domestic Licensing of Source Material." The applicant is seeking an NRC source and byproduct material license to authorize commercial-scale ISR uranium recovery at the proposed Dewey-Burdock ISR Project. The purpose and need for the proposed federal action is to either grant or deny the applicant a license to use ISR technology to recover uranium and produce yellowcake at the proposed project. Yellowcake is the uranium oxide product of the ISR milling process used to produce various products including fuel for commercially operated nuclear power reactors.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in either the AEA-required safety review or in the NEPA environmental analysis that would lead NRC to reject a license application, NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

The BLM purpose and need for the proposed action is to provide for orderly, efficient, and environmentally responsible mining of the uranium resource. The uranium resource is needed to fulfill market demands for this product for power generation and other needs. These public lands are open to mineral entry, and the applicant has filed mining claims on them. Within the proposed project area, Powertech maintains the mining claims associated with 1,708 ha [4,220 ac] of federal minerals that the U.S. Government reserved under the Stock-Raising Homestead Act. The BLM federal decision is to either approve the Powertech-modified POO subject to mitigation included in the license application and this draft SEIS, or deny approval of the POO. BLM's responsibility to respond to the POO establishes the need for the action. The mining claimant has the right to mine and develop the mining claims as long as it can be done without causing unnecessary or undue degradation of the public lands and follows pertinent laws and regulations under 43 CFR Part 3800.

THE PROJECT AREA

The proposed Dewey-Burdock ISR Project is located in Custer and Fall River Counties, South Dakota, within the Great Plains physiographic province on the edge of the Black Hills uplift. The proposed site is located approximately 21 km [13 mi] north-northwest of the city of Edgemont, approximately 64 km [40 mi] west of the city of Hot Springs, and approximately 80 km [50 mi] southwest of the city of Custer. The total land area of the proposed Dewey-Burdock Project is 4,282 ha [10,580 ac]. Sections within the proposed project area are split estate, in which two or more parties own the surface and subsurface mineral rights. The surface rights are both publicly and privately owned. Approximately 4,185 ha [10,340 ac] of land is privately owned, and the remaining 97 ha [240 ac] of surface rights are owned by the U.S. Government and administered by BLM. The subsurface mineral rights are owned by various private entities and federally reserved by the U.S. Government.

The proposed Dewey-Burdock ISR Project will consist of processing facilities and sequentially developed wellfields in two contiguous areas: the Burdock area and the Dewey area. Planned facilities associated with the proposed project include buildings associated with a central processing plant in the Burdock area and a satellite facility in the Dewey area; surface impoundments; wellfields and their associated infrastructure (e.g., wells, header houses, and pipelines); Class V deep injection wells and/or land application areas for disposal of liquid wastes; and access roads. The applicant estimated that the land surface area that would be affected by proposed ISR operations would be approximately 98 ha [243 ac] if Class V deep injection wells alone are used to dispose of process-related liquid wastes and approximately 566 ha [1,398 ac] if land application alone is used to dispose of liquid wastes.

IN-SITU RECOVERY PROCESS

During the ISR process, an oxidant-charged solution, called a lixiviant, is injected into the production zone aquifer (uranium ore body) through injection wells. Typically, a lixiviant uses native groundwater (from the production zone aquifer), carbon dioxide, and sodium carbonate/bicarbonate, with an oxygen or hydrogen peroxide oxidant. As the lixiviant circulates through the production zone, it oxidizes and dissolves the mineralized uranium, which is present in a reduced chemical state. The resulting uranium-rich solution is drawn to recovery wells by pumping and then transferred to a processing facility via a network of pipelines, which may be buried just below the ground surface. At the processing facility, the uranium is removed from solution (typically via ion exchange). The resulting barren solution is then recharged with the oxidant and reinjected to recover more uranium.

During production, the uranium recovery solution continually moves through the aquifer from injection wells to recovery wells. These wells can be arranged in a variety of geometric patterns depending on the location and orientation of the ore body, aquifer permeability, and operator preference. Wellfields are typically designed in a five-spot or seven-spot pattern, with each recovery (i.e., production) well located inside a ring of injection wells. Monitoring wells are installed in the production zone aquifer and surround the wellfield pattern area. Monitoring wells are screened (i.e., open to allow water to enter) in the appropriate stratigraphic horizon to detect the potential migration of lixiviant away from the production zone. Monitor wells are also installed in the overlying and underlying aquifers to detect the potential vertical migration of lixiviant outside the production zone. The uranium that is recovered from the solution is processed, dried into yellowcake, packaged into NRC- and U.S. Department of Transportation (USDOT)-approved 208-L [55-gal] steel drums, and trucked offsite to a licensed conversion facility.

Once production is complete, the production zone groundwater is restored to NRC-approved groundwater protection standards, which are protective of the surrounding groundwater. The site is decommissioned according to an NRC-approved decommissioning plan and in accordance with NRC-approved standards. Once decommissioning is approved, the site may be released for public use.

ALTERNATIVES

The NRC environmental review regulations that implement NEPA in 10 CFR Part 51 require NRC to consider reasonable alternatives, including the No-Action alternative, to a proposed action. The NRC staff considered a range of alternatives that would fulfill the underlying purpose and need for the proposed action. From this analysis, a set of reasonable alternatives was developed, and the impacts of the proposed action were compared with the impacts that would result if a given alternative was implemented. This SEIS evaluates the potential environmental impacts of the proposed action and the No-Action alternative and also considers alternative wastewater disposal options to the proposed action. Under the No-Action alternative, the applicant would not construct and operate ISR facilities at the proposed site. Other alternatives considered at the proposed Dewey-Burdock ISR Project site but eliminated from detailed analysis include conventional mining and milling, conventional mining and heap leach processing, alternative lixiviants, alternative site locations, and alternative well completion methods. These alternatives were eliminated from detailed study because they either would not meet the purpose and need of the proposed project or would cause greater environmental impacts than the proposed action. This SEIS also discusses alternative wastewater disposal options (evaporation ponds and surface water discharge) that were not included in the proposed action.

SUMMARY OF ENVIRONMENTAL IMPACTS

This draft SEIS includes the NRC staff analysis that considers and weighs the environmental impacts from the construction, operation, aquifer restoration, and decommissioning of ISR operations at the proposed Dewey-Burdock ISR Project site and the No-Action alternative. This draft SEIS also describes mitigation measures for the reduction or avoidance of potential adverse impacts that (i) the applicant has committed to in its NRC license application, (ii) will be required under other federal and state permits or processes, or (iii) are additional measures NRC staff identified as having the potential to reduce environmental impacts but that the applicant did not commit to in its application. The draft SEIS uses the assessments and conclusions reached in the GEIS in combination with site-specific information to assess and categorize impacts.

As discussed in the GEIS and consistent with NUREG–1748 (NRC, 2003), the significance of potential environmental impacts is categorized as follows:

SMALL: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Chapter 4 of this draft SEIS provides the NRC evaluation of the potential environmental impacts from the construction, operation, aquifer restoration, and decommissioning of the proposed Dewey-Burdock ISR Project. The significance of impacts from the ISR facility lifecycle is listed next, followed by a summary of impacts by environmental resource area and ISR phase for the proposed action.

Impacts by Resource Area and ISR Facility Phase

<u>Land Use</u>

<u>Construction</u>: Impacts will be SMALL. If deep well disposal via Class V injection wells alone is used to dispose of liquid wastes, approximately 98 ha [243 ac] or 2.3 percent of the proposed project area will be disturbed by the construction phase. If land application alone is used to dispose of liquid wastes, the construction phase will disturb approximately 566 ha [1,398 ac] or 13.2 percent of the proposed project area. Topsoil will be stripped and stockpiled to build surface facilities, develop the initial wellfields and the attendant infrastructure, and construct access roads. Livestock grazing and recreational activities will be excluded from fenced areas surrounding the central plant, satellite facility, surface impoundments, and wellfields.

Operation: Impacts will be SMALL. Land use impacts during the operations phase will be limited to the wellfields and will be similar to, or less than, those during the construction phase. Wellfields will be sequentially developed resulting in the disturbance of approximately 57 ha [140 ac]. Land disturbance and access restrictions will result from drilling new wells and constructing additional header houses and pipelines. Livestock grazing and recreational activities will continue to be restricted from the central plant, satellite facility, surface impoundments, and wellfields. Potential land application areas may also be fenced to control livestock access.

Aquifer Restoration: Impacts will be SMALL. Land use impacts will be similar to, or less than those described for the operations phase. Land use impacts will decrease as fewer wells and pump houses are used and overall equipment traffic and use diminish. Access to wellfields and surface facilities will continue to be restricted. No additional land will be disturbed to construct facilities.

Decommissioning: Impacts will be SMALL to MODERATE. Land use impacts during the decommissioning phase will be similar to those experienced during the construction phase. Decommissioning the buildings, wellfields, storage ponds, and access roads and removing potentially contaminated soil will result in a temporary, short-term increase in land-disturbing activities. Upon completion of the plugging and abandonment of wells, the soil will be returned to areas in the wellfield where it had been removed and reseeded. At the end of decommissioning, because the reclaimed land will be released for other uses and no longer restricted, the land use impact in disturbed areas will be MODERATE until vegetation becomes reestablished. After vegetation is reestablished in reclaimed areas, the land will be returned to a condition that can support a variety of land uses; therefore, the impact will be SMALL.

Transportation

Construction: Impacts will be SMALL to MODERATE. Dewey Road, the road nearest the proposed site, will experience a sixteenfold increase in daily vehicle traffic during the ISR construction phase. This increase in traffic will accelerate degradation of road surfaces, increase the generation of dust, and increase the potential for traffic accidents and wildlife or livestock kills. The well-traveled regional roads will not be significantly impacted by the construction traffic.

Operation: Impacts will be SMALL to MODERATE. Dewey Road, the road nearest the proposed site, will experience a fivefold increase in daily vehicle traffic during the ISR operations phase. This increase in traffic will accelerate degradation of road surfaces, increase the generation of dust, and increase the potential for traffic accidents and wildlife or livestock kills. Additionally, the transport of yellowcake product, hazardous materials, uranium-loaded resins from the Dewey Unit to the Burdock Unit, and wastes could result in spills or leakage if an accident occurred; however, this risk was determined to be low and will be further limited by compliance with existing NRC and USDOT transportation regulations and the implementation of best management practices (BMPs) for containing leakage and spills.

Aquifer Restoration: Impacts will be SMALL. Transportation impacts will be less than those estimated for the construction and operation phases because the need to transport yellowcake product, hazardous materials, and uranium-loaded resins between units will decrease as aquifer restoration progressed. The decrease in the supply shipments, waste shipments, and employee commuting (because fewer workers will be involved) will reduce the potential for spills or leakage from accidents.

Decommissioning: Impacts will be SMALL. Transportation impacts will be less than those during the construction and operation phases because the transport of yellowcake product and processing chemicals will end during decommissioning. Access roads will either be reclaimed or left in place for future use. Waste shipments will increase temporarily, but will still represent a small contribution to daily traffic. Fewer workers will be employed, further reducing the potential transportation impact during this phase.

Geology and Soils

Construction: Impacts will be SMALL. Earthmoving activities associated with construction of the Burdock central plant and Dewey satellite plant facilities, access roads, wellfields, pipelines, and surface impoundments will include topsoil clearing and land grading. Topsoil removed during these activities will be stored and reused later to restore disturbed areas. The limited areal extent of the construction area, the soil stockpiling procedures, the implementation of BMPs, the short duration of the construction phase, and mitigative measures such as reestablishment of native vegetation will further minimize the potential impact on soils.

Operation: Impacts will be SMALL. The operation phase will not remove rock matrix or structure and will not dewater production zone aquifers. Therefore, no significant matrix compression or ground subsidence is expected. The occurrence of potential spills during transfer of uranium-bearing lixiviant to and from the Burdock central plant and Dewey satellite facility will be mitigated by implementing onsite standard procedures and by complying with NRC requirements for spill response and reporting of surface releases and cleanup of any contaminated soils. The U.S. Environmental Protection Agency (EPA) will determine the suitability of deep geologic formations for deep Class V disposal of liquid waste before issuing a underground injection control (UIC) permit for Class V injection wells. Treated wastewater disposed of in Class V injection wells will be required to meet release standards as referenced in 10 CFR Part 20, Subparts D and K and Appendix B. Potential soil contamination in proposed land application areas will be mitigated by implementing soil collection and monitoring procedures. Treated wastewater applied to land application areas will be required to meet NRC release limit criteria, as referenced in 10 CFR Part 20, Appendix B, and applicable state groundwater quality standards under a Groundwater Discharge Permit (GDP) issued by South Dakota Department of Environmental and Natural Resources (SDDENR).

Aquifer Restoration: Impacts will be SMALL. During aquifer restoration, the processes of groundwater sweep and groundwater transfer will not remove rock matrix or structure. The formation groundwater pressure within the extraction zone will be decreased during restoration as groundwater is removed to ensure the direction of groundwater flow is into the wellfields to reduce the potential for lateral migration of constituents. However, the change in groundwater pressure will not result in collapse of overlying rock strata as it is supported by the rock matrix of the formation. The potential impact to soils from spills, leaks, and land application of treated wastewater will be comparable to that described for the operations phase. The NRC requirements for spill response and recovery and routine monitoring programs will also apply.

Decommissioning: Impacts will be SMALL. Disruption or displacement of soils will occur during dismantling of the facilities and reclamation of the land; however, the disturbed lands will be restored to their preextraction land use. Topsoil will be reclaimed and the surface regraded to the original topography.

Surface Waters and Wetlands

Construction: Impacts will be SMALL. The occurrence of surface water at the proposed Dewey-Burdock site is limited, and surface water flow in channels is intermittent. The applicant will construct ISR processing and support facilities on level areas and outside the 100-year floodplain. National Pollutant Discharge Elimination System (NPDES) permits issued by SDDENR will set limits to control the amount of pollutants that can enter surface water bodies. Implementation of a storm water pollution management plan (SWMP) will control storm water runoff during construction and ensure that surface water runoff from disturbed areas meets NPDES permit limits. U.S. Army Corps of Engineers permits under Section 404 of the Clean Water Act will be required before conducting work in jurisdictional wetlands identified in the project area.

Operation: Impacts will be SMALL. The applicant's SDDENR-approved NPDES permit and SWMP will be in place to mitigate impacts to surface water from erosion, runoff, and sedimentation. The applicant will implement an emergency response plan to identify and clean up accidental spills and leaks. Processing facilities and chemical and fuel storage tanks will have secondary containment to contain potential spills. Operations will create liquid wastes that will be contained in radium-settling and storage ponds for eventual Class V injection well disposal and/or land application. Radium settling and storage ponds will be constructed with liners, underdrains, and leak detection systems. Liquid waste applied to land application areas will be required to meet NRC release limit criteria for radiological contaminants, as referenced in 10 CFR Part 20, Appendix B. SDDENR will require liquid waste applied to land application areas to meet applicable state discharge requirements under a GDP.

Aquifer Restoration: Impacts will be SMALL. Impacts will be similar to those during the operations phase because the same infrastructure will be used and the same activities will be conducted. The applicant's SDDENR-approved NPDES permit and SWMP will be in place to mitigate impacts to surface water from erosion, runoff, and sedimentation. Restoration of groundwater aquifers will create wastewater that will be contained in radium settling and storage ponds for eventual Class V injection well disposal and/or land application. Radium settling and storage ponds will be constructed with liners, underdrains, and leak detection systems. Treated wastewater applied to land application areas will be required to meet NRC release limit criteria for radiological contaminants, as referenced in 10 CFR Part 20, Appendix B. SDDENR will require wastewater applied to land application areas to meet applicable state discharge requirements under a GDP.

Decommissioning: Impacts will be SMALL. The impacts will be similar to those during the construction phase. Activities to cleanup, recontour, and reclaim the land surface during decommissioning will mitigate long-term impacts to surface water. The applicant's SDDENR-approved NPDES permit and SWMP will be in place to mitigate impacts to surface water from erosion, runoff, and sedimentation.

Groundwater

Construction: Impacts will be SMALL. The primary impact to groundwater during the construction phase will be from the consumptive use of groundwater, introduction of drilling fluids into the environment during well installation, and from surface spills of fuels and lubricants. The applicant is required to obtain water appropriation use permits from SDDENR prior to withdrawing water from aquifers. During well installation, drilling fluids (mud) will have the potential to impact surficial aquifers; however, all wells will undergo mechanical integrity tests of the casing and therefore ensure against well leakage prior to entering service. Impacts to groundwater from surface spills of fuels and lubricants will be mitigated by the applicant's implementation of BMPs and by following a spill prevention program that will require an immediate cleanup response to prevent soil contamination or infiltration to groundwater.

<u>Operation</u>: Impacts will be SMALL. The operations phase may impact near-surface (alluvial) aquifers, production zone aquifers containing the orebodies and surrounding aquifers, and deep aquifers below the ore production zone used for the disposal of liquid wastes.

Alluvial aquifers are separated from production zone and surrounding aquifers by thick aquitards (confining units) and, therefore, are not hydraulically connected to production zone and surrounding aquifers. In addition, alluvial aquifers do not serve as a water supply for domestic use or livestock. The impacts from spills and leaks will be SMALL. The applicant's leak detection and cleanup program will include rapid response and remediation to minimize impacts to soils and groundwater. Liquid waste applied to land application areas will be required to meet NRC release limit criteria for radiological contaminants, as referenced in 10 CFR Part 20, Appendix B and applicable state discharge requirements under a GDP issued by SDDENR.

The applicant has committed to removing and replacing existing domestic wells drawing water from production zone aquifers within the project area from private use prior to ISR operations. In addition, the applicant will monitor all domestic wells within 2 km [1.2 mi] of the project boundary during operations and replace these wells in the event of significant drawdown or degradation of water quality. Water levels in affected wells will recover with time after ISR operations and aquifer restoration activities are complete.

The establishment of an inward hydraulic gradient during wellfield operations along with the applicant-installed groundwater monitoring network to detect potential vertical and horizontal excursions will limit the potential for undetected lixiviant excursions that could degrade groundwater quality. Because the ore production zones are overlain and underlain by impermeable shale layers, this further ensures the hydraulic isolation of the ore production zones, which helps to limit potential groundwater contamination in surrounding aquifers.

Liquid wastes generated from operation of the proposed Dewey-Burdock ISR Project will be disposed of via Class V deep well injection, land application, or a combination of Class V deep well injection and land application. The groundwater in deep formations targeted for Class V deep well injection must not be a potential underground source of drinking water. Class V injection wells will be permitted in accordance with the EPA Underground Injection Control Program. Liquid wastes injected into Class V injection wells may not be classified as hazardous under the Resource Conservation and Recovery Act. NRC will require the liquid waste pumped into Class V injection wells to be treated and monitored to verify it meets NRC release standards in 10 CFR Part 20, Subparts D and K and Appendix B.

<u>Aquifer Restoration</u>: Impacts will be SMALL to MODERATE. Groundwater restoration will be initiated once a wellfield is no longer being used to produce uranium. Larger withdrawals will produce larger drawdowns in production aquifers during aquifer restoration, resulting in a greater impact on yields of nearby wells. As with operations, the applicant will monitor all

domestic wells within 2 km [1.2 mi] of the project boundary during aquifer restoration and replace these wells in the event of significant drawdown or degradation of water quality. Water levels in affected wells will recover with time after ISR operations and aquifer restoration activities are complete. Natural recovery and the well monitoring measures established by the applicant will reduce impacts to nearby wells, ensuring the long-term environmental impact from consumptive use will be SMALL.

During aquifer restoration, hydraulic control for the former production zone will be maintained; this will be accomplished by maintaining an inward hydraulic gradient through a production bleed. During aquifer restoration activities, water will be pumped from the wellfield (without reinjection), resulting in an influx of “fresh” groundwater into the affected (mined) portion of the aquifer. Hydraulic connection (leakage) between production aquifers (Fall River and Chilson aquifers) through the intervening confining unit (Fuson Shale) in the Burdock area may impact aquifer restoration. The Fall River aquifer is hydraulically connected to abandoned open pit mines in the Burdock area. Water in the abandoned open pit mines has elevated dissolved uranium and gross alpha concentrations exceeding EPA-regulated maximum concentration levels. If contaminants are drawn into production zones within the Chilson aquifer from abandoned open pit mines through the hydraulically connected Fall River aquifer during aquifer restoration, the impacts will be MODERATE.

During the aquifer restoration phase, disposal of liquid wastes via Class V injection wells, land application, or a combination of Class V injection wells and land application will occur as described for ISR operations. The goal of aquifer restoration will be to restore groundwater quality in the ore production zone to Commission-approved background conditions under 10 CFR Part 40, Appendix A, Criterion 5B(5). If the aquifer cannot be restored to background conditions, then NRC will require that either the production zone be returned to maximum contaminant levels in 10 CFR Part 40, Appendix A, Table 5C or to NRC-approved alternate concentration limits. Postrestoration groundwater quality will be protective of public health and the environment.

<u>Decommissioning</u>: Impacts will be SMALL. The potential impact to groundwater quality during decommissioning and reclamation is comparable to that described in the construction phase. Groundwater consumptive use will be less than that of the operation and restoration phases. All monitoring, injection, and production wells will be plugged and abandoned in accordance with UIC program requirements. Wells will be filled with cement and clay to ensure groundwater does not flow through the abandoned wells. Abandoned wells will be properly isolated from the flow domain. NRC will review and approve the wellfield restoration efforts to ensure that restoration standards were followed and public health and safety is protected.

Ecological Resources

<u>Construction</u>: Impacts will be SMALL to MODERATE. Construction disturbance under current development plans, which require vegetative removal, will affect approximately 98 ha [243 ac] if deep well injection is used to dispose of treated wastewater or approximately 566 ha [1,398 ac] if land application or a combination of deep well injection and land application is used to dispose of treated wastewater. Some habitat loss or alteration, displacement of wildlife, and mortality due to encounters with vehicles or heavy equipment will occur, though wildlife species will likely disperse from the area once construction commences. Following recommended fencing and power line construction designs will minimize impediments to game and avian movement. Mitigation will control the introduction and spread of undesirable and invasive, nonnative plants;

reduce the likelihood of injury or mortality to wildlife; and ensure no loss of aquatic habitat. Impacts to wildlife and habitat will be minimized with mitigation measures and the timely reseeding of disturbed areas following construction. Any trees with raptor nests will not be removed, and following U.S. Fish and Wildlife Service (FWS) and South Dakota Game Fish and Parks (SDGFP) seasonal noise, vehicular traffic, and human proximity guidelines will help to ensure the continued nesting success of area raptors. No federally threatened or endangered species are known to occur within the proposed project area. Impacts to state-protected species will not noticeably affect species' populations within the vicinity of the proposed project site.

Operation: Impacts will be SMALL to MODERATE. Ecological impacts due to noise, vehicles, structures, and the presence of humans will be similar to, but less than, those experienced during construction for either disposal option because fewer earthmoving activities will occur. However, larger areas of habitat will be converted to crops and animals will be disturbed with irrigation activities during the land application disposal option. The applicant will reseed disturbed areas with SDDENR- or BLM-approved seed mixtures to restore habitat. Spill detection and response plans will reduce the potential impact to terrestrial and aquatic species. Fencing and netting will limit wildlife access to liquid waste holding ponds. Potential conflicts between active raptor nest sites and project-related activities will continue to be mitigated by annual raptor monitoring and mitigation plans.

Aquifer Restoration: Impacts will be SMALL to MODERATE. Impacts will be similar to those experienced during the operations phase with no major differences in type or degree of impact. The existing infrastructure will be used during this phase, and mitigation measures will continue to apply from the construction and operations phases.

Decommissioning: Impacts will be SMALL to MODERATE. Temporary disturbances to land and soils during decommissioning could displace vegetation and wildlife species that had recolonized the proposed project area since initiation of ISR activities. Shrubland vegetative communities will be more difficult to reestablish and achieve full site recovery. The applicant commits to vegetation reestablishment efforts to be ongoing throughout the ISR facility life cycle. However, new vegetative growth could be affected by future grazing, droughts, or intense winters, thus reducing the rate of plant productivity and delaying full recovery, Revegetation and recontouring will restore habitat previously altered during construction and operations.

Air Quality

Construction: Impacts will be SMALL to MODERATE. The proposed Dewey-Burdock ISR Project is located in the Black Hills-Rapid City Intrastate Air Quality Control Region, which is classified as being in attainment for all National Ambient Air Quality Standards (NAAQS) primary pollutants. Air emissions during the construction phase of the proposed project will consist primarily of combustion emissions from drill rigs and fugitive road dust. The magnitude of the pollutant concentrations around the proposed project site from the construction phase combustion emissions are below NAAQS and Prevention of Significant Deterioration (PSD) Class II regulatory thresholds. This also holds true for the peak year pollutant emission levels. The peak year accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action will generate in any one project year. The construction phase and peak year fugitive dust concentrations are also below NAAQS and PSD Class II thresholds. However, the mass of particulate matter generated from fugitive emissions is much greater than that generated from combustion emissions. In addition, these fugitive dust emission sources are spread out over a large area and tend to generate emissions sporadically. Due to the level and nature of these fugitive emissions, there is potential for short-term, intermittent impacts to localized areas in and around the site particularly when vehicles travel on unpaved roads. Wind Cave National Park, a Class I area located about 47 km [29 mi] northeast of the proposed project area, has experienced visibility impacts from air pollution. The initial air dispersion modeling the applicant conducted only considered the area in and around the proposed site. The applicant committed to perform additional air dispersion modeling before the final SEIS is prepared (Powertech, 2012). Meanwhile, based on the modeling results from a similar project, the Dewey-Burdock ISR Project will contribute to visibility impacts at Wind Cave National Park but the impact magnitude will be minimal.

The deep Class V injection well disposal option has more combustion emissions than the land application option due to the contribution of the deep well drill rig. The land application option has more fugitive emissions due to the greater amount of land disturbed. However, these differences are relatively small and NRC staff do not expect to see any appreciable difference in the overall air emission levels between the two disposal options. Therefore, the impact magnitudes are expected to be the same.

Operation: Impacts will be SMALL to MODERATE. Combustion emission and fugitive dust emission pollutant levels will be less than those experienced during construction. ISR facilities are not major point source emitters of regulated pollutants. Combustion emissions in this phase are basically evenly divided between light duty vehicles and construction and field equipment. The combustion and fugitive dust emissions around the proposed site will be below NAAQS and PSD Class II regulatory thresholds. However, due to the level and nature of the fugitive emissions, there is potential for short-term, intermittent impacts to localized areas in and around the site particularly when vehicles travel on unpaved roads. The Dewey-Burdock ISR Project will contribute to visibility impacts at Wind Cave National Park but the impact magnitude will be minimal.

The land application disposal option has more fugitive emissions than the Class V injection well option due to the greater amount of land disturbed. However, this difference is relatively small and NRC staff do not expect to see any appreciable difference in the overall air emission levels between the two disposal options. Therefore, the impact magnitudes are expected to be the same.

Aquifer Restoration: Impacts will be SMALL to MODERATE. Combustion emission and fugitive emission levels for the aquifer restoration phases are the lowest relative to the other three phases. For the aquifer restoration phase, combustion emissions are primarily from light duty vehicles and wind erosion can generate more fugitive emissions than travel on unpaved roads. Fugitive emissions can result in short-term, intermittent impacts to localized areas. The proposed project can contribute to visibility impacts at Wind Cave National Park, but the impact magnitude will be minimal.

The land application disposal option can generate up to about twice the amount of fugitive emissions compared to the Class V injection well disposal option. Although there is some difference in the overall fugitive dust emissions levels between the two disposal options, the impact magnitude is expected to be similar.

Decommissioning: Impacts will be SMALL to MODERATE. The decommissioning phase pollutant sources and emission levels closely match those from the operation phase. Therefore, the decommissioning phase will produce the same impact magnitude as the operation phase. As in the operation phase described previously, NRC staff do not expect to see any appreciable difference in the overall decommissioning phase air emission levels between the Class V injection well and land application disposal options.

Noise

Construction: Impacts will be SMALL. Increased traffic, as well as use of drill rigs, heavy trucks, bulldozers, and other equipment to construct and operate the wellfields, drill wells, access roads, and build the central plant and satellite facility, will generate noise audible above ambient (background) levels. The sound from construction activities will return to background levels at a distance of approximately 305 m [1,000 ft]. Two onsite dwellings will be impacted by noise above background levels from heavy equipment use. The Daniels residence is within 305 m [1,000 ft] of wellfields B-WF6 and B-WF7 in the Burdock area, and the Beaver Creek Ranch Headquarters is within 305 m [1,000 ft] of land application areas in the Dewey area. Increased noise levels at these residences during construction will be short term (1 to 2 years) and mitigated by using sound abatement controls on operating equipment. Administrative and engineering controls will be expected to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and be mitigated by use of personal hearing protection. Noise impacts to raptors will be mitigated by adhering to FWS and SDGFP seasonal noise guidelines, locating all planned facilities outside of BLM-recommended buffer zones of all raptor nests, and following an FWS-approved raptor monitoring and mitigation plan.

Operation: Impacts will be SMALL. Impacts from traffic-related noise will be similar to those during construction. Because wellfields will be developed and operated sequentially, potential noise impacts at the Daniels residence will be short term (1 to 2 years each for wellfields B-WF6 and B-WF-7). In addition, the Daniels residence will not be occupied year round. Residents at the Beaver Creek Ranch Headquarters will only be exposed to noise from nearby land application areas during the growing season (May 11 to September 24). Noise impacts will be mitigated by using sound abatement controls on operating equipment. The central plant and satellite facility will generate indoor noise audible to workers. OSHA regulatory limits will be maintained and mitigated by use of personal hearing protection. Potential noise-related impacts to active raptor nest sites will continue to be mitigated by adherence to timing and spatial restrictions within specified distances of active raptor nests as determined by appropriate regulatory agencies (e.g., FWS, SDGFP, and BLM).

Aquifer Restoration: Impacts will be SMALL. Noise impacts will be similar to, or less than, those experienced during the operations phase. Pumps and other wellfield equipment contained in buildings would reduce the potential sound impact to an offsite individual. Because the aquifers in wellfields will be restored sequentially, potential noise impacts at the Daniels residence will be short term (1 to 2 years each for wellfields B-WF6 and B-WF7). In addition, the Daniels residence will not be occupied year round. During aquifer restoration, residents at the Beaver Creek Ranch Headquarters will only be exposed to noise from nearby land application areas during the growing season (May 11 to September 24). Noise impacts will be mitigated by using sound abatement controls on operating equipment. Noise impacts from traffic will be SMALL because there will be fewer vehicular trips than during the operations phase. Potential noise-related impacts to active raptor nest sites will continue to be mitigated by adherence to timing and spatial restrictions within specified distances of active raptor nests as determined by appropriate regulatory agencies (e.g., FWS, SDGFP, and BLM).

Decommissioning: Impacts will be SMALL. Noise impacts will either be similar to, or less than, those experienced during the construction phase. Noise during this phase will be temporary, and when decommissioning and reclamation activities are complete, the noise levels will return to baseline. Noise impacts from traffic will be SMALL because there will be fewer shipments to and from the proposed site as decommissioning progressed. Potential noise-related impacts to active raptor nest sites will continue to be mitigated by adherence to timing and spatial restrictions within specified distances of active raptor nests as determined by appropriate regulatory agencies (e.g., FWS, SDGFP, and BLM).

Historic and Cultural Resources

Construction: Impacts will be SMALL to LARGE. Archaeological and historic sites may potentially be disturbed during construction. Within the area of potential effect at the proposed Dewey-Burdock site, 18 historic sites are either listed in the National Register of Historic Places (NRHP) or eligible for listing in the NRHP. Based on the proposed location of ISR facilities and infrastructure, avoidance of 12 of these sites is possible during the construction phase and, therefore, no impacts are anticipated. Avoidance and mitigation, such as fencing and data recovery excavations, are recommended for the remaining six NRHP-eligible sites. In addition, avoidance is recommended for two unevaluated historic burial sites located in proximity to proposed construction activities until their NRHP eligibility is determined. Avoidance and mitigation is also recommended for 4 unevaluated site located within 76 m [250 ft] of proposed wellfields or land application areas.

Prior to construction, an agreement between NRC, South Dakota State Historic Preservation Office (SD SHPO), BLM, interested Native American tribes, the applicant, and other interested parties will be established outlining the mitigation process for each affected resource. Prior to construction, the applicant will also develop an Unexpected Discovery Plan that will outline the steps required if unexpected historical and cultural resources are encountered.

Consultation efforts to identify properties of religious and cultural significance to Native American tribes have not been completed. Thus, NRC cannot determine effects to these properties at this time. Section 106 consultation between NRC, SD SHPO, BLM, tribal representatives, and the applicant regarding potential impacts to these sites is ongoing.

Operation: Impacts will be SMALL. Minimal impacts will result during the operations phase because impacts to cultural resources will be mitigated before facility construction and identified resources will be avoided. If historical or cultural resources are encountered during operations, the Unexpected Discovery Plan will be implemented. Work would stop in the immediate area, and appropriate agencies would be notified.

Aquifer Restoration: Impacts will be SMALL. Impacts to historical and cultural resources during the aquifer restoration phase will be similar to operations. Minimal impacts will result because impacts to cultural resources will be mitigated before facility construction, and identified resources will be avoided. If historical or cultural resources are encountered during operations, the Unexpected Discovery Plan will be implemented. Work would stop in the immediate area, and appropriate agencies would be notified.

Decommissioning: Impacts will be SMALL. Minimal impacts will result during the decommissioning phase because impacts to cultural resources will be mitigated prior to facility construction. If historical or cultural resources are encountered during operations, the Unexpected Discovery Plan will be implemented. Work would stop in the immediate area, and appropriate agencies would be notified.

Visual/Scenic Resources

Construction: Impacts will be SMALL. During facilities construction, short-term (1 to 2 years) visual and scenic impacts will result from construction equipment and fugitive dust emissions. Temporary and short-term visual impacts during the construction period in each wellfield will result from header house construction, well drilling, and construction of access roads and electrical distribution lines. Dust suppression and selecting building materials and paint that complement the natural environment will reduce overall visual and scenic impacts of project construction. Center pivot irrigation systems in proposed land application areas in the Dewey area will be visible to travelers on Dewey Road; however, Dewey Road is a lightly traveled county road with few residences. Proposed activities at the project will be consistent with the BLM visual classification of this area.

Operation: Impacts will be SMALL. Visual impacts will be similar to, or less than, those experienced during construction. Less heavy machinery will be used, and standard dust control measures (e.g., water application and speed limits) will be implemented to reduce visual impacts from fugitive dust. Wellfields will be developed sequentially, and there will be no large expanse of land undergoing development at one time. Buildings and other structures will be painted so they blend in to the natural landscape, and power lines and pipelines will be buried where appropriate. Center pivot irrigation systems in proposed land application areas in the Dewey area will be visible to travelers on Dewey Road; however, Dewey Road is a lightly traveled county road with few residences. Proposed activities at the project will be consistent with the BLM visual classification of this area.

Aquifer Restoration: Impacts will be SMALL. Visual impacts will be similar to, or less than, those experienced during the operations phase. Aquifer restoration activities will use in-place infrastructure; therefore, no modifications to either scenery or topography will occur. There will be less vehicular traffic, creating less of a visual impact. The applicant identified mitigation measures, such as dust suppression, which will be used to further reduce visual impacts.

Decommissioning: Impacts will be SMALL. Temporary impacts to the visual landscape will be comparable to those during the construction phase. Reclamation will return the visual landscape to baseline contours and will reduce the visual impact by removing buildings and the associated infrastructure. Implementation of mitigation measures (e.g., dust suppression) will further reduce the visual impacts from decommissioning.

Socioeconomics

Construction: Impacts will be SMALL. Because of the small size of the construction workforce (86 workers) and because of the short duration of the ISR construction phase (1 to 2 years), the overall potential socioeconomic impact, including the effects of ISR facility construction on demographic conditions, income, housing, employment rate, local finance, education, and health and social services, will be SMALL.

Operation: Impacts will be SMALL. Because of the small size of the operations workforce (84 workers), the migration of workers and their families to nearby towns will have a SMALL impact on demographics. Although wage rates will be higher for Dewey-Burdock employees than for workers in similar skilled positions in Fall River, Custer, and Weston Counties, the operations workforce will be small in comparison to the combined labor force in the counties; therefore, income impacts will be SMALL. The impact on housing will be SMALL because of available housing in the immediate area surrounding the proposed ISR facility. Operation of the proposed Dewey-Burdock ISR Project will create new jobs, but because of the small workforce size and because most skilled workers will be drawn from areas outside of the region of influence, impacts on employment will not be noticeable. The local economy will experience a SMALL beneficial impact from the purchasing of local goods and services and an increase in sales and income tax revenues. An increased demand for schools will have a SMALL impact on education because the current school systems are not at full capacity and can accommodate more students. Increased demand for health and social services will have a SMALL impact.

Aquifer Restoration: Impacts will be SMALL. Impacts will be less than those experienced during the operations phase. Fewer workers will be required, which will reduce pressure on housing, education, and health and social services.

Decommissioning: Impacts will be SMALL. Impacts will be less than those during the construction and operations phases because fewer workers will be required. Demand for housing, education, and health and social services will also be reduced.

Environmental Justice

All Phases: The percentage of minority populations living in affected block groups in the vicinity of the proposed Dewey-Burdock ISR Project site in Custer and Fall River Counties in South Dakota and Weston County in Wyoming does not significantly exceed the percentage of minority populations recorded at the state and county level and is well below the national level. Furthermore, the percentage of low-income populations living in affected census tracts in the vicinity of the proposed project site in Custer, Fall River, and Weston Counties does not significantly exceed the percentage of low-income populations recorded at the state or county level. Therefore, there will be no disproportionately high and adverse impacts to minority and low-income populations from the construction, operation, aquifer restoration, and decommissioning of the proposed Dewey-Burdock ISR facility.

The closest population to the proposed Dewey-Burdock ISR Project that could be impacted by environmental justice concerns is the Pine Ridge Indian Reservation located approximately 80 km [50 mi] east in Shannon County, South Dakota. Based on 2010 United States Census Bureau data, this reservation has both minority {greater than 95 percent Native American (Oglala Sioux Tribe)} and low-income populations. Environmental justice impacts to Native American tribes living in the vicinity of the proposed project will be no different than those experienced by other populations. The proposed action may potentially affect certain sites of religious and cultural significance to Native American tribes; however, the impacts to such sites could be reduced through mitigation strategies developed through the National Historic Preservation Act Section 106 consultation process.

Public and Occupational Health

Construction: Impacts will be SMALL. Construction activities, including the use of construction equipment and vehicles, will disturb the topsoil and create fugitive dust emissions. Fugitive dust generated from construction activities will be short term (1 to 2 years), and the levels of radioactivity in soils at the proposed project site are low; therefore direct exposure, inhalation, and ingestion of fugitive dust will not result in a radiological dose to workers and the public. Construction equipment will be diesel powered and will exhaust particulate diesel emissions. The potential impacts and potential human exposures from these emissions will be SMALL, because of the short duration of the release and because the emissions will be readily dispersed into the atmosphere.

Operation: The radiological impacts from normal operations will be SMALL. Public and occupational exposure rates at ISR facilities during normal operations have historically been well below regulatory limits. Dose assessments using the MILDOS computer code indicate that the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr] will not be exceeded at any property boundary. The remote location of the proposed Dewey-Burdock site and the use of the proposed ISR technology coupled with the applicant procedures to minimize exposure demonstrate that the potential impact on public and occupational health and safety from facility operation will be SMALL. The radiological impacts from accidents will be SMALL for workers (if the applicant's radiation safety and incident response procedures in an NRC-approved radiation protection plan are followed) and SMALL for the public because of the facility's remote location. The nonradiological public and occupational health and safety impacts from normal operations and accidents, due primarily to risk of chemical exposure, will be SMALL if handling and storage procedures are followed.

Aquifer Restoration: Impacts will be SMALL. Impacts will be similar to, but less than, those during the operations phase. The reduction or elimination of some operational activities will further reduce the magnitude of potential worker and public health impacts and safety hazards.

Decommissioning: Impacts will be SMALL. Impacts will be similar to those experienced during construction. Soil and facility structures will be decontaminated, and lands will be restored to preoperational conditions.

Waste Management

Construction: Impacts will be SMALL. Small-scale and incremental wellfield development will generate small volumes of construction waste. Waste will primarily consist of building materials, piping, and other solid wastes. No byproduct material will be generated during construction. Nonhazardous solid waste will be disposed of at a nearby municipal solid waste landfill with available capacity to accommodate estimated construction-phase waste volumes.

Operation: Impacts will be SMALL. Liquid byproduct material, including production bleed, waste brine streams from elution and precipitation, resin transfer wash, laundry water, plant wash-down water, and laboratory chemicals will be treated and disposed using Class V injection wells. If a permit cannot be obtained from EPA for Class V injection, the applicant would pursue land application of treated liquid effluent. If the capacity of either method is limited, the applicant will pursue a combination of both Class V injection and land application. Deep well injection in a Class V well requires an EPA permit, and wastes will have to meet EPA permit conditions and NRC effluent discharge limits in 10 CFR Part 20, Appendix B (both would limit potential impacts). Land application will require SDDENR-permitting of discharge water, and the land application area would be monitored to assess compliance with NRC and SDDENR requirements that would limit impacts. Solids classified as byproduct material will be sent to a licensed facility for disposal. A preoperational agreement with a licensed facility to accept wastes the proposed action generates will avoid capacity impacts. Capacity is available for disposal of nonradiological, nonhazardous wastes at regional municipal landfills. Capacity will be sufficient for disposal of low volumes of generated hazardous wastes.

Aquifer Restoration: Impacts will be SMALL based on the type and quantity of waste expected to be generated and the available capacity for disposal. Waste disposal procedures will be the same as those during the operations phase, resulting in similar impacts. One exception is the addition of reverse osmosis treatment of aquifer restoration water if a Class V deep disposal well is used. The applicant proposal includes adequate disposal capacity, and the applicant is required to comply with EPA Class V disposal permit conditions, NRC effluent limits, and other NRC safety regulations. Although the wastewater volume could increase during aquifer restoration activities, this will be offset by the reduction in production capacity from completion of wellfield production and removal from service.

Decommissioning: Impacts will be SMALL to MODERATE. Safe handling, storage, and disposal of decommissioning wastes will be described in a required decommissioning plan for NRC review before decommissioning activities begin. A preoperational agreement with a licensed disposal facility to accept solid byproduct material will ensure that sufficient disposal capacity will be available at the time of decommissioning. Equipment and building materials that meet release criteria will be reused, recycled, or disposed as construction waste at a landfill. The available local landfill capacity may be insufficient to accommodate all decommissioning nonhazardous solid waste from the proposed Dewey Burdock ISR Project. The potential impacts on waste management resources will depend on the long-term status of the existing local landfill resources. If the capacity of the Newcastle or Custer-Fall River landfills is expanded prior to project decommissioning, the impacts to local landfills will be SMALL. If capacity at either landfill is not expanded prior to the Dewey-Burdock decommissioning, the NRC staff conclude the Newcastle landfill will have no disposal capacity at the time of decommissioning. Impacts to the Custer-Fall River landfill are expected to be MODERATE because the increase in solid waste disposal will more rapidly consume storage capacity during the last years of the landfill's projected operational life. The disposal of any waste from the Dewey-Burdock facility in the Rapid City landfill will have a SMALL impact due to the projected operational life and available capacity of that landfill.

CUMULATIVE IMPACTS

Chapter 5 of this SEIS provides the NRC evaluation of potential cumulative impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Dewey-Burdock ISR Project considering other past, present, and reasonably foreseeable future actions. Cumulative impacts from past, present, and reasonably foreseeable future actions were considered and evaluated in this draft SEIS, regardless of what agency (federal or nonfederal) or person undertook the action. The NRC staff determined that the SMALL to MODERATE impacts from the proposed Dewey-Burdock ISR Project are not expected to contribute perceptible increases to the SMALL to LARGE cumulative impacts, due primarily to ongoing uranium and oil and gas exploration activities, potential wind energy projects, and proposed infrastructure and transportation projects.

SUMMARY OF COSTS AND BENEFITS OF THE PROPOSED ACTION

The implementation of the proposed action would generate primarily regional and local costs and benefits. The regional benefits of building the proposed project would be increased employment, economic activity, and tax revenues in the region around the proposed site. Costs associated with the proposed Dewey-Burdock ISR Project are, for the most part, limited to the immediate area surrounding the site. The NRC staff determined the benefit from constructing and operating the facility would outweigh the economic, environmental, and social costs.

COMPARISON OF ALTERNATIVES

For the No-Action alternative, the applicant would not construct or operate ISR facilities at the proposed Dewey-Burdock ISR Project site. As a result, no uranium ore would be recovered from the proposed site. This alternative would result in neither positive nor negative impacts to any resource area.

PRELIMINARY RECOMMENDATION

After weighing the impacts of the proposed action and comparing the alternatives, the NRC staff, in accordance with 10 CFR 51.71(f), set forth its preliminary NEPA recommendation regarding the proposed action (issuing a source material license for the proposed Dewey-Burdock ISR Project). Unless safety issues mandate otherwise, the preliminary NRC staff recommendation to the Commission related to the environmental aspects of the proposed action is that a source and byproduct material license for the proposed action be issued as requested.

The NRC staff conclude that the overall benefits of the proposed action outweigh the environmental disadvantages and costs based on the following:

- Potential adverse impacts to all environmental resource areas are expected to be SMALL, with the exception of

    1. Land use resources during decommissioning. Land disturbance during decommissioning will be MODERATE until vegetation is reestablished in seeded areas (see SEIS Sections 4.2.1.1.4, 4.2.1.2.4, and 4.2.1.3).

    2. Transportation resources during construction and operation. Increases in traffic during construction and operations will have a MODERATE impact on Dewey Road, the road nearest the proposed site (see SEIS Sections 4.3.1.1.1, 4.3.1.2.1, 4.3.1.1.2, 4.3.1.2.2, and 4.3.1.3).

    3. Groundwater resources during aquifer restoration. During aquifer restoration in the Burdock area, drawdown-induced migration of contaminants into the production zone (i.e., the Chilson aquifer) from abandoned open pit mines could adversely affect restoration goals and have a MODERATE impact (see SEIS Sections 4.5.2.1.1.3, 4.5.2.1.2.3, and 4.5.2.1.3).

    4. Ecological resources during construction, operations, aquifer restoration, and decommissioning. Under the land application and combined Class V deep well disposal and land application options, construction, operations, and aquifer

restoration activities would have a MODERATE impact on vegetation, small- to medium-sized mammals, raptors, nongame and migratory birds, and reptiles (see SEIS Sections 4.6.1.2.1, 4.6.1.2.2, 4.6.1.2.3, and 4.6.1.3). Under all disposal options, land-disturbing activities during decommissioning would have a MODERATE impact on vegetation until it is reestablished (see SEIS Sections 4.6.1.1.4, 4.6.1.2.4, and 4.6.1.3).

5. Air quality during construction, operations, aquifer restoration, and decommissioning. During all phases of the ISR lifecycle, there will be the potential for MODERATE air impacts from short-term, intermittent fugitive dust emissions (see SEIS Sections 4.7.1.1.1 through 4.7.1.1.4, 4.7.1.2.1 through 4.7.1.2.4, and 4.7.1.3).

6. Historical and cultural resources during construction. Construction could have a MODERATE or LARGE impact on 18 historic properties—those sites currently listed or eligible for listing on the NRHP—and other unevaluated historic, cultural, and religious properties in the project area (see SEIS Sections 4.9.1.1.1, 4.9.1.2.1, and 4.9.1.3).

7. Waste management resources during decommissioning. Impacts from disposal of nonhazardous solid waste may be MODERATE depending on the long-term status of existing local landfill resources (see SEIS Sections 4.14.1.1.4 and 4.14.1.2.4).

- Regarding groundwater, the portion of the aquifer(s) designated for uranium recovery must be exempted as underground sources of drinking water prior to the start of ISR operations. Additionally, the applicant will be required to monitor for excursions of lixiviant from the production zones and to take corrective actions in the event of an excursion. Prior to operations, the applicant will be required to provide detailed hydrologic pump test data packages and operational plans for each wellfield at the proposed project. The applicant will also be required to restore groundwater parameters affected by ISR operations to levels that are protective of human health and safety.

- The costs associated with the proposed project are, for the most part, limited to the area surrounding the site.

- The regional benefits of building the proposed project will be increased employment, economic activity, and tax revenues in the region around the proposed site.

This preliminary recommendation is based on NRC staff's independent review of (i) the license application the applicant submitted; (ii) applicant responses to NRC staff requests for additional information; (iii) consultation with federal, state, tribal, and local agencies; and (iv) the assessments summarized in this draft SEIS, including the potential mitigation measures identified in the license application and this draft SEIS.

References

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10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51. "*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*." Washington, DC: U.S. Government Printing Office.

43 CFR Part 3800. Code of Federal Regulations, Title 43, *Public Lands: Interior*, Part 3800. *"Mining Claims Under the General Mining Laws."* Washington, DC: U.S. Government Printing Office.

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NRC. NUREG–1910, "Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC: NRC. May 2009.

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ABBREVIATIONS/ACRONYMS

ACHP	Advisory Council on Historic Preservation
ACL	alternate concentration limit
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
AET, Inc.	American Engineering Testing, Inc.
ALAC	Archaeology Laboratory Augustana College
ALARA	as low as reasonably achievable
AUM	animal unit month
APE	area of potential effect
ARC	Archaeological Research Center
ARPA	Archaeological Resources Protection Act
ARSD	Administrative Rules of South Dakota
ASLB	Atomic Safety and Licensing Board
AWEA	American Wind Energy Association
BGEPA	Bald and Golden Eagle Protection Act
bgs	below ground surface
BHNF	Black Hills National Forest
BLM	U.S. Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
CAB	Commission-approved background
CCSDWPC	Custer County, South Dakota, Weed and Pest Control
CFR	*U.S. Code of Federal Regulations*
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESQC	conditionally exempt small quantity generator
CNWRA	Center for Nuclear Waste Regulatory Analyses
cpm	counts per minute
CPP	central processing plant
dBA	decibels
DM&E	Dakota Minnesota and Eastern (Railroad)
DOE	U.S. Department of Energy
EFRC	Energy Fuels Resources Corporation
EIA	Energy Information Administration
EIS	environmental impact statement
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
FACU	facultative upland
FACW	facultative wet
FHWA	Federal Highway Administration
FR	*Federal Register*

ABBREVIATIONS/ACRONYMS (continued)

FRA	Federal Railroad Administration
FWS	U.S. Fish and Wildlife Service
GCRP	U.S. Global Change Research Program
GDP	Groundwater Discharge Permit
GEIS	generic environmental impact statement
GHG	greenhouse gas
GPS	global-positioning-system
HABS	Historic American Buildings Survey
HDPE	high-density polyethylene
ID	well identification
IQR	interquartile range
ISL	*in-situ* leach
ISR	i*n-situ* recovery
IX	ion exchange
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MILDOS	computer code
MIT	mechanical integrity test
MOA	Memorandum of Agreement
mya	million years ago
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAU	Rapid City Campus of the National American University
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act of 1966, as amended
NOGCC	Nebraska Oil and Gas Conservation Commission
NPDES	national pollutant discharge elimination system
NPWRC	Northern Prairie Wildlife Research Center
NRC	U.S. Nuclear Regulatory Commission
NRCS	National Resource Conservation Service
NRHP	National Register of Historic Places
OBL	obligate
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
OTGR	Office of Tribal Government Relations
OW	Open Water
PABJh	Palustrine Aquatic Bed Intermittently Flooded Diked
PEM	Palustrine Emergent
PEMC	Seasonally Flooded
POO	Plan of Operations

ABBREVIATIONS/ACRONYMS (continued)

POP	Perimeter of Operational Pollution
Powertech	Powertech (USA) Inc.
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
PUB	Palustrine Unconsolidated Bottom
PUS	Palustrine Unconsolidated Shore
PUSA	Palustrine Unconsolidated Shore Temporarily Flooded
R2EM	Riverine Lower Perennial Emergent
R4SB7	Riverine Intermittent Streambed Vegetated
R4US	Riverine Intermittent Unconsolidated Streambed
RCRA	Resource Conservation and Recovery Act
RMP	regional management plan
RO	reverse osmosis
ROI	region of influence
ROW	right of way
SDCL	South Dakota Codified Law
SDDENR	South Dakota Department of Environment and Natural Resources
SDDOA	South Dakota Department of Agriculture
SDDOE	South Dakota Department of Education
SDDOH	South Dakota Department of Health
SDDOL	South Dakota Department of Labor
SDDOT	South Dakota Department of Transportation
SDDLR	South Dakota Department of Labor and Regulation
SDDRR	South Dakota Department of Revenue and Regulation
SDGFP	South Dakota Game, Fish, and Parks
SDGS	South Dakota Geological Survey
SDNHP	South Dakota Natural Heritage Program
SDRMP	South Dakota Resource Management Plan
SD SHPO	South Dakota State Historic Preservation Office
SDSMT	South Dakota School of Mines and Technology
SDSU	South Dakota State University
SDWA	Safe Drinking Water Act
SEA	U.S. Department of Transportation Section of Environmental Analysis
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SERP	safety and environmental review panel
SF	satellite facility
SMCL	secondary maximum concentration limit
SNAP	Supplemental Nutrition Assistance Program
SOW	statement of work
SPAW	soil-plant-atmosphere-water
SQR	scenic quality rating
SRI	SRI Foundation
STB	Surface Transportation Board
SUNSI	sensitive unclassified non-safeguards information
SWMP	storm water pollution management plan

ABBREVIATIONS/ACRONYMS (continued)

TANF	Temporary Assistance for Needy Families
TCP	traditional cultural property
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Office
TLD	thermoluminescent dosimeter
TVA	Tennessee Valley Authority
UCL	upper control limit
UDEQ	Utah Department of Environmental Quality
UMTRCA	Uranium Mill Tailings Radiation Control Act
UIC	underground injection control
UPL	upland
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USDW	underground source of drinking water
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UXC	The Ux Consulting Company
VRM	Visual Resource Management
WDAI	Wyoming Department of Administration and Information
WDEQ	Wyoming Department of Environmental Quality
WDTI	Western Dakota Technical Institute
WDWS	Wyoming Department of Workforce Services
WGFD	Wyoming Game and Fish Department
WIA	walk-in hunting area
WSDOT	Washington State Department of Transportation
WUS	waters of the United States
WYOGCC	Wyoming Oil and Gas Conservation Commission

1 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) and U.S. Bureau of Land Management (BLM) as a cooperating agency prepared this Supplemental Environmental Impact Statement (SEIS) in response to an application Powertech (USA) Inc. (Powertech, or the applicant) submitted on August 10, 2009, to develop and operate the Dewey Burdock *In-Situ* Uranium Recovery (ISR) Project (herein referred to as the Dewey-Burdock ISR Project), located in Custer and Fall River Counties, South Dakota (Powertech, 2009a–c). Figure 1.1-1 shows the geographic location of the proposed project. This site-specific SEIS is a supplement to the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities (herein referred to as the GEIS) prepared in accordance with the process described in GEIS Section 1.8 (NRC, 2009a) and as detailed in Section 1.4.1 of this chapter. The NRC's Office of Federal and State Materials and Environmental Management Programs prepared this SEIS as required by Title 10, Energy, of the *U.S. Code of Federal Regulations* (10 CFR), Part 51. These regulations implement the requirements of the *National Environmental Policy Act of 1969* (NEPA), as amended (Public Law 91-190), which requires the Federal Government to assess the potential environmental impacts of major federal actions that may significantly affect the human environment.

BLM has requested to be and is acting as a cooperating agency with NRC to evaluate the impacts of the Plan of Operations for the proposed Dewey-Burdock ISR Project in accordance with the National Memorandum of Understanding between the two agencies. BLM manages 97 ha [240 ac] of land within the proposed Dewey-Burdock ISR Project area. The applicant controls the locatable mineral rights on this land through Federal Lode Claims and secures access to mineral rights through the terms of the 1872 Mining Law. Under 43 CFR Part 3800, Mining Claims Under the General Mining Laws, BLM is required to review the environmental impacts of federal actions on surface lands to assure that there is no "unnecessary or undue degradation of public lands." To fulfill this requirement, the applicant submitted a Plan of Operations to BLM for the Dewey-Burdock ISR Project on August 26, 2009. The Plan of Operations was modified and resubmitted to BLM on January 28, 2011.

The GEIS (NRC, 2009a) used the terms "*in-situ* leach (ISL) process" and "11e.(2) byproduct material" to describe the uranium milling technology and waste stream generated by the uranium recovery process. For the purposes of this SEIS, "*in-situ* recovery" or ISR is synonymous with "*in-situ* leach" or ISL. This SEIS also uses the term "byproduct material" instead of "11e.(2) byproduct material" to describe the waste stream generated by this milling process to be consistent with the definition in 10 CFR 40.4.

1.2 Proposed Action

On August 10, 2009, the applicant initiated the proposed action by submitting an application for an NRC source and byproduct material license to construct and operate an ISR facility at the proposed Dewey-Burdock ISR Project site and to conduct aquifer restoration, site decommissioning, and reclamation activities. Based on the application, the NRC's federal decision is to either grant or deny the license. The applicant's proposal is discussed in detail in SEIS Section 2.1.1.

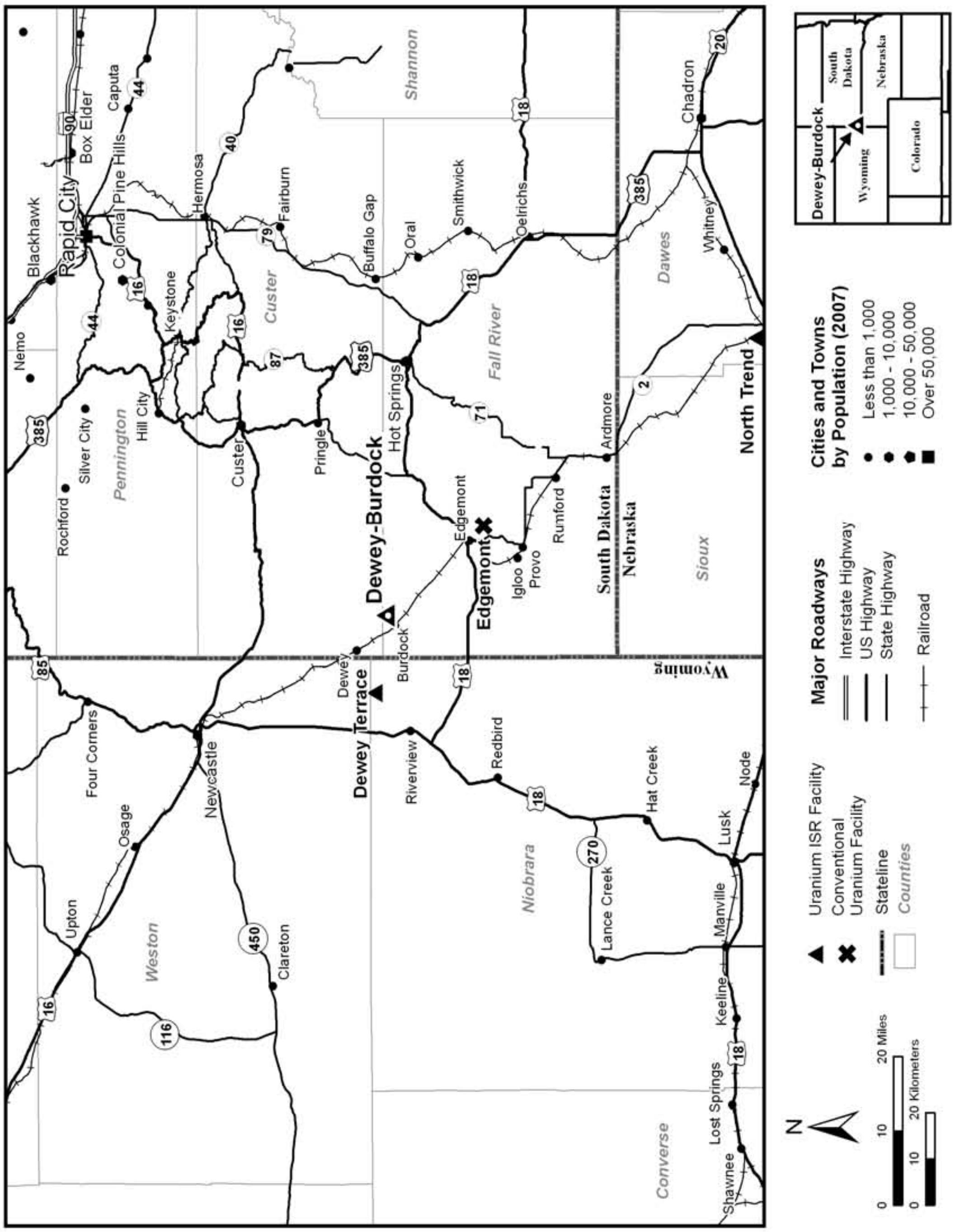

Figure 1.1-1. Geographic Location of the Proposed Dewey-Burdock ISR Project.
Sources: Environmental Systems Research Institute (2008); Powertech (2009b).

1.2.1 BLM's Proposed Action

The BLM's federal decision is to either approve the applicant's Plan of Operations (submitted August 26, 2009, modified and resubmitted January 28, 2011) subject to mitigation included in the license application and this draft SEIS or deny approval of the Plan of Operations if it is found that the applicant's proposal would result in unnecessary or undue degradation of the public lands. The total amount of BLM managed land expected to be disturbed by the applicant over the life of the proposed project is 4.7 ha [11.63 ac]. This disturbance includes an access road, overhead power lines, operational wellfields, groundwater monitoring wells, and underground pipeline installations.

1.3 Purpose of and Need for the Proposed Action

NRC regulates uranium milling, including the ISR process, under 10 CFR Part 40, Domestic Licensing of Source Material. The applicant is seeking an NRC source material license to authorize commercial-scale ISR uranium recovery at the proposed Dewey-Burdock ISR Project site. The purpose and need for the proposed federal action is to provide an option that allows the applicant to recover uranium and produce yellowcake slurry at the proposed project site. Yellowcake is the uranium oxide product of the ISR milling process that is used to produce various products including fuel for commercially operated nuclear power reactors.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the *Atomic Energy Act of 1954* (AEA), as amended, or findings in the NEPA environmental analysis that would lead NRC to reject a license application, NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

1.3.1 BLM's Purpose and Need

The BLM purpose and need for the proposed action is to provide for orderly, efficient, and environmentally responsible mining of the uranium resource. The uranium resource is needed to fulfill market demands for this product for power generation and other needs. The proposed Dewey-Burdock ISR Project area contains BLM-administered public lands open to mineral entry, and the applicant has filed mining claims on them. In addition, the applicant maintains the unpatented mining claims associated with 1,708 ha [4,220 ac] of federal minerals that the U.S. Government reserved under the Stock-Raising Homestead Act. The BLM federal decision is either to approve the revised applicant Plan of Operations subject to mitigation included in the license application and this draft SEIS, or deny approval of the Plan of Operations. BLM's responsibility to respond to the applicant's Plan of Operations establishes the need for the action. The mining claimant (Powertech) has the right to mine and develop the mining claims as long as it can be done without causing unnecessary or undue degradation and is in accordance with pertinent laws and regulations under 43 CFR Part 3800.

1.4 Scope of the SEIS

NRC staff prepared this SEIS to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the proposed action and of reasonable alternatives to the proposed action. The scope of this SEIS considers both radiological and nonradiological (including chemical) impacts associated with the proposed action and its alternatives. This SEIS also considers unavoidable adverse environmental impacts, the relationship between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources.

1.4.1 Relationship to the GEIS

As discussed in Section 1.1, this SEIS is a supplement to the GEIS published as a final report in May 2009. The final GEIS assessed the potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of an ISR facility that could be located in four specific geographic regions of the western United States. The proposed Dewey-Burdock ISR Project is located in the Nebraska-South Dakota-Wyoming Uranium Milling Region, one of the regions considered in the GEIS. Table 1.4-1 summarizes the expected environmental impacts by resource area in the Nebraska-South Dakota-Wyoming Uranium Milling Region based on the GEIS analyses (NRC, 2009a).

Table 1.4-1. *In-Situ* Leach GEIS Range of Expected Impacts in the Nebraska-South Dakota-Wyoming Uranium Milling Region

Resource Area	Construction	Operation	Aquifer Restoration	Decommissioning
Land Use	S	S	S	S to M
Transportation	S to M	S to M	S to M	S
Geology and Soils	S	S	S	S
Surface Water	S to M	S to M	S to M	S to M
Groundwater	S	S to L	S to M	S
Terrestrial Ecology	S to M	S	S	S
Aquatic Ecology	S	S	S	S
Threatened and Endangered Species	S to L	S	S	S
Air Quality	S	S	S	S
Noise	S to M	S to M	S to M	S
Historical and Cultural Resources	S to L	S	S	S
Visual and Scenic Resources	S	S	S	S
Socioeconomics	S to M	S to M	S	S to M
Public Health and Safety	S	S to M	S	S
Waste Management	S	S	S	S

Source: NRC (2009a)
S: SMALL Impact, M: MODERATE Impact, L: LARGE Impact

Scoping provides an opportunity for the public and other stakeholders to identify key issues and concerns they believe should be addressed in an EIS. The NRC staff consider the GEIS scoping process to be sufficient for the purposes of defining the scope of this SEIS. NRC accepted public comments on the scope of the GEIS from July 24, 2007 to November 30, 2007, and held three public scoping meetings in Albuquerque and Gallup, New Mexico, and Casper, Wyoming to aid in this effort. In addition, NRC held eight public meetings to solicit comments on the draft GEIS, after its publication in July 2008. One public meeting was held in Spearfish, South Dakota, on August 25, 2008. Comments on the draft GEIS were accepted from July 28, 2008 until November 8, 2008. Public comments made during the scoping meetings and on the draft GEIS are available on the NRC website (http://www.nrc.gov/ reading-rm/adams.html). Transcripts of the scoping meetings and draft GEIS comment meeting held in South Dakota are available on the NRC web site (http://www.nrc.gov/materials/uranium-recovery/geis/pub-involve-process.html). The scoping summary report was provided in GEIS Appendix A, and GEIS Appendix G provides responses to public comments (NRC, 2009a).

This SEIS was prepared to fulfill the requirement in 10 CFR 51.20(b)(8) and 43 CFR 3809 to prepare either an Environmental Impact Statement (EIS) or supplement to an EIS for the issuance of a source material license for an ISR uranium recovery facility (NRC, 2009a) and for BLM's approval of the applicant's Plan of Operations. The GEIS provides a starting point for the NRC/BLM NEPA analyses for site-specific license applications for new ISR facilities, as well as applications to amend or renew existing ISR licenses. As discussed in the GEIS, the GEIS provides criteria for each environmental resource area to assess the significance level of impacts (i.e., SMALL, MODERATE, or LARGE).

NRC staff applied these criteria to the site-specific conditions at the proposed Dewey-Burdock ISR Project. This SEIS tiers from or incorporates by reference the GEIS relevant information, findings, and conclusions concerning environmental impacts. The extent to which NRC incorporates GEIS impact conclusions depends on the consistency between (i) the applicant's proposed facility, activities, and conditions at the proposed Dewey-Burdock ISR Project and (ii) the general ISR facility description and activities in the GEIS and information or conclusions in the GEIS. NRC determinations of potential environmental impacts and the discussion of which GEIS impact conclusions were incorporated by reference are discussed in SEIS Chapter 4. GEIS Section 1.8.3 describes the use of tiering and incorporation by reference in using the GEIS for environmental reviews of site-specific ISR license applications (NRC, 2009a).

1.4.2 Public Participation Activities

As part of the preparation of this SEIS, NRC staff met with federal, state, tribal, and local agencies and authorities over the course of an expanded visit to the proposed Dewey-Burdock ISR Project site and vicinity in November and December 2009 (NRC, 2009b). Attempts to arrange for an initial briefing meeting with the Oglala Sioux Tribe were unsuccessful at that time. The purpose of these meetings was to gather additional site-specific information to support the NRC staff's environmental review and to help the staff determine consistency between site-specific and local information and corresponding information in the GEIS. As part of information gathering, the NRC staff also contacted potentially interested Native American tribes and local authorities, entities, and public interest groups in person, by email, and by telephone. Additionally, in January and February 2010, the NRC staff published an advertisement in six newspapers circulated near the proposed project area (Rapid City Journal, Edgemont Herald

Tribune, Custer Chronicle, Hot Springs Star, Lakota Country Times, and the Native Sun) soliciting public comments on the proposed action; five comments were received from this effort.

NRC published a Notice of Opportunity for Hearing on the Dewey-Burdock ISR Project license application in the Federal Register (FR) on January 5, 2010 (75 FR 467). Hearing requests from Consolidated Petitioners and the Oglala Sioux Tribe were received on March 8, 2010, and April 6, 2010, respectively (Consolidated Petitioners, 2010; Oglala Sioux Tribe, 2010). NRC also published a Notice of Intent to prepare this SEIS on January 20, 2010 (75 FR 3261).

1.4.3 Issues Studied in Detail

To meet its NEPA obligations related to its review of the Dewey-Burdock ISR Project license application, the NRC staff conducted an independent, detailed, and comprehensive evaluation of the potential environmental impacts from construction, operation, aquifer restoration, and decommissioning of an ISR facility at the proposed site and from reasonable alternatives. As discussed in GEIS Section 1.8.3, the GEIS (i) evaluated the types of environmental impacts that may occur from ISR uranium milling facilities, (ii) identified and assessed generic impacts (the same or similar) at all ISR facilities (or those with specified facility or site characteristics), and (iii) identified the scope of environmental impacts that needed to be addressed in site-specific environmental reviews. Therefore, although all of the environmental resource areas identified in the GEIS would be addressed in site-specific reviews, certain resource areas would require a more detailed analysis, because the GEIS determined a range in the significance of impacts (e.g., SMALL to MODERATE, SMALL to LARGE) could result, depending upon site-specific conditions (see Table 1.4-1).

Based on the GEIS analysis, this SEIS provides a more detailed analysis of the following resource areas:

- Land use
- Transportation
- Surface water and wetlands
- Groundwater
- Geology and soils
- Terrestrial ecology
- Threatened and endangered species
- Noise
- Visual and scenic resources
- Historical and cultural resources
- Socioeconomics
- Public health and safety
- Waste management

In addition, site-specific analyses of cumulative impacts and environmental justice concerns that were not part of the GEIS are presented in this SEIS. NRC also considers the effects the proposed action could have on global climate; the analysis estimates the potential effect of the facility's greenhouse gas emissions based on a 10-year licensing period.

1.4.4 Issues Outside the Scope of the SEIS

Some issues and concerns raised during the public scoping process on the GEIS (NRC, 2009a, Appendix A) were determined to be outside the scope of the GEIS. These issues and concerns (e.g., general support or opposition for uranium milling, impacts associated with conventional uranium milling, comments regarding the alternative sources of uranium feed material, comments regarding energy sources, requests for compensation for past mining impacts, and comments regarding the credibility of NRC) are also outside the scope of this SEIS.

1.4.5 Related NEPA Reviews and Other Related Documents

A number of NEPA documents (environmental assessments) and EISs and other documents were reviewed and used in the development of this SEIS. The related NEPA reviews are described next.

NUREG–1910, Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities, Final Report (NRC, 2009a). As previously discussed, this GEIS was prepared to assess the potential environmental impacts from the construction, operation, aquifer restoration, and decommissioning of an ISR facility located in one of four different geographic regions of the western United States, including the Nebraska-South Dakota-Wyoming Uranium Milling Region where the proposed Dewey-Burdock ISR Project would be located. The environmental analysis in this SEIS both tiers and incorporates by reference from the GEIS. [Agencywide Documents Access and Management System (ADAMS) Accession No. Volume 1, ML091480244; Volume II, ML091480188]

NUREG–0706, Final Generic Environmental Impact Statement on Uranium Milling (NRC, 1980). This EIS provided a detailed evaluation of the impacts and effects of anticipated conventional uranium milling operations in the United States through the year 2000, including analysis of tailings disposal programs. NUREG–0706 concluded the environmental impacts of underground mining and conventional milling would be more severe than using ISR technology. As described in SEIS Section 2.2.1, conventional mining and milling were considered, but eliminated from the detailed analysis at the proposed Dewey-Burdock ISR Project. (ADAMS Accession No. Volume I, ML032751663; Volume II, ML032751667; Volume III, ML032751669)

NUREG–1508, Final Environmental Impact Statement To Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico (NRC, 1997). This EIS evaluated the use of ISR technology at the Church Rock and Crownpoint sites at Crownpoint, New Mexico. Alternative uranium mining methods were not evaluated, because the uranium ore located at the proposed sites was too deep to be extracted economically and the final EIS concluded underground mining would have more significant environmental impacts than ISR recovery. (ADAMS Accession No. ML082170248)

Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 1), Final Report (NRC, 2010a). NRC prepared this EIS as a supplement to the GEIS based on its review of an application from Energy Metals Corporation (now Uranium One) for a source material license for the proposed Moore Ranch ISR Project, which is located in Campbell County, Wyoming. The proposed Moore Ranch ISR project would encompass 2,877 ha [7,110 ac] of privately owned and State of Wyoming lands. However, Uranium One estimates that only 61 ha [150 ac] would be disturbed as a result of the project. (ADAMS Accession No. ML102290470)

Draft Environmental Impact Statement for the Dewey Conveyor Project (BLM, 2009). BLM, in cooperation with the U.S. Forest Service (USFS), prepared this draft EIS to evaluate the environmental impacts of the proposed Dewey Conveyor Project. GCC Dacotah Inc. proposed the Dewey Conveyor Project as a means to transport limestone along a 10.6-km [6.6-mi] conveyor from a future quarry location in Custer County, South Dakota, to a rail load-out facility near Dewey, South Dakota. The proposed route of the conveyor crosses BLM-administered public lands and USFS-administered National Forest System lands north of the proposed Dewey-Burdock ISR Project. (ADAMS Accession No. ML12209A089)

South Dakota Resource Management Plan, Final Environmental Impact Statement (BLM, 1985). BLM prepared the South Dakota Resource Management Plan (SDRMP) to address future management options for 113,584 ha [280,672 ac] of public land surface and 2,142,455 ha [5,294,122 ac] of federal mineral estate BLM administers through its South Dakota Resource Area Office in Belle Fourche, South Dakota. The SDRMP focuses on alternative approaches to management of vegetation apportionment and land actions. The plan includes resource management options for lands within and in the vicinity of the proposed Dewey-Burdock ISR Project area in Fall River and Custer Counties. The proposed Dewey-Burdock ISR Project is in conformance with the SDRMP as discussed on pages 14 and 44–47 of the SDRMP (ADAMS Accession No. ML12209A099)

Newcastle Resource Management Plan (BLM, 2000). BLM prepared this resource management plan to provide management direction for approximately 118,236 ha [292,168 ac] of BLM-administered public land surface and 687,507 ha [1,698,866 ac] of federal mineral estate the Newcastle Field Office administers in Crook, Niobrara, and Weston Counties in northeast Wyoming. The plan includes resource management objectives and management actions for lands adjacent to the proposed Dewey-Burdock ISR Project in Niobrara and Weston Counties. (ADAMS Accession No. ML12209A101)

Proposed Resource Management Plan and Final Environmental Impact Statement for Public Lands Administered by the Bureau of Land Management Rawlins Field Office (BLM, 2008). BLM prepared this resource management plan to direct the management of 1.4 million ha [3.5 million ac] of BLM-administered public surface land and 1.8 million ha [4.5 million ac] of BLM-administered federal mineral estate in Albany, Carbon, Laramie, and Sweetwater Counties in southwestern Wyoming. The plan established guidance, objectives, policies, and management actions for public lands the Rawlins Field Office administers. (ADAMS Accession No. ML12209A103)

Black Hills National Forest Land and Resource Management Plan (USFS, 1997). USFS prepared this plan to provide guidance for all resource management activities in the Black Hills National Forest. The plan (i) establishes goals, objectives, standards, and guidelines for resource management and (ii) describes resource management practices, levels of resource production, people-carrying capacities, and the availability and suitability of lands for resource management. (ADAMS Accession No. ML12209A110)

Black Hills National Forest, Phase I Amendment: 1997 Land and Resource Management Plan Environmental Assessment (USFS, 2001). USFS prepared a Phase I Amendment to the Black Hills National Forest Land and Resource Management Plan to address short-term concerns with sensitive species that occur or potentially occur in the Black Hills. (ADAMS Accession No. ML12209A113)

Black Hills National Forest, Phase II Amendment: 1997 Land and Resource Management Plan Final Environmental Impact Statement (USFS, 2005). USFS prepared a Phase II Amendment to the Black Hills National Forest Land and Resource Management Plan to address long-term concerns with sensitive species that occur or potentially occur in the Black Hills. The Phase II Amendment includes provisions to conserve species and protect communities, property, and other forest values by reducing fire and insect hazards. (ADAMS Accession No. ML12209A121)

Updated Land and Resource Management Plan for the Nebraska National Forest (USFS, 2009). USFS prepared this revised management plan to provide guidance for all resource management activities in the Nebraska National Forest. The plan describes management standards and guidelines, resource management practices, levels of resource production, people-carrying capacities, and the availability and suitability of lands for resource management. The Nebraska National Forest encompasses the Buffalo Gap National Grassland of southwestern South Dakota, which is located south of the proposed Dewey-Burdock ISR Project area. (ADAMS Accession No. ML12209A127)

NRC's Safety Evaluation Report (SER) for the Dewey-Burdock Project, Fall River and Custer Counties, South Dakota. The NRC staff are preparing an SER for the Dewey-Burdock license application. In the SER, the NRC staff evaluates whether the licensee's proposed action can be accomplished in accordance with the applicable regulations in 10 CFR Part 20; 10 CFR Part 40; and 10 CFR Part 40, Appendix A. Areas of review include the applicant's proposed facility design and operations, health and environmental protection, and accident analyses. The SER also provides the staff's analysis of the applicant's initial estimate of the funding needed to complete site decommissioning and reclamation. The SER will soon be available for public review.

Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 2), Final Report (NRC, 2011a). NRC prepared this EIS as a supplement to the GEIS based on its review of an application from Uranerz Energy Corporation for a source material license for the proposed Nichols Ranch ISR Project, which is located in Campbell and Johnson Counties, Wyoming. The proposed Nichols Ranch ISR project would encompass approximately 1,251 ha [3,091 ac] of privately owned land and approximately 113 ha [280 ac] of BLM-managed land. The proposed project would consist of two noncontiguous mining units: the Nichols Ranch Unit would contain the central processing plant, and the Hank Unit would contain a satellite ion-exchange facility. (ADAMS Accession No. ML103440120)

Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 3), Final Report (NRC, 2011b). NRC prepared this EIS as a supplement to the GEIS based on its review of an application from Lost Creek ISR, LLC for a source material license for the proposed Lost Creek ISR Project located in Sweetwater County, Wyoming. The proposed project site covers approximately 1,708 ha [4,220 ac] with approximately 1,450 ha [3,583 ac] of federal owned, BLM-managed land and 259 ha [640 ac] of land owned by the State of Wyoming, Office of State Lands and Investment. Planned facilities associated with the project include a well field with injection, production, and monitor wells; header houses; a central processing plant; an access road network; and pipeline system. (ADAMS Accession No. ML11125A006)

1.5 Applicable Regulatory Requirements

NEPA establishes national environmental policy and goals to protect, maintain, and enhance the environment. NEPA provides a process for implementing these specific goals for those federal agencies responsible for an action. This SEIS was prepared in accordance with NEPA requirements, NRC-implementing regulations in 10 CFR Part 51, and other regulations that were in effect at the time of writing. GEIS Appendix B summarizes other federal statutes, implementing regulations, and Executive Orders that are potentially applicable to environmental reviews for the construction, operation, decommissioning, and groundwater restoration of an ISR facility.

GEIS Sections 1.6.3.3 and 1.7.5.3 summarize the State of South Dakota's statutory authority pursuant to the ISR process, relevant state agencies that are involved in the permitting of an ISR facility, and the range of state permits that would be required (NRC, 2009a). These agencies and their permitting authority are as follows:

- Under the South Dakota Mined Land Reclamation Act (South Dakota Codified Law Chapter 45-6B), the South Dakota Board of Minerals and Environment is charged with issuing state permits and developing licensing requirements for ISR facilities.

- The South Dakota Department of Environmental and Natural Resources (SDDENR) is in charge of issuing the air quality permit through the National Ambient Air Quality Standards program as well as issuing a surface water discharge permit through the National Pollutant Discharge Elimination System (NPDES) program and a groundwater discharge plan permit for land application of treated wastewater.

- The South Dakota State Historical Society, within the Department of Tourism and State Development, is in charge of administering the South Dakota State Historic Preservation Office (SD SHPO), which coordinates, plans, and manages historic preservation programs across the state.

1.6 Licensing and Permitting

NRC has statutory authority through the AEA and Uranium Mill Tailings Radiation Control Act to regulate uranium ISR facilities. In addition to obtaining an NRC license, uranium ISR facilities must obtain the necessary permits from the appropriate federal, state, tribal, and local governmental agencies. The NRC licensing process for ISR facilities was described in GEIS Section 1.7.1. GEIS Sections 1.7.2 through 1.7.5 describe the role of the other federal, state, and tribal agencies in the ISR permitting process.

This section of the SEIS summarizes the status of the NRC licensing process at the proposed Dewey-Burdock ISR Project site and the status of the applicant permitting with respect to other applicable federal, tribal, and state requirements. Section 1.6.1 describes the NRC licensing process and Section 1.6.2 describes the status of other required permits.

1.6.1 NRC Licensing Process

By letter dated August 10, 2009, the applicant submitted a license application to NRC for the Dewey-Burdock ISR Project (Powertech, 2009a). As discussed in GEIS Section 1.7.1, NRC initially conducts an acceptance review of a license application to determine whether the application is complete enough to support a detailed technical review. The NRC staff accepted the Dewey-Burdock ISR Project license application for detailed technical review by letter dated October 2, 2009 (NRC, 2009c).

The NRC's detailed technical review of the Dewey-Burdock ISR Project license application includes both a safety review and an environmental review. These two reviews are conducted in parallel (see GEIS Figure 1.7-1). The safety review focuses on assessing compliance with the applicable regulatory requirements in 10 CFR Part 20 and 10 CFR Part 40, Appendix A. The environmental review is conducted in accordance with the regulations in 10 CFR Part 51.

The NRC hearing process (10 CFR Part 2) applies to licensing actions and offers stakeholders a separate opportunity to raise concerns associated with the proposed action. In accordance with the regulation, NRC published a Notice of Opportunity for Hearing on the Dewey-Burdock ISR Project license application in the FR on January 5, 2010 (see 75 FR 467). NRC received a request for hearing from Consolidated Petitioners (Theodore P. Ebert, David Frankel, Gary Heckenlaible, Susan Henderson, Dayton Hyde, Lilias C. Jones Jarding, Clean Water Alliance, and Aligning for Responsible Mining) on March 8, 2010 (Consolidated Petitioners, 2010). Additionally, the Oglala Sioux Tribe filed a petition to intervene on April 6, 2010 (Oglala Sioux Tribe, 2010).

Regulations in 10 CFR Part 2 specify that a petition for review and request for hearing must include a showing that the petitioner has standing and that the Atomic Safety and Licensing Board (ASLB) would rule on a petitioner's standing by considering (i) the nature of the petitioner's right under the AEA or NEPA to be made a party to the proceeding, (ii) the nature and extent of the petitioner's property, financial, or other interest in the proceeding, and (iii) the possible effect of any decision or order that may be issued in the proceeding on the petitioner's interest. All of the individual Consolidated Petitioners based their claim of standing on the possibility that contamination from the applicant's proposed ISR operation would contaminate the aquifer or surface water from which Consolidated Petitioners obtain their water (Consolidated Petitioners, 2010). The Oglala Sioux Tribe's central standing claim is interest in protecting cultural and historical resources that have been or might be found in the proposed Dewey-Burdock ISR Project site, which the Oglala Sioux Tribe claims is within the aboriginal territory of the Oglala Sioux Tribe under the 1868 Fort Laramie Treaty (Oglala Sioux Tribe, 2010). In addition, the Oglala Sioux Tribe bases its claim of standing on possible groundwater contamination from the proposed Dewey-Burdock ISR Project (Oglala Sioux Tribe, 2010).

On August 5, 2010, ASLB ruled that three individuals (Susan Henderson, Dayton Hyde, and David Frankel) and the two organizations (Clean Water Alliance and Aligning for Responsible Mining) among the Consolidated Petitioners demonstrated standing to be parties to the licensing proceeding, and one of their contentions as pled and three of their contentions as modified by ASLB were admissible (ASLB, 2010). Three other members of the Consolidated Petitioners (Gary Heckenlaible, Lilias C. Jones Jarding, and Theodore P. Ebert) did not demonstrate standing and were not admitted as parties to the licensing proceeding (ASLB, 2010). ASLB also found that the Oglala Sioux Tribe demonstrated standing to be admitted as a party to the licensing proceeding and three of their contentions as pled and one as modified by ASLB were admissible (ASLB, 2010).

1.6.2 Status of Permitting With Other Federal and State Agencies

In addition to obtaining a source material license from NRC prior to conducting ISR operations at the Dewey-Burdock ISR Project, the applicant is required to obtain necessary permits and approvals from other federal and state agencies to address (i) the underground injection of solutions and liquid effluent from the ISR process, (ii) the exemption of all or a portion of the ore zone aquifer from regulation under the *Safe Drinking Water Act*, and (iii) the discharge of storm water during construction and operation of the ISR facility. Table 1.6-1 lists the status of the required permits and approvals.

Table 1.6-1. Environmental Approvals for the Dewey-Burdock Project

Issuing Agency	Description	Status
South Dakota Department of Environment and Natural Resources (SDDENR) Joe Foss Building 523 East Capitol Pierre, SD 57501	Uranium Exploration Permit	Application submitted July 2008; approved by South Dakota Board of Minerals and Environment November 2008.
	Scenic and Unique Lands Designation	Submitted August 2008; SDDENR determined lands described by applicant do not constitute special, exceptional, critical, and unique; February 2009.
	Large-Scale Mine Permit	Application not yet submitted (expected July 2012).
	Water Appropriation Permits • Madison • Inyan Kara	Applications submitted June 2012.
	Underground Injection Control Class III Permit	Application submitted April 2009 and deemed incomplete; revised application submitted February 2010 and deemed incomplete. Rules tolled by Senate Bill 158, March 2011.
	Air Quality Permit	Application not yet submitted.
	Groundwater Discharge Permit	Submitted June 2012 and under review.
	National Pollutant Discharge Elimination System Water Discharge Permit	Application not yet submitted.

Table 1.6-1. Environmental Approvals for the Dewey-Burdock Project (continued)

Issuing Agency	Description	Status
U.S. Nuclear Regulatory Commission Washington, DC 20555	Source Materials License (10 CFR Part 40)	Submitted August 10, 2009. Deemed complete October 2009.
U.S. Environmental Protection Agency 1595 Wynkoop Street Denver, CO 80202-1129	Aquifer Exemption (40 CFR Parts 144 and 146) and Underground Injection Control Class III Permit	Application submitted December 2008 and under review.
	Underground Injection Control Class V Permit	Application submitted March 2010 and under review.
Custer County 420 Mount Rushmore Road Custer, SD 57730-1309	Building Permits	Applications not yet submitted.
Fall River County County Courthouse Hot Springs, SD 57730-1309	Building Permits	Not required.
U.S. Bureau of Land Management South Dakota Field Office	Plan of Operations	Application submitted August 2009; revised document submitted January 2011 and under review.
Source: Powertech (2010); Revised June 2012		

1.7 Consultation

As a federal agency, NRC is required to comply with consultation requirements in Section 7 of the *Endangered Species Act of 1973* (ESA), as amended, and Section 106 of the *National Historic Preservation Act of 1966* (NHPA), as amended. The GEIS took a programmatic look at the environmental impacts of ISR uranium milling within four distinct geographic regions and acknowledged that each site-specific review would include its own consultation process with relevant agencies. Section 7 (ESA) and Section 106 (NHPA) consultations conducted for the proposed Dewey-Burdock ISR Project are summarized in Sections 1.7.1 and 1.7.2. Copies of the consultation correspondence are provided in SEIS Appendix A. Section 1.7.3 describes NRC coordination with other federal, tribal, state, and local agencies conducted during the development of the SEIS.

1.7.1 Endangered Species Act of 1973 Consultation

The ESA was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. ESA Section 7 requires consultation with the U.S. Fish and Wildlife Service (FWS) to ensure that actions it authorizes, permits, or otherwise carries out will not jeopardize the continued existence of any listed species or adversely modify designated critical habitats.

By letter dated March 15, 2010, NRC staff initiated consultation with FWS, requesting information on endangered or threatened species and critical habitat in the proposed Dewey-Burdock ISR Project area (NRC, 2010b). NRC received a response from the FWS South Dakota Field Office, dated March 29, 2010, that (i) listed the threatened and endangered species that may occur in the project area and (ii) provided maps showing the location of wetlands within the two proposed initial mine units at the Dewey-Burdock ISR Project (FWS, 2010).

In accordance with ESA Section 7, FWS determined that the whooping crane (*Grus americana*) and black-footed ferret (*Mustela nigripes*) are federally listed species that may occur within Custer County. The whooping crane generally migrates through the eastern portion of Custer County, and the black-footed ferret is currently only found in the Wind Cave National Park. FWS had no information to indicate that these species are located within the project boundaries. No federally listed endangered species occur in Fall River County; however, the greater sage-grouse (*Centrocercus urophasianus*) is a candidate species that historically occurred in this area and has a potential to be present within the proposed area of review of the Dewey-Burdock ISR Project. At the present time, candidate species have no legal protection under ESA. By email dated August 27, 2012, the FWS South Dakota Field Office confirmed that there are no additional updates or changes to these federally listed species in the proposed Dewey-Burdock ISR Project area (FWS, 2012).

In accordance with NEPA regulations and other environmental laws and rules [e.g., Fish and Wildlife Coordination Act and Executive Order 11990 (Protection of Wetlands)], FWS encouraged the following when reviewing potential impacts to wetlands at the proposed Dewey-Burdock ISR Project: (i) avoidance of wetlands, if possible; (ii) minimization of impacts to wetlands if they cannot be avoided; and (iii) replacement of wetland values that may be impacted by the project (FWS, 2010).

1.7.2 National Historic Preservation Act of 1966 Consultation

In accordance with 36 CFR Part 800.1(a), Section 106 of NHPA requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on such undertakings. The Section 106 process seeks the views of consulting parties including the federal agency, the State Historic Preservation Officer (SHPO), Indian tribes and Native Hawaiian organizations, Tribal Historic Preservation Officers (THPO), local government leaders, the applicant, cooperating agencies, and the public. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess the effects of the undertaking on these properties, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. As detailed in 36 CFR Part 800.2(c)(1)(i), the role of the South Dakota State Historic Preservation Office (SD SHPO) in the Section 106 process is to advise and assist federal agencies in carrying out their Section 106 responsibilities. As part of the 106 consultation process for the proposed Dewey-Burdock ISR Project, NRC continues consultation with potentially affected Native American tribes and consulting parties. These interactions are detailed in SEIS Section 1.7.3.5.

NRC staff met with members of the SD SHPO office on December 2, 2009, to discuss site-specific issues, including the SD SHPO review process, cumulative impacts to historic sites, and best management practices (NRC, 2009b). NRC and SD SHPO staff also discussed the possibility of entering into a programmatic agreement or memorandum of agreement, pursuant to Section 106, with all consulting parties to set forth procedures and mitigation measures to preserve existing historic and cultural resources at the proposed Dewey-Burdock ISR Project site. The NRC staff continue to consult with the SD SHPO to evaluate the effects of the proposed project on historic and cultural resources.

1.7.3 Coordination With Other Federal, Tribal, State, and Local Agencies

The NRC staff interacted with multiple federal, tribal, state, and local agencies and/or entities during preparation of this SEIS to gather information on potential issues, concerns, and environmental impacts related to the proposed Dewey-Burdock ISR Project. The consultation and coordination process included, but was not limited to, discussions with BLM; tribal governments (see SEIS Section 1.7.3.5); SDDENR; South Dakota Game, Fish and Parks (SDGFP); and local organizations (e.g., Custer County, Town of Edgemont).

1.7.3.1 Coordination With U.S. Bureau of Land Management

U.S. Bureau of Land Management (BLM) is serving as a cooperating agency in the NEPA assessment and licensing process for the proposed Dewey-Burdock ISR Project because BLM has jurisdiction over the locatable mineral rights on federal land that the applicant holds within the proposed project area. As discussed in Section 1.3, the BLM's responsibility for the proposed action is to fulfill its statutory responsibilities to regulate mining on federal lands as described in 43 CFR Part 3809.

BLM is responsible for administering the National System of Public Lands and the federal minerals underlying these lands. BLM is also responsible for managing split estate situations where federal minerals underlie a surface that is privately held or owned by state or local government. In situations where BLM administers the surface rights, operators on mining claims, including ISR uranium facilities, must submit a Plan of Operations and obtain BLM approval before beginning operations beyond those for casual use. BLM also reviews and approves Plans of Operations on split estate lands patented under the Stock-Raising Homestead Act but only where the surface owners and the claimant cannot come to terms on access or surface damages. In this case there are no surface owner/mining claimant conflicts and as a result the proposed development activity on the split estate lands is not subject to BLM approval. The proposed Dewey-Burdock ISR Project site contains approximately 97 ha [240 ac] of BLM-administered surface lands.

The U.S. government reserved 1,708 ha [4,220 ac] of mineral estate under the Stock-Raising Homestead Act, when the surface was originally patented. The applicant maintains the unpatented mining claims associated with the 1,708 ha [4,220 ac] of federal minerals. In addition, the applicant maintains unpatented mining claims on the 97 ha [240 ac] of BLM-administered surface lands. The statutory responsibilities pertaining to mining claims under the General Mining Laws are described in 43 CFR Part 3800.

NRC has coordinated with BLM during preparation of this SEIS. Numerous conference calls and meetings have been held, and a Memorandum of Understanding between NRC and BLM was negotiated.

The NRC staff met with the staff of South Dakota BLM field office on December 1, 2009. BLM staff indicated that the applicant's Plan of Operations for the proposed Dewey-Burdock ISR Project had been received, but review had not been initiated at the time of the meeting. BLM staff noted that an ethnographic study was conducted prior to preparation of the draft EIS for the GCC Dacotah Inc. Dewey Conveyor Project to assess the traditional use of the area by tribes in North Dakota and South Dakota (BLM, 2009; Sprague, 2008). The proposed route of the conveyor project crosses BLM-administered public lands and USFS-administered National Forest System lands north of the proposed Dewey-Burdock ISR Project. Most of the tribal members interviewed knew their people had regular ceremonial, cultural, and religious activity in the Black Hills prior to the establishment of reservations; however, no one could pinpoint present cultural, ceremonial, or religious use in the proposed area. (Sprague, 2008, p. 14). During the meeting, BLM provided NRC staff with guidance documents and with information on oil and gas leases in the proposed project area. Additionally, BLM staff expressed concerns related to water quality and hydrology, land use, and cumulative effects.

1.7.3.2 Coordination With the U.S. Army Corps of Engineers

NRC staff met with U.S. Army Corps of Engineers (USACE) staff on December 2, 2009, in Pierre, South Dakota, to discuss wetlands and surface water bodies within and in the vicinity of the proposed Dewey-Burdock ISR Project site. USACE regulates, monitors, and oversees “jurisdictional waters of the United States,” which are subject to the Clean Water Act. USACE requires issuance of a Section 404 Permit prior to discharge of dredge or fill material into waters determined to be jurisdictional waters of the United States. In August 2008, the applicant requested that USACE evaluate the proposed Dewey-Burdock ISR Project site to determine whether jurisdictional waters of the United States are present. By letter dated January 14, 2009, USACE documented the presence of 20 wetlands within the project area and determined that 4 were jurisdictional waters; these are Beaver Creek, an unnamed tributary to Beaver Creek, Pass Creek, and an unnamed tributary to Pass Creek (Powertech, 2009b, Appendix 3.5–H).

1.7.3.3 Coordination With the U.S. Forest Service

NRC staff met with USFS staff on December 3, 2009, in Hot Springs, South Dakota. USFS manages wildlife habitat on and uses of USFS lands. USFS has no permitting authority for the proposed Dewey-Burdock ISR Project; however, it expressed concerns that construction and operational activities could impact the nearby Black Hills National Forest and Buffalo Gap National Grasslands. USFS staff noted a concern about the cumulative groundwater effects of the project on the USFS-managed aquatic recreation areas of Cascade Springs and Keith Park Springs. USFS also expressed concerns about potential effects the project could have on Craven Canyon, known to have traditional cultural significance to Native American tribes.

1.7.3.4 Coordination With the U.S. Geological Survey

NRC staff met with U.S. Geological Survey (USGS) staff on December 1, 2009, in Rapid City, South Dakota, to discuss geological and hydrological aspects of the proposed Dewey-Burdock ISR Project. USGS staff provided information on the regional hydrology of the Black Hills area, including major hydrostratigraphic units, regional hydrological gradients, and major sources of municipal drinking water in the region. With respect to the proposed Dewey-Burdock ISR Project, USGS staff expressed a concern that contaminated groundwater may travel from the project area and discharge into Beaver Creek within the proposed project area and the Cheyenne River south of the proposed project area.

1.7.3.5 Interactions With Tribal Governments

Under Section 106 of the NHPA, NRC is required to conduct consultation with Native American tribes to determine whether a proposed federal action will affect historic properties. In conjunction with the tribal government consultation process, NRC staff met with Office of Tribal Government Relations (OTGR) staff on December 2, 2009, in Pierre, South Dakota, to discuss issues and concerns that tribal governments in South Dakota may have with the proposed Dewey-Burdock ISR Project. OTGR staff noted that tribal governments would be most interested in potential harm to the environment from the proposed project. OTGR staff suggested tribal organizations should have the opportunity to express their concerns with the proposed project and should be contacted prior to NRC outreach activities associated with the project.

The SD SHPO identified 20 Native American tribes that might attach historic, cultural, and religious significance to historic properties within the proposed Dewey-Burdock ISR Project area. The NRC staff contacted the 20 tribal governments by letters dated March 19, 2010; September 10, 2010; and March 4, 2011 (NRC, 2010c,d, 2011c). The staff invited the tribes to participate as consulting parties in the NHPA Section 106 process and requested assistance in identifying tribal historic sites or cultural resources that may be affected by the proposed action. Specifically, NRC staff solicited information regarding properties of religious and cultural significance to tribes. The contacted tribes follow.

- Cheyenne River Sioux Tribe
- Crow Creek Sioux Tribe
- Flandreau Santee Sioux Tribe
- Lower Brule Sioux Tribe
- Oglala Sioux Tribe
- Rosebud Sioux Tribe
- Sisseton Wahpeton Sioux Tribe
- Standing Rock Sioux Tribe
- Yankton Sioux
- Three Affiliated Tribes (Mandan, Hidasta, and Arikara Nation)—North Dakota
- Turtle Mountain Band of Chippewa—North Dakota
- Spirit Lake Tribe—North Dakota
- Lower Sioux Indian Community—Minnesota
- Fort Peck Assiniboine and Sioux—Montana
- Northern Cheyenne Tribe—Montana
- Northern Arapaho Tribe—Wyoming
- Eastern Shoshone Tribe—Wyoming
- Santee Sioux Tribe—Nebraska
- Ponca Tribe—Nebraska
- Crow Tribe—Montana

By letter dated April 7, 2010, the Turtle Mountain Band of Chippewa–North Dakota responded to NRC and stated that the proposed project would not have an effect on historic properties of importance to the Turtle Mountain Band of Chippewa Indians. The THPO also stated that "determination of No Historic Properties Affected is granted for the project to proceed" (Turtle Mountain Band of Chippewa Indians, 2010).

NRC staff continued its efforts to engage in consultation with tribes that might be affected by the proposed action with follow-up telephone calls and by sending emails to further gather information related to identification efforts and coordinate meetings.

On September 10, 2010, NRC staff sent another letter inviting the tribes to participate in consultation to help facilitate the identification of areas on the proposed Dewey-Burdock site that the tribes believe have traditional religious or cultural significance (NRC, 2010d). NRC staff also followed up with phone calls and emails to ensure tribal officials received this correspondence.

By letter dated September 20, 2010, Mr. Perry "No Tears" Brady of the Three Affiliated Tribes (Mandan, Hidatsa, and Arikara Nations–North Dakota) responded that the tribe had determined there would be no adverse effects on historic or cultural resources important to the Mandan, Hidasta, and Arikara Nations within the proposed project area (Three Affiliated Tribes, 2010).

The Sisseton Wahpeton Oyate, Rosebud Sioux Tribe, Lower Brule Sioux Tribe, and Yankton Sioux Tribe, responded by letters dated November 2, 2010; November 7, 2010; November 15, 2010; and December 3, 2010, respectively, expressing interest in becoming consulting parties to the proposed project (Sisseton Wahpeton Oyate, 2010; Rosebud Sioux Tribe, 2010; Lower Brule Sioux Tribe, 2010; Yankton Sioux Tribe, 2010). The Sisseton Wahpeton Oyate and Rosebud Sioux THPOs recommended that NRC undertake group consulting, whereby a number of tribal representatives would participate in a meeting, possibly hosted by the Oglala Sioux Tribe. The Yankton Sioux Tribe THPO requested face-to-face consultation and expressed concerns regarding protection of traditional cultural properties (TCPs) within the project area. While the term TCP does not appear in the NHPA or its implementing regulations, the tribes apply this term to historic properties of religious and cultural significance to Indian tribes that may be affected by an undertaking. The NRC uses the term in this context.

By letter dated January 31, 2011, the Oglala Sioux Tribe THPO accepted the invitation to participate as a consulting party and stated that the proposed Dewey-Burdock Project represents a substantial potential threat to the preservation of cultural and historic resources of the Oglala Sioux Tribe (Oglala Sioux Tribe, 2011). The THPO also stated that the proposed project site is located within an area of which Sioux Tribes, along with the Cheyenne, Arapahoe, Crow, and Arikara Tribes, possess intimate cultural knowledge (Oglala Sioux Tribe, 2011). The THPO stated that impacts resulting from the proposed project include not only site-specific physical impacts, but intangible impacts to the integrity of the area from cultural, historical, spiritual, and religious perspectives. The letter also requested NRC's assistance in facilitating a site visit and regional meeting to provide all affected tribes an opportunity to review and identify the cultural and historic resources at stake.

Mr. Hubert B. Two Leggins (Crow Tribal Cultural Resource Director/Renewable Resource Supervisor) of the Crow Tribe of Montana responded by email dated March 9, 2011, indicating that the Dewey-Burdock Project area has religious and cultural significance to the Crow Tribe (Crow Tribe, 2011). Mr. Two Leggins accepted the invitation for formal consultation and stated that the Crow Tribe wanted to be a consulting party.

By letter dated May 12, 2011, NRC staff invited THPOs and/or Cultural Resources Officers to an informal information gathering meeting on June 8, 2011, at the Prairie Winds Casino and Hotel on the Pine Ridge Reservation in South Dakota (NRC, 2011d). The purpose of the meeting was to help NRC identify tribal historic sites and cultural resources that may be affected by actions associated with the proposed Dewey-Burdock ISR Project and with the Crow Butte North Trend and Crow Butte license renewal ISR projects in Nebraska. Representatives of six tribes (Oglala Sioux, Standing Rock Sioux, Flandreau-Santee Sioux, Sisseton-Wahpeton Oyate, Cheyenne River Sioux, and Rosebud Sioux) attended. BLM and SD SHPO staff also attended.

During the June 8^{th} meeting, tribal officials expressed concerns about the identification and preservation of historic properties of traditional religious and cultural importance to tribes at the proposed Dewey-Burdock and Crow Butte sites. Tribal officials stated that historic and cultural resource studies of the sites should be conducted with tribal involvement. The SD SHPO stated that Tribal representatives would need access to the Dewey-Burdock site to assist in identification of historic properties. A transcript of this meeting (NRC, 2011e) is available through the NRC Agencywide Documents Access and Management System database on the NRC website (http://www.nrc.gov/reading-rm/adams.html).

In conjunction with the June 8, 2011, information gathering meeting, the applicant hosted a visit to the Dewey-Burdock ISR Project site on June 9, 2011. Tribal officials, NRC staff, and BLM, SD SHPO, and South Dakota Historical Society Archaeological Research Center (ARC) staff interacted with the applicant's personnel and archaeologists from Archaeology Laboratory of Augustana College during the site visit. The Level III cultural resource evaluations at the site were conducted by the Archaeology Laboratory of Augustana College. The Level III cultural resource evaluations are described in SEIS Section 3.9.2. The Dewey-Burdock site visits included a presentation of the proposed project identifying the location of facilities and wellfields. Augustana College staff provided an overview of the results of archaeological and cultural evaluations. At the conclusion of the presentations, participants toured the proposed Dewey-Burdock ISR Project site stopping at several locations to view and investigate cultural and historic features identified during the Level III cultural resource evaluations, including stone circles and rock alignments.

To facilitate the identification of possible historic properties of importance to Native American tribes within the area of potential effect (APE), the NRC began efforts to open the Dewey-Burdock site to tribal representatives for a survey. On August 12, 2011, NRC staff sent a letter requesting the applicant submit a written plan for acquiring information on historic properties within the APE (NRC, 2011f).

On October 28, 2011, NRC staff sent a letter to the tribes stating that the staff had requested the applicant undertake studies and surveys to provide information on properties of traditional religious and cultural importance to tribes at the proposed Dewey-Burdock site, as is permissible under 36 CFR 800.2(c)(4) (NRC, 2011g). The letter informed the tribes that the applicant had engaged the services of SRI Foundation (SRI) of Rio Rancho, New Mexico, to collect information concerning historic properties that may be located in the proposed project area. The letter also informed the tribes that NRC had authorized SRI, acting on behalf of the applicant, to contact tribes to obtain information. The letter stated further that NRC would remain legally responsible for all findings and determinations and for maintaining government-to-government relationships with the involved tribes.

By letter dated January 19, 2012, NRC staff invited the THPOs to a tribal consultation on February 14–15, 2012, at the Ramkota Best Western Hotel in Rapid City, South Dakota (NRC, 2012a). The purpose of the meeting was to hear the views of interested tribes about the general types and descriptions of historic properties of religious and cultural significance that may be affected by the proposed project and how these properties can be identified and evaluated as part of the ongoing consultations under Section 106 of NHPA. The meeting was attended by officials from 13 tribes (Cheyenne River Sioux, Crow Creek Sioux, Crow Tribe of Montana, Eastern Shoshone, Fort Peak Assiniboine Sioux, Northern Arapaho, Northern Cheyenne, Oglala Sioux, Rosebud Sioux, Yankton Sioux, Sisseton-Wahpeton Sioux, Santee Sioux Nation, and Standing Rock Sioux). In addition to applicant, SRI, and NRC staffs, BLM and U.S. Environmental Protection Agency (EPA) Region 8 staffs were also in attendance.

During the February 14–15th meeting, the tribes provided the following information to NRC and BLM staffs: (i) the tribes expressed an interest in developing a confidentiality agreement before submitting any traditional cultural studies to NRC; (ii) tribal representatives stated that the purpose of any future meetings be made clearer to ensure that tribal participants have appropriate levels of decision-making authority; (iii) tribal representatives volunteered to develop project-specific statements of work (SOWs) to conduct traditional religious and cultural properties studies for the proposed Dewey-Burdock Project; and (iv) tribal representatives requested another meeting to review draft SOWs the tribes and the applicants prepared for each of the three projects suggesting March 14–15, 2012, as possible meeting dates.

Due to conflicts with many participating tribal representatives, the proposed March 14–15, 2012, meeting was cancelled. NRC staff transmitted the applicant's SOW for the Dewey-Burdock project to the THPOs for review and consideration by letter dated March 9, 2012 (NRC, 2012b). The NRC staff proposed to host a conference call to discuss the proposed SOW in April 2012. On April 5, 2012, NRC staff sent a letter inviting the tribes to participate in a teleconference on April 24, 2012, to discuss the applicant's SOW to identify historic properties (NRC, 2012c).

On April 24, 2012, the NRC staff held a teleconference with staff from Powertech, Cameco, SRI, SD SHPO, EPA Region 8, BLM, and eight tribes (Northern Cheyenne, Oglala Sioux, Rosebud Sioux, Northern Arapaho, Sisseton-Wahpeton, Standing Rock Sioux, Yankton Sioux, and Cheyenne and Arapaho). During the call, the consulting parties discussed the following aspects of the applicant's SOW: (i) adequacy of compensation for tribal officials conducting the field work, (ii) confidentiality of information gathered by the tribes, (iii) amount of acreage to be covered during fieldwork, and (iv) tribal involvement in making eligibility determinations.

The following steps were discussed at the April 24, 2012, teleconference: (i) tribal representatives would continue to develop a draft tribal SOW; (ii) tribes would hold an intertribal teleconference to discuss a draft tribal SOW; (iii) tribes would provide a copy of a draft SOW to the NRC, once it was approved by all tribal officials; (iv) NRC would distribute a draft tribal SOW to consulting parties (applicant, BLM, EPA, SD SHPO); (v) NRC would arrange another meeting with consulting parties to finalize an SOW, agreeable to the parties, for the identification of potential historic properties; (vi) the applicant would schedule fieldwork for a historic property survey at the proposed Dewey-Burdock site; (vii) tribes would write preliminary and final reports for submission to the NRC to provide tribal views on effects of the undertaking on such properties; and (viii) NRC would assess effects on properties under NHPA and develop an impact determination pursuant to NEPA based on information provided by the tribes. The tribes also requested that two tribal representatives be provided access to conduct a reconnaissance visit to the Dewey-Burdock license area, for the purpose of securing information that would enable the tribes to complete a detailed proposed SOW for the project area. The applicant agreed to the request, and the Dewey-Burdock Project tribal reconnaissance visit took place on Saturday, May 26, 2012.

On June 19, 2012, the tribes provided NRC staff with a preliminary tribal SOW for identifying properties of religious and cultural significance at the Dewey-Burdock ISR Project site. Subsequently, NRC staff held teleconferences on August 9, 2012, and August 21, 2012, to solicit additional details on the SOWs prepared by the applicant and tribes. Representatives of the tribes and staff from the NRC, Powertech, SRI, SD SHPO, EPA Region 8, and BLM attended these teleconferences. Discussions centered on (i) defining the areas of potential effects (direct and indirect) that would be included in the proposed surveys, (ii) the need to provide survey cost estimates, and (iii) the need to provide a survey schedule that met the NRC licensing review schedule and completion of its scheduled NEPA review. The participating tribes requested an opportunity to revise the applicant's proposed SOW for completing a tribal survey for the Dewey-Burdock ISR Project. During the August 21, 2012, teleconference, NRC staff agreed to meet with tribal representatives in Bismarck, North Dakota on September 5, 2012 to develop a revised SOW for completion of a field survey in the fall of 2012.

The applicant informed NRC by letter dated August 29, 2012, that it was unable to reach an agreement with the tribes on a SOW and it would be unable to provide information to the NRC on properties of religious and cultural significance to the tribes that may be affected by the proposed Dewey-Burdock ISR Project (Powertech, 2012). The applicant indicated that additional efforts on its part to negotiate a mutually acceptable SOW are unlikely to be productive. The applicant, however, committed to support efforts to complete identification of historic properties by offering up to $100,000 in funding to tribal representatives to carry out fieldwork and reporting activities, with the stipulation that the work be completed in fall 2012. The applicant committed to working with NRC and BLM to provide access for tribal representatives to the project area to carry out work agreed to by the tribes.

On September 5, 2012, NRC staff met with representatives of seven tribes (Yankton Sioux, Sisseton-Wahpeton Oyate Sioux, Rosebud Sioux, Standing Rock Sioux, Northern Cheyenne, Oglala Sioux, and Crow Nation) at the Kelly Inn in Bismarck, North Dakota. During this meeting, participants discussed the how to proceed with development of a SOW to identify religious and cultural properties within the APE. The APE is the area in which properties of cultural significance may be affected by the undertaking, including direct effects (such as destruction, damage, or alteration of all or part of a property) and indirect effects (such as visual, audible, and atmospheric changes which affect the character or setting of a property). All parties agreed that a survey was necessary and that a revised SOW be prepared to focus survey efforts on identifying properties directly affected by ISR activities. All parties also agreed that further consultation would be required to develop a SOW to address survey efforts for identifying properties indirectly affected by the proposed project. The area of potential indirect effect could include properties that are well beyond the proposed license area. In addition, the parties acknowledged the need for a Programmatic Agreement for any future disturbances outside of areas directly affected by the proposed project.

By letter dated September 18, 2012, NRC staff asked participants in the September 5, 2012, meeting in Bismarck, North Dakota to designate a preferred contractor to submit a proposal for a survey on their behalf. The NRC staff requested that a cost estimate based on the area of direct effect that may be disturbed during the initial phase of the Dewey-Burdock ISR Project be included in the proposal (NRC, 2012d). The letter included NRC staff's written response to four NHPA-related concerns the tribes raised at the September 5, 2012, meeting in Bismarck, North Dakota. The letter stated (i) the NRC agrees that a Programmatic Agreement will need to be developed to address the phased identification and evaluation of historic properties; (ii) the NRC will continue to consult with BLM, SD SHPO, and the tribes on all issues arising under Section 106 of the NHPA, including potential indirect effects; and (iii) NRC intends to keep survey information confidential to the fullest extent allowed by law.

On September 27, 2012, NRC received a proposal and cost estimate from the tribes for a traditional cultural properties survey for the proposed Dewey-Burdock Project. The proposal and cost estimate was prepared by Makoche Wowapi/Mentz-Wilson Consultants, LLP, the contractor selected by tribes to complete the cultural resources survey of the proposed project. By letter dated October 4, 2012, NRC transmitted the tribe's proposal and cost estimate to the applicant for review and comment (NRC, 2012e).

NRC informed the tribes by letter dated October 12, 2012 that significant differences exist in the proposal submitted by Makoche Wowapi/Mentz-Wilson Consultants, LLP and the applicant's proposal described in its letter to NRC dated August 29, 2012 (NRC, 2012f; Powertech, 2012). NRC indicated that resolving these differences will not support completion of a field survey at the Dewey-Burdock site in the fall 2012. NRC requested that the tribes provide their ideas on alternative methods for identifying potential properties of traditional religious and cultural importance to the tribes. NRC suggested that alternative methods might include opening the site to interested tribal specialists over a period of several weeks with payment for survey costs made to individual tribes or seeking ethnohistoric and ethnographic information from tribal specialists in interviews at tribal headquarters.

The Section 106 consultation process is ongoing. The NRC staff will continue to consult with BLM, SD SHPO, and the tribes on all issues arising under Section 106 of the NHPA. The staff will also consult with ACHP as necessary. Results of the consultation will be presented in the final SEIS.

1.7.3.6 Coordination With South Dakota Department of Environment and Natural Resources

NRC staff met with SDDENR in Pierre, South Dakota, on December 2, 2009, to discuss SDDENR's role in NRC's environmental review process for the proposed Dewey-Burdock ISR Project. SDDENR, the primary state permitting agency, will make determinations on issuance of the following state permits for the proposed Dewey-Burdock ISR Project: (i) mining permit, (ii) NPDES surface water discharge permit, (iii) air quality permit, (iv) water appropriation permit, and (v) groundwater discharge permit for land application of treated wastewater.

Discussions between NRC and SDDENR staffs focused on geological and hydrological issues with the proposed Dewey-Burdock site, including (i) the adequacy of subsurface characterization, (ii) groundwater flow rates within and in the vicinity of the project area, (iii) potential complications in hydrology caused by past exploratory drill holes, (iv) potential hydrologic connection of production zones and abandoned onsite surface mines, and (v) the effectiveness of confining layers in isolating ore-bearing aquifers. NRC and SDDENR staffs also discussed the applicant's Class III UIC permit application (Powertech, 2010) and the water appropriation and waste management permitting processes for the proposed project. Potential risks to wildlife from wastewater surface impoundments associated with the proposed project were also discussed. SDDENR would coordinate with SDGFP to mitigate the potential effects of surface impoundments on wildlife; mitigation measures discussed included the use of netting and fencing to protect wildlife and implementing protocols to assess the effects of wastewater constituents on wildlife.

1.7.3.7 Coordination With South Dakota Game Fish and Parks

NRC staff met with SDGFP staff on November 30, 2009, to discuss potential impacts on ecological resources at the proposed Dewey-Burdock ISR Project. SDGFP manages South Dakota's wildlife resources, parks, and outdoor recreational areas. SDGFP does not issue permits related to the proposed project; however, it oversees the management of state-listed threatened species and species of local concern. In addition, SDGFP consults closely with SDDENR on activities that could affect ecological resources within the proposed project area. Conversations between NRC and SDGFP staffs focused primarily on threatened or potentially threatened and endangered species (e.g., the plains topminnow, sage-grouse, and black-footed ferret) and species of local concern (e.g., raptors). SDGFP expressed a major concern: the potential effects on birds flying through the proposed project area and drinking at exposed wastewater evaporation ponds. SDGFP suggested two measures to mitigate effects on bird populations: (i) testing to determine the toxicity of constituents in the evaporation ponds and (ii) using netting and fencing to restrict wildlife access to exposed ponds. SDGFP also noted the need for testing and monitoring of soils at the proposed site to identify any buildup of salts and metals that could result from proposed land application of treated wastewater.

1.7.3.8 Coordination With South Dakota State Historical Society Archaeological Research Center

NRC staff met with staff of the ARC on November 30, 2009, to discuss historic and cultural resources at the proposed Dewey-Burdock Project. ARC is the lead agency for archaeological investigations pertaining to mineral exploration and mining in South Dakota. ARC described the results of a Level III Cultural Resources Evaluation conducted by the Archaeology Laboratory of Augustana College within the proposed project area. ARC also described stipulations of a Memorandum of Agreement executed between the applicant and ARC concerning avoidance and mitigation measures, which the applicant had committed to performing if historic or archaeological sites are encountered during ISR activities at the proposed site (Powertech, 2009b, Appendix 4.10–B). ARC's evaluation of the applicant's request for determination of the proposed project area as special, exceptional, critical, or unique lands was also discussed.

NRC staff returned on June 7, 2011, to meet with the Assistant State Archaeologist to review and gather additional information on cultural and historic resources related to the proposed Dewey-Burdock ISR Project site. During this visit, the results of the Level III Cultural Resources Evaluation conducted by archaeologists from the Archaeology Laboratory of Augustana College were discussed in more detail. Discussions focused on the recorded occurrence of cairn features at several identified archaeological sites at the proposed site and the potential for these types of features to contain human burials. A cairn is a manmade pile of rocks or stones often erected as a marker. NRC staff and the Assistant State Archaeologist also discussed the potential for historic properties of religious and cultural importance to Native American tribes to be present on or adjacent to the proposed project site.

1.7.3.9 Coordination With Localities

The NRC staff held meetings with the Edgemont Area Chamber of Commerce in Edgemont, South Dakota, and Custer County Planning and Economic Development in Custer, South Dakota, on December 3, 2009, to discuss site-specific issues related to the proposed Dewey-Burdock ISR Project. Meetings with these entities focused on local economics, housing availability, and community services. Members of the Edgemont Area Chamber of Commerce described current infrastructure projects that would support growth and economic development in Edgemont and the surrounding area. Discussions with Custer County Planning and Economic Development staff focused on available housing, land, and medical services to handle the anticipated population increase from the proposed project.

1.8 Structure of the SEIS

As noted in Section 1.4.1 of this document, the GEIS (NRC, 2009a) evaluated the broad impacts of ISR projects in a four-state region where such projects are anticipated, but did not reach site-specific decisions for new ISR projects. The NRC staff evaluated the extent to which information and conclusions in the GEIS could be incorporated by reference into this SEIS. The NRC staff also determined whether any new and significant information existed that would change the expected environmental impact beyond what was evaluated in the GEIS.

Chapter 2 of this SEIS describes the proposed action and reasonable alternatives considered for the proposed Dewey-Burdock ISR Project, Chapter 3 describes the affected environment, and Chapter 4 evaluates the environmental impacts of implementing the proposed action and alternatives. Cumulative impacts are discussed in Chapter 5, while Chapter 6 summarizes mitigation measures to reduce adverse environmental impacts at the proposed project. Chapter 7 describes the environmental measurement and monitoring programs proposed for the Dewey-Burdock ISR Project. A cost-benefit analysis is provided in Chapter 8, and environmental consequences from the proposed action and alternatives are summarized in Chapter 9.

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2 *IN-SITU* URANIUM RECOVERY AND ALTERNATIVES

This chapter describes the proposed federal action, which is to issue a U.S. Nuclear Regulatory Commission (NRC) source and byproduct material license to Powertech (USA) Inc. (Powertech), herein referred to as the applicant. The applicant would use its NRC license in connection with the construction, operation, aquifer restoration, and decommissioning of the Dewey-Burdock *In-Situ* Recovery (ISR) Project. In addition, the U.S. Bureau of Land Management (BLM) will utilize this analysis in its determination of whether or not to approve the applicant's modified Plan of Operations. This chapter also discusses alternatives to the proposed action. The alternatives analyzed in this Supplemental Environmental Impact Statement (SEIS) include a consideration of the No-Action alternative as required under the National Environmental Policy Act of 1969 (NEPA). Under the No-Action alternative, NRC would not issue a license to the applicant. The No-Action alternative is included to provide a basis for comparing and evaluating the potential impact of the proposed action and alternatives.

Section 2.1 of this SEIS describes the alternatives considered for detailed analysis, including the proposed action. Section 2.2 describes those alternatives that were considered but eliminated from detailed analysis. Section 2.3 compares the predicted environmental impacts of the proposed action and other alternatives. Section 2.4 sets forth the preliminary NRC staff recommendation on the proposed federal action. Section 2.5 provides the references cited for this chapter.

2.1 Alternatives Considered for Detailed Analysis

NRC staff used a variety of sources to determine a range of alternatives for detailed analysis in this SEIS. These sources include (i) the application's environmental report (Powertech, 2009a), technical report (Powertech, 2009b), and a supplemental report to the application (Powertech, 2009c); (ii) the applicant's responses to NRC staff requests for additional information (Powertech, 2010a–c, 2011); (iii) the scoping and draft comments on NUREG–1910, Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities (GEIS) (NRC, 2009a); (iv) the information gathered during the NRC staff site visits in November and December 2009 (NRC, 2009b); and (v) multidisciplinary discussions held among NRC staff and various stakeholders. This SEIS evaluates the potential environmental impacts from two alternatives: the Proposed Action (Alternative 1) and the No-Action alternative (Alternative 2).

2.1.1 The Proposed Action (Alternative 1)

Under the proposed action, NRC would issue the applicant a source material license. The applicant would use its NRC license in connection with the construction, operation, aquifer restoration, and decommissioning of an ISR facility at the Dewey-Burdock ISR Project site. The project site is in Fall River and Custer Counties, South Dakota, as described in the license application. The applicant also is seeking BLM approval of its modified Plan of Operations subject to mitigation included in the license application and this draft SEIS. The applicant's proposed project would include processing facilities and sequentially developed wellfields sited in two contiguous areas: the Burdock area and the Dewey area. As uranium recovery activities cease at a wellfield, the area will be restored and reclaimed while a new wellfield and its supporting infrastructure is developed. Under the applicant's proposal, ISR methods would be used to extract uranium from sandstone-hosted uranium ore bodies in the Fall River Formation and the Chilson Member of the Lakota Formation that make up the Inyan Kara Group. The extracted uranium would be loaded onto ion exchange (IX) resin at a central processing plant in the Burdock area and a satellite facility in the Dewey area. All processing of the uranium-loaded IX resin, including elution (stripping uranium off the resin), precipitation, drying, and packaging of the final "yellowcake" product, would take place at the Burdock central processing plant. The applicant proposes the following options (discussed in SEIS Section 2.1.1.1.6.2) for the disposal of liquid wastewater generated during uranium recovery: deep well disposal via Class V injection wells, land application, or a combination of deep well disposal via Class V injection wells and land application. Alternative wastewater disposal options for the proposed action are evaporation ponds and surface water discharge, and these are discussed in SEIS Section 2.1.1.2.

2.1.1.1 Proposed ISR Facility and Waste Disposal Options

The proposed Dewey-Burdock ISR Project includes buildings, infrastructure, wellfields, and options for waste disposal, which are described in the following sections. The general ISR process was detailed in GEIS Chapter 2 (NRC, 2009a) and will not be repeated here. The projected schedule for the proposed action is shown in Figure 2.1-1.

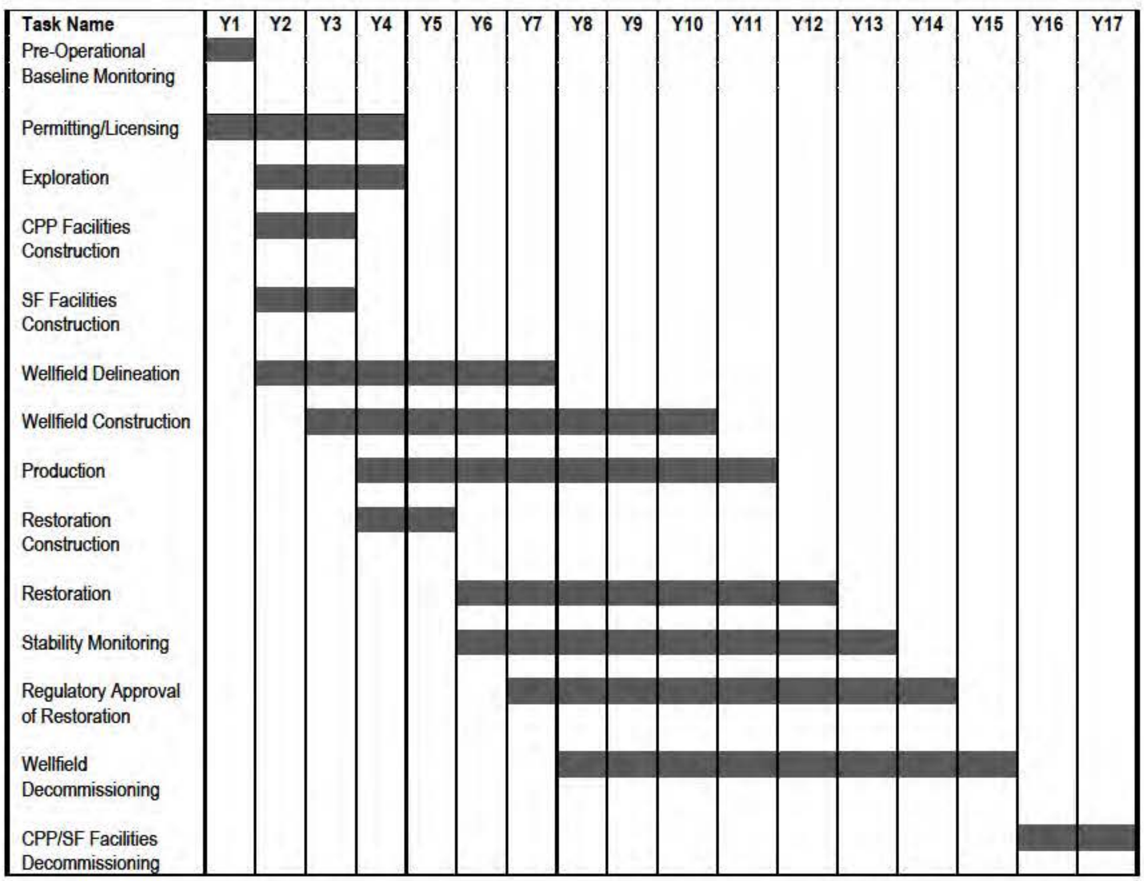

Figure 2.1-1. Projected Schedule for Construction, Operation, Aquifer Restoration, and Decommissioning Activities for the Proposed Dewey-Burdock ISR Project.
Source: Modified From Powertech (2009a, 2011).

2.1.1.1.1 Site Description

The proposed Dewey-Burdock ISR Project is approximately 21 km [13 mi] north-northwest of Edgemont, South Dakota, in northern Fall River and southern Custer Counties, South Dakota (Figure 2.1-2). The project area is within the Nebraska-South Dakota-Wyoming Uranium Milling Region, described in the GEIS (NRC, 2009a). The proposed license area encompasses 4,282 ha [10,580 ac] of mostly privately owned land and is contained within two contiguous areas: the Burdock area and the Dewey area (Figure 2.1-3). The Burdock area (Township 7 South, Range 1 East, all or portions of Sections 1–3, 10–12, and 14–15; Township 6 South, Range 1 East, all or portions of Sections 27 and 34–35) would occupy the eastern part of the overall project area. The Dewey area (Township 7 South, Range 1 East, all or portions of Sections 4–5; Township 6 South, Range 1 East, all or portions of Sections 20–21 and 28–33) would occupy the western part of the overall project area. BLM manages approximately 97.1 ha [240 ac] of the permit area located in Township 7 South, Range 1 East, portions of Sections 3, 10, 11, and 12 (Figure 2.1-3). The U.S. Forest Service manages parcels of the Black Hills National Forest that lie adjacent to the eastern and northern boundaries of the proposed project area.

The proposed Dewey-Burdock ISR Project area is located within the Great Plains physiographic province on the southwestern edge of the Black Hills Uplift (Powertech, 2009a). The vegetation is a mix of short grasses and shrubs typical of semiarid steppe land along with ponderosa pine forest toward the Black Hills. The elevation within the project area ranges from approximately 1,097 to 1,189 m [3,600 to 3,900 ft] above mean sea level, with the highest elevations along the pine breaks that overlap the project area’s eastern boundary. Topography in the project area and surrounding lands is primarily gently rolling in the western quarter, with more varied terrain in the pine breaks and dissected hills in the rest of the area. Two main streams pass through the proposed project area: Beaver Creek (perennial) and Pass Creek (intermittent) (Figure 2.1-3). Pass Creek joins Beaver Creek southwest of the proposed project area. Approximately 4 km [2.5 mi] south of the confluence of Beaver and Pass Creeks, Beaver Creek flows into the Cheyenne River. The primary land use within and surrounding the project area is cattle grazing (Powertech, 2009a).

Material shipment and employee commutes to and from the proposed Dewey-Burdock ISR Project area would be primarily from Edgemont, Hot Springs, and Custer in South Dakota and Newcastle in Wyoming (Figure 2.1-2). The main highways that would be used to access the proposed project site are U.S. Highway 18, which connects Edgemont with Hot Springs, and State Highway 89, which connects Edgemont via U.S. Highway 18 with Custer (see Figure 2.1-2). Most traffic would travel to the proposed site via Fall River County Road 6463 (referred to herein as Dewey Road), which extends northwestward from Edgemont to the abandoned community of Burdock, located in the southwest corner of the Burdock area (Powertech, 2009a). This road is a two-lane, all-weather gravel road.

Dewey Road continues north from Burdock to the Fall River-Custer County line where it becomes Custer County Road 769 and continues on to the community of Dewey, a total distance of about 37 km [23 mi] from Edgemont. Dewey Road closely follows the tracks of the Burlington Northern Santa Fe Railroad (see Figure 2.1-3), which runs northward from Edgemont to Newcastle, Wyoming. The community of Dewey is about 3.2 km [2 mi] from the northwest corner of the proposed Dewey-Burdock ISR Project boundary. Some traffic is expected to

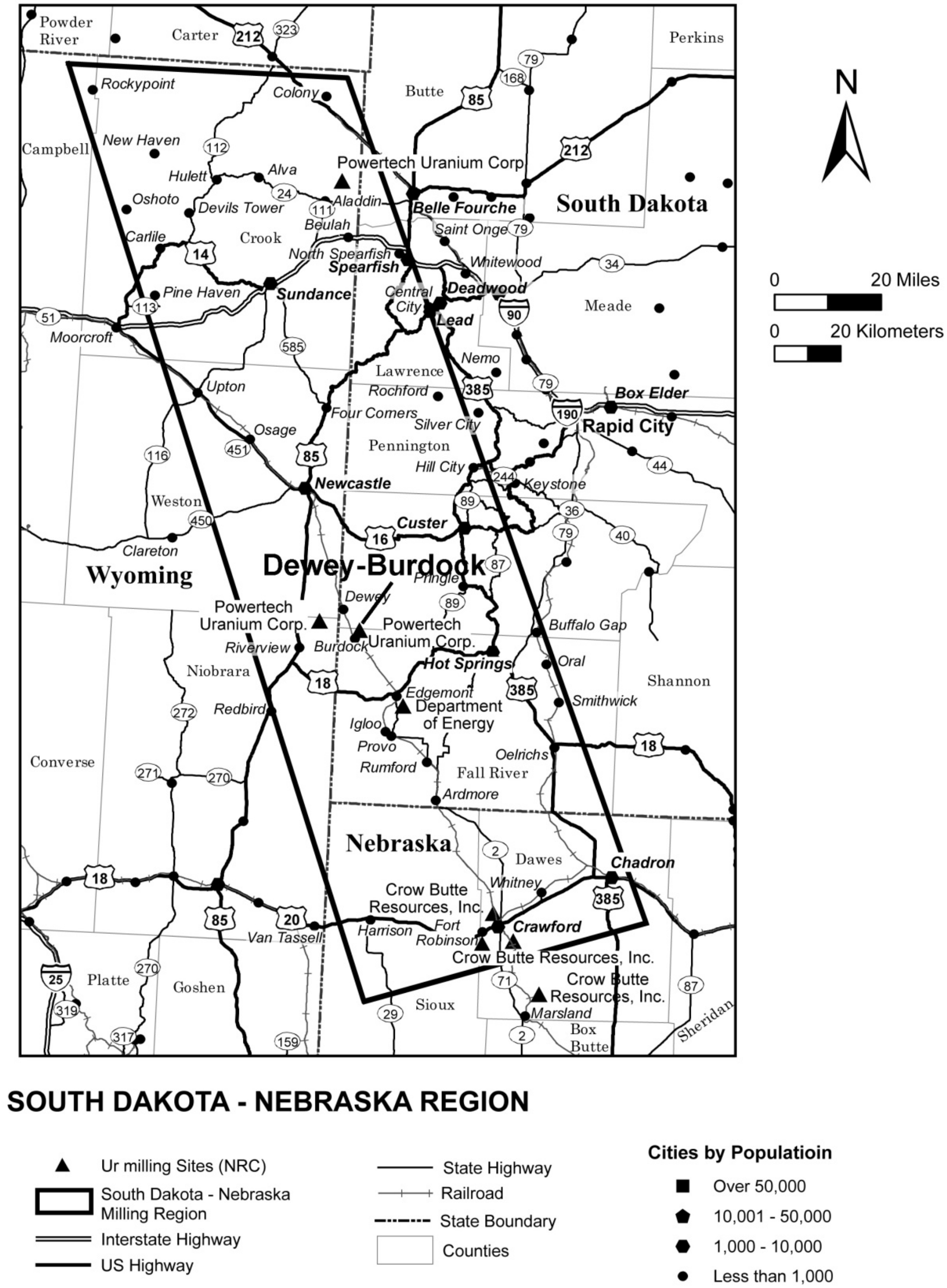

Figure 2.1-2. Map Showing Location of the Dewey-Burdock ISR Project Within the Nebraska-South Dakota-Wyoming Uranium Milling Region.
Source: Modified From NRC (2009a).

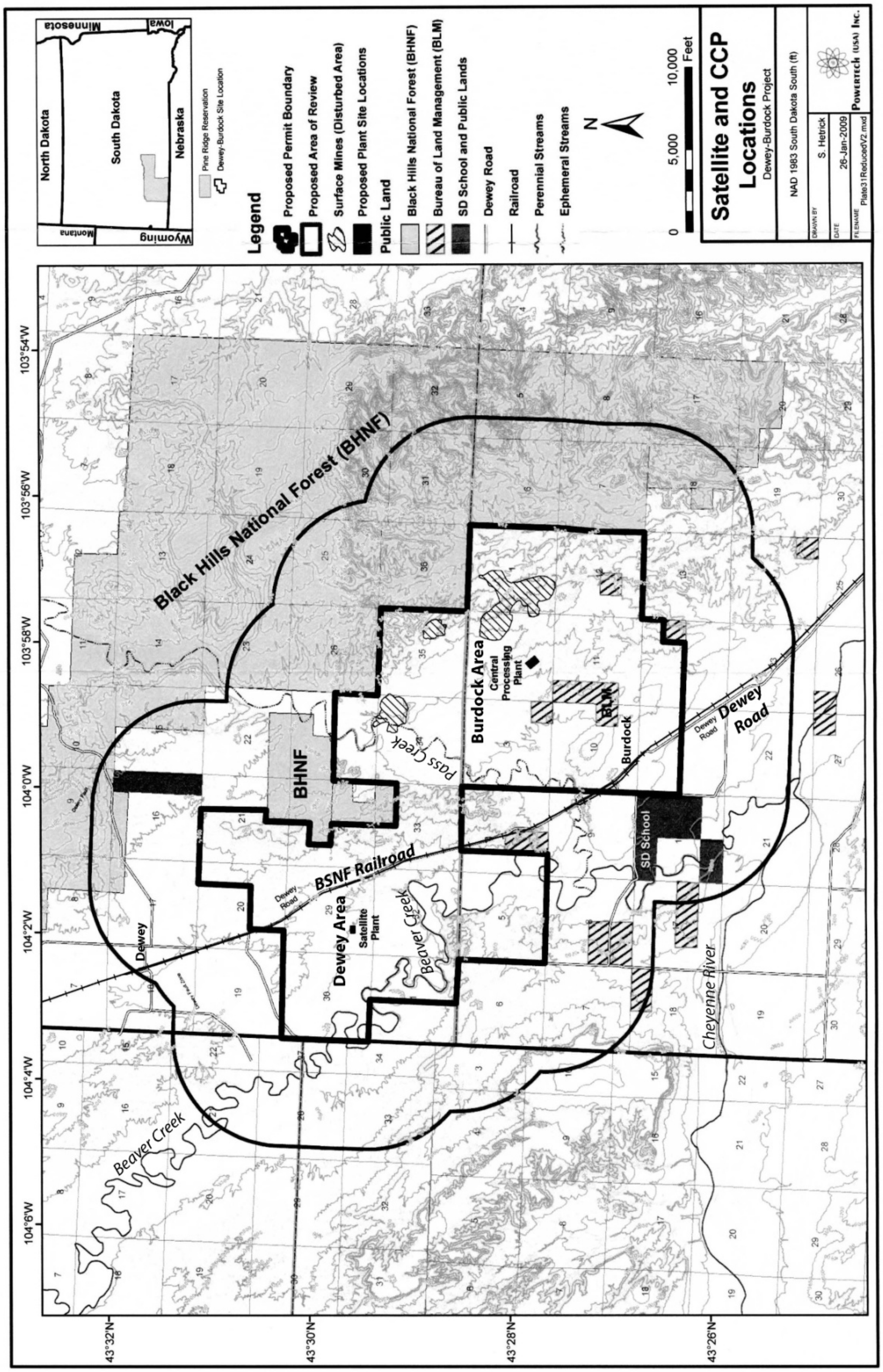

Figure 2.1-3. Dewey-Burdock ISR Project Permit Boundary Showing Dewey Area and Burdock Area, Location of BLM-Managed Land Within Burdock Area, and Position of Parcels of the Black Hills National Forest Bordering the Permit Area.
Source: Modified From Powertech (2009a).

access the site by traveling south from Newcastle along U.S. Highway 85, Old Highway 85, and Dewey Road (Powertech, 2010a). In addition, commuters who reside in the vicinity of Custer could use Pleasant Valley Road to access the proposed site from the north (Powertech, 2010a); however, this route would require much longer commute times than using the paved highways (State Highway 89 and U.S. Highway 18) to reach Edgemont, and then Dewey Road to access the proposed site from the south.

2.1.1.1.2 Construction Activities

As described in GEIS Section 2.3, the general construction activities associated with ISR facilities are drilling wells; clearing and grading associated with road construction; excavating and building foundations and surface impoundments; assembling buildings; trenching; and laying pipelines (NRC, 2009a). The facilities to be constructed as part of the proposed Dewey-Burdock ISR Project are the central processing plant, satellite facility, and associated infrastructure, such as wellfields, pipelines, power lines, header houses, ponds, center pivot circles (land application), and access roads (Powertech, 2009a). Surface facilities, underground infrastructure, and access roads at the proposed Dewey-Burdock site would be designed and built using standard construction techniques. Construction vehicles would include bulldozers, drilling rigs, water trucks, forklifts, pump hoist trucks, pickup and flatbed trucks, and other support vehicles. Construction-related activities at the proposed project would continue throughout much of the life of the project, as wellfields are sequentially developed and additional wells, underground piping, and surface structures are added and then subsequently decommissioned.

The applicant is proposing deep well injection via Class V injection wells, land application, or a combination of both methods as options for liquid waste disposal (Powertech, 2009a, 2011). The proposed Dewey-Burdock ISR Project area encompasses 4,282 ha [10,580 ac]. The applicant estimates that the land disturbed by the proposed project, excluding wellfields, would be approximately 42 ha [103 ac] if deep well injection alone is used to dispose of liquid waste and approximately 509 ha [1,258 ac] if land application alone is used to dispose of liquid waste (Powertech, 2010a). These estimates include site facilities, pipeline installation, access roads, impoundments, and center pivot circles for land application. As wellfields and supporting infrastructure are developed and constructed over the life of the project, the total disturbed area is estimated to increase to a maximum of 98 ha [243 ac] for the deep well disposal option with eight Class V injection wells and to a maximum of 566 ha [1,398 ac] for the land application option (Powertech, 2010a).

The applicant intends to salvage and manage topsoil from building sites, permanent storage areas, access roads, and chemical storage areas prior to construction, in accordance with South Dakota Department of Environment and Natural Resources (SDDENR) requirements under Administrative Rules of South Dakota (ARSD) 74:29:07:07 and South Dakota Codified Law (SDCL) 45-6B-40. For topsoil stripping, earthmoving equipment, such as rubber-tired scrapers and front-end loaders, would be used. In the wellfields, topsoil removal would be limited to header house locations and access roads. Over the life of the project, the applicant estimates that 5.3 ha [13 ac] of topsoil would be stripped, stockpiled, and replaced (Powertech, 2009b). Stockpiles for salvaged topsoil would be situated to minimize losses from wind and water erosion. To minimize sediment runoff, berms would be constructed around the perimeter of stockpiles, and the stockpiles would be vegetated with an approved seed mix. All stockpiles of topsoil would be identified with visible signs per SDDENR requirements under ARSD 74:29:07:07 (Powertech, 2009b).

2.1.1.1.2.1 Buildings

The Dewey-Burdock ISR Project would consist of a central processing plant in the Burdock area and a satellite facility in the Dewey area (Figure 2.1-3). The Burdock central plant would fully process pregnant lixiviant (i.e., uranium-bearing solution) and would process uranium-loaded resin from the Dewey satellite facility. Major process equipment housed in the Burdock central plant would include the IX system; an elution, precipitation, and thickening circuit; a chemical addition system; a filtration system for the liquid waste stream circuit; and the yellowcake filtering, drying, and packaging system. The Dewey satellite facility would house an IX system; a lixiviant (leaching solution) make-up circuit; and a treatment circuit for the liquid waste stream. Uranium-loaded resin from the Dewey satellite facility would be transported to the Burdock central plant in tanker trucks for final processing and packaging. Both the central processing plant and satellite facility would have a resin transfer system and loading area. (Powertech, 2009a)

The general layout of the Burdock central plant is shown in Figure 2.1-4 and includes the placement of an office building, maintenance shop and warehouse, and central processing plant.

These facilities would be located on approximately 2.7 ha [6.7 ac] within Section 2, Township 7 South, Range 1 East and would be surrounded by a controlled access area fence. The central processing plant would be within an approximately 32-m × 114-m [105-ft × 375-ft], pre-engineered, metal building that would house the major process equipment. The entire perimeter of the central processing plant floor would be surrounded by 15.2-cm [6-in] containment curbs and sloped toward trench drains and sumps to contain spilled and leaked fluids. Spilled and leaked fluids would be removed from the sumps by pumps and transported to the appropriate liquid waste treatment and disposal system or recycled back to the appropriate uranium recovery process component. Bulk storage tanks for the processing chemicals, such as sulfuric and/or hydrochloric acid, sodium hydroxide, and hydrogen peroxide, would be located outside the central processing plant. The storage tanks would be placed in concrete secondary containment basins, designed to contain 110 percent of the tank volume, and would be designed to withstand a 25-year, 24-hour storm event. The secondary containment basins would be separated physically from the containment basins for all other chemical systems. Carbon dioxide would be stored outside the central plant. Oxygen would be stored either near the central plant or within wellfields. Because oxygen is combustible, it would be stored at a safe distance from the central plant and other chemical storage areas. (Powertech, 2009a)

Other substances stored at the Burdock central plant would include petroleum products (gasoline, diesel) and propane. Due to the flammable and/or combustible nature of these materials, all bulk quantities of these substances would be stored outside of the central processing plant. All gasoline and diesel storage tanks would be located aboveground and within secondary containment structures, designed and constructed to meet U.S. Environmental Protection Agency (EPA) requirements.

The general layout of the Dewey satellite facility is shown in Figure 2.1-5, which also shows the placement of the IX processing facility and administrative building. These facilities would be located on an estimated 1.2-ha [2.9-ac] area within Section 29, Township 6 South, Range 1 East and would be surrounded by a controlled access area fence. The IX processing facility

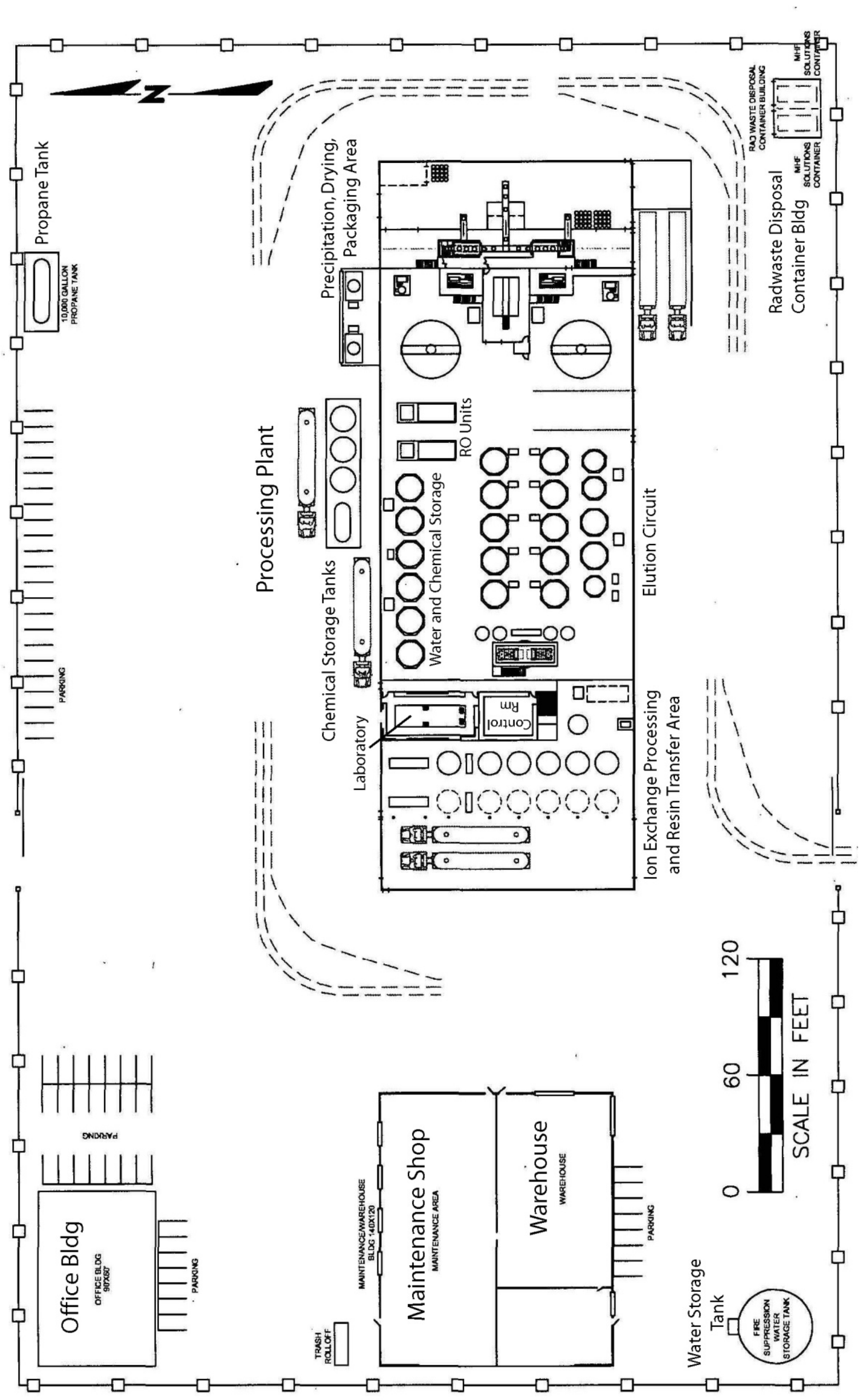

Figure 2.1-4. General Site Plan for the Burdock Central Processing Plant.
Source: Modified From Powertech (2009b).

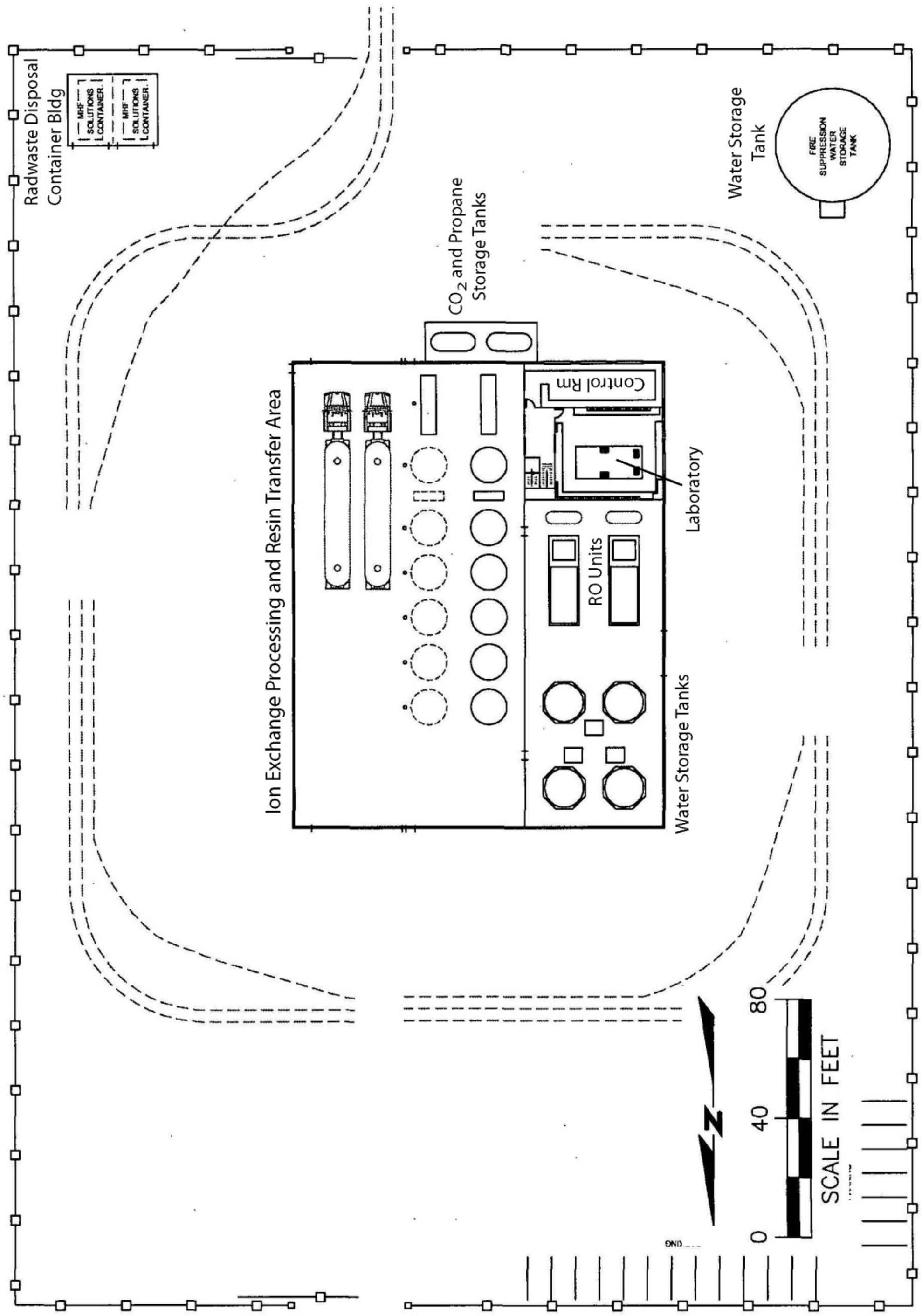

Figure 2.1-5. General Site Plan for the Dewey Satellite Facility. Source: Modified From Powertech (2009b).

would be within an approximately 38-m × 43-m [125-ft × 140-ft], pre-engineered, metal building. A 15.2-cm [6-in]-high containment curb would be constructed around the perimeter wall of the processing building slab. The satellite facility floor would be sloped toward trench drains and sumps to contain spilled and leaked fluids. Spilled and leaked fluids would be removed from the sumps by pumps and transported to the appropriate liquid waste treatment and disposal system or recycled back to the appropriate process component. Bulk storage tanks for oxygen and carbon dioxide would be located outside the IX processing building in concrete secondary containment basins designed to contain 110 percent of the tank volume plus withstand a 25-year, 24-hour storm event. (Powertech, 2009a)

Byproduct material, consisting of contaminated used equipment parts, personal protective equipment, and wastes from cleanup of spills or other housekeeping activities, would be stored in designated byproduct storage buildings. The Burdock central plant site and the Dewey satellite facility site will each have one byproduct storage building (Figures 2.1-4 and 2.1-5). These buildings would consist of a concrete slab with a containment curb surrounding the perimeter. Byproduct material would be stored in rolloff containers (bins), which would be both liquid tight and fully enclosed. The storage buildings would accommodate two 15-m^3 [20-yd^3] bins. The concrete slabs would be designed so the rolloff bins could be externally decontaminated before being transported from the proposed facility. (Powertech, 2009b)

2.1.1.1.2.2 Access Roads

As described in SEIS Section 2.1.1.1.1, the main highway that would be used to access the proposed Dewey-Burdock ISR Project is U.S. Highway 18, which connects Edgemont with Hot Springs to the east of the proposed site. Material shipment and employee commutes to and from the project area would be primarily via Dewey Road (Fall River County Road 6463 and Custer County Road 769), which extends northwestward from Edgemont to the community of Dewey, which is about 3.2 km [2 mi] from the northwest corner of the Dewey-Burdock ISR Project boundary.

The proposed Dewey-Burdock ISR Project would utilize existing roads to the greatest degree possible. However, the construction of additional access roads would be required. A main access road to the proposed central processing plant in the Burdock area would be constructed off Dewey Road in Township 7 South, Range 1 East, Section 10, near the abandoned community of Burdock (see figures in Sections 2.1.1.1.2.4.1 and 2.1.1.1.2.4.2). This access road would join with several preexisting roads that traverse the Burdock area. A main access road to the proposed satellite facility in the Dewey area would be constructed farther to the north, off Dewey Road in Township 6 South, Range 1 East, Section 20 (see figures in Sections 2.1.1.1.2.4.1 and 2.1.1.1.2.4.2). This access road would connect with several preexisting roads that traverse the Dewey area. The preexisting roads within the Burdock and Dewey areas would be used to the fullest extent possible to provide access to the proposed facility structures and wellfields and to limit the construction of new roads. Secondary roads would be constructed to provide access to other proposed facilities (such as header houses) and wellfields not currently accessible by existing roads. The applicant would secure approvals from private landowners and BLM, as well as required county permits, prior to constructing any access roads within the proposed project area (Powertech, 2009a). Construction of access roads within the proposed project area would be kept to a minimum.

2.1.1.1.2.3 Wellfields

The proposed locations of wellfields in the Dewey and Burdock areas are shown in Figure 2.1-6. Exploratory drilling, conducted by the applicant and the Tennessee Valley Authority (TVA), has demonstrated that commercially extractable uranium ore bodies at the proposed site are located in sandstones in the Fall River Formation and the Chilson Member of the Lakota Formation that make up the Inyan Kara Group. The uranium mineralization occurs along a large U-shaped trend that is 8 km [5 mi] long and 5 to 6 km [3 to 4 mi] wide (Figure 2.1-6). Mineralized sands within the project area occur at depths of less than 30 m [100 ft] in the outcrop area of the Fall River Formation in the eastern portion of the Burdock area and at depths of up to 244 m [800 ft] in the Chilson Member of the Lakota Formation in the northwestern portion of the Dewey area (Powertech, 2009c, 2011). The geology, hydrology, and characteristics of the uranium mineralization at the Dewey-Burdock site are detailed in SEIS Sections 3.4 and 3.5. The applicant estimated the mineable resource within the permit area at 3.45 million kg [7.6 million lb] of U_3O_8 with an average grade of 0.21 percent (Powertech, 2009a).

Extraction is proposed at 10 wellfields in the Burdock area and at 4 wellfields in the Dewey area, as shown in Figure 2.1-6 (Powertech, 2011). The initial Burdock wellfield (B-WF1) would be located over mapped ore bodies within the Chilson Member of the Lakota Formation; the initial Dewey wellfield (D-WF1) would be located over mapped ore bodies within the Fall River Formation (Powertech, 2011). Wellfield construction would affect an area of 15.9 ha [39.3 ac] in D-WF1 and an area of 7.1 ha [17.6 ac] in B-WF1 (Powertech, 2010c). Prior to finalizing the design of wellfields, the applicant would conduct closely spaced and localized delineation drilling to refine information on the location, grade, thickness, and production capability of the ore. The applicant estimated that 248 delineation holes (77 holes at B-WF1 and 171 holes at D-WF1) would be drilled during the construction phase of the proposed project (Powertech, 2010c). To estimate and manage ore production, geologic and geophysical data from the drill holes would be analyzed to determine the depth of the mineralized zone and confining units, identify and locate potential barriers to groundwater flow caused by clay stringers, and determine the thickness and grade of ore deposits. After field data are collected, delineation drill holes would be plugged and abandoned in place, according to SDDENR regulations under ARSD 74:11:08 (Powertech, 2009a). The applicant would design the production well spacing and the size and depth of the well screen intervals for each well based on the results of the delineation drilling data. The wellfields would be located over the delineated mineralization zones, to facilitate extraction of 0.45 million kg [1 million lb] of U_3O_8 per year, which is the design capacity of the facilities (Powertech, 2009a).

Two types of wells would be installed as part of the operations at the proposed Dewey-Burdock ISR Project: dual-purpose injection/production wells and monitoring wells. Injection wells would be used to introduce lixiviant into the uranium mineralization; production wells would be used to extract uranium-bearing solutions; and monitoring wells would be used to identify and assess impacts of ongoing operations and detect groundwater excursions.

2.1.1.1.2.3.1 Injection and Production Wells

The applicant plans to construct wellfields consisting of a series of injection and production wells laid out in geometric-shaped patterns across target uranium mineralization zones (Powertech, 2009a). The applicant estimated 100 production wells and 194 injection wells would be installed at the initial wellfields during the construction phase of the proposed project (Powertech, 2010c). The wells would be “cased” by lowering a pipe into the borehole either during or after drilling to

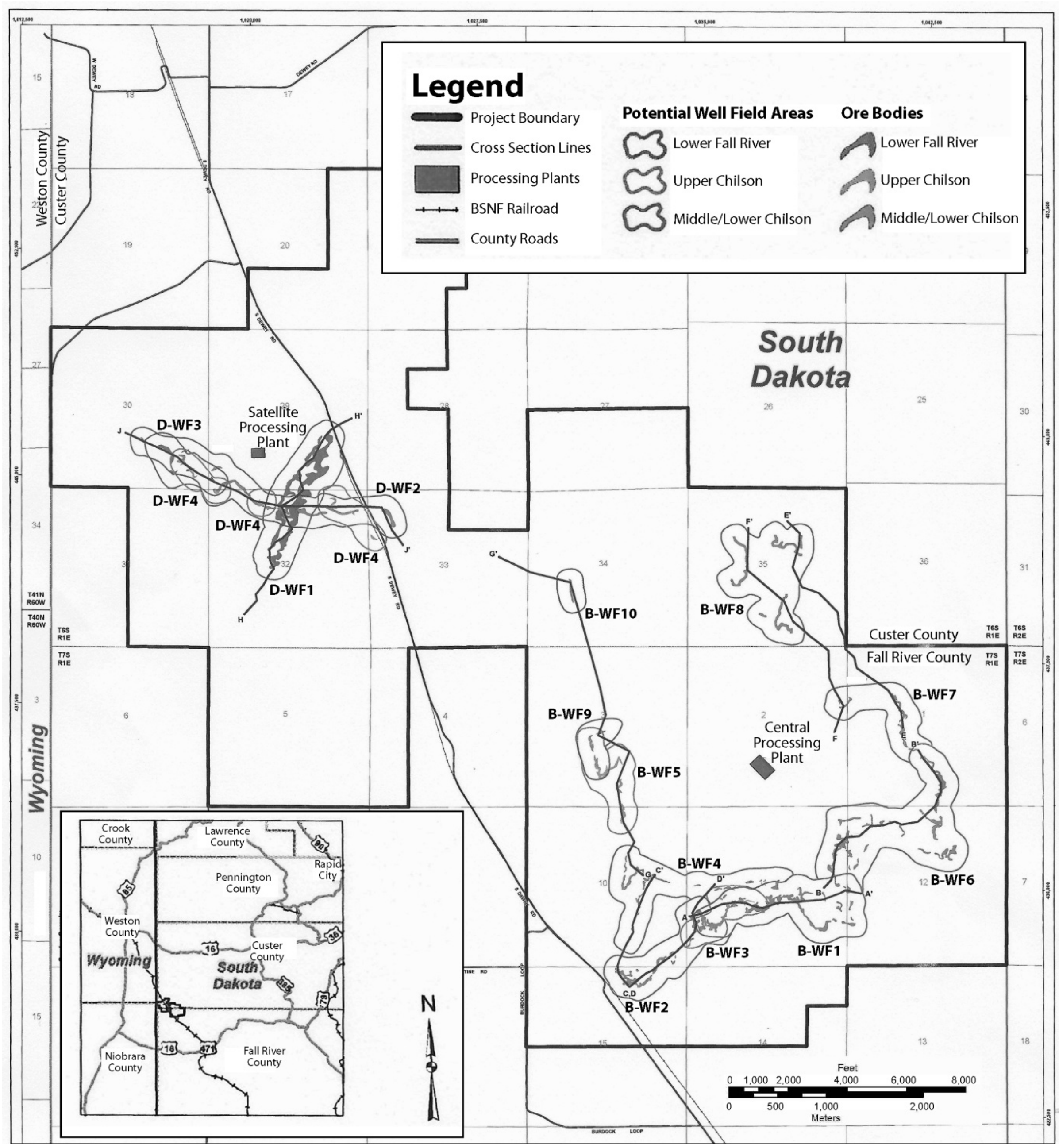

Figure 2.1-6. Map of Dewey-Burdock ISR Project Area Showing Locations of the Dewey Satellite Facility, Burdock Central Plant, Mapped Orebodies, and Proposed Wellfields.
Source: Modified From Powertech (2011).

prevent the sides of the borehole from caving, prevent loss of drilling fluids into porous formations, and prevent unwanted fluids from entering the borehole. The base of the well casing at all injection and production wells would extend to or below the confining unit overlying the mineralized zone. The screened interval of injection and production wells would be completed only across the targeted ore zone (Figure 2.1-7). Wells will be designed and constructed so they can be used as either injection or production wells. The dual use of wells

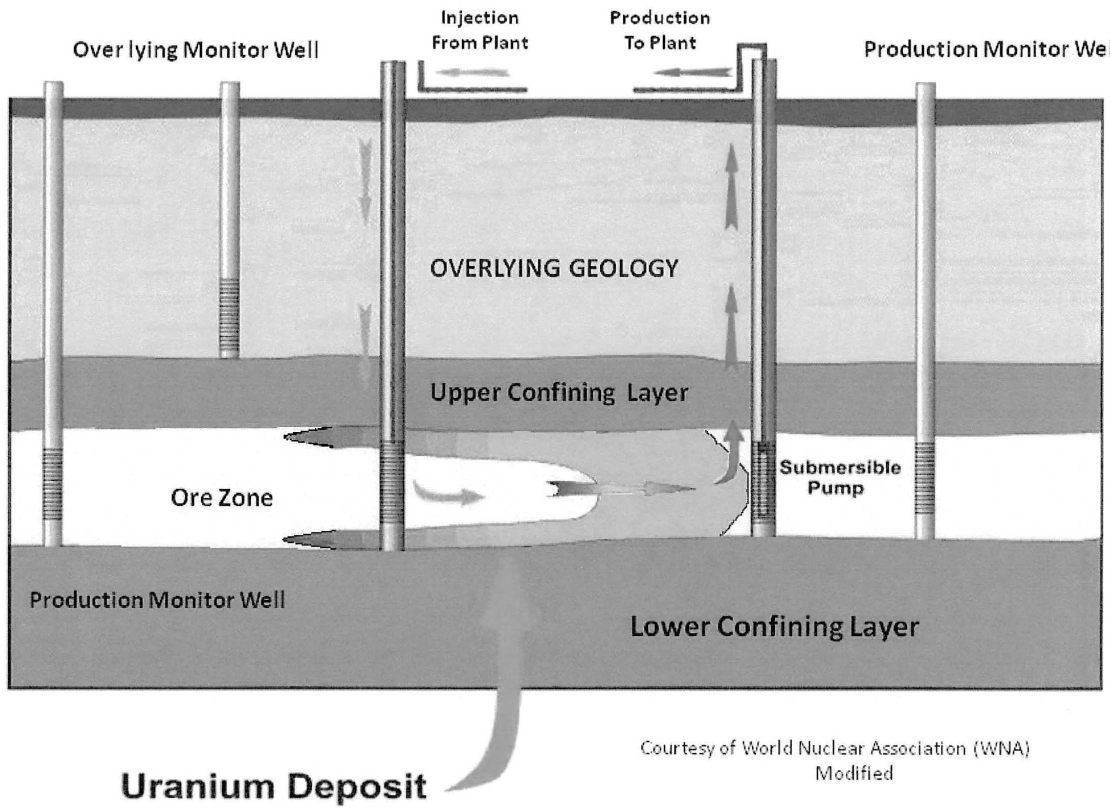

Figure 2.1-7. Schematic Diagram of Typical Well Placement.
Source: Powertech (2009a).

allows wellfield flow patterns to be changed to improve uranium production at the proposed project. Dual-use wells also result in more effective restoration of groundwater quality during the aquifer restoration phase of the ISR process (see SEIS Section 2.1.1.1.4).

Wellfield patterns and well spacing at the proposed Dewey-Burdock ISR Project site may vary at each wellfield due to variations in the lateral distribution and ore grade within the mineralized zone (Powertech, 2009a). The applicant plans to utilize a five-spot square pattern where injection wells would be at the corners of a 30-m [100-ft] wide square and a production well would be placed in the center of the square (Figure 2.1-8). Rectangular, hexagonal, or triangular configurations may be used depending on the geometry and characteristics of the ore body as it is mapped during delineation drilling and prior to final wellfield design.

The applicant may elect to space the injection wells as close as 15 m [50 ft] apart for efficient uranium recovery based on the results of delineation drilling, thus increasing the overall number of wells needed for this process (Powertech, 2009c).

Production and injection wells would be connected to manifolds in a wellfield header house; header houses distribute injection fluid to injection wells and collect production solution from recovery wells. The header house would include manifolds, valves, flow meters, pressure meters, and booster pumps. Oxygen would be incorporated into the lixiviant at the header house before it is injected into the production formation. Typically, one header house would

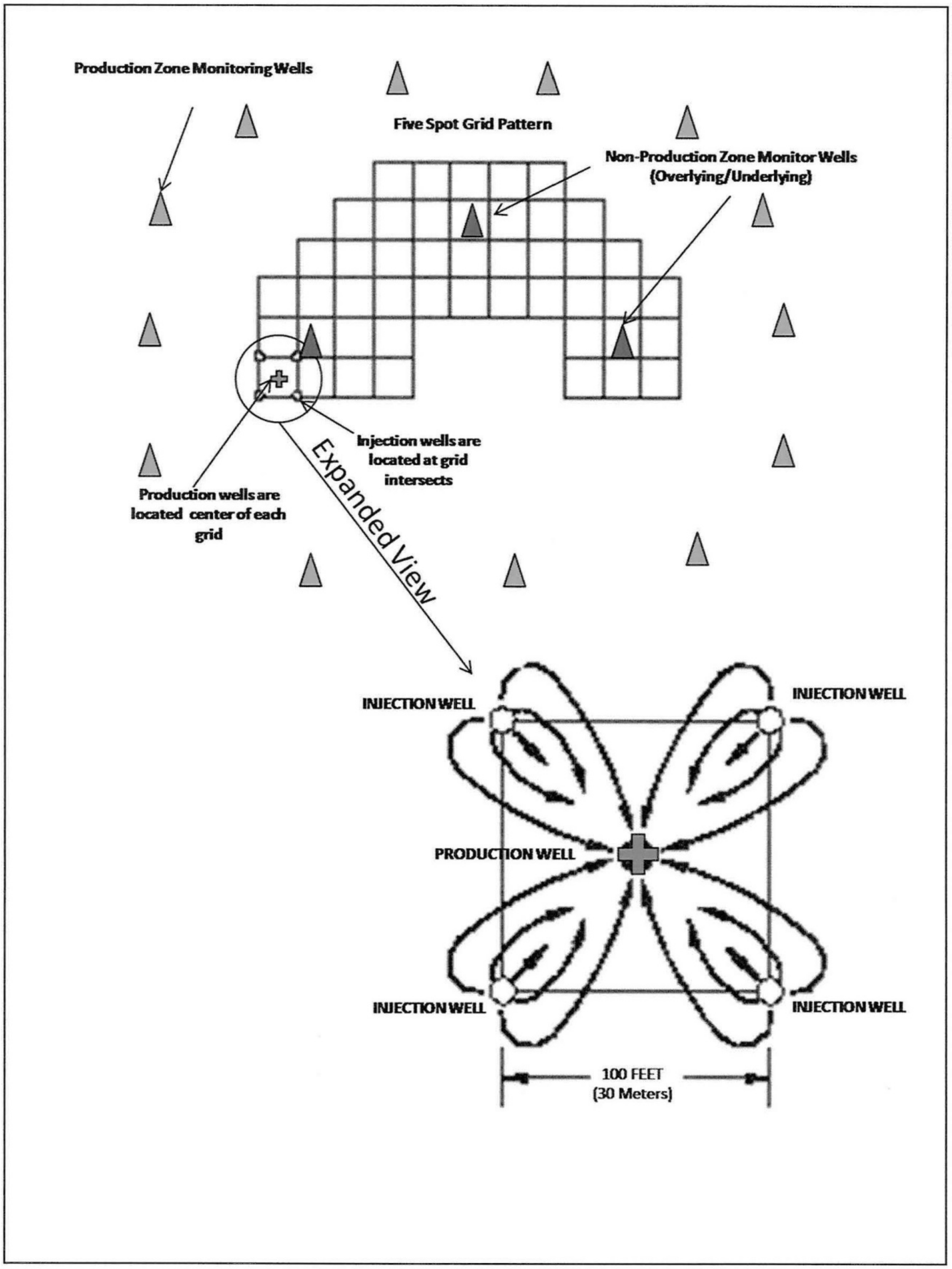

Figure 2.1-8. Schematic Diagram of Typical Five-Spot Wellfield Pattern. Source: Modified From Powertech (2009a).

serve up to 20 production wells and 80 injection wells. Additional header houses would be constructed as the wellfield expands (Powertech, 2009a).

The applicant estimates that, at full production, wellfields in the proposed Dewey and Burdock areas would operate at an average production flow rate of 15,140 Lpm [4,000 gpm] (Powertech, 2011). The typical production flow rate would be approximately 9,084 Lpm [2,400 gpm] from the Burdock wellfields and approximately 6,056 Lpm [1,600 gpm] from the Dewey wellfields (Powertech, 2011). To create an overall hydraulic cone of depression, more water would be withdrawn than injected into each wellfield. Under this pressure gradient, the groundwater movement would flow toward the center of the production zone and control the movement of production solution. The difference between the amount of water withdrawn and injected is referred to as the wellfield "bleed." The applicant's projected production bleed for the proposed Dewey-Burdock ISR Project would be approximately 0.875 percent of the total production flow rate, or approximately 79.5 Lpm [21 gpm] at the Burdock wellfields and approximately 53 Lpm [14 gpm] at the Dewey wellfields (Powertech, 2011). The bleed rate would be adjusted, as necessary, during production to maintain the wellfield cone of depression.

An EPA-administered underground injection control (UIC) program regulates the design, construction, testing, operation, and closure of injection wells. Injection wells for uranium extraction are classified under UIC as Class III wells; these wells are located in the aquifer(s) containing the uranium that will be recovered. The proposed operation requires the applicant to obtain a UIC permit from EPA to use Class III injection wells. Before ISR operations begin, the portion of the aquifer(s) designated for uranium recovery must be exempted from the underground source of drinking water (USDW) designation, in accordance with the Safe Drinking Water Act (SDWA) and pursuant to 40 CFR Part 146. A USDW is defined as an aquifer or its portion that: (1)(i) supplies any public water system; or (ii) that contains a sufficient quantity of groundwater to supply a public water system; and (a) currently supplies drinking water for human consumption; or (b) contains fewer than 10,000 mg/L (10,000 ppm) total dissolved solids; and that (2) is not an exempted aquifer. An aquifer or aquifer portion that meets the criteria for a USDW may be determined to be an "exempted aquifer" if: (i)(a) it does not currently serve as a source of drinking water and (b) it cannot now and will not in the future serve as a source of drinking water because it is mineral, hydrocarbon, or geothermal energy producing; or (ii) can be demonstrated by a permit applicant as part of a permit application for a Class III operation to contain minerals that, considering their quantity and location, are expected to be commercially producible. The applicant, therefore, must obtain an aquifer exemption from EPA before initiating ISR operations.

> The EPA Underground Injection Control (UIC) Program is responsible for regulating construction, operation, permitting, and closure of injection wells that place fluids underground. The types of injection wells regulated by the EPA UIC Program are defined below:
>
> **Class I** (Industrial and Municipal Waste Disposal Wells) are used to inject hazardous and nonhazardous wastes into deep, isolated rock formations that are thousands of meters [feet] below the lowermost USDW.
>
> **Class II** (Oil- and Gas-Related Injection Wells) are used to inject fluids associated with oil and natural gas production.
>
> **Class III** (Mining Wells) are used to inject fluids to dissolve and extract minerals such as uranium, salt, copper, and sulfur.
>
> **Class IV** (Shallow Hazardous and Radioactive Injection Wells) are shallow wells used to inject hazardous and nonhazardous or radioactive wastes into or above a geologic formation that contains a USDW.
>
> **Class V** wells are used to inject nonhazardous fluids underground. Most are used to dispose of wastes into or above USDWs.
>
> **Class VI** (CO_2 Geosequestration Wells) are deep wells used to inject carbon dioxide into deep geologic formations for long- term storage.

Once exempted, the defined aquifer(s) or its portion would no longer be protected as a USDW under SDWA. For example, at the proposed Dewey-Burdock ISR Project, portions of the Fall River and Chilson aquifers could potentially be exempted in defined areas related to commercial mineral production uranium recovery operations. The remaining portion of the Fall River and Chilson aquifers, beyond the designated exempted area, would still be considered a USDW and continue to be protected under the SDWA.

2.1.1.1.2.3.2 Monitoring Wells

The applicant has proposed installing production zone monitoring wells at the periphery of each production area (Figure 2.1-8). This perimeter monitoring well "ring" would be utilized for early detection of horizontal excursions from within the sand unit or aquifer where production is occurring. An excursion is declared when the concentrations of certain indicator parameters exceed upper control limits established by the license and verified by NRC and EPA or the state. The purpose of the monitoring well ring is to ensure that groundwater quality in aquifers outside exempted zones is not impacted by ISR operations.

In some areas of the proposed Dewey-Burdock ISR Project site, multiple ore bodies are vertically stacked within the Fall River Formation or the Chilson Member of the Lakota Formation with no substantial confining layers between the ore bodies. In these areas, the perimeter production zone monitor wells would be screened across the full thickness of the stacked ore bodies and the ore bodies treated as a single production zone (Powertech, 2011). In other areas of the project site, stacked ore bodies within the Fall River and Chilson Member are separated by low permeability units that may act as localized confining units (Powertech, 2011). If delineation drilling and pump testing demonstrate that localized confining units provide hydraulic separation between ore bodies within one of the primary production units (e.g., the Fall River or Chilson), then monitor wells could be located and screened only within the portion of the unit in which the orebody is located (Powertech, 2011).

Production zone monitor wells would be located at a maximum of 122 m [400 ft] from the production area (Powertech, 2009a, 2009c, 2011). The spacing between monitor wells would also be 122 m [400 ft] (Powertech, 2009a). To support the proposed spacing of monitor wells, the applicant conducted numerical simulations using site-specific hydrogeologic data and proposed production flow rates to evaluate groundwater conditions related to ISR at the proposed Dewey-Burdock ISR Project (Powertech, 2011). Results of the simulations indicated that the proposed maximum monitor well spacing of 122 m [400 ft] would be adequate to detect a potential excursion (Powertech, 2011).

Production zone monitoring wells will be installed before production activities begin; required groundwater sampling and hydrologic tests will be conducted on samples taken from the monitoring wells. The applicant estimates that approximately 100 monitoring wells will be installed in the initial wellfields during the construction phase of the proposed project (Powertech, 2010c).

The applicant plans to design and install two types of nonproduction zone monitoring wells; these wells are labeled "overlying" and "underlying." Placement of overlying and underlying monitor wells is designed to correspond to the site-specific lithology and the hydrologic characteristics within the production zone(s) of each wellfield. The screened intervals of overlying wells would be located in the sand unit or aquifer immediately above the ore-bearing sandstone (Figure 2.1-7). The overlying nonproduction monitoring wells are designed to monitor any upward movement of leach fluids away from the production zone and identify leakage from production and injection well casings before fluids could enter the overlying aquifer. In the sand unit or aquifer immediately above the ore-bearing sandstone, overlying nonproduction zone monitoring wells would be evenly distributed with a minimum placement of one well for every 1.6 ha [4 ac] of production area in accordance with guidance in NUREG–1569 (NRC, 2003a). When additional aquifers exist above the first sand unit or aquifer above the ore-bearing sandstone, additional monitoring wells would be located in these aquifers, with a minimum placement of one well for every 3.2 ha [8 ac] of production area in accordance with guidance in NUREG–1569 (Powertech, 2011, Figure TR RAI 5.7.8-12-1).

The applicant would complete underlying nonproduction monitor wells in the first sand unit or aquifer underlying the ore-bearing sandstone. Where the production zone in the Chilson Member of the Lakota Formation is bounded below by the Morrison Formation, no underlying nonproduction monitor wells would be installed. In this case, the thickness {approximately 30 m [100 ft]} and relatively impermeable nature of the Morrison Formation minimize concerns about vertical excursion of lixiviant (Powertech, 2011). The underlying nonproduction monitoring wells are designed to monitor any downward movement of leach fluids from the production zone and to identify leakage from production and injection well casings before fluids could enter the underlying aquifer. Underlying nonproduction monitoring wells would be evenly distributed through the production area with a minimum placement of one well for every 1.6 ha [4 ac] of production area (Powertech, 2009a, 2011).

The production zone monitor ring and overlying and underlying monitor wells will be designed for each wellfield based on site-specific lithologic and hydrologic characteristics of production zones gathered during delineation drilling and hydrologic testing. The location and/or number of monitoring wells will be determined after pump testing is complete to demonstrate that monitoring wells are hydrologically connected to injection and production wells (see following section). The applicant must present each monitoring well program to EPA for administrative approval before installing proposed wells. In addition, wells completed in overlying and underlying aquifers are subject to sampling procedures, remedial actions, and reporting requirements prescribed in NRC and EPA rules and regulations. (Powertech, 2009b)

2.1.1.1.2.3.3 Pumping Tests

Prior to operation of each wellfield, the applicant would design and implement pumping tests to establish that the production and injection wells are hydraulically connected to the perimeter production zone monitor wells and hydraulically isolated from nonproduction zone monitor wells in underlying and overlying sand units (Powertech, 2011). The pumping test system for each wellfield would include production zone pumping wells and monitor wells. Monitor wells would include (i) perimeter production zone monitor wells; (ii) monitor wells within the production zone at a minimum density of one per 1.6 ha [4 ac]; (iii) monitor wells in the immediately overlying and underlying nonproduction zone sand unit at a minimum density of one per 1.6 ha [4 ac]; (iv) monitor wells in the subsequently overlying nonproduction sand unit at a minimum density of one per 3.2 ha [8 ac]; and (v) monitor wells in alluvium, if present, at a minimum density of one per 3.2 ha [8 ac] (Powertech, 2011). As described in SEIS Section 2.1.1.1.2.3, delineation drilling data would provide detailed lithologic information to map production zones targeted for ISR operations and define the overlying and underlying sand units and confining layers to be monitored. The delineation drilling data would be used to determine the location and screened intervals of pumping and monitor wells for each wellfield during pumping tests.

The pumping test data would be used to evaluate and confirm hydraulic connection between the production zone and perimeter production zone monitor wells and hydraulic isolation (i.e., confinement) between the production zone and overlying and underlying sand units. In addition, the pumping test data would be used to demonstrate that solutions can be controlled with typical wellfield bleed rates and to detect and identify leakage due to anomalies such as improperly plugged wells and exploration boreholes (Powertech, 2011).

2.1.1.1.2.3.4 Wellfield Hydrogeologic Data Packages

The applicant's delineation drilling results and pumping test data would be included in wellfield hydrogeologic data packages, which would be submitted for review and evaluation to the Safety and Environmental Review Panel (SERP), which is established by NRC requirements (Powertech, 2011). The wellfield hydrogeologic data package would describe the wellfield, including (i) production and injection well patterns and location of monitor wells; (ii) documentation of wellfield geology (e.g., geologic cross sections and isopach maps of production zone sand and overlying and underlying confining units); (iii) pumping test results; and (iv) sufficient information to demonstrate that perimeter production zone monitor wells adequately communicate with the production zone (Powertech, 2011).

The SERP would review the wellfield hydrogeologic test results and documentation to determine whether monitoring wells are hydrologically connected to the injection and production wells. The wellfield hydrogeologic data package and written SERP evaluation would be maintained on site and be available for NRC review. By license condition, wellfields in the partially saturated portion of the Dewey-Burdock Project area, specifically wellfields B-WF6, B-WF7, and B-WF8 (see Figure 2.1-6), will be prohibited from operating until NRC staff have reviewed and approved the hydrogeologic data packages for those wellfields (NRC, 2012).

2.1.1.1.2.3.5 Well Construction, Development, and Testing

The applicant intends to use standard mud rotary drilling techniques and equipment to construct production, injection, and monitor wells. Wells would be drilled to the bottom of the target completion interval with a small rotary drilling unit, using bentonite or polymer drilling mud with pH adjusted water and mixed to control viscosity (Powertech, 2008). A temporary mud pit, to contain the drilling mud, would be excavated adjacent to the drill site. During excavation of mud pits, topsoil would be separated from the subsoil with a backhoe. The subsoil would be deposited next to the mud pit, and the topsoil would be stored at a separate location until the well site is restored. Residual cuttings and drilling fluids are typically held in the mud pit after drilling and construction activities are completed (NRC, 2009a). Depending on state and local regulations, such mud pits are backfilled and graded or are alternatively emptied and cleaned, and residual solids and liquids transported and disposed of offsite (NRC, 2006). After well drilling is completed at the proposed project, the applicant proposes to redeposit the excavated subsoil in the mud pit followed by topsoil application and grading, usually within 30 days of the initial excavation of the mud pit (Powertech, 2009a).

All production, injection, and monitoring wells will be cased and cemented to prevent fluids migrating into or between USDWs in accordance with EPA requirements in 40 CFR 146.32. A schematic for a completed well is shown in Figure 2.1-9. Before an injection, production, or monitoring well enters service, the applicant proposes to perform mechanical integrity tests (MITs) using pressure-packer tests (Powertech, 2009a). The mechanical integrity of wells is tested to verify that the well casing will not fail, which could cause water loss and fluid migration across confining units during injection, recovery, and monitoring operations (NRC, 2009a).

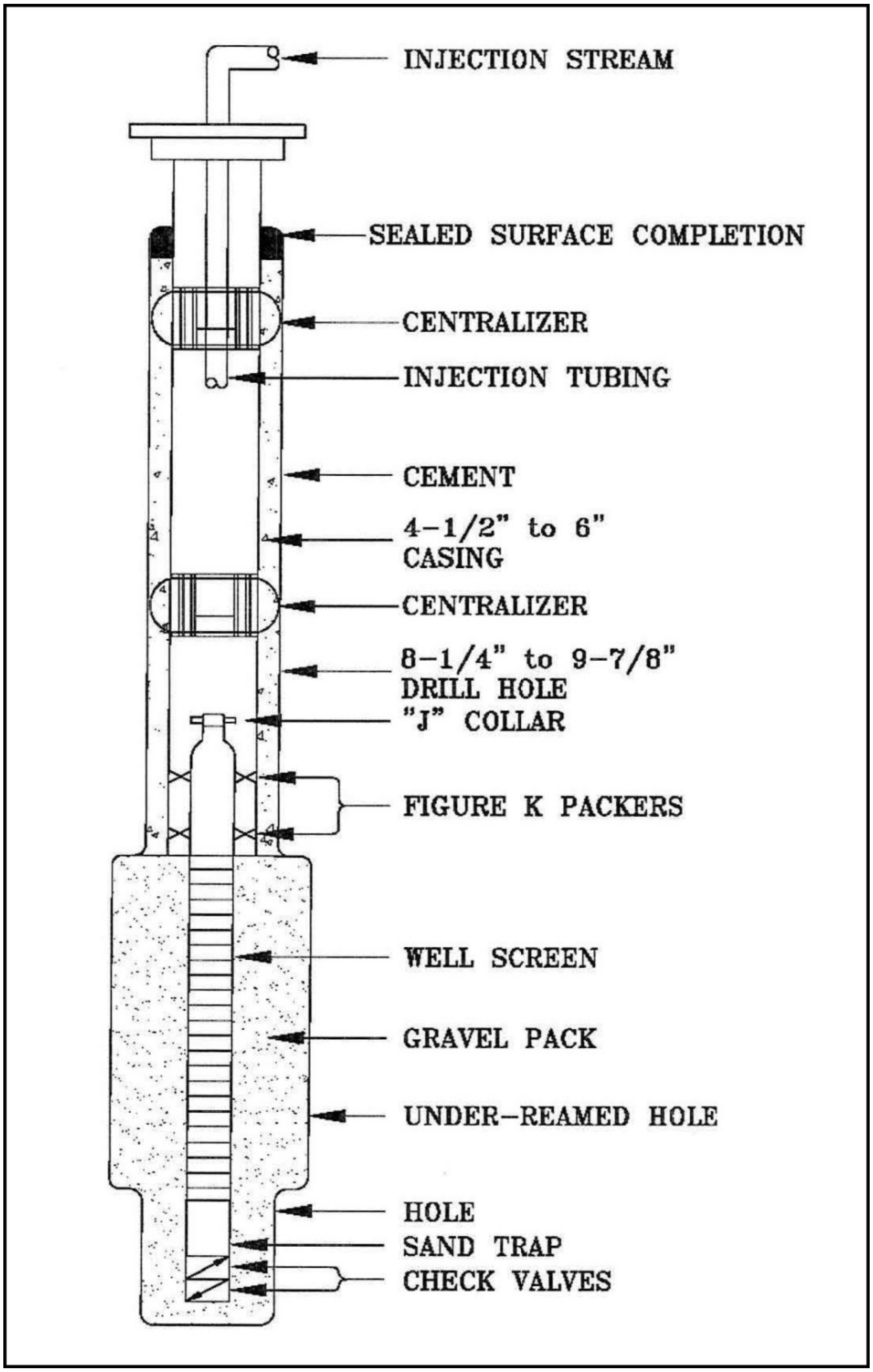

Figure 2.1-9. Schematic of Typical Injection Well Construction (the Design of a Typical Production and Monitor Well Would Be Identical Except for the Addition of a Submersible Pump in the Production Well).
Source: Powertech (2009a).

MITs are performed by sealing a casing bottom with a plug, a downhole packer, or other suitable sealing device. The casing is then filled with water, and the top of the casing is sealed with a threaded cap or mechanical seal. The well casing is then pressurized with water and air, and a calibrated pressure gauge monitors the mechanical integrity of the well casing. Internal casing pressure is increased to 125 percent of the maximum operating pressure of the well, 125 percent of the maximum operating pressure rating of the well casing, or 90 percent of the formation fracture pressure, whichever is less (Powertech, 2009a). If obvious leaks are present or the pressure drops by more than 10 percent during a 10-minute period, the seals and fittings on the packer system must be checked and reset and another test is conducted. A well casing that maintains a high level of pressure demonstrates acceptable mechanical integrity, and the well would be qualified for service at the facility.

To ensure the continued integrity of the wellfields, the applicant will test the mechanical integrity of all active wells at least once every 5 years or after any rework that may need to be performed on the well. The applicant will document the details of the MITs (specifically, the well designation, date of test, test duration, and beginning and ending pressures), and the individual conducting the test will sign the test report. MIT results will be maintained onsite and will be available for NRC inspection. MIT results will also be reported quarterly to EPA, in accordance with the EPA UIC regulations in 40 CFR 146.33.

In addition to conducting pressure tests on new wells to establish mechanical integrity, the applicant will conduct an MIT following any repair to a well that involves the use of a downhole tool or underreaming tool (Powertech, 2009a). Downhole and underreaming tools will be used to repair or replace the well casing, screen assembly, or the gravel/sand pack. A well that shows evidence of subsurface damage will be subjected to an MIT before being returned to service. If, following repair, a well does not demonstrate acceptable MIT mechanical integrity, the well will be plugged and abandoned. The applicant plans to plug wells in accordance with EPA regulations in 40 CFR 146.10 (Powertech, 2009a). The applicant’s commitment to MIT procedures and frequencies, as described previously, will be included as a standard license condition for the proposed action (NRC, 2012).

2.1.1.1.2.3.6 Pipelines

As part of the underground infrastructure at ISR facilities, a network of process pipelines and cables are typically installed connecting (i) the central uranium processing facility or the satellite facility and the header houses for transferring lixiviant; (ii) the header houses and wellfields for injecting and recovering lixiviant; and (iii) the central plant and wastewater disposal facilities (e.g., deep injection wells or land application areas) (NRC, 2009a). The piping and metering system for production and injection solutions at the proposed Dewey-Burdock ISR Project would require buried trunk lines to connect the Dewey satellite facility and its related operating wellfield areas and the Burdock central processing plant and its related wellfields to the metering and flow distribution headers inside the header houses. Piping would also be installed to transport liquid waste streams from the Burdock central processing plant and Dewey satellite facility to their respective wastewater disposal facilities (i.e., deep injection wells and/or land application areas).

The applicant proposes to install up to eight underground pipelines between the Burdock central processing plant and the Dewey satellite facility to transport various fluids used during ISR operations (Powertech, 2011). Conduits for electronic communication and control purposes would also be installed between the central plant and satellite facility. The plant-to-plant pipelines would transport fluids including but not limited to (i) barren and pregnant lixiviant,

(ii) restoration water, (iii) reverse osmosis reject brines, (iv) wastewater from well drilling and maintenance operations, and (v) supply water from the Madison Formation or other aquifers.

High density polyethylene (HDPE) pipe with heat-welded joints is used to connect the wells, header houses, and processing facilities; the piping is buried approximately 1.5 m [5 ft] below grade to prevent freezing (Powertech, 2009b). Trenches containing pipelines are typically backfilled with native soil and graded to surrounding ground topography (Powertech, 2009b). The same procedure used in mud pit excavation during well construction will be used to preserve topsoil; topsoil is stored separately from subsoil and replaced on the subsoil after the pipeline ditch is backfilled.

HDPE piping to be used at the proposed project is designed to withstand operating pressures of 10.5–21.1 kg/cm^2 {150–300 pounds per square inch [psig]}, although the applicant expects actual operating pressures to be less than 0.7 kg/cm^2 [100 psig] (Powertech, 2009b). At the header house, the piping would be connected to manifolds equipped with control valves, flow meters, check valves, pressure sensors, oxygen and carbon dioxide feed systems (injection only), and programmable logic controllers. Sensors will measure and record pipeline pressures to monitor for potential leaks and spills resulting from failure of fittings and valves. Electrical power to the header houses would be delivered by overhead power lines and buried cable. Electrical power to individual wells would be delivered by buried cable from the header house. As the wellfield expands, additional header houses would be constructed and connected to one another via buried header piping. The header piping is designed to accommodate injection and production flow rates of 7,570 Lpm [2,000 gpm] and operating pressures of 10.5–21.1 kg/cm^2 [150–300 psig]. The only exposed pipes at the proposed project site would be at the central plant, satellite facility, wellheads, and wellfield header houses.

2.1.1.1.2.3.7 Power Lines

The applicant plans to use existing power line corridors wherever possible when constructing new power lines. However, a new power line corridor will be constructed alongside Dewey Road between the Dewey and Burdock areas to connect the Dewey satellite facility and the Burdock central processing plant. This proposed corridor will be approximately 9 m [30 feet] in width; the poles will be approximately 0.3 m [1.0 ft] in diameter and will be placed every 30–91 m [100–300 ft]. No access roads will be built during construction of the power lines and minimal disturbance to the ground surface is anticipated.

2.1.1.1.2.4 Liquid Waste Disposal Systems

The applicant plans to dispose of liquid wastes generated during uranium recovery operations through deep injection wells, land application, or a combination of both methods. Project-generated liquid wastes would include bleed water from the production wells, groundwater generated during aquifer restoration, process solutions (e.g., resin transfer water and brine generated from the elution and precipitation circuits), affected well development water, laboratory wastewater, laundry water, and plant washdown water. The applicant's preferred option for disposal is deep injection using Class V wells (Powertech, 2009c, 2011). Liquid waste injected into potential Class V injection wells at the proposed Dewey-Burdock ISR Project site must not be hazardous or radioactive, as defined at 40 CFR 144.3. SDDENR regulates land application under a Groundwater Discharge Permit (GDP). Details about the permitting process and applicable requirements for the deep Class V injection well and land application disposal options are presented in Section 2.1.1.1.6.2.

2.1.1.1.2.4.1 Deep Class V Injection Well Option

The applicant proposes to inject up to 1,135 Lpm [300 gpm] of liquid waste into the Minnelusa and/or Deadwood Formations using a maximum of eight deep Class V injection wells (Powertech, 2011). The proposed locations of the first four Class V injection wells (two near the Burdock central plant and two near the Dewey satellite facility) are shown in Figure 2.1-10.

Deep injection well design and construction must meet EPA requirements (Powertech, 2009c). The proposed deep injection well disposal design is shown in Figure 2.1-11; in this design a cemented steel casing extends from the base of the well to the surface, an internal tubing string is fit with the casing, and a packer seals the casing, just above the point of injection. Fluid is injected through the tubing and through the packer and exits into the injection zone by perforations in the casing (see Figure 2.1-11). Pressure on the fluid-filled annulus between the tubing and well casing must be continuously maintained and monitored to detect leakage of the injection tubing or well casing. The constant pressure on the annulus will be maintained at a minimum of 100 psi above the injection tubing pressure to prevent injected waste fluid from migrating into overlying formations. Operational procedures include MIT of the casing to ensure against well leakage and reporting of MIT test results to EPA as described in SEIS Section 2.1.1.1.2.3.5. The applicant's Class V injection well monitoring program is described in detail in SEIS Section 7.6.

The Class V injection well disposal option requires surface impoundments or ponds for storage and settling of radium before injection into deep disposal wells (Powertech, 2009c, 2011). As described in SEIS Section 2.1.1.2.1, these ponds are designed following NRC requirements (NRC, 2003a, 2008; 10 CFR Part 40, Appendix A, Criterion 5). Deep injection well pond design for the proposed project would include the following:

- Two 0.93-ha [2.3-ac] radium settling ponds, one each in the Dewey and Burdock areas, each with a storage capacity of 1.96 ha-m [15.9 ac-ft]. These ponds would contain production bleed and restoration water and allow radium to settle out of solution.

- Two 0.4-ha [1.0-ac] outlet ponds, one each in the Dewey and Burdock areas, each with a storage capacity of 0.63 ha-m [5.1 ac-ft]. These ponds would intercept treated water from the radium settling ponds and store storm water falling on the radium settling ponds.

- Two 0.45-ha [1.1-ac] surge ponds, one each in the Dewey and Burdock areas, each with a storage capacity of 1.04 ha-m [8.4 ac-ft]. These ponds would contain treated water that is pumped to the disposal wells.

- A 0.61-ha [1.5-ac] central plant pond in the Burdock area with a capacity of 1.96 ha-m [15.9 ac-ft]. This pond would contain brine produced at the Burdock central plant.

- Two 0.93-ha [2.3-ac] spare ponds, one each in the Dewey and Burdock areas, each having a capacity of 1.96 ha-m [15.9 ac-ft]. These ponds would be used for emergency containment should a pond liner fail.

Under these design conditions, ponds for Class V injection well disposal would occupy a total of 2.75 ha [6.8 ac] in the Dewey area and a total of 3.36 ha [8.3 ac] in the Burdock area (Powertech, 2010a). Based on the design for the Class V injection well disposal option, the

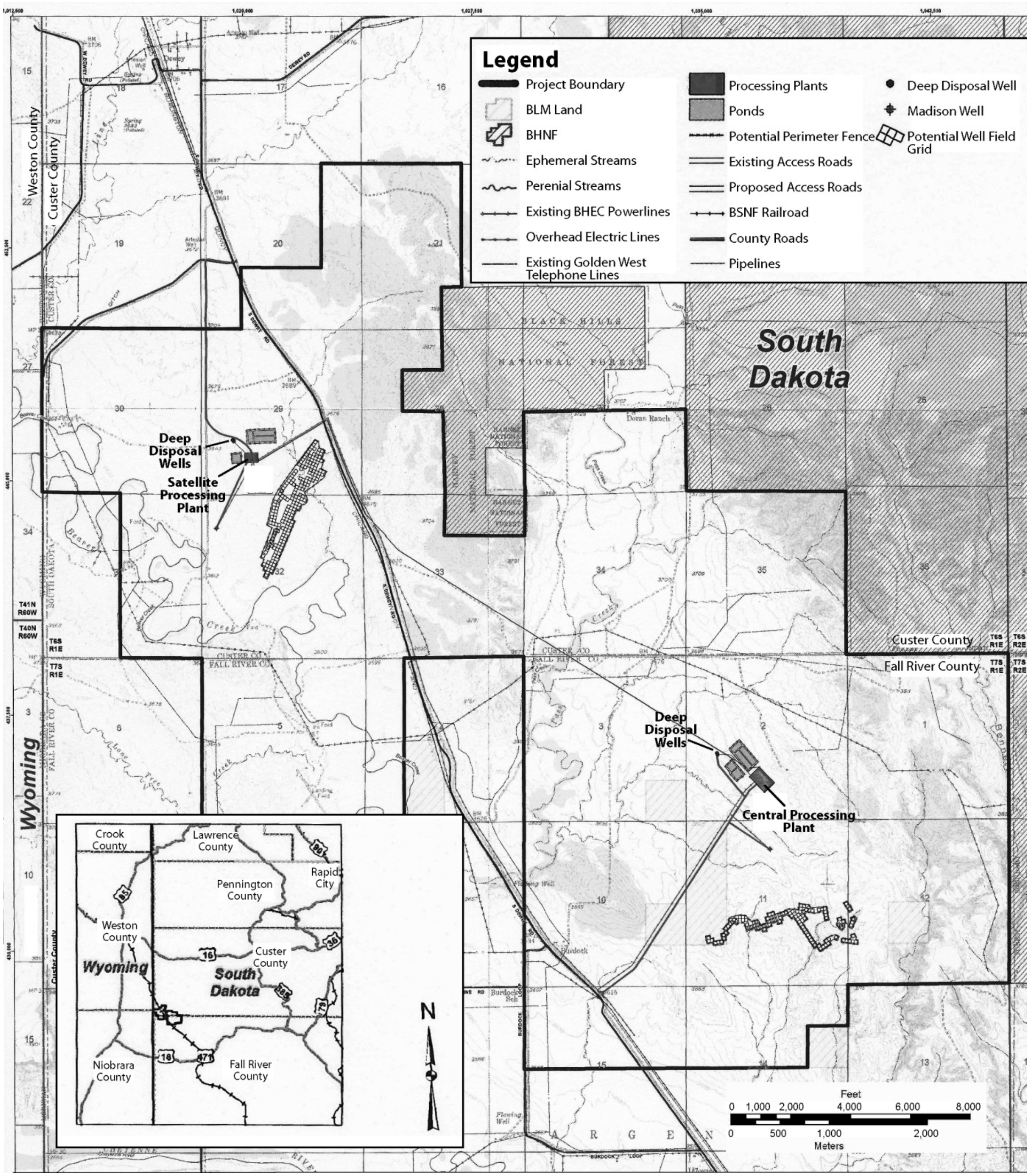

Figure 2.1-10. Location of Deep Injection Wells and Ponds for the Deep Injection Well Disposal Option.
Source: Modified From Powertech (2011).

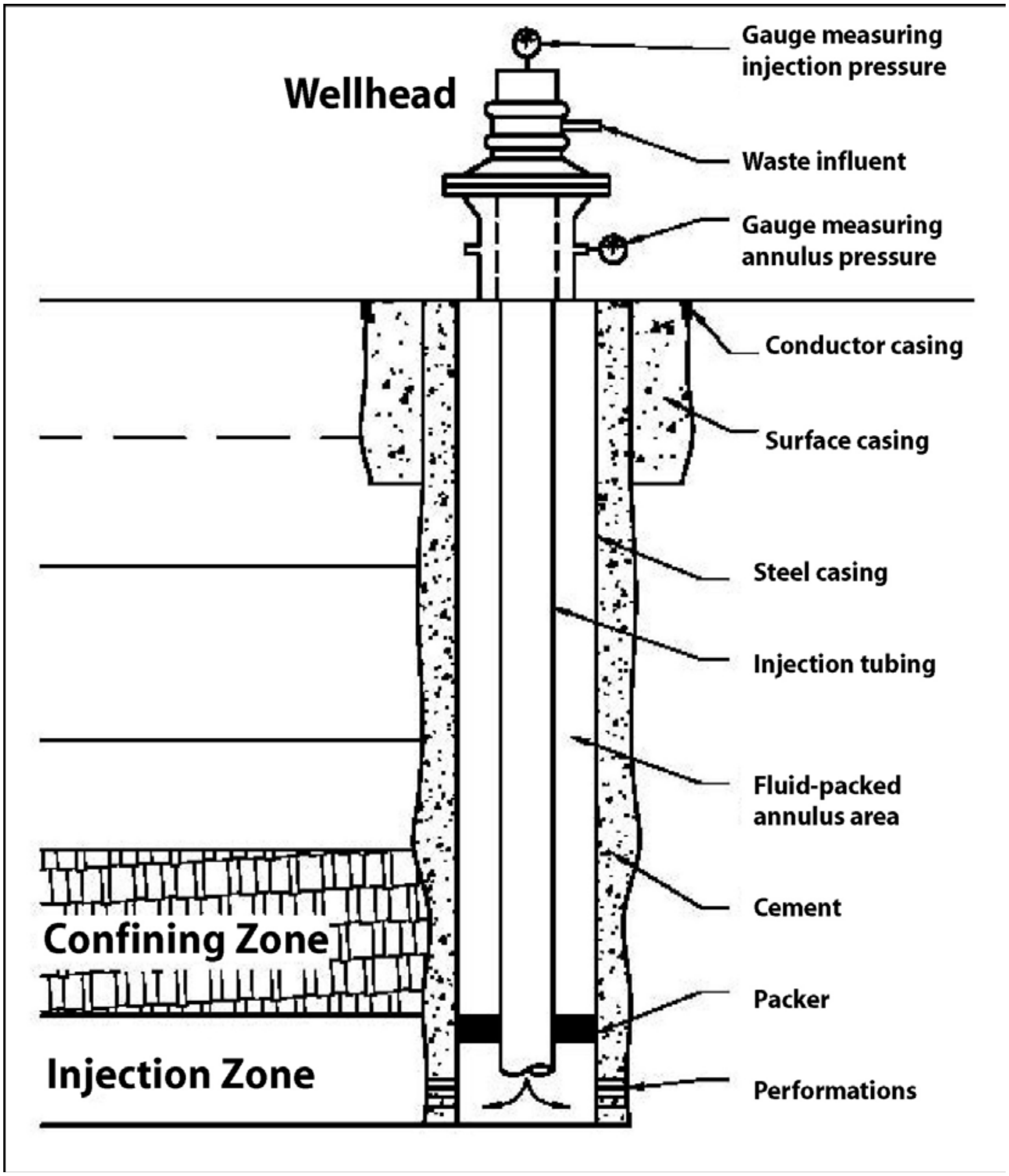

Figure 2.1-11. Schematic of the Design of Deep Injection Well.
Source: Powertech (2009c).

applicant would need to acquire the necessary permits from EPA to ensure compliance with 40 CFR Part 61, Subpart W. All ponds would be designed to store the amount of water discharged to them while maintaining 1 m [3.3 ft] of freeboard (i.e., distance from the water level to the top of the embankment). Control structures, such as collector ditches and berms, would be used to prevent surface runoff for events up to and including a 100-year, 24-hour rainfall event from entering the ponds (Powertech, 2011). The radium settling, spare, and central plant ponds would be constructed with a lining system consisting of the following: (i) an 80-mil HDPE primary liner; (ii) a 60-mil HDPE secondary liner; (iii) a 0.3-m [1-ft]-thick clay liner below the secondary liner; (iv) a geonet drainage layer sandwiched between the primary and secondary HDPE liners; and (v) a leak detection sump and access port system (Powertech, 2009c). All other ponds would contain treated water for deep Class V well injection. These ponds would include a single 40-mil HDPE liner underlain by a 0.3-m [1-ft]-thick clay liner. All ponds would be fenced to restrict and control access.

An inspection program for all ponds would be implemented in accordance with Regulatory Guide 3.11 (NRC, 2008). Inspections would include (i) daily inspections of the liner, liner slopes, and other earthwork features; (ii) daily inspections of pond freeboard; (iii) monthly inspections of leak detection systems or daily checks for water accumulation in leak detection systems; and (iv) quarterly inspections of embankment settlement and slope stability (Powertech, 2011). If inspections reveal damage or defects that could result in leakage, this information would be reported to NRC within 24 hours, and appropriate repairs would be implemented. Significant water found in the standpipes of the leak detection system would be sampled immediately for chloride and conductivity to determine whether the water in the detection system is from the pond. If analysis confirms a leak, a second sample would be collected and analyzed within 24 hours. If the second analysis confirms a leak, the pond would be taken out of service and the leak reported to NRC within 24 hours. The pond taken out of service because of a leak would be drained by transferring its contents to a spare pond until repaired.

2.1.1.1.2.4.2 Land Application Option

For the land application option, liquid waste would be treated in lined settling ponds followed by seasonal application of the treated waste through center pivot irrigation sprinklers (Powertech, 2009c, 2011). The applicant will treat all land application water to meet the requirements of 10 CFR Part 20, Appendix B, Table 2, Column 2, which are the established limits for discharge of radionuclides to the environment and include limits for natural uranium, Ra-226, Pb-210, and Th-230 (Powertech, 2011, 2012). This will be accomplished by IX for uranium removal followed by radium removal through co-precipitation with barium sulfate in radium settling ponds. It is not anticipated that Th-230 and Pb-210 will be present at concentrations above the limits (Powertech, 2012a).

Two land application (irrigation) areas, one in the Dewey area and one in the Burdock area, are proposed for the land application option (Figure 2.1-12). The applicant estimates that the maximum area for land application of treated wastewater would be 426 ha [1,052 ac], including all normally operating irrigation pivots, standby irrigation pivots, and areas constructed to contain surface runoff (Powertech, 2010a). The total irrigated area at any given time in the Dewey area would be 127.5 ha [315 ac], consisting of four 20.23-ha [50-ac] pivots, four 10.12-ha [25-ac] pivots, and one 6.1-ha [15-ac] pivot (Powertech, 2009c). In addition, one 20-ha [50-ac] pivot would be on standby. The total irrigated area at any given time in the Burdock area would also be 127.5 ha [315 ac] but would consist of six 20.23-ha [50-ac] pivots and one 6.1-ha [15-ac] pivot. In addition, two, 10.12-ha [25-ac] pivots and one 6.1-ha [15-ac] pivot would be on standby. Runoff from precipitation events or snowmelt on land application areas will be conveyed to catchment areas downgradient of land application areas and allowed to evaporate or infiltrate (Powertech, 2012a).

Potential wellfields areas at the proposed Dewey-Burdock site (see Figure 2.1-6) overlap with portions of proposed land applications areas illustrated in Figure 2.1-12 (Powertech, 2011). In the Dewey area, only land application areas designated for standby operation overlap with potential wellfields. Standby land application areas would serve as contingency areas and generally would not be used at the same time as the wellfields (Powertech, 2011). In the Burdock area, there is limited potential overlap between proposed land application areas and

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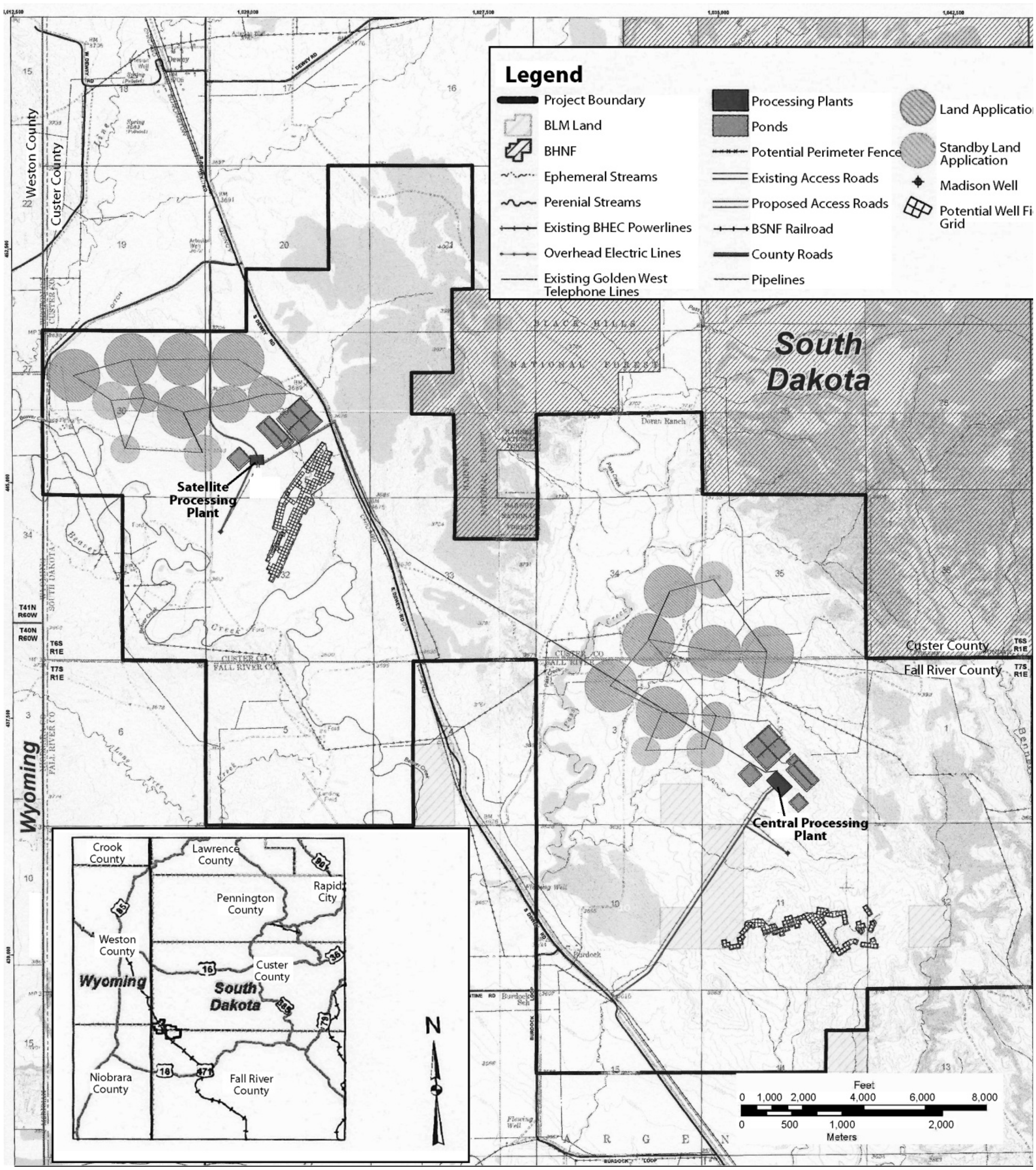

Figure 2.1-12. Location of Land Application Irrigation Areas and Ponds for the Land Application Liquid Waste Disposal Option.
Source: Modified from Powertech (2011).

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proposed wellfields. Overlap in the Burdock area is expected to be limited to areas where perimeter monitor wells are located (Powertech, 2011).

The center pivot irrigation systems would typically operate 24 hours per day during the growing season, which is approximately April through October (Powertech, 2011). The applicant used the SPAW (Soil-Plant-Atmosphere-Water) model to estimate the disposal capacity for the land application option (Powertech, 2011). The model predicted that each land application area would be able to dispose of approximately 1,124 Lpm [297 gpm] from March 29 to May 10; approximately 2,472 Lpm [653 gpm] from May 11 to September 24; and approximately 1,124 Lpm [297 gpm] from September 25 to October 31. During winter months (i.e., November through March), when land application would not be used, treated liquid waste would be temporarily stored in ponds located near the Burdock central plant and Dewey satellite facility (Powertech, 2011). The available storage pond capacity for the treated liquid waste during the nonirrigation winter months would be approximately 62.9 ha-m [510 ac-ft]. In comparison, the applicant estimated the maximum capacity required to store liquid waste throughout the winter months to be approximately 26.6 ha-m [216 ac-ft] using the SPAW model (Powertech, 2011).

In addition to ponds for storage during nonirrigation periods, the land application option requires ponds to permit radium to settle out to levels allowable for land application (Figure 2.1-12). As with the Class V injection well disposal option, pond design would be completed following NRC requirements (NRC, 2003a, 2008; 10 CFR Part 40, Appendix A, Criterion 5). Land application pond design for the proposed project would include the following (Powertech, 2009c, 2011):

- Two 1.62-ha [4.0-ac] radium settling ponds, one each in the Dewey and Burdock areas, each with a storage capacity of 4.86 ha-m [39.4 ac-ft]. These ponds would contain production bleed and restoration water and settle radium out of solution.

- Two 0.32-ha [0.8-ac] outlet ponds, one each in the Dewey and Burdock areas, each with a storage capacity of 0.60 [4.9 ac ft]. These ponds would intercept treated water from the radium settling ponds and store storm water falling on the radium settling ponds.

- Two sets of storage ponds would be used to store treated water during the nonirrigation season:

    — A system of four 1.78-ha [4.4-ac] ponds constructed in the Dewey area, each having a capacity of 7.87 ha-m [63.8 ac-ft].

    — A system of four 1.78-ha [4.4-ac] ponds constructed in the Burdock area, each having a capacity of 7.87 ha-m [63.8 ac-ft].

- Two 1.78-ha [4.4-ac] spare storage ponds, one each in the Dewey and Burdock areas, each having a storage capacity of 7.87 ha-m [63.8 ac-ft]. These ponds would be used for emergency containment should any of the storage ponds fail or portions of the land application system become temporarily inoperable.

- A 1.09-ha [2.7-ac] central plant pond in the Burdock area having a capacity of 4.46 ha-m [36.2 ac-ft]. This pond would contain brine produced at the Burdock central plant.

- Two 1.62-ha [4.0-ac] spare ponds, one each in the Dewey and Burdock areas, each having a capacity of 4.86 ha-m [39.4 ac-ft]. These ponds would be used for emergency containment should a liner on the radium settling ponds fail.

Under these design conditions, land application ponds would occupy 12.5 ha [30.8 ac] in the Dewey area and 13.6 ha [33.5 ac] in the Burdock area (Powertech, 2010a). Based on the design for the land application option, the applicant would need to acquire the necessary permits from EPA to ensure compliance with 40 CFR Part 61, Subpart W. All ponds would be designed to store the amount of water discharged to them while maintaining 1 m [3.3 ft] of freeboard. Control structures, such as collector ditches and berms, would be used to prevent surface runoff for events up to and including a 100-year, 24-hour rainfall event from entering the ponds (Powertech, 2011). As with the Class V injection well option, the radium settling, spare, and central plant ponds would be constructed with a lining system consisting of the following: (i) an 80-mil HDPE primary liner; (ii) a 60-mil HDPE secondary liner; (iii) a 0.3-m [1-ft]-thick clay liner below the secondary liner; (iv) a geonet drainage layer sandwiched between the primary and secondary HDPE liners; and (v) a leak detection sump and access port system (Powertech, 2009c). All other ponds would be constructed with a lining system consisting of a single 40-mil HDPE liner underlain by a 0.3-m [1-ft]-thick clay liner. All ponds would be fenced to restrict and control access.

As described in SEIS Section 2.1.1.1.2.4.1 for the deep Class V injection well option, an inspection and reporting program for land application ponds would be implemented in accordance with Regulatory Guide 3.11 (NRC, 2008). Inspections would include (i) daily inspections of the liner, liner slopes, and other earthwork features; (ii) daily inspections of pond freeboard; (iii) monthly inspections of leak detection systems or daily checks for water accumulation in leak detection systems; and (iv) quarterly inspections of embankment settlement and slope stability (Powertech, 2011).

2.1.1.1.2.4.3 Combined Deep Class V Injection Well and Land Application Option

If Class V injection wells are permitted and constructed but lack sufficient capacity to dispose of the entire waste stream, the applicant would combine the use of Class V injection wells and land application for liquid waste disposal (Powertech, 2011). For the combined waste disposal option, land application facilities and infrastructure (e.g., irrigation areas, storage ponds, center pivot irrigation systems) would be constructed and operated on an as-needed basis depending on the capacity of the Class V injection wells to dispose of the liquid waste stream. As described in the previous section, SDDENR would regulate land application under a GDP. In addition, pond design for the combined Class V injection well and land application option would be completed following NRC regulations and requirements (NRC, 2003a, 2008; 10 CFR Part 40, Appendix A, Criterion 5).

2.1.1.1.2.5 Schedule

The applicant estimates that constructing the buildings, initial wellfields, and waste disposal systems for the proposed Dewey-Burdock ISR Project would take approximately 2 years (Figure 2.1-1). Wellfields would be developed sequentially along with supporting infrastructure, including header houses and pipelines. The construction of subsequent wellfields would begin during the operational stage of the initial wellfields in the Dewey and Burdock areas.

The applicant estimates that 86 workers will be directly involved in the construction phase of the proposed project (Powertech, 2009a). Workers are expected to come from the nearby towns of

Edgemont, Hot Springs, and Custer, South Dakota, and Newcastle, Wyoming. These towns are 21 to 80 km [13 to 50 mi] from the proposed project site.

2.1.1.1.3 Operation Activities

As discussed in GEIS Section 2.4, uranium extraction by the ISR process involves two primary operations. First, uranium mobilization occurs in underground aquifers when lixiviant (leaching solution) is injected into the orebody and uranium-laden solutions are recovered (NRC, 2009a). The uranium-laden solutions, referred to as pregnant lixiviant, are then pumped from the production wells into IX systems within surface facilities, where uranium is recovered and prepared for shipment (NRC, 2009a). The applicant proposes to conduct operations at the proposed Dewey-Burdock ISR Project consistent with those activities described in the GEIS (Powertech, 2009a). These activities are described in the following sections.

2.1.1.1.3.1 Uranium Mobilization

Uranium mobilization would consist of the following steps: (i) injection of lixiviant into the production zone, (ii) oxidation and formation of uranium-bearing aqueous complexes underground, and (iii) extraction (production) and transport of the pregnant lixiviant to the processing facility. The uranium mobilization steps and excursion monitoring of lixiviant are described in the following sections.

2.1.1.1.3.1.1 Lixiviant Chemistry

The applicant proposes to add lixiviant, consisting of varying concentrations of oxygen and carbon dioxide, to the groundwater acquired from onsite wells to promote the dissolution and mobilization of uranium (Powertech, 2009a). The oxygen in the lixiviant oxidizes the uranium from the relatively insoluble, reduced tetravalent state (U^{4+}) to the more soluble, oxidized hexavalent state (U^{6+}). The carbon dioxide in the lixiviant provides a source of carbonate and bicarbonate ions that react with the oxidized uranium to form either dissolved uranyl tricarbonate complexes $[UO_2(CO_3)_3^{-4}]$ or uranyl dicarbonate complexes $[UO_2(CO_3)_2^{-2}]$. The relative abundance of each dissolved uranyl carbonate complex is a function of pH and total carbonate strength. GEIS Table 2.4-1 summarizes typical lixiviant chemistry (NRC, 2009a). As noted in GEIS Section 2.4.1.1, the principal geochemical reactions caused by the lixiviant are (i) oxidation and subsequent dissolution of uranium and other metals from the orebody and (ii) their subsequent extraction (NRC, 2009a).

2.1.1.1.3.1.2 Lixiviant Injection and Production

Lixiviant is pumped down injection wells to the mineralized zones hosted in sandstones in the Fall River and Chilson Member of the Lakota Formations, where it would oxidize and dissolve uranium from the formations. The uranium-bearing solution migrates through the pore spaces in the sandstone and is recovered by production wells. The applicant has estimated that approximately 191 production wells and approximately 406 injections wells would be installed annually over the 8-year operational life of the proposed project (Powertech, 2010c). The applicant estimates production flow rates of 9.084 Lpm [2,400 gpm] in the Burdock area and 6,056 Lpm [1,600 gpm] in the Dewey area (Powertech, 2011). Uranium-enriched pregnant lixiviant would be pumped from production wells to the Burdock central plant or the Dewey satellite facility for uranium extraction by IX. The resulting barren lixiviant would then be refortified with oxygen and carbon dioxide and reinjected into the wellfield to dissolve additional uranium. This process would continue until further uranium recovery is uneconomical.

Production wells are normally positioned to pump pregnant lixiviant from a number of injection wells. As described in SEIS Section 2.1.1.1.2.3.1, square well patterns and sometimes hexagons or triangles would be utilized to access all economically recoverable portions of the uranium ore body. As described in GEIS Section 2.4.3, the production wells at an ISR facility extract slightly more water than is reinjected into the host aquifer to create a net inward flow of groundwater into the wellfield, which minimizes the potential movement of lixiviant and its associated contaminants out of the wellfield. This excess water, referred to as production bleed, is byproduct material that must be properly managed (NRC, 2009a). The applicant proposes to withdraw 0.5 to 3 percent more groundwater than is reinjected (Powertech, 2009a). Production bleed rates would be controlled by withdrawing a small portion of the barren solution from the IX circuit, which would then be disposed of via Class V deep well injection and/or land application in both the Dewey and Burdock areas. Production bleed is detailed in SEIS Section 2.1.1.1.3.3.

2.1.1.1.3.1.3 Excursion Monitoring

GEIS Section 2.4.1.4 describes how ISR operations potentially affect the groundwater quality near a site, if lixiviant moves from the production zone resulting in either a vertical or lateral excursion (NRC, 2009a). The applicant proposes to implement an operational groundwater monitoring program that meets the requirements of 10 CFR Part 40, Appendix A, Criteria 7 and 7A. This program would be designed to detect and correct any condition that could lead to excursions [the unintended spread of lixiviant either horizontally or vertically outside of the production zone (Powertech, 2009a)]. As described in GEIS Section 2.4.3, excursions may be caused by improper water balance between injection and recovery rates, undetected high permeability strata or geological faults, improperly abandoned exploration drill holes, discontinuities within the confining layers, poor well integrity, or unintentional disruption (fracturing) of the ore zone or confining units (NRC, 2009a). The applicant’s proposed excursion monitoring program includes monitoring (i) flow rates, (ii) operating pressures of injection, production, and monitoring wells, and (iii) the flow rates and operating pressures of the main pipelines leading to and from the Burdock central plant and the Dewey satellite facility.

The applicant estimated that approximately 57 monitoring wells would be installed annually over the 8-year operational life of the project (Powertech, 2010c). The applicant proposes to sample the monitoring wells in the ore zone and overlying and underlying aquifers at approximately 2-week intervals (Powertech, 2009a). Samples from these wells would be analyzed for chloride, conductivity, and total alkalinity, and the data would be compared to the upper control limits (UCLs) for these constituents (Powertech, 2011). The applicant would establish UCLs after background water quality is established for the monitor wells in a particular wellfield, as described in SEIS Section 7.3.1.2. The water level in each monitor well would also be measured and recorded prior to each sampling event. Water level and analytical monitoring data for the UCL parameters would be retained onsite for NRC review.

An excursion occurs when two or more excursion indicators in a monitoring well exceed their UCLs (NRC, 2003b). If the concentration of two or three excursion indicators exceeds established UCL concentrations during a sampling event, a second sample would be taken within 48 hours after results of the first analysis are received and analyzed (Powertech, 2011). If an excursion is not confirmed by a second sample, a third sample would be taken within

48 hours after the second set of sampling data are received. If the second or third samples produce results where two or more excursion indicators exceed the UCL concentrations, the well producing these results would be placed on excursion status and corrective action would be required. The first sample results would be considered in error if the second and third samples do not confirm the results from the first sample.

If an excursion is detected, the applicant would be required to notify NRC within 24 hours by telephone or email, and in writing within 7 days; corrective actions should begin immediately. Corrective actions would include increasing sampling frequency to weekly, increasing the pumping rates of production wells in the area of the excursion to increase the net bleed, and pumping individual wells to enhance recovery of solutions. If these actions do not retrieve the excursion within 60 days, the applicant would suspend injection of lixiviant into the production zone adjacent to the excursion until the excursion is retrieved and the UCL parameters are no longer exceeded. Within 60 days of a confirmed excursion, the applicant would be required to file a written report to NRC describing the event and the corrective action taken (NRC, 2003b).

2.1.1.1.3.2 Uranium Processing

Uranium would be recovered from the pregnant lixiviant and processed into yellowcake in a multistep process (NRC, 2009a). The steps include (i) loading of uranium complexes onto IX resin, (ii) eluting (recovering) uranium complexes from the resin, and (iii) precipitating, drying, and packaging of uranium. Figure 2.1-13 shows the general flow of the uranium processing steps for the proposed Dewey-Burdock Project.

2.1.1.1.3.2.1 Ion Exchange

Recovery of uranium from the pregnant lixiviant solution would be accomplished via an IX process. Pregnant lixiviant would be pumped from the wellfields into the IX columns, which contain uranium-specific IX resin beads (Dowex 21K XLT or equivalent) (Powertech, 2009a). As the lixiviant flows through the resin beads, the dissolved uranium complexes in the solution would attach to the resin beads by displacing a chloride ion or bicarbonate ion. The resin would be considered loaded when uranium complexes occupy most of the available sites on the resin beads.

The proposed IX systems at both the Dewey satellite facility and Burdock central plant consist of eight fixed-bed IX columns (Powertech, 2009a). The columns would be operated as four sets of two vessels in series (Figure 2.1-13). The IX vessels are designed to operate in pressurized downflow mode, and each would contain approximately 14.15 m^3 [500 ft^3] of IX resin. The barren lixiviant leaving the IX system will normally contain less than 2 mg/L [2 ppm] uranium (NRC, 2009a).

After the barren lixiviant leaves the IX vessels, the production bleed would be removed and routed to the liquid waste system for deep well injection and/or land application. Carbon dioxide would then be added to the barren lixiviant to return the carbonate/bicarbonate concentration to the desired level. The lixiviant solution would then be pumped back to the wellfield, where oxygen would be added prior to reinjection into the wellfields to repeat the leaching cycle.

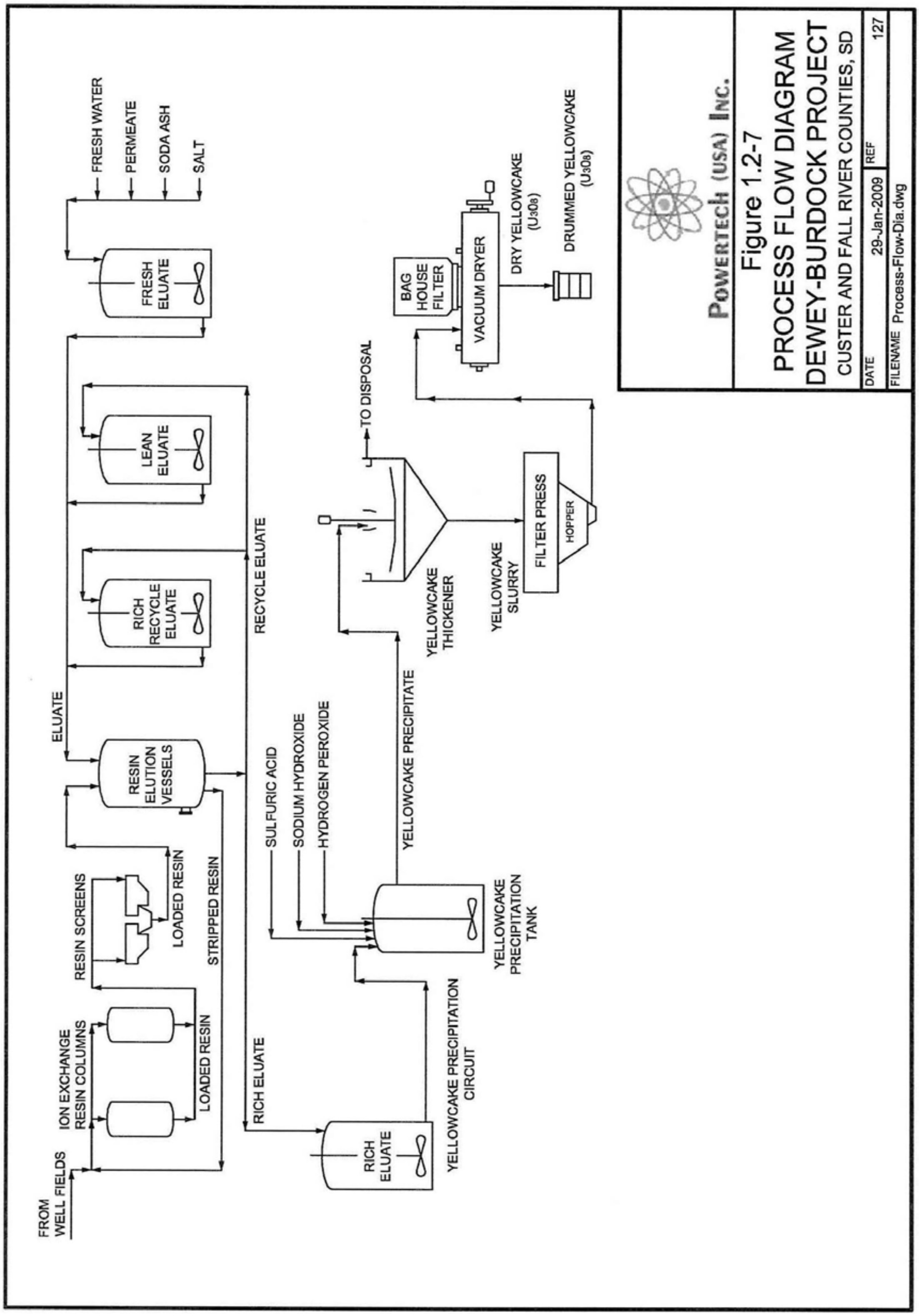

Figure 2.1-13. Overall Process Flow Diagram.
Source: Powertech (2009a).

2.1.1.1.3.2.2 Elution

GEIS Section 2.4.2.2 describes the elution circuit at ISR facilities (NRC, 2009a). The proposed elution circuit at the Burdock central plant is designed to accept and elute uranium-loaded resin from the Burdock central plant and the Dewey satellite facility (Powertech, 2009a).

At the Burdock central plant, resin transfer out of the IX vessels into the elution circuit would be accomplished via resin-transfer piping. Transfer of loaded resin from the Dewey satellite facility to the elution circuit at the Burdock central plant would be accomplished via resin-transfer trucks. Resin-transfer trucks would have one or more compartments with minimum capacities of 14.15 m^3 [500 ft^3] per compartment (Powertech, 2009a). The resin would be hydraulically removed from the compartments and screened for debris and other particulates before transfer into the elution vessels.

An elution process removes the uranyl dicarbonate and uranyl tricarbonate ions from the resin and restores the resin to its chloride form for reuse. Fresh eluant would be prepared by combining saturated chloride (salt) solution and saturated sodium carbonate (soda ash) solution with water, forming a solution that is approximately 10 percent sodium chloride and 2 percent sodium carbonate. The elution circuit proposed for use at the Dewey-Burdock ISR Project is illustrated in Figure 2.1-13. The elution process involves recycling eluant passing through the resin elution vessel to maximize the removal of uranium from the uranium-loaded resins. The applicant estimates the proposed process will remove more than 95 percent of the uranyl carbonate complexes from the resin (Powertech, 2009a).

2.1.1.1.3.2.3 Precipitation, Drying, and Packaging

GEIS Section 2.4.2.3 describes precipitation, drying, and packaging at ISR facilities (NRC, 2009a). The proposed precipitation and drying process at the Burdock central plant uses rich eluate, which has been transferred from the rich eluate tank to a precipitation tank (Figure 2.1-13). Precipitation and drying would be initiated by adding sulfuric or hydrochloric acid to the rich eluate in the precipitation tank to breakdown the carbonate portion of the dissolved uranyl carbonate complex. The proposed process uses hydrogen peroxide to precipitate out the uranium as uranium peroxide (UO_4). Next, sodium hydroxide is added to adjust the pH before the precipitated uranyl peroxide or yellowcake slurry settles. After settling, the yellowcake slurry is pumped to a gravity thickener (Figure 2.1-13). The thickened slurry is pumped to a filter press to remove excess water. The yellowcake slurry is washed with fresh water to remove impurities, especially chloride, and air dried to further reduce the moisture content.

After air drying is complete, the next step of the proposed process moves the filtered yellowcake to a rotary vacuum dryer housed in a separate room of the central plant. The dryer operates at a temperature of approximately 232 °C [450 °F] at full vacuum and has a production rate of 998 dry kg [2,200 dry lb] per day (Powertech, 2009a). The dryer would be operated under a vacuum to reduce the ability of water-soluble uranium oxides and other compounds to form and to pull solids and water vapor toward the center of the system, which helps to prevent unwanted releases. Vapor is pulled from the dryers by sealed liquid ring vacuum pumps and filtered through baghouse filters located on the tops of the dryers; this removes particles larger than 1 micron [3.9×10^{-5} in] in size. The vapor exiting the baghouses would be cooled using condensers to remove water vapor and any remaining smaller sized particulates. Any water in the condensers would be collected and pumped to the solids removal tank in the wastewater system.

Following the drying stage, the yellowcake would be packaged in approved 208-L [55-gal] steel drums and stored within a restricted storage area until shipment offsite (Powertech, 2009a). Onsite inventory of drummed yellowcake typically would not exceed 90,718 kg [200,000 lb]. Packaged yellowcake would be shipped offsite via truck to licensed uranium conversion facilities for further processing. Conversion facilities are currently located in Metropolis, Illinois, and Port Hope, Ontario, Canada. The applicant projects an annual production of 453,600 kg/yr [1 million lb/yr] of yellowcake (as U_3O_8) over the 8-year projected operational life of the proposed Dewey-Burdock ISR Project (Powertech, 2009a).

2.1.1.1.3.3 Management of Production Bleed and Other Liquid Effluents

As stated in GEIS Section 2.4.3, uranium mobilization would produce excess water that must be properly managed (NRC, 2009a). The production wells at any ISR facility extract slightly more water than is reinjected into the host aquifer, which creates a net inward flow of groundwater into the wellfield. This excess water, referred to as production bleed, is byproduct material that must be properly managed. At the proposed Dewey-Burdock ISR Project, the applicant proposes to use the process described in SEIS Section 2.1.1.1.3.2.1. As part of normal operations, the production bleed is diverted from the IX circuit after the uranium is recovered, but before the lixiviant is recharged. The applicant estimates the production bleed would be approximately 0.5 to 3.0 percent of the production flow rate of 9,084 Lpm [2,400 gpm] in the Burdock area and 6,056 Lpm [1,600 gpm] in the Dewey area (Powertech, 2011). The typical production bleed would be approximately 0.875 percent of the production flow rate, or approximately 79.5 Lpm [21 gpm] in the Burdock area and approximately 53 Lpm [14 gpm] in the Dewey area (Powertech, 2011). The bleed rate would be adjusted as necessary to maintain the wellfield cone of depression. The applicant proposes to dispose of production bleed from the Burdock and Dewey areas by deep Class V well injection and/or land application (see SEIS Section 2.1.1.1.6.2).

Other liquid waste streams, including spent elution circuit bleed, liquids from process drains, groundwater generated during aquifer restoration, well development water, pumping test water, and washdown water, would be produced as part of the proposed Dewey-Burdock ISR Project. As described in SEIS Section 2.1.1.1.6.2, these waste streams would be handled in the same manner as the production bleed.

2.1.1.1.3.4 Schedule

The applicant currently plans to develop 10 wellfields in the Burdock area and 4 wellfields in the Dewey area (Figure 2.1-6). The applicant anticipates that production activities in the initial wellfields would commence 2 years after construction begins (Figure 2.1-1). Wellfield operations would continue for 8 years as additional wellfields are completed along the uranium roll fronts in both the Burdock and Dewey areas. The applicant estimated that 84 workers would be directly involved in the operations phase of the proposed Dewey-Burdock ISR Project (Powertech, 2009a). As during the construction phase, some workers would come from the towns of Edgemont, Hot Springs, and Custer, South Dakota, and Newcastle, Wyoming, each of which is 21 to 80 km [13 to 50 mi] away from the proposed project site.

2.1.1.1.4 Aquifer Restoration Activities

GEIS Section 2.5 described aquifer restoration activities within wellfields that ensure water quality in surrounding aquifers would not be adversely affected by the uranium recovery operations (NRC, 2009a). At the end of the uranium recovery process, constituents that were mobilized by the lixiviant remain in the production aquifer. The primary goal of aquifer restoration is to return groundwater quality within the production zone of wellfields to the preoperational water quality conditions or to standards consistent with NRC requirements at 10 CFR Part 40, Appendix A, Criterion 5B(5) (Powertech, 2009b, 2011). 10 CFR Part 40, Appendix A, Criterion 5B(5) requires that groundwater quality in the exempted ore-bearing aquifer be restored to (i) a Commission-approved background (CAB) concentration; (ii) the maximum contaminant levels (MCLs) listed in 10 CFR Part 40, Appendix A, Table 5C, for constituents listed in Table 5C and if the background level of the constituents fall below the listed value; or (iii) an alternate concentration limit (ACL) established by the Commission, if the constituent background level and the values listed in Table 5C are not reasonably achievable. The ACL development is described in SEIS Appendix B. These groundwater quality standards would be implemented, as part of the aquifer restoration phase, to ensure public health and safety. The applicant would also be required to provide financial sureties to cover the costs of both planned and delayed restoration programs, in accordance with 10 CFR Part 40, Appendix A, Criterion 9. NRC reviews financial sureties annually.

Under the Federal UIC program (40 CFR Parts 144 to 146), the exempted production aquifer(s) would no longer be protected under the SDWA as a source of drinking water. In compliance with 40 CFR 146.4, the exempted aquifer(s) does not currently serve as a source of drinking water and cannot now and would not in the future serve as a source of drinking water. Hence, groundwater in exempted aquifers cannot be considered as a source of drinking water after restoration. However, outside of the aquifer exemption boundary, the aquifer is still protected as a source of drinking water, and UIC regulation 40 CFR 144.12 prohibits the movement of any contaminant into the underground source of drinking water located outside the aquifer exemption boundary. Contaminant is defined broadly in the UIC regulations (40 CFR 144.3) to include “any physical, chemical, biological, or radiological substance or matter in water.” Therefore, groundwater at the aquifer exemption boundary must meet 10 CFR Part 40, Appendix A, Criterion 5B(5) water quality requirements.

Before beginning wellfield operations, the applicant must determine background water quality by sampling and analysis of water quality indicator constituents in the mineralized zone(s) and underlying and overlying aquifers across each wellfield (Powertech, 2009b). The applicant would establish target restoration goals [CAB concentrations per 10 CFR Part 40, Appendix A, Criterion 5B(5)] as a function of the average background water quality and the variability in each parameter based on statistical methods (Powertech, 2011). SEIS Section 7.3.1.1 describes these background water quality parameters and methods to be used to establish groundwater restoration targets for the proposed Dewey-Burdock ISR Project.

Background water quality samples obtained from monitoring wells placed in the ore-bearing aquifers, as well as the underlying and overlying aquifers (where present), will be used to define excursion parameters and UCLs. UCLs must be established before ISR operations begin because they are used to control and manage any excursions that may occur during the ISR operation and restoration phases. Groundwater monitoring for selected constituents, throughout the life of the proposed project, is discussed in SEIS Section 7.3.1.2.

2.1.1.1.4.1 Groundwater Restoration Methods

The applicant proposes to begin restoring the initial wellfields in the Burdock and Dewey areas immediately after production activities are terminated (Powertech, 2009a). As new wellfields are opened, the applicant plans to operate one wellfield in restoration and one wellfield in production in both areas during the life of the project. The methods selected for groundwater restoration would depend on the liquid waste disposal option (see SEIS Section 2.1.1.1.2.4). For the Class V injection well option, groundwater treatment using reverse osmosis (RO) with permeate injection would be the primary restoration method (Powertech, 2011).

If land application is used for liquid waste disposal, then groundwater sweep with injection of clean makeup water from the Madison Formation would be used to restore the aquifer. In either case, the applicant proposes to remove at least six pore volumes during aquifer restoration. A pore volume is the volume of water required to replace the water in the volume of aquifer that was mined. Restoration monitoring and stabilization would also be part of the overall restoration program. The groundwater restoration methods and the monitoring and stabilization program proposed for the proposed Dewey-Burdock ISR Project are described in the following sections.

2.1.1.1.4.1.1 Deep Class V Injection Well Option

For the deep Class V injection well disposal option, the primary method of aquifer restoration would be RO treatment with permeate injection. In this method, water would be pumped from the wellfields to the Burdock central processing plant or the Dewey satellite facility for treatment. The water would be treated in IX columns to remove uranium and other dissolved ions and then passed through high pressure RO membranes, which would remove more than 90 percent of the remaining dissolved constituents. The treated effluent, or permeate, would be returned to the wellfields for injection. The RO reject, or brine, would undergo radium removal in the radium settling ponds and then would be disposed of in one or more deep Class V injection wells. The total liquid waste flow rate would be approximately 746 Lpm [197 gpm] during concurrent uranium production and aquifer restoration and approximately 568 Lpm [150 gpm] during aquifer restoration alone (Powertech, 2011). These liquid waste flow rates are lower than the proposed disposal capacity of up to 1,135 Lpm [300 gpm] for the Class V injection well disposal option (see SEIS Section 2.1.1.1.2.4.1).

About 70 percent of the water withdrawn from the wellfields and passed through the RO membranes will be recovered as permeates. Before reinjection into the wellfields, the permeate would be supplemented with makeup water from wells in the Madison Formation and injected into the wellfields at an amount slightly less than the amount withdrawn to maintain a slight restoration bleed. The restoration bleed would maintain hydraulic control of the wellfields during aquifer restoration and would typically be 1 percent of the restoration flow.

2.1.1.1.4.1.2 Land Application Option

For the land application disposal option, the primary method of aquifer restoration would be groundwater sweep with Madison Formation water injection (Powertech, 2011). In this method, water would be pumped to the Burdock central processing plant or Dewey satellite facility for removal of uranium and other dissolved species in IX columns. The partially treated water would undergo radium removal in the radium settling ponds and then would be disposed of in land application areas. The typical liquid waste flow rates for the land application option would be approximately 2,070 Lpm [547 gpm] during concurrent uranium production and aquifer restoration and approximately 1,892 Lpm [500 gpm] during aquifer restoration alone. The combined disposal capacities of the Burdock and Dewey land application areas would be sufficient to dispose of the liquid waste streams during the spring, summer, and fall months (see SEIS Section 2.1.1.1.2.4.2). In addition, excess capacity would be present during these months to dispose of stored liquid waste from the winter months. None of the water recovered from the wellfields would be reinjected back into the wellfields. Instead, makeup water for the Madison Formation would be injected into the wellfields at a flow rate sufficient to maintain the restoration bleed, which would typically be 1 percent of the restoration flow rate (Powertech, 2011).

2.1.1.1.4.1.3 Optional Groundwater Sweep

Although a 1 percent restoration bleed would typically be used to maintain hydraulic control of wellfields, higher bleed rates may be required to recover flare (i.e., outward spreading) of lixiviant from the wellfield pattern areas during aquifer restoration. If necessary, the applicant has proposed to increase the restoration bleed by withdrawing up to one pore volume of water through groundwater sweep over the course of aquifer restoration, which would result in an average restoration bleed of approximately 17 percent, or approximately 159 Lpm [42 gpm] of water being removed from the production aquifer under both disposal options (Powertech, 2011).

2.1.1.1.4.2 Restoration Monitoring and Stabilization

During aquifer restoration, lixiviant injection stops and groundwater transfer, sweep, and/or treatment are used to attempt to restore the production aquifer groundwater quality to original background levels. Stopping lixiviant injection reduces the potential for an excursion and reduces the frequency of sampling the monitoring wells. The applicant's restoration monitoring program for the proposed project would include taking samples from monitoring wells, overlying aquifer wells, and underlying aquifer wells every 60 days during the restoration phase of operations (Powertech, 2009b). The samples would be analyzed to determine whether background water quality conditions have been restored in the wells. Water levels in wells would be measured prior to sampling. If unforeseen conditions, such as snowstorms, flooding, and equipment malfunctions, make monitoring impossible for 65 days, the applicant would be required to report this condition to NRC (Powertech, 2009b).

The applicant would maintain hydraulic control of each wellfield through the end of aquifer restoration. Verification of hydraulic control would be performed through water level measurements in perimeter monitor wells (Powertech, 2011). Water levels in the perimeter monitor wells would be measured continuously using pressure transducers to confirm hydraulic wellfield control. Aquifer restoration would be complete when the applicant demonstrates that water quality conditions have been restored in accordance with 10 CFR Part 40, Appendix A, Criterion 5B(5) requirements. These standards are either CAB water quality; water quality equivalent to the MCLs provided in the table in 10 CFR Part 40, Appendix A, Criterion 5C; or water quality equivalent to or an ACL NRC established in accordance with Criterion 5B(6). The NRC process for reviewing and approving ACLs is found in SEIS Appendix B.

After NRC determines the production area is restored, the applicant would implement a groundwater stability monitoring program for a minimum of 12 months. The results of the monitoring program determine whether the approved standards for each constituent have been met and whether any adjacent nonexempt aquifers are affected (Powertech, 2009b, 2011). Over the 12-month minimum stability monitoring period, there would be an initial sampling event at the beginning of the stability monitoring period followed by the sampling events described next (Powertech, 2011):

- Perimeter monitor wells in the production zone and monitor wells in the overlying and underlying aquifers would continue to be sampled once every 60 days for the UCL indicator excursion parameters of chloride, total alkalinity, and conductivity. The applicant would contact NRC if any of the wells cannot be monitored within 65 days of the last sampling event due to unforeseen conditions, such as snowstorms, flooding, and equipment malfunctions.

- Quarterly, the production zone wells would be sampled and analyzed for the water quality parameters listed in SEIS Table 7.3-1. The criteria to establish successful stability are as follows: for each sampling event, the mean concentration of each water quality parameter must meet the target restoration goal established for that parameter.

If the analytical results from the stability monitoring program meet the target restoration goals and do not exhibit significant increasing trends, the applicant would (i) submit supporting documentation to NRC showing that the restoration parameters have remained at to below the restoration standards and (ii) request that the wellfield be declared restored (Powertech, 2011).

2.1.1.1.4.3 Schedule

The applicant estimates that wellfield restoration in the Burdock and Dewey areas would commence immediately after production activities in the wellfields end. The applicant projected that restoration of the first wellfields would begin 2 years after production activities commence and would continue for 9 years (see Figure 2.1-1). As additional wellfields are brought into production in the Burdock and Dewey areas, the applicant would operate simultaneously one wellfield in restoration phase for each wellfield in production phase. The applicant estimates nine workers would be directly involved in aquifer restoration activities (Powertech, 2009a). Most workers would come from Edgemont, Hot Springs, and Custer, South Dakota, and Newcastle, Wyoming, which are 13 to 80 km [21 to 50 mi] from the proposed project site.

2.1.1.1.5 Decontamination, Decommissioning, and Reclamation Activities

Decommissioning of the proposed Dewey-Burdock ISR Project would require an NRC-approved decommissioning plan. All decommissioning activities would be carried out in accordance with 10 CFR Part 40 and other applicable regulatory standards (Powertech, 2009b). GEIS Section 2.6 (NRC, 2009a) describes the general processes for the decontamination, decommissioning, and reclamation of an ISR facility. NRC regulations require a licensee to submit a detailed decommissioning plan for NRC review and approval at least 12 months before final decommissioning is planned. NRC evaluates a proposed decommissioning plan, and if approved, the plan becomes an amendment to the license. Only after receiving NRC approval of a plan may a licensee initiate the decommissioning process. Unless the Commission approves an alternative schedule for completion of decommissioning, pursuant to 10 CFR 40.42(i), the licensee would be required by 10 CFR 40.42(h)(1) to complete decommissioning as soon as practicable but no later than 2 years after approval of the decommissioning plan.

Before the property is released for unrestricted use, the licensee would conduct a comprehensive radiation survey to establish that the levels of various constituents are within limits identified in 10 CFR Part 40, Appendix A. The applicant would be required to return all lands to their previous land use, unless the landowner justified an alternative and the state approved the alternative. For example, a landowner could decide to retain access roads. The goal of the decommissioning and reclamation process would be to return disturbed lands to a production use equal to or better than that which existed prior to uranium recovery. As part of the decommissioning and reclamation process, the applicant would (i) plug and abandon wells, (ii) reclaim disturbed lands, (iii) remove contaminated equipment and materials, (iv) establish appropriate cleanup criteria for structures, (v) decontaminate to NRC requirements items to be released for unrestricted use, and (vi) survey soils and structures to identify residual contamination.

On BLM-administered land, the licensee must comply with reclamation requirements in 43 CFR Part 3800 to assure that there is no unnecessary or undue degradation of public surface lands. These reclamation requirements include standards for (i) plugging and abandoning wells, (ii) removing pipelines, (iii) replacing topsoil, (iv) controlling weeds, (v) restoring acceptable physical and chemical properties to affected soils, (vi) restoring land to blend with adjoining topography, and (vii) seeding and restoring native vegetation. The following sections describe the general decommissioning activities proposed for the Dewey-Burdock ISR Project.

2.1.1.1.5.1 Radiological Surveys and Contamination Control

The applicant proposes to conduct pre-decommissioning radiological surveys of the Dewey-Burdock ISR Project to identify areas that would need to be cleaned to applicable regulatory limits (NRC, 2009a). Decommissioning surveys of soils, structures, and equipment would be required. The results of these surveys would be used to determine how best to handle contaminated soils, structures, or other materials.

The applicant has committed to conducting land cleanup in accordance with 10 CFR Part 40, Appendix A, Criterion 6(6) and SDDENR regulations (Powertech, 2011). Radiation surveys would be conducted to determine whether any contaminated areas exist. The most likely areas of contaminated soils would be wellfield surfaces and mud pits, surface impoundment bottoms and berms, process building areas, storage yards, transportation routes for uranium recovery products or contaminated materials, and pipeline runs. Areas near deep Class V disposal wells and areas used for land application of treated water would also be surveyed and decontaminated as necessary. NRC would review and approve survey and sampling results. Contaminated soil would be removed and disposed, as byproduct material, at a licensed disposal facility. Pond liners and leak detection systems would also be surveyed. If radiological contamination were found, the liners and detection systems would be removed and disposed of in a licensed disposal facility.

2.1.1.1.5.2 Wellfields

Wellfield decommissioning and surface reclamation would be initiated when the regulatory agencies concur that the groundwater in a wellfield has been adequately restored and that the water quality is stable (NRC, 2009a). Decommissioning and decontamination of wellfields would include well abandonment; the removal of piping, tanks, ancillary buildings, and equipment; cleaning surface soils to the radiological standards provided in 10 CFR Part 40, Appendix A, Criterion 6; and revegetation of disturbed areas (Powertech, 2009b). To prevent adverse impacts to groundwater quality, all production, injection, and monitoring wells, as well as all drill holes, would be abandoned in place according to SDDENR regulations established in ARSD 74:11:08 (Powertech, 2009a). Well abandonment would require plugging wells with bentonite or cement grout (Powertech, 2009b, 2011). Prior to abandonment wells must be opened to remove debris and equipment (e.g., tubing, pumps, and screens) to prevent obstacles from interfering with plugging operations. Wellhead casing would be removed to a depth of 1 m [3 ft] below the ground surface and set in a cement plug 2 m [6 ft] below ground surface on each well or borehole plugged and abandoned (Powertech, 2009b, 2011).

Wellfield reclamation would involve removing surface and subsurface equipment including injection and production feed lines, header houses, electrical and control distribution systems, well boxes and wellhead equipment, and buried piping. NRC decommissioning guidelines require surveying all piping, equipment, buildings, and wellhead machinery for contamination prior to release. If still usable, wellfield piping, well heads, and associated equipment would be moved to new production areas. When the final production area is reclaimed, all contaminated piping, well heads, and associated equipment that is not salvageable would be removed to an NRC-approved disposal facility. A final background gamma survey would identify contaminated earthen materials requiring removal (Powertech, 2009b). As final steps, the wellfield surface would be recontoured where necessary and revegetated (Powertech, 2009b).

The applicant would be required to provide a land reclamation plan to NRC for review and approval within 12 months before wellfield reclamation begins. The plan would include descriptions of the areas to be reclaimed, the planned reclamation activities, methods to protect workers and the environment against radiation hazards, and a cost estimate for reclamation (Powertech, 2009b).

2.1.1.1.5.3 Process Buildings and Equipment and Other Structures

After groundwater is restored in the final production area, the Burdock central plant, the Dewey satellite facility, and auxiliary facilities associated with both areas would be decommissioned. All processing equipment associated with the central plant and the satellite facility would be dismantled and either sold to another NRC-licensed facility or decontaminated in accordance with NRC regulations and guidance documents. Materials that cannot be decontaminated would be disposed of at an NRC-approved facility. Decontaminated materials would be reused, sold, or removed and disposed of offsite. After the dismantling and removal of buildings is completed, the former building sites would be contoured to blend in with the surrounding terrain. Gamma surveys would be conducted to verify that radiation levels are within acceptable limits (Powertech, 2009b).

2.1.1.1.5.4 Engineered Structures and Access Roads

After final site decontamination and decommissioning is complete, site access and wellfield access roads would be reclaimed. If landowners prefer, the roads may be left in place for their private use. BLM, however, requires complete reclamation of roads on BLM-managed lands. Where the access roads are reclaimed, they would be ripped up and/or disked to relieve compaction; gravel would be removed from road surfaces. Culverts would also be removed, and pre-mining drainage patterns would be reestablished. In addition to being graded, all roads and ditches would be recontoured to blend in with the surrounding terrain; topsoil would be reapplied uniformly onto road surfaces prior to revegetation (Powertech, 2009b).

2.1.1.1.5.5 Final Contouring and Revegetation

Once the proposed Dewey-Burdock Project is complete, all disturbed lands will be returned to their preproduction uses for livestock grazing and as wildlife habitat. Surface reclamation and decommissioning efforts would be conducted to return the disturbed lands to their original or better condition. Disturbed lands would be restored to blend with the contour of adjoining topography. Topsoil removed and stored during construction would be reapplied during the reclamation process. Soil amendments, which may include chemical amendments, may be necessary to restore acceptable physical and chemical properties to any soils exhibiting salinity and/or sodium accumulations or other obstacles to reclamation. Revegetation of the project area is the final state of reclamation and would involve seeding the area with a seed mixture approved by SDDENR, the local conservation district, BLM, and landowners. SDDENR would determine when revegetation is complete and when the conditions for bond release have been met (Powertech, 2009b).

2.1.1.1.5.6 Schedule

The applicant estimates that decommissioning of the Burdock central plant and Dewey satellite facility would take 2 years to complete. There would be some overlap between wellfield decommissioning and the groundwater restoration activities as shown in Figure 2.1-1. Wellfield decommissioning is estimated to continue for 8 years and would proceed sequentially as production and restoration activities are completed in each wellfield. The applicant estimates that nine workers would be directly involved in the reclamation and decommissioning phases of the proposed project (Powertech, 2009a). The majority of these workers would come from towns such as Edgemont, Hot Springs, and Custer, South Dakota, and Newcastle, Wyoming, each of which is 13 to 80 km [21 to 50 mi] from the proposed project site.

2.1.1.1.6 Effluents and Waste Management

All phases of the proposed action, construction, operation, aquifer restoration, and decommissioning would generate effluents and waste streams that must be handled and disposed of properly. This section describes the types and volumes of effluents or wastes the applicant estimates would be generated during the life of the proposed Dewey-Burdock ISR Project. Definitions of the liquid and solid wastes that would be generated are found in the text box in SEIS Section 2.1.1.1.6.2. The proposed disposal methods and locations for liquid and solid wastes are described in SEIS Section 3.13. The potential impacts of generating and disposing of these types of waste are detailed in SEIS Section 4.14. Air quality and air emission impacts are provided in SEIS Sections 3.7 and 4.7. Transportation of waste materials for offsite disposal is described in SEIS Section 2.1.1.1.7. Regional transportation conditions are found in SEIS Section 3.3, and the potential impacts on transportation are detailed in SEIS Section 4.3.

2.1.1.1.6.1 Gaseous or Airborne Particulate Emissions

Gaseous or airborne particulate emissions generated during the life of the Dewey-Burdock ISR Project would primarily consist of fugitive dusts, combustion engine exhaust, radon gas emissions from various stages of the processing system, and uranium particulate emissions from yellowcake drying (Powertech, 2009a).

2.1.1.1.6.1.1 Nonradiological Emissions

Fugitive dust and engine exhaust emissions would be generated primarily from vehicle traffic, ground-surface-disturbing construction and decommissioning activities, and diesel construction equipment including well drill rigs and water trucks (Powertech, 2009a). Combustion emissions include greenhouse gases and National Ambient Air Quality Standards-regulated pollutants. Fugitive dust sources include vehicular travel on unpaved roads and land disturbance associated with the construction of wellfields, roads, and support facilities. The applicant proposes imposing speed limits on unpaved roads, encouraging carpooling, and promptly restoring disturbed areas to limit dust generation, traffic, and erosion (Powertech, 2009a). Combustion emission sources from onsite and offsite sources would include construction equipment and trucks transporting materials and product. Point or stationary source emissions would be limited to equipment like propane heaters and emergency generators. These stationary emissions would represent a small portion of the overall emissions. SEIS Section 3.7.2.1 identifies the prevailing wind direction as from the southeast, which would result in dust being moved in a northwest direction. All four phases of the proposed action are expected to produce nonradiological emissions.

Combustion exhaust emission estimates for non-greenhouse gases would be produced by (i) stationary sources, (ii) mobile construction and drilling field equipment, and (iii) other mobile sources excluding commuters. Table 2.1-1 presents estimates for combustion emission mass flow rates (i.e., mass of pollutant generated annually) from stationary sources during each of the four phases of the proposed action. Table C–1 details these stationary sources estimates. Table 2.1-2 presents estimates for combustion emission mass flow rates from mobile sources for each phase. Two types of construction phase emission estimates were provided in Table 2.1-2. The construction phase in project year one consists of two main activities: facilities construction and wellfield construction. Therefore, one emission estimate includes both activities. Facilities construction will be completed at the end of project year one. The construction phase associated with the

remaining life of the project is limited to wellfield construction. Therefore, the other emission estimate is for wellfield construction only. Table C–2 details the mobile source estimates. Commuter traffic was not included in the combustion emission estimates for mobile sources, because the magnitude of proposed road vehicle activity is small relative to existing regional road traffic (see SEIS Section 4.3) and the EPA regulates emission standards for the manufacture of new motor vehicles. The calculation of the mobile emission inventory in Table 2.1-2 incorporates mitigation that the applicant has committed to perform. These

Table 2.1-1. Nonradiological Combustion Emission Mass Flow Rate Estimates (Metric Tons per Year*) From Stationary Sources for Various Phases of the Proposed Action

Project Phase	PM_{10}†	SO_2†	NOx†	CO†	TOC†	Aldehydes
Construction	0	0	0	0	0	0
Operations	0.135	0.00212	2.40	1.35	0.187	0.00
Aquifer Restoration	0	0	0	0	0	0
Decommissioning	0	0	0	0	0	0

Source: Modified from Powertech (2010a)
*To convert metric tons to short tons, multiply by 1.10231.
†PM_{10} = particulate matter 10 micrometers or less; SO_2 = sulfur dioxide; NOx = nitrogen oxide; CO = carbon monoxide; TOC = total organic carbon

Table 2.1-2. Nonradiological Combustion Emission Mass Flow Rate Estimates (Metric Tons* per Year) From Mobile Sources for Various Phases of the Proposed Action

Pollutant	Phase: Construction†: Facilities and Wellfields	Phase: Construction†: Wellfield Only	Phase: Operation	Phase: Aquifer Restoration	Phase: Decommissioning	Total‡
Particulate Matter PM_{10}	3.8	3.4	0.8	0.09	0.5	4.8
Particulate Matter $PM_{2.5}$	3.7	3.2	0.8	0.09	0.5	4.6
Sulfur Dioxide	10.3	9.16	1.8	0.09	2.0	13.0
Nitrogen Oxides	65.2	57.5	13.7	1.1	11.5	83.8
Carbon Monoxide	67.2	62.7	9.1	0.7	6.6	79.1
Total Hydrocarbon	21.2	16.7	17.8	2.3	5.9	42.7
Formaldehyde	2.4	2.2	0.7	0	0.5	3.4

Source: Modified from Powertech (2012)
*To convert metric tons to short tons, multiply by 1.10231.
†Two types of construction phase emission estimates were provided. Construction (facilities and wellfields) only occurs in project year 1 (i.e., facility construction complete after project year 1). In subsequent project years, construction (wellfield only) occurs.
‡Total accounts for when all four phases occur simultaneously and represents the highest amount of mobile source emissions the proposed action would generate in any one project year. Project year 1 only includes the construction phase (i.e., no overlap with other phases), and facilities construction only occurs in project year 1. Therefore, the construction—wellfield only—is used when calculating the total.

mitigation commitments are described in SEIS Section 4.7, and the manner in which the mitigation was incorporated into the calculation of the emission inventory is provided in Section C.2.1.

ISR phases may occur simultaneously. To account for overlapping phases, a total emission estimate was calculated by adding together the annual emissions from all four phases. This total or peak year estimate accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed action would generate in any one project year. Table 2.1-3 contains the peak year estimate for when the stationary (see Table 2.1-1) and mobile source (see Table 2.1-2) emissions are combined.

Expressing the proposed project's emissions in concentrations can help characterize the magnitude of the emission levels because regulatory standards, such as NAAQS and Prevention of Significant Deterioration, are also expressed in concentrations. The AERMOD dispersion model was used to predict pollutant concentrations at 47 locations on and in the vicinity of the proposed site based on the annual emission mass flow rates from the sources in Tables 2.1-1 and 2.1-2. These concentrations were calculated for the construction, operation, aquifer restoration, and decommissioning phases and based on the emission estimates from stationary and mobile sources. Figure 4.7-1 in this SEIS identifies the locations. Tables C–5 to C–8 detail the modeling results. This modeling used the initial emission inventory the applicant provided (Powertech, 2010a). However, the applicant revised the mobile source emission inventory in part to incorporate mitigation and improve the accuracy (Powertech, 2012b). Section C.2.1 describes the differences between the initial and revised emission inventory. The

Table 2.1-3. Total (i.e., Peak Year) Nonradiological Combustion Emission Mass Flow Rate (Metric Tons* per Year) Estimates for All Phases and Both Stationary and Mobile Sources

Pollutant	Total (i.e., Peak Year)
Particulate Matter PM_{10}†	4.9
Sulfur Dioxide	13.0
Nitrogen Oxides	86.2
Carbon Monoxide	80.4
Total Hydrocarbon	42.9
Formaldehyde	3.4

Source: Stationary source values from Powertech (2010a) and mobile source values from Powertech (2012)
*To convert metric tons to short tons, multiply by 1.10231.
†Stationary source emission inventory for $PM_{2.5}$ not available.
‡Stationary source value was for total organic carbon rather than total hydrocarbon.

applicant committed to perform air dispersion modeling using the revised emission inventory before preparing the final SEIS (Powertech, 2012b). However, this updated modeling has not yet been provided to NRC. Therefore, the modeling results based on the initial inventory were used to generate the peak year pollution concentrations for the updated emission inventory. Section C.2.3 explains this process. Table 4.7-1 in this SEIS contains the peak year pollutant concentrations from combustion emission from stationary and mobile sources. This table also compares these concentrations to NAAQS and Prevention of Significant Deterioration standards. These standards are described in SEIS Section 3.7.2. Tables 2.1-1 to 2.1-3 and Table 4.7-1 summarize the detailed emission estimates presented in Appendix C.

Combustion exhaust estimates for greenhouse gas emissions fall into three source categories. The first category consists of stationary sources. The second category consists of mobile sources, which include construction and drilling equipment and other mobile sources excluding commuter vehicles. Emissions from commuter traffic are not included in the combustion emission estimates, because the amount of proposed road vehicle activity is small relative to existing regional road traffic (see SEIS Section 4.3) and the EPA regulates emission standards for the manufacture of new motor vehicles. The third category consists of indirect emissions from electricity consumption (i.e., emissions associated with the production of the electricity that the proposed project consumes). Table 2.1-4 presents the greenhouse gas emission estimates for the proposed action. Emission estimates are provided for each of the three source categories for each of the four phases of the proposed action. Table 2.1-4 summarizes the detailed emission estimates presented in Appendix C. Chlorofluorocarbon and hydrochlorofluorocarbon greenhouse gases were not included in the analysis, because these emissions are not expected.

NRC staff believes that any emissions of volatile organic compounds from the potential land application of liquid byproduct material described in SEIS Section 2.1.1.1.6.2 would be negligible. The ISR process as described in SEIS Section 2.1.1.1.3.2 does not introduce or utilize volatile organic compounds. Furthermore, the list of constituents in the example ISR liquid waste stream from the GEIS does not include any volatile organic compounds (NRC, 2009a, Table 2.7-3). As described in Table 2.1-8, both NRC and SDDENR regulate land application of this liquid waste stream.

Fugitive dust emissions would be mainly produced by vehicle travel on unpaved roads and wind erosion to disturbed land. Table 2.1-5 contains the fugitive emission mass flow rate estimates from travel on unpaved roads. This table provides emission estimates for the projected related

Table 2.1-4 Annual Greenhouse Gas Emission Estimates in Metric Tons/Year* for the Proposed Action

	Stationary Sources			Mobile Sources			Electrical Consumption			All Sources			Total
	CO_2†	CH_4†	N_2O†	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e
Construction	0	0	0	21,841	6.14	2.67	542	0.09	0.5	22,383	6.23	3.17	23,748
Operations	2,242	0.19	0	21,704	15.21	5.38	22,098	2.4	23.8	46,044	17.8	29.2	55,764
Aquifer Restoration	0	0	0	534	3.62	1.17	6,685	0.7	7.2	7,219	4.32	8.37	9,949
Decommissioning	0	0	0	3,383	2.64	1.03	542	0.09	0.5	3,925	2.73	1.53	4,564

Source: Modified from Powertech (2010a)
*To convert metric tons to short tons, multiply by 1.10231.
†CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide

Table 2.1-5. Fugitive Emission Mass Flow Rate Estimates (Metric Tons* per Year) from Travel on Unpaved Roads

	Onsite Fugitive Emissions		Offsite Fugitive Emissions	
Phase	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Construction: Facilities + Wellfields	290.7	29.1	159.7	16.0
Construction: Wellfields Only	229.5	22.9	95.3	9.5
Operation	155.6	15.6	132.6	13.3
Aquifer Restoration	11.8	1.2	12.0	1.2
Decommissioning	84.9	8.5	60.5	6.0
Total†	481.8	48.2	300.4	46

Source: Modified from Powertech (2012)
*To convert metric tons to short tons, multiply by 1.10231.
†Calculation for total (i.e., peak year) emissions used construction (wellfield only). Construction of facilities only occurs in project year one, and construction is the only phase that occurs in project year one. Therefore, facility construction emissions do not overlap with other phases.

vehicle traffic both onsite and offsite. The offsite project fugitive emissions are mostly from commuter vehicles. The onsite emissions include the commuter vehicles and the various construction and drill field equipment. This table also provides a peak year estimate for when all four phases occur simultaneously. Just like the combustion emissions, two types of construction phase estimates were provided. The calculation of the fugitive emission inventory in Table 2.1-5 incorporates mitigation that the applicant has committed to perform. The mitigation commitment is described in SEIS Section 4.7, and the manner in which the mitigation was incorporated into the calculation of the emission inventory is provided in Section C.4. Table 2.1-6 contains the fugitive mass flow rate emissions from wind erosion. The annual wind erosion estimates levels did not vary much over the span of the project. The amount of fugitive emissions from wind erosion is a function of the amount of disturbed land. The two liquid waste disposal options, deep Class V well disposal and land application, did vary in the amount of land disturbed. Therefore, the information in Table 2.1-6 is provided for each liquid waste disposal option.

Table 2.1-6. Onsite Fugitive Emission Mass Flow Rate Estimates (Metric Tons* per Year) from Wind Erosion for the Deep Class V Well and Land Application Disposal Options

Pollutant	Deep Class V Well Disposal	Land Application Disposal
Particulate Matter PM_{10}†	10.1	29.7
Particulate Matter $PM_{2.5}$‡	1.5	4.4

Source: Modified from Powertech (2012) and Inter-Mountain Labs (2012)
*To convert metric tons to short tons, multiply by 1.10231.
†Annual values varied slightly over the project lifetime. Reported values are maximums. Minimum values could be as much as 2.5 metric tons lower.
‡Annual values varied slightly over the project lifetime. Reported values are maximums. Minimum values could be as much as 0.4 metric tons lower.

The applicant revised the initial fugitive emission inventory at the same time the combustion emission inventory was updated (Powertech, 2012b). The information in Tables 2.1-5 and 2.1-6 comes from the revised emission inventory. The applicant revised the inventory in part to incorporate mitigation and improve accuracy. Section C.2.4 describes the differences between the initial and revised inventory. The applicant committed to perform air dispersion modeling using the revised emission inventory before the final SEIS is prepared (Powertech, 2012b).

GEIS Section 1.7.2 describes air permitting. Briefly, the Clean Air Act permitting process is divided into two programs: the New Source Review program (preconstruction) and the Title V program (operation). The New Source Review requires stationary air pollution sources to obtain permits prior to construction. Three types of New Source Review permits exist: (i) Prevention of Significant Deterioration, (ii) nonattainment New Source Review, and (iii) minor New Source Review. In attainment areas (i.e., those areas where air quality meets the National Ambient Air Quality Standards), Prevention of Significant Deterioration permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in an attainment area is based on the potential to emit either 90.7 or 227 metric tons [100 or 250 short tons] of a regulated pollutant, depending on the source. In nonattainment areas, the nonattainment New Source Review permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in a nonattainment area is generally based on the potential to emit 90.7 metric tons [100 short tons] of a regulated pollutant. This threshold can be lower for areas with more serious nonattainment problems. A minor New Source Review permit supplements the Prevention of Significant Deterioration and nonattainment New Source Review programs. The New Source Review permit provides regulators (i.e., SDDENR for the Dewey-Burdock project) a method to implement permit conditions as needed to limit emissions from sources not covered by those two programs. Title V permits are required for stationary sources that, during operation, have the potential to emit 90.7 metric tons [100 short tons] of any air permit (lower thresholds for areas that are in nonattainment). (NRC, 2009a)

SDDENR, the regulatory authority for the Clean Air Act permitting process, has not yet conducted the New Source Review for the proposed Dewey-Burdock ISR Project (see Table 1.6-1). The applicant stated that the process will be conducted following the SDDENR and EPA procedures and timelines and would include emission estimates and dispersion modeling results to support the review process (Powertech, 2010a).

2.1.1.1.6.1.2 Radioactive Emissions

Radon gas emissions are most likely to occur during the operation and aquifer restoration stages of the proposed action, as detailed in SEIS Section 4.13. Radon releases may occur in the wellfield when the pregnant lixiviant is brought to the surface from the ore zone aquifer. Radon would also be released to air from radium settling ponds (Sections 2.1.1.1.2.4.1 and 2.1.1.1.2.4.2). Radon gas release could also occur when the downflow IX columns are taken offline for resin transfer and opened to the atmosphere. Radon gas would disperse quickly into the air. The use of general area and local ventilation systems would control radon buildup within the onsite facilities. General area ventilation could involve forced air ventilation of work areas in process buildings. Local ventilation for process vessels, where radon releases are more likely, may involve ducting or piping radon from the point of release through fans that exhaust to the outside, where the radon would disperse quickly into the air.

The applicant estimates an annual release of 34,077 GBq [921 curies] of Rn-222 from the proposed Dewey-Burdock ISR Project (Powertech, 2009b). Wellfield operations would account for 52 percent of the released radon, 47 percent would be the result of processing activities, and land application activities would produce the remainder. Potential dose impacts from radon releases were calculated at the site boundary in 16 compass directions each from the Burdock central plant and the Dewey satellite facility (Powertech, 2011). Results indicated that the 10 CFR Part 20 public dose limit of 1 mSV/yr [100 mrem/yr] is not exceeded at any property boundary. The applicant's calculations are discussed in SEIS Section 4.13.

An additional potential source for airborne particulate emissions is the yellowcake dryer, which would be located at the proposed Burdock central plant. The applicant proposes to use vacuum dryer technology for yellowcake drying operations at the Burdock central plant (Powertech, 2009a). NUREG–1569 (NRC, 2003a) provides guidance for evaluating air emissions at *in-situ* leach (ISL) facilities; dust emissions produced in the drying stage are negligible, where a vacuum dryer is used to dry yellowcake. A vacuum dryer utilizes a heat source contained in a separate, isolated system, which ensures no radioactive materials are trapped in the heating system or the exhaust it generates, as detailed in NUREG/CR–6733 (Mackin, et al., 2001). The applicant's proposed dryer contains a drying chamber where yellowcake slurry is added and is subjected to vacuum pressure (Powertech, 2009a). The dryer would retain all yellowcake dusts that could be produced during loading and unloading operations. The proposed dryer is designed so that moisture from the yellowcake is the only source of vapor in the system. Vapor exiting the dryer is filtered through a baghouse filter above the dryer, which removes particulates down to a size of approximately 1 micron [3.9×10^{-5} in]. Vapor exiting the baghouse filter is then cooled using a condenser to remove water vapor and remaining small particulates (Powertech, 2009a). Water from the condenser would be collected and pumped to the solids removal tank in the wastewater disposal system. The overhead baghouse system collects dust in the baghouse filter and returns it to the drying chamber. The applicant proposes routine monitoring and analysis of the drying system exhaust to detect the presence of natural uranium, Th-230, Ra-226, and Pb-210 (Powertech, 2009a). The proposed monitoring ensures releases of Th-230, Ra-226, and Pb-210 are (detected and kept) as low as is reasonably achievable. The monitoring system would be instrumented to operate automatically and to shut down if malfunctions such as heating or vacuum system failures occur. Monitoring results must be submitted to NRC in semiannual reports.

2.1.1.1.6.2 Liquid Wastes

The applicant expects to generate liquid wastes during all phases of uranium recovery at the proposed Dewey-Burdock ISR Project. These wastes include well development and well test waters, storm water runoff, waste petroleum products and chemicals, sanitary wastewater, production bleed, process solutions and laboratory chemicals, plant washdown water, and restoration water. Process solutions include process bleed, elution and precipitation brines, and resin transfer wash. NRC classifies wastewater generated during or after the uranium extraction phase of site operations as byproduct material; however, storm water runoff, domestic sewage, waste petroleum, and hazardous waste are not byproduct material. Byproduct material does not meet the definition of solid waste in 40 CFR 261.4(a)(4) and therefore is not regulated as hazardous waste under Resource Conservation and Recovery Act (RCRA) regulations. Liquid byproduct material generated by the proposed Dewey-Burdock ISR Project will contain chemical and radiological constituents including uranium and radium (Powertech, 2011).

> These terms define the various types of solid and liquid wastes generated at the Dewey-Burdock ISR Project:
>
> **Liquid wastes**
> Liquid byproduct material: All liquid wastes resulting from the proposed action, except for sanitary wastewater and well development and testing wastewater
>
> Sanitary wastewater: Ordinary sanitary septic system wastewater; this wastewater is not hazardous waste and not byproduct material wastewater
>
> Well development and testing wastewaters: Wastewater produced during well development and pumping tests; this water is not hazardous waste or byproduct material and would not require treatment before disposal
>
> **Solid wastes**
> Solid byproduct material: All solid wastes resulting from the proposed action
>
> Nonhazardous solid waste: Solid waste that is not hazardous waste, including domestic/municipal wastes (trash), construction/demolition debris, septic solids, and radioactive facilities and equipment resulting from the proposed action that meet the criteria for unrestricted release specified in the NRC license (see NRC, 1993)
>
> Hazardous waste: RCRA or state-defined hazardous waste that is not byproduct material, and includes universal hazardous wastes

The applicant proposed deep Class V well injection, land application, or a combination of these processes for managing liquid byproduct material. The particular waste management option used will affect how wastes are treated and will determine the final disposal method. As described in SEIS Chapter 1, the proposed options require the applicant to obtain all applicable federal and South Dakota permits, in addition to an NRC license, before it operates the facility. Alternative wastewater disposal options are described in SEIS Section 2.1.1.2. However, the applicant did not propose using these alternative methods.

The applicant's proposed deep Class V well injection disposal option involves drilling wells at the project site to dispose of liquid byproduct material. A typical deep injection well design is shown in Figure 2.1-11. The applicant submitted a permit application to EPA to construct four to eight UIC Class V deep injection wells to inject liquid byproduct material into the Minnelusa and Deadwood Formations; the application is currently under review (Powertech, 2011, Appendix 2.7-L). The first four of the proposed wells are detailed in the permit application. The depth from the ground surface to the disposal horizon for the 4 wells ranges from 492 to 1,076 m [1,615 to 3,530 ft] (Powertech, 2011, Appendix 2.7–L). For disposal using a UIC Class V well, an EPA permit, if granted, would prohibit injection of any material defined as hazardous waste as defined by RCRA regulations in 40 CFR 261.3. Additionally, if a license was granted, NRC would require the effluent pumped into deep injection wells to be treated and monitored to verify it meets NRC release standards in 10 CFR Part 20, Subparts D and K, and Appendix B.

The applicant has proposed to manage liquid byproduct material under the Class V injection well disposal option using a system of storage ponds, treatment methods, and deep injection wells. During the operations phase, the applicant proposes to combine the plant wastewater stream (including the waste brine streams from elution and precipitation, resin transfer wash, laundry water, plant washdown water, and laboratory chemicals) with the production bleed and well development waster. Wastewater would be redirected back to the central processing plant for ion-exchange treatment to remove uranium, the wastewater would then be mixed with barium chloride, and finally wastewater would be discharged into lined settling ponds (i.e., radium removal ponds) (Powertech, 2009b, 2010a, 2011). The barium chloride chemically binds to radium in solution and deposits as a sludge that would be removed and sent to a licensed disposal facility (Powertech, 2010a). Following radium removal processing, the applicant would then inject the combined waste streams in the Class V deep injection wells. During the aquifer restoration phase, the applicant proposes to manage aquifer restoration wastewater (i.e., liquid byproduct material) by treating the wastewater by reverse osmosis and reinjecting the treated water back into the aquifer production zone undergoing restoration (see SEIS Section 2.1.1.1.4.1.1). The applicant would combine the contaminants removed from water with operational wastewater and transfer the combined wastewater to the radium settling ponds for further treatment prior to disposal in the Class V injection wells. The applicant's Class V injection well monitoring program which includes monitoring of injection pressure at the wellhead, the fluid-filled annulus pressure between the casing and injection tubing string (see Figure 2.1-11), and injection zone pressure is described in detail in SEIS Section 7.6.

The applicant's proposal includes options for managing liquid byproduct material by land application independently and in conjunction with deep Class V injection well disposal. For land application, the applicant would need to obtain a state GDP and comply with applicable state discharge requirements for land application of treated wastewater. The applicant submitted a GDP application for the proposed project in March 2012; SDDENR is currently reviewing the application (Powertech, 2012a). In the land application option, the applicant would route the central plant wastewater stream, which includes waste brine streams from elution and precipitation, resin transfer wash, laundry water, plant washdown water, and laboratory chemicals, into a storage pond. Wastewater would be redirected back to the central processing plant for IX treatment to remove uranium, the wastewater would be mixed with barium chloride, and finally wastewater would be discharged into lined settling ponds (i.e., radium removal ponds). In the application, the applicant proposes to sample water from the ponds to verify it is within South Dakota and NRC discharge limits. Treated wastewater would be pumped through center pivot sprinklers to irrigate alfalfa during the growing season (May 11 to September 24). The applicant plans to irrigate soils beyond the growing season (relying on evaporation to remove water) as conditions permit (e.g., irrigation becomes ineffective during winter freezes).

The applicant proposes regular monitoring of air, soil, crops and livestock, surface water, and groundwater to identify the presence of NRC- and SDDENR-regulated constituents. Monitoring results must be reported to NRC semiannually (see SEIS Chapter 7). As part of the decommissioning phase, NRC would require radiological surveys of land application areas to ensure that the soil concentration limits in 10 CFR Part 40, Appendix A, Criterion 6-(6) are met. If soil concentration limits are exceeded, NRC would require the removal of contaminated materials, which could add to the total amount of material for disposal at a licensed facility. In addition, the applicant proposes to dispose of any pond liners and precipitated solids accumulated in radon settling ponds as solid byproduct material, as described in SEIS Section 2.1.1.1.6.3.

The amount of liquid byproduct material produced by the proposed action varies by ISR lifecycle phase, disposal option, and aquifer restoration method. The applicant estimated the maximum estimated flow of produced liquid byproduct material at any time considering concurrent uranium recovery operations and aquifer restoration activities. For the Class V injection well option, the applicant's maximum calculated liquid byproduct material production is 749 L/min [197 gal/min] (Powertech, 2011). For the land application option, the applicant's maximum calculated liquid byproduct material production is 2,080 L/min [547 gal/min] (Powertech, 2011).

The applicant proposes to dispose of sanitary wastewater from restrooms and lunchrooms into onsite septic systems located near the Burdock central plant and Dewey satellite facility. The applicant is required to obtain a permit from the State of South Dakota to construct the onsite septic systems (Powertech, 2009b). The applicant also proposes to collect and route storm water for discharge to surface water (Powertech, 2009a). The applicant is required to obtain a National Pollutant Discharge Elimination System (NPDES) permit to discharge storm water to surface water from the State of South Dakota.

2.1.1.1.6.3 Solid Wastes

As described in GEIS Section 2.7.3, all phases of the operational lifecycle of an ISR facility generate solid wastes (NRC, 2009a). Solid byproduct material includes spent resin, empty chemical containers and packaging, pipes and fittings, tank or storage pond sediments, contaminated soil from leaks and spills, and contaminated construction and demolition debris. Nonhazardous solid waste includes septic solids, municipal solid waste (general trash), and other solid wastes. Solid hazardous waste includes used batteries and light bulbs.

Solid byproduct material does not meet the NRC criteria for unrestricted release and must be disposed of at a licensed disposal site, in accordance with the requirements of 10 CFR Part 40, Appendix A, Criterion 2. The applicant estimates the proposed Dewey-Burdock facility will produce 22 m^3 [29 yd^3] of solid byproduct material from radium settling ponds annually from the deep Class V injection well option and 50 m^3 [66 yd^3] of solid byproduct material from the land application option (Powertech, 2011). Assuming a 10-year operational period, the NRC staff calculated total radium settling byproduct material accumulation as 222 m^3 [290 yd^3] from the deep Class V injection well option and 500 m^3 [660 yd^3] from the land application option. The applicant plans to store these wastes temporarily onsite. The applicant proposes to transport these materials offsite to a licensed facility for disposal in accordance with U.S. Department of Transportation (USDOT) requirements using shipment capacities of 23 m^3 to 33 m^3 [30 yd^3 to 40 yd^3] (Powertech, 2010a, 2011). It is estimated that one to three shipments of operational byproduct material would occur per year.

The NRC staff calculated the amount of solid byproduct material that would be generated from decommissioning activities using the financial assurance information the applicant submitted; the land application option estimate is 1,580 m^3 [2,067 yd^3] and the deep Class V injection well disposal option estimate is 1,419 m^3 [1,856 yd^3] (Powertech, 2011). These estimates apply to decommissioning wellfields, removal of constructed ponds, pond liners, and equipment and IX resin. The applicant anticipates that decommissioning of facilities will take 2 years; therefore, the annual byproduct waste generation estimate for decommissioning is 790 m^3 [1,034 yd^3] for the land application option and 710 m^3 [928 yd^3] for the deep Class V injection well disposal option. At this time, the applicant does not have an agreement in place with a licensed site to accept its solid byproduct material for disposal. If an NRC license is granted, an NRC license condition would require the applicant to have a byproduct material disposal agreement in place before operations begin. The applicant assumes it will obtain an agreement for disposal of byproduct material at the White Mesa site in Blanding, Utah, which is detailed in SEIS Section 3.13. SEIS Section 4.14 describes the impacts of solid byproduct material disposal.

During all phases of the proposed project, the applicant expects to produce nonhazardous solid waste. This waste could be composed of municipal waste (facility trash), septic solids, and other solid wastes, such as uncontaminated equipment, hardware, and packing materials. The applicant proposes to collect nonhazardous solid waste at designated onsite areas and dispose of this material at the Custer-Fall River Waste Management District landfill in Edgemont, South Dakota, or at the Newcastle Solid Waste Facility, if additional capacity is needed (Powertech, 2010a). SEIS Section 3.13 provides additional descriptions of the local solid waste facilities. The applicant estimates the proposed action will generate approximately 184 t [203 T] of nonhazardous solid waste annually during the construction phase (Powertech, 2010a). The NRC staff calculates the annual volume of construction debris as 144 m^3 [188 yd^3], which assumes a density of 1,281 kg/m^3 [1.08 T/yd^3]. During the operational period, the applicant estimates that less than 1.4 t [3,000 lb] per week of nonhazardous solid waste will be generated. The mass of nonhazardous solid waste is equivalent to an annual volume of 150 m^3 [196 yd^3], assuming a density of 475 kg/m^3 [800 lb/yd^3].

The NRC staff used the data in the applicant's financial assurance section of the application (Powertech, 2011) to estimate the total amount of nonhazardous solid waste that would be generated during the proposed 2-year decommissioning period; these totals are 12,496 m^3 [16,344 yd^3] for the land application option and 10,427 m^3 [13,638 yd^3] for the deep Class V injection well disposal option. The NRC staff calculates the annual decommissioning nonhazardous solid waste as 6,248 m^3 [8,172 yd^3] for the land application option and 5,213 m^3 [6,819 yd^3] for the deep Class V injection well disposal option by dividing the total estimates by the applicant's proposed 2-year decommissioning period. The applicant's nonhazardous solid waste estimates for decommissioning include plant building materials and equipment and wellfield equipment that do not contain radioactive materials or that meet NRC limits for unrestricted release.

The applicant's proposal describes hazardous waste that would be generated as waste oil, cleaning solvents, and used batteries (Powertech, 2009a). The applicant has estimated the proposed Dewey-Burdock ISR Project would generate less than 100 kg [220 lb] per month of all forms of hazardous waste, a quantity that the applicant expects would allow the facility to be classified as a Conditionally Exempt Small Quantity Generator (CESQG) under RCRA and South Dakota regulations (Powertech, 2009a). A CESQG (i) must determine whether its waste is hazardous; (ii) must not generate more than 100 kg [220 lb] per month of hazardous waste or, except with regard to spills, more than 1 kg [2.2 lb] of acutely hazardous waste; (iii) may not accumulate more than 1,000 kg [2,205 lb] of hazardous waste onsite at any time; and (iv) must treat or dispose of its hazardous waste in a treatment storage or disposal facility that meets the requirements specified in 40 CFR 261.5. If the facility fails to meet any of these four criteria, it would lose CESQG status. Without CESQG classification it would be fully regulated as either (i) a small-quantity generator of more than 100 kg [220 lb], but less than 1,000 kg [2,205 lb] of nonacute hazardous waste per calendar month or (ii) a large-quantity generator of 1,000 kg [2,205 lb] or more of nonacute hazardous waste per calendar month. Any hazardous wastes, such as organic solvents, paints, used oil and paint thinners, empty chemical containers, tank sediments/sludges, chemical wastes, or spent batteries, must be disposed of in accordance with applicable local, state, and federal regulatory requirements.

2.1.1.1.7 Transportation

The applicant proposes using trucks to transport construction equipment and materials, operational processing supplies, IX resins, yellowcake product, and waste materials. The applicant commits to complying with all applicable USDOT and NRC packaging and transportation requirements for shipments of hazardous chemicals and radioactive materials (Powertech, 2009b). During all phases of the facility lifecycle, both temporary and permanent workers would commute to and from the facility and generate additional traffic on local roads.

The applicant proposes using trucks to ship construction supplies and the vehicles used to construct facilities and wellfields at the proposed site. As stated previously, the applicant proposes phased wellfield development. After the processing facilities are constructed, the remaining wellfield construction activities and associated transportation would occur over a number of years (Figure 2.1-1). The applicant estimated 205 workers would commute during the construction period and estimated potential traffic assuming there would be no carpooling. The applicant's estimate of construction-related traffic is presented in Table 2.1-7.

During operations, the applicant plans to use tanker trucks to transfer uranium-loaded and barren IX resins between the Burdock central processing plant and the Dewey satellite facility. The applicant estimates that each day, one uranium-loaded resin truck will travel from the satellite facility to the central processing plant and one barren resin truck will travel from the central processing plant to the satellite facility. The applicant proposes to ship yellowcake product from the central processing plant to a conversion facility located in Metropolis, Illinois, or Port Hope, Ontario, Canada. The NRC staff estimates the shipment distances from the proposed site to Metropolis, Illinois, and Port Hope, Ontario, to be approximately 2,270 km [1,410 mi] for either location (NRC, 2009a). The applicant proposes loading yellowcake into sealed 210-L [55-gal] drums and shipping by certified carrier. Assuming a proposed production rate of 0.45 million kg [1 million lb] of yellowcake per year, the applicant estimates approximately 25 yellowcake shipments annually. Proposed chemical supply shipments to the Dewey-Burdock facility include carbon dioxide, oxygen, salt, soda ash, barium chloride, hydrogen peroxide, sulfuric acid, hydrochloric acid, sodium hydroxide, and fuel. Shipments of waste products, including byproduct material, nonhazardous solid wastes, and hazardous wastes would originate at the proposed site for disposal at licensed disposal facilities during the plant operations. Estimates of traffic for all phases of the facility lifecycle are provided in Table 2.1-7. Based on the information in Table 2.1-7, the total daily operations phase truck traffic is estimated at 2 one-way trips per day for either waste disposal option.

During the decommissioning phase, the applicant proposes to decommission and dismantle structures and equipment, and to reclaim land surfaces. The applicant also proposes to ship some materials and equipment offsite for recycling or reuse. The applicant expects that waste materials, which will include byproduct material (e.g., contaminated facilities and equipment, pond bottoms, and excavated soils), nonradiological and nonhazardous solid waste, and hazardous solid waste, will be shipped offsite to licensed disposal facilities. Traffic estimates for the decommissioning phase are provided in Table 2.1-7. The total daily decommissioning phase truck traffic estimates are 1.2 one-way trips per day for the land application option and 1.1 one-way trips per day for the Class V injection well disposal option.

Table 2.1-7. Estimated Daily One-Way Vehicle Trips for the Proposed Dewey-Burdock ISR Project Waste Management Options

Cargo	Land Application Option	Deep Class V Injection Well Option
Construction Equipment/Supplies	9	9
Construction/Employee Commuting	205	205
Remote Ion-Exchange Shipments	1	1
Processing Chemicals	0.92	0.92
Processing Byproduct Material	0.0085*	0.0037*
Yellowcake	0.1†	0.1†
Operations Employee Commuting	60	60
Aquifer Restoration Employee Commuting	15	15
Decommissioning Nonhazardous Solid Waste	1.0‡	0.87‡
Decommissioning Byproduct Material	0.13‡	0.12‡
Decommissioning Recycle/Reuse Equipment	0.07§//	0.07§//
Decommissioning Employee Commuting	15	15

Source: Powertech, 2009b, 2010a. The applicant's reported vehicle trips from these references were not reported for each waste disposal option, and therefore the NRC staff assumed that the reported vehicle trips applied to both disposal options.
*The NRC staff divided the applicant's annual byproduct material estimate by the reported truck capacity and an assumed 260 shipping days per year.
†The NRC staff divided the applicant's annual yellowcake production rate by the reported truck capacity and an assumed 260 shipping days per year.
‡The NRC staff divided the estimated waste for each option by the proposed 2-year decommissioning period, by the proposed truck capacity, and by an assumed 260 shipping days per year.
§The NRC staff divided the applicant's estimated shipments by the proposed 2-year decommissioning period and an assumed 260 shipping days per year.

2.1.1.1.8 Financial Surety

As stated in GEIS Section 2.10, NRC regulations at 10 CFR Part 40, Appendix A, Criterion (9) require applicants to assure that sufficient funds will be available to carry out decommissioning, reclamation of disturbed areas, waste disposal, dismantling and disposal of all facilities including buildings and wellfields, and groundwater restoration by independent third parties (NRC, 2009a). NRC regulations require the applicant to establish financial surety arrangements to cover such costs before operations begin at the proposed Dewey-Burdock ISR Project. The applicant must also maintain these surety arrangements until NRC determines the applicant has complied with its reclamation plan.

The amount of funds covered by the applicant's surety arrangements will be based on Commission-approved cost estimates in a Commission-approved plan. The initial surety estimate would be based on the decommissioning costs projected after the first year of operation. These costs would cover dismantling and decommissioning of the Burdock central plant, the initial wellfield in the Burdock area, the Dewey satellite facility, and the initial wellfield in the Dewey area. These costs would also cover reclamation of the entire site.

NRC and SDDENR would require annual revisions to the applicant's financial surety mechanism to ensure that funds are available for the decommissioning of existing and planned operations and existing and planned construction. The applicant would thereafter submit a reclamation performance bond, irrevocable letter of credit, or other surety instrument to NRC and SDDENR. NRC reviews financial surety arrangements and decommissioning plans in detail as part of its review for the safety evaluation report. For additional information on financial surety requirements, see 10 CFR Part 40, Appendix A, Criterion (9) and GEIS Section 2.10.

2.1.1.2 Alternative Liquid Waste Disposal Options

Liquid wastes are expected to be generated during the operations and aquifer restoration phases of the proposed Dewey-Burdock ISR Project. The applicant is required to manage and dispose of liquid byproduct material in compliance with applicable state and federal regulations, as established by license and permit. SEIS Section 2.1.1.1.6.2 describes the characteristics and quantities of the proposed liquid waste streams and the proposed approach for the applicant to apply for a permit to dispose of these waste streams using Class V deep injection wells. If EPA does not grant the applicant a UIC permit, the applicant would need to rely solely on the proposed land application or seek an NRC license amendment to approve another disposal option before it initiated operations. Historically, ISR facilities have used evaporation ponds and surface water discharge to manage and dispose of liquid wastes. Some licensed ISR facilities have used Class I deep disposal wells; however, Class I deep disposal wells are not permitted in South Dakota. For this reason, Class I deep disposal wells are not discussed as a potential option for the proposed Dewey-Burdock ISR Project.

The following subsections describe alternative wastewater disposal options. These options were mentioned in the GEIS. Table 2.1-8 compares the characteristics of several wastewater disposal options (NRC, 2009a). Potential environmental impacts of the waste management options are analyzed in SEIS Section 4.14.1.

2.1.1.2.1 Evaporation Ponds

One commonly used method for disposal of liquid wastes involves pumping liquids into one or more ponds and allowing natural solar radiation to reduce the volume through evaporation. The waste streams are not always treated prior to being discharged into evaporation ponds, and radionuclides and other metals are concentrated as the liquids evaporate. The basic design criteria for an evaporation pond system are contained in 10 CFR Part 40, Appendix A, Criteria 5A and 5E. NRC regulations set standards for the location of the pond(s) and the design and construction of the necessary clay or geosynthetic liner systems and embankments for the ponds (NRC, 2003a, 2008). NRC regulations also establish criteria for pond inspection and maintenance. The NRC guidance in Regulatory Guide 3.11 (NRC, 2008) recommends considering applicable EPA regulations in any impoundment design.

The effectiveness of evaporation ponds depends on evaporation rates and how quickly liquid wastes are generated. The evaporation rate varies seasonally and is dependent on temperature and relative humidity; the rate is highest during warm, dry conditions and is lower

Table 2.1-8. Comparison of Different Liquid Wastewater Disposal Options

	Class V Injection Well	Evaporation Ponds	Land Application	Discharge to Surface Waters
Land Size/ Footprint	13.4 ha [33 ac] Applicant estimate of proposed additional disposal option-specific land required including impoundments (e.g., radium settling, central plant pond, outlet pond, surge pond, reserve capacity)	40.5 ha [100 ac] Individual pond: 0.4 to 2.5 ha [1 to 6.25 ac], max 16.2 ha [40 ac] Pond system: about 40 ha [100 ac]	481 ha [1,188 ac] Applicant estimate of proposed additional disposal-option-specific land required including 55.1 ha [136 ac] for impoundments (e.g., radium settling, central plant pond, outlet pond, surge pond, reserve capacity) and 426 ha [1052 ac] for land application areas	13.4 ha [33 ac] Assumed by NRC to be similar to applicant estimate for Class V injection option Potential additional separate storage facilities (impoundments, tanks) to maintain separate waste streams
Relevant Regulations and Permits	10 CFR Part 20, Subparts D and K and Appendix B UIC Class V permit (EPA) NPDES permit (SDDENR) Large-Scale Mine Permit (SDDENR)	10 CFR Part 40, Appendix A Large-Scale Mine Permit (SDDENR) NESHAPS permit (40 CFR Part 61, Subpart W) Contract for byproduct material disposal (liners, sludges)	10 CFR Part 20, Subparts D and K and Appendix B 10 CFR Part 40, Appendix A, Criterion 6(6) Groundwater discharge permit (SDDENR) NESHAPS permit (40 CFR Part 61) Large-Scale Mine Permit (SDDENR)	10 CFR Part 20, Subparts D and K and Appendix B NPDES permit (SDDENR) No release to navigable waters standard in 40 CFR Part 440.34(b)(1) Large-Scale Mine Permit (SDDENR)
Construction Requirements	Land clearing and excavation equipment for pad, mud pits, radium-settling basins, treatment facilities Drilling rig	Land clearing and excavation equipment to prepare surface for pond(s) Construction equipment to construct pond liner(s)	Land clearing and excavation equipment for roads, radium settling basins, treatment facilities	Land clearing and excavation equipment for roads, radium-settling basins, treatment facilities

Table 2.1-8. Comparison of Different Liquid Wastewater Disposal Options (continued)

	Class V Injection Well	**Evaporation Ponds**	**Land Application**	**Discharge to Surface Waters**
Is wastewater storage required prior to disposal?	Yes, storage/surge tank(s) Radium settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations	No additional storage needed; evaporation pond provides necessary storage prior to disposal	Yes, storage/surge tank(s) Radium-settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations	Yes, applicant may elect to maintain separate “process” and “mine” wastewater streams Radium-settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations
Wastewater Treatment Issues	Decontamination through ion exchange and radium settling during operations and reverse osmosis during aquifer restoration. Effluent must meet 10 CFR Part 20, Appendix B effluent limits. May add antifouling agent to reduce scaling in well.	No additional treatment is required (optional)	Decontamination through ion exchange and radium settling during operations and aquifer restoration	Decontamination through ion exchange/reverse osmosis; additional treatment to meet conditions of NPDES discharge permit
Decommissioning Issues	Radium-settling basin liners and sludges, treatment of building debris to be disposed as byproduct material, additional transportation of wastes to licensed disposal facility Plug and abandon well in accordance with South Dakota Well Construction Standards Sections 74:02:04:67 and 74:02:04:69	Pond liners and sludges to be disposed as byproduct material; additional transportation of wastes to licensed disposal facility	Radium-settling basin liners and sludges, treatment of building debris to be disposed as byproduct material, additional transportation of wastes to licensed disposal facility Application soils to be disposed as byproduct material if limits exceeded Additional transportation of wastes to licensed disposal facility	Radium-settling basin liners and sludges, treatment of building debris to be disposed as byproduct material, additional transportation of wastes to licensed disposal facility

Table 2.1-8. Comparison of Different Liquid Wastewater Disposal Options (continued)

	Class V Injection Well	Evaporation Ponds	Land Application	Discharge to Surface Waters
Environmental Benefits	Wastewater treated to 10 CFR Part 20, Appendix B effluent limits	Containment during storage, waste volume reduction, liquid waste form converted to solid prior to final disposal	Wastewater treatment to reduce uranium, radium, and other constituents Limited construction needed for land application area	Wastewater treated to meet conditions of an NPDES discharge permit
Climatic Influences	Deeper drilling requires larger rig, longer rig time, higher diesel emissions (CO_2 emission estimate for one deep well was approximately 1,000 × typical production well)* Additional equipment needed to construct wastewater storage and treatment facilities	Additional equipment needed to construct evaporation ponds	Additional equipment needed to construct wastewater storage and treatment facilities	Additional equipment needed to construct wastewater storage and treatment facilities
Health and Safety Issues	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning	Potential leaks from evaporation ponds Additional waste volume during decommissioning	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning
Source: NRC (2009a)				

during cool, humid conditions. When the evaporation rate is low or seasonal conditions reduce evaporation, the operator can increase the size and the surface area of the evaporation ponds to augment evaporation.

Evaporation ponds are commonly used at facilities that employ a combination of waste disposal methods. Historically, the area of individual evaporation ponds at uranium ISR facilities has ranged from 0.04 to 2.5 ha [0.1 to 6.2 ac] (NRC, 1997, 1998a,b; Sanford Cohen and Associates, 2008). The total footprint of the evaporation pond system for all liquid byproduct material streams at an ISR facility has been estimated to be as high as 40 ha [100 ac] (NRC, 1997).

The applicant will design, construct, and monitor a leak detection system and conduct routine inspections, with special inspections as described in NRC guidance to identify and repair leaks that might occur in the evaporation pond system (NRC, 2008). NRC guidance recommends that an applicant's design incorporate sufficient freeboard (the distance from the water level to top of the embankment) of about 1 to 2 m [3 to 6 ft], depending on the size of the individual pond, so that precipitation or wind-driven waves would not overtop the embankment (NRC, 2008). In addition, sufficient reserve capacity in the evaporation pond system must be maintained to allow the entire contents of one or more ponds to be transferred to other ponds in the event of a leak requiring corrective action and liner repair (NRC, 2009a). When necessary, an applicant would install perimeter fencing to ensure safety. These requirements would be written as conditions in an NRC license, and enforcement would be managed through the NRC inspection program.

The applicant may need to demonstrate that radionuclides, such as radon, released to the air from ponds met 40 CFR Part 61 requirements, in particular the provisions of Subpart W that incorporates the requirements of 40 CFR Part 192 (NRC, 2008; Sanford Cohen and Associates, 2008). In developing the impoundment design, the applicant would also need to consider EPA surface impoundment regulations for surface impoundments in 40 CFR Part 264 (NRC, 2008).

Because ponds are open to the air, dust and dirt can blow into ponds and the concentrations of dissolved solids may increase due to evaporation, resulting in the precipitation of salts from the solution. Ponds may require periodic cleaning to maintain good repair and the necessary freeboard; additionally, accumulated salts and solids may need to be disposed of as byproduct material at a licensed disposal facility. Similarly, when the operations and aquifer restoration phases end, the pond liners and any accumulated materials would need to be disposed of as byproduct material. To provide an example of decommissioning waste volume, the volume of byproduct material that would be generated during decommissioning and reclamation of evaporation ponds at the Smith Ranch ISR facility in Converse County, Wyoming, was estimated in 2007 at 52 m^3 [68 yd^3] (NRC, 2009a).

During the winter months in South Dakota, where temperatures are generally below freezing, ponds could ice over, thereby reducing evaporation to zero. To maintain year-round liquid disposal capability using evaporation ponds at the proposed Dewey-Burdock ISR Project facilities, the applicant would likely need to have either sufficient storage capacity or at least one other disposal option available. Deep Class V well injection and land application are proposed as optional methods. The applicant currently does not consider evaporation ponds a viable liquid waste disposal option at the proposed Dewey-Burdock site (Powertech, 2009b). This is due to unfavorable climatic conditions at the site; notably, the short period of high temperatures, long periods of sub-freezing temperatures, and strong winds.

2.1.1.2.2 Surface Water Discharge

Another disposal method historically used at uranium ISR facilities is treatment of liquid waste and discharge at the surface. EPA, in accordance with 40 CFR 440.34, does not allow new ISL facilities to discharge process waste water to navigable waters. For release of this effluent to non-navigable surface waters, the effluent would be pretreated to meet the NRC release requirements in 10 CFR Part 20, Subparts D and K and Appendix B and the provisions of 10 CFR Part 40, Appendix A. The regulations at 10 CFR 20.2007 require compliance with other applicable federal, state, and local regulations. This would include EPA effluent discharge regulations for ISL facilities at 40 CFR Part 440, Subpart C and the SDDENR requirements imposed by an NPDES water discharge permit. The NPDES permit specifies effluent limits to ensure water quality standards are maintained. Pretreatment of the liquid effluent using IX columns, reverse osmosis, and barium/radium sulfate precipitation is typically incorporated into the surface water discharge process to decrease uranium and radium levels in the wastewater below the permitted discharge limits. Like the land application wastewater disposal option, this treatment might require additional land for the construction of radium settling basins and storage reservoirs (NRC, 2003a). An applicant would need to control (i) byproduct material remaining at storage facilities and within tanks, impoundments, and radium-settling basins until the site and facilities are decommissioned (NRC, 2003a) or (ii) the radioactivity at storage facilities and within tanks, impoundments, and radium settling basins until the site and facilities are decommissioned (NRC, 2003a; Sanford Cohen and Associates, 2008).

2.1.2 No-Action (Alternative 2)

Under the No-Action alternative, NRC would not approve the license application for the proposed Dewey-Burdock ISR Project and BLM would not approve the applicant's modified Plan of Operations. The No-Action alternative would result in the applicant not constructing or operating the proposed Dewey-Burdock ISR Project. No buildings, access roads, wellfields, pipelines, or liquid waste disposal systems would be constructed. No uranium would be recovered from the subsurface ore bodies; therefore, injection, production, and monitoring wells would not be installed to operate the facility. No lixiviant would be introduced into the subsurface, and no facilities would be constructed to process extracted uranium or store chemicals. Because no uranium would be recovered, neither aquifer restoration nor decommissioning activities would occur. No liquid effluents or solid wastes would be generated. The No-Action alternative is included to provide a basis for comparing and evaluating the potential impacts of the other alternatives, including the proposed action.

2.2 Alternatives Eliminated From Detailed Analysis

As required by NEPA regulations, the NRC staff considered alternatives to issuing the applicant a license. The range of alternatives was determined by considering the purpose and need for the proposed action and the private party's objective in extracting uranium from a particular ore body. In a site-specific environmental review the identification of reasonable alternatives depends on the proposed action, as well as site conditions. This section describes alternatives to the proposed action that were considered by the NRC, but not subjected to detailed analyses for the reasons described in the following sections. Sections 2.2.1 and 2.2.2 describe different mining techniques and associated milling alternatives for the proposed project site. Section 2.2.3 discusses the use of different lixiviant chemistry. Section 2.2.4 describes alternative site locations for the central plant and satellite facility within the proposed project area. Section 2.2.5 details the use of alternative well completion methods at the proposed project site.

2.2.1 Conventional Mining and Milling

Uranium ore deposits may be accessed either by open pit surface mining or by underground mining techniques. Open pit mining is used to extract shallow ore deposits—generally deposits less than 168 m [550 ft] below ground surface (EPA, 2008a). To access shallow deposits, the topsoil is removed and stockpiled for later site reclamation, while the overburden (the remainder of the material overlying the deposit) is removed via mechanical shovels and scrapers, via trucks or loaders, or by blasting (EPA, 1995, 2008a). The depth to which an orebody is surface mined depends on the ore grade, the nature of the overburden, and the ratio of overburden to be removed to one unit of ore extracted (EPA, 1995).

Underground mining techniques vary depending on the size, depth, orientation, and grade of the orebody; the stability of the subsurface strata; and economic factors (EPA, 1995, 2008b). In general, underground mining involves sinking a shaft near the ore body and then extending levels horizontally from the main shaft at different depths to access the ore. Ore and waste rock are removed through shafts by elevator or by using trucks to carry these materials up inclines to the surface (EPA, 2008a).

In addition, when the open pit or underground workings are established, the mine may need to be dewatered to allow the extraction of the uranium ore. Dewatering is accomplished by either pumping water directly from the open pit or pumping interceptor wells to lower the water table (EPA, 1995). The mine water usually requires treatment prior to discharge because it becomes contaminated with radioactive constituents, metals, and suspended and dissolved solids. Discharge of these mine waters may have subsequent impacts to surface water drainages and sediments, as well as to near-surface sources of groundwater (EPA, 1995).

Following the completion of mining, either by open pit or underground techniques, the mine will be reclaimed. Stockpiled overburden is reintroduced into the mined area, either during or following extraction operations, and topsoil is reapplied in an attempt to reestablish topography consistent with the surroundings. When dewatering ceases, the water table may rebound and fill portions of the open pit and underground workings. Historically, uranium mines have had negative impacts on local groundwater supplies and the waste materials from the mines have contaminated lands surrounding the mines (EPA, 2008b).

Ore extracted from an open pit or underground mine is processed in a conventional mill. As discussed in GEIS Appendix C (NRC, 2009a), ore processing at a conventional mill involves a series of steps (handling and preparation, concentration, and product recovery). While conventional milling techniques recover approximately 90 percent of the uranium content of the feed ore (NRC, 2009a), the process generates substantial wastes, known as tailings, because roughly 95 percent of the ore rock is disposed as waste (NRC, 2006). The conventional mill process also consumes large amounts of water. For example, the water usage estimate for the proposed Pinon Ridge Mill in Colorado is approximately 534 Lpm [141 gpm] (EFRC, 2009).

Tailings are disposed of in lined impoundments; NRC reviews the design and construction of impoundments to ensure safe disposal of the tailings (NRC, 2009a). Reclamation of the tailings pile generally involves evaporation of liquids in the tailings and settlement of the tailings over time. The tailings pile is then covered with a thick radon barrier and earthen material or rocks for erosion control. The area surrounding the reclaimed tailings piles would be fenced off in perpetuity and the site transferred to either a state or federal agency for long-term care (EIA, 1995). The costs associated with final mill decommissioning and tailings reclamation can run into the tens of millions of dollars (EIA, 1995).

In the final GEIS on uranium milling (NRC, 1980), NRC evaluated the potential environmental impacts of conventional uranium milling operations in a programmatic context, including the management of mill tailings. This GEIS evaluated the nature and extent of conventional uranium milling as part of the development of regulatory requirements for the management and disposal of mill tailings and for mill decommissioning. The impacts from operating a conventional mill are significantly greater than for operating an ISR facility. For example, at the proposed Dewey-Burdock ISR Project, approximately 75 ha [185 ac] would be used for uranium extraction operations. This would include wellfields, the central processing plant, a satellite facility, and pipeline infrastructure (Powertech, 2010a). A conventional mill requires much more land; approximately 300 ha [741 ac] would be affected by construction and milling operations and related activities would use approximately an additional 150 ha [370 ac] (NRC, 1980). The deposition of windblown tailings could further restrict land use near the tailings. In conventional mill modeling, levels of contamination extend several hundred meters [feet] beyond the model site boundary evaluated in the GEIS for conventional milling. Because of these factors, conventional milling was eliminated from detailed analysis in the SEIS.

2.2.2 Conventional Mining and Heap Leaching

Heap leaching is discussed in GEIS Appendix C. For low-grade ores, heap leaching is a viable alternative. Heap leaching is typically used when the ore body is small and situated far from the milling site. After extraction by conventional open pit or underground mining, the low-grade ore is crushed to approximately 2.6 cm [1 in] in size and mounded above grade on a prepared pad. A sprinkler or drip system positioned over the top continually distributes leach solution over the mound. Depending on the lime content, an acid or alkaline solution is used. The leach solution trickles through the ore and mobilizes the uranium, as well as other metals, into solution. The solution is collected at the base of the mound by a manifold and is then processed to extract the uranium. The uranium recovery from heap leaching ranges from 50 to 80 percent, resulting in a final tailings material of around 0.01 percent U_3O_8 content. When heap leaching is complete, the depleted materials are byproduct material that must be placed in a conventional mill tailings impoundment unless NRC grants an exemption for disposal in place. The impacts from heap leaching may be less than those associated with conventional milling; however, the impacts from open pit or underground mining are substantial. For these reasons, which are the same as those listed in SEIS Section 2.2.1, this alternative is not subjected to detailed analysis in this document.

2.2.3 Alternative Lixiviants

Alternative lixiviant chemistry was considered for the operations phase of the applicant's proposed project. Alternative chemistry includes acid leach solutions and ammonia-based lixiviants (Powertech, 2009a). Acid-based lixiviants, such as sulfuric acid, dissolve heavy metals and other solids associated with uranium in the host rock and other chemical constituents that require additional remediation and have greater environmental impacts. At a small-scale research facility in Wyoming, acid-based solutions were used to test their effectiveness as a lixiviant in the ISR process. During operations, significant problems developed. The mineral gypsum precipitated on the well screens and in the aquifer, which plugged the wells and reduced the efficiency of the wellfield restoration. Aquifer restoration had limited success, because of the gradual dissolution of the precipitated gypsum, which resulted in increased salinity and sulfate levels in the affected groundwater (Uranium One Americas, 2009). Because it is technically more difficult to restore acid mine sites, the use of an acid-based lixiviant was eliminated from detailed analysis in the SEIS.

Ammonia-based lixiviants have been used at ISR operations in Wyoming. However, operational experience has shown that ammonia tends to adsorb onto clay minerals in the subsurface and then slowly desorbs from the clay during restoration. This requires that a much larger volume of groundwater be removed and processed during aquifer restoration (Mudd, 2001). Because of the greater consumptive use of groundwater to meet groundwater restoration requirements, the use of an ammonia-based lixiviant was eliminated from detailed analysis.

2.2.4 Alternative Sites

Alternative sites within the proposed Dewey-Burdock ISR Project area were evaluated for the locations of the central plant and satellite facility (Powertech, 2009a). The applicant considered site-specific conditions in choosing the proposed central plant and satellite facility locations. The applicant made siting decisions to avoid proximity to historical and cultural resources, to avoid construction and operations in areas of historical environmental disturbance from past surface mining, to protect wildlife by avoidance of nesting sites for raptors, to avoid proximity to drainages, and to utilize surface and subsurface geological characteristics efficiently.

Based on the site-specific conditions used to choose the proposed locations of the Burdock central plant and Dewey satellite facility, alternative sites were not chosen for detailed analysis.

2.2.5 Alternative Well Completion Methods

Within the Dewey-Burdock ISR Project area, there is at least one area where one production zone overlies another (Powertech, 2009a). The applicant proposed the following preferred scenario for well completion for areas that contain more than one ore-bearing sand. First, the production and injection wells would be completed within the lowest ore sand. After the uranium has been recovered in the lowest sand, the production and injection wells would be completed in the next ore-bearing sand upward. After recovering the uranium from all the ore-bearing sands, restoration would begin by restoring the uppermost sandstone horizon first and working down to the lowermost sandstone horizon. The monitoring well ring design would correspond to the depth of uranium-bearing sand undergoing production or restoration.

Two alternative well completion methods were considered for areas within the project area containing more than one ore-bearing sand or production zone. The first alternative considered completion of wells across multiple sand horizons using the same wells and same monitoring ring. This alternative was not selected for detailed analysis due to the difficulties in (i) ensuring that the injection and productions fluids would be efficiently distributed through the various sands and (ii) monitoring the performance of the wellfield. The second alternative considered construction of larger wellfields and monitoring rings to encompass more reserves. Under this alternative, wells would be completed in the same manner as the applicant’s preferred option. This method was considered and rejected due to (i) the increase in scale, (ii) the potential difficulties in evaluating pump tests, (iii) the increase in time and activities associated with installing and producing the wellfield, and (iv) delay in final restoration and reclamation of the wellfield. Therefore, this alternative well completion method was not selected for detailed analysis.

2.3 Comparison of the Predicted Environmental Impacts

NUREG–1748 (NRC, 2003b) categorizes the significance of potential environmental impacts as follows:

SMALL: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.

MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

Chapter 4 presents a detailed evaluation of the environmental impacts from the proposed action and the No-Action alternative on resource areas at the proposed Dewey-Burdock ISR Project. Table 2.3-1 compares the significance level (SMALL, MODERATE, or LARGE) of potential environmental impacts of the proposed action and the No-Action alternative and identifies the section in Chapter 4 where more detailed information can be found. For each resource area, the NRC staff identifies the significance level during each phase of the ISR process: construction, operation, aquifer restoration, and decommissioning. The predicted environmental impact to each resource area for the proposed action can also be found in the Executive Summary.

Table 2.3-1. Summary of Impacts for the Proposed Dewey-Burdock ISR Project

Section 4.2 Land Use Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.2.1.1.1	SMALL 4.2.1.2.1	SMALL 4.2.1.3	NONE 4.2.2
Operations	SMALL 4.2.1.1.2	SMALL 4.2.1.2.2	SMALL 4.2.1.3	NONE 4.2.2
Aquifer Restoration	SMALL 4.2.1.1.3	SMALL 4.2.1.2.3	SMALL 4.2.1.3	NONE 4.2.2
Decommissioning	SMALL to MODERATE 4.2.1.1.4	SMALL to MODERATE 4.2.1.2.4	SMALL to MODERATE 4.2.1.3	NONE 4.2.2
Section 4.3 Transportation Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL to MODERATE 4.3.1.1.1	SMALL to MODERATE 4.3.1.2.1	SMALL to MODERATE 4.3.1.3	NONE 4.3.2
Operations	SMALL to MODERATE 4.3.1.1.2	SMALL to MODERATE 4.3.1.2.2	SMALL to MODERATE 4.3.1.3	NONE 4.3.2
Aquifer Restoration	SMALL 4.3.1.1.3	SMALL 4.3.1.2.3	SMALL 4.3.1.3	NONE 4.3.2
Decommissioning	SMALL 4.3.1.1.4	SMALL 4.3.1.2.4	SMALL 4.3.1.3	NONE 4.3.2

Table 2.3-1. Summary of Impacts for the Proposed Dewey-Burdock ISR Project (continued)

Section 4.4 Geology and Soils Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.4.1.1.1	SMALL 4.4.1.2.1	SMALL 4.4.1.3	NONE 4.4.2
Operations	SMALL 4.4.1.1.2	SMALL 4.4.1.2.2	SMALL 4.4.1.3	NONE 4.4.2
Aquifer Restoration	SMALL 4.4.1.1.3	SMALL 4.4.1.2.3	SMALL 4.4.1.3	NONE 4.4.2
Decommissioning	SMALL 4.4.1.1.4	SMALL 4.4.1.2.4	SMALL 4.4.1.3	NONE 4.4.2
Section 4.5.1 Water Resources Impacts (Surface Water and Wetlands)				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.5.1.1.1.1	SMALL 4.5.1.1.2.1	SMALL 4.5.1.1.3	NONE 4.5.1.2
Operations	SMALL 4.5.1.1.1.2	SMALL 4.5.1.1.2.2	SMALL 4.5.1.1.3	NONE 4.5.1.2
Aquifer Restoration	SMALL 4.5.1.1.1.3	SMALL 4.5.1.1.2.3	SMALL 4.5.1.1.3	NONE 4.5.1.2
Decommissioning	SMALL 4.5.1.1.1.4	SMALL 4.5.1.1.2.4	SMALL 4.5.1.1.3	NONE 4.5.1.2
Section 4.5.2 Water Resources Impacts (Groundwater)				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.5.2.1.1.1	SMALL 4.5.2.1.2.1	SMALL 4.5.2.1.3	NONE 4.5.2.2
Operations	SMALL 4.5.2.1.1.2	SMALL 4.5.2.1.2.2	SMALL 4.5.2.1.3	NONE 4.5.2.2
Aquifer Restoration	SMALL to MODERATE 4.5.2.1.1.3	SMALL to MODERATE 4.5.2.1.2.3	SMALL to MODERATE 4.5.2.1.3	NONE 4.5.2.2
Decommissioning	SMALL 4.5.2.1.1.4	SMALL 4.5.2.1.2.4	SMALL 4.5.2.1.3	NONE 4.5.2.2

Table 2.3-1. Summary of Impacts for the Proposed Dewey-Burdock ISR Project (continued)

Section 4.6 Ecological Resources Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.6.1.1.1	SMALL to MODERATE 4.6.1.2.1	SMALL to MODERATE 4.6.1.3	NONE 4.6.2
Operations	SMALL 4.6.1.1.2	SMALL to MODERATE 4.6.1.2.2	SMALL to MODERATE 4.6.1.3	NONE 4.6.2
Aquifer Restoration	SMALL 4.6.1.1.3	SMALL to MODERATE 4.6.1.2.3	SMALL to MODERATE 4.6.1.3	NONE 4.6.2
Decommissioning	SMALL to MODERATE 4.6.1.1.4	SMALL to MODERATE 4.6.1.2.4	SMALL to MODERATE 4.6.1.3	NONE 4.6.2

Section 4.7 Air Quality Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL to MODERATE 4.7.1.1.1	SMALL to MODERATE 4.7.1.2.1	SMALL to MODERATE 4.7.1.3	NONE 4.7.2
Operations	SMALL to MODERATE 4.7.1.1.2	SMALL to MODERATE 4.7.1.2.2	SMALL to MODERATE 4.7.1.3	NONE 4.7.2
Aquifer Restoration	SMALL to MODERATE 4.7.1.1.3	SMALL to MODERATE 4.7.1.2.3	SMALL to MODERATE 4.7.1.3	NONE 4.7.2
Decommissioning	SMALL to MODERATE 4.7.1.1.4	SMALL to MODERATE 4.7.1.2.4	SMALL to MODERATE 4.7.1.3	NONE 4.7.2

Section 4.8 Noise Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.8.1.1.1	SMALL 4.8.1.2.1	SMALL 4.8.1.3	NONE 4.8.2
Operations	SMALL 4.8.1.1.2	SMALL 4.8.1.2.2	SMALL 4.8.1.3	NONE 4.8.2
Aquifer Restoration	SMALL 4.8.1.1.3	SMALL 4.8.1.2.3	SMALL 4.8.1.3	NONE 4.8.2
Decommissioning	SMALL 4.8.1.1.4	SMALL 4.8.1.2.4	SMALL 4.8.1.3	NONE 4.8.2

Table 2.3-1. Summary of Impacts for the Proposed Dewey-Burdock ISR Project (continued)

Section 4.9 Historical and Cultural Resources Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL to LARGE 4.9.1.1.1	SMALL to LARGE 4.9.1.2.1	SMALL to LARGE 4.9.1.3	NONE 4.9.2
Operations	SMALL 4.9.1.1.2	SMALL 4.9.1.2.2	SMALL 4.9.1.3	NONE 4.9.2
Aquifer Restoration	SMALL 4.9.1.1.3	SMALL 4.9.1.2.3	SMALL 4.9.1.3	NONE 4.9.2
Decommissioning	SMALL 4.9.1.1.4	SMALL 4.9.1.2.4	SMALL 4.9.1.3	NONE 4.9.2

Section 4.10 Visual and Scenic Resources Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.10.1.1.1	SMALL 4.10.1.2.1	SMALL 4.10.1.3	NONE 4.10.2
Operations	SMALL 4.10.1.1.2	SMALL 4.10.1.2.2	SMALL 4.10.1.3	NONE 4.10.2
Aquifer Restoration	SMALL 4.10.1.1.3	SMALL 4.10.1.2.3	SMALL 4.10.1.3	NONE 4.10.2
Decommissioning	SMALL 4.10.1.1.4	SMALL 4.10.1.2.4	SMALL 4.10.1.3	NONE 4.10.2

Section 4.11 Socioeconomic Impacts (Demographics)		
	Proposed Action (Alternative 1)	No Action (Alternative 2)
Construction		NONE 4.11.2
Demographics	SMALL 4.11.1.1.1	
Income	SMALL 4.11.1.1.2	
Housing	SMALL 4.11.1.1.3	
Employment Rate	SMALL 4.11.1.1.4	
Local Finance	SMALL 4.11.1.1.5	
Education	SMALL 4.11.1.1.6	
Health and Social Services	SMALL 4.11.1.1.7	
Operations		NONE
Demographics	SMALL 4.11.1.2.1	
Income	SMALL 4.11.1.2.2	
Housing	SMALL 4.11.1.2.3	

Table 2.3-1. Summary of Impacts for the Proposed Dewey-Burdock ISR Project (continued)

Employment Rate	SMALL 4.11.1.2.4			4.11.2
Local Finance	SMALL 4.11.1.2.5			
Education	SMALL 4.11.1.2.6			
Health and Social Services	SMALL 4.11.1.2.7			
Aquifer Restoration	SMALL 4.11.1.3			NONE 4.11.2
Decommissioning	SMALL 4.11.1.4			NONE 4.11.2
Section 4.12 Environmental Justice Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
Construction	SMALL 4.12.1			NONE 4.12.2
Operations	SMALL 4.12.1			NONE 4.12.2
Aquifer Restoration	SMALL 4.12.1			NONE 4.12.2
Decommissioning	SMALL 4.12.1			NONE 4.12.2
Section 4.13 Public and Occupational Health and Safety Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.13.1.1.1	SMALL 4.13.1.2.1	SMALL 4.13.1.3	NONE 4.13.2
Operations	SMALL 4.13.1.1.2	SMALL 4.13.1.2.2	SMALL 4.13.1.3	NONE 4.13.2
Aquifer Restoration	SMALL 4.13.1.1.3	SMALL 4.13.1.2.3	SMALL 4.13.1.3	NONE 4.13.2
Decommissioning	SMALL 4.13.1.1.4	SMALL 4.13.1.2.4	SMALL 4.13.1.3	NONE 4.13.2
Section 4.14 Waste Management Impacts				
	Proposed Action (Alternative 1)			No Action (Alternative 2)
	Deep Well Disposal Via Class V Injection Option	Land Application Option	Combined Disposal Via Class V Injection and Land Application Option	
Construction	SMALL 4.14.1.1.1	SMALL 4.14.1.2.1	SMALL 4.14.1.3	NONE 4.14.2
Operations	SMALL 4.14.1.1.2	SMALL 4.14.1.2.2	SMALL 4.14.1.3	NONE 4.14.2
Aquifer Restoration	SMALL 4.14.1.1.3	SMALL 4.14.1.2.3	SMALL 4.14.1.3	NONE 4.14.2
Decommissioning	SMALL to MODERATE 4.14.1.1.4	SMALL to MODERATE 4.14.1.2.4	SMALL to MODERATE 4.14.1.3	NONE 4.14.2

2.4 Preliminary Recommendation

After weighing the impacts of the proposed action and comparing the alternatives, NRC staff, in accordance with 10 CFR 51.71(f), set forth a preliminary NEPA recommendation regarding the proposed action. Unless safety issues mandate otherwise, the preliminary NRC staff recommendation to the Commission related to the environmental aspects of the proposed action is that a source and byproduct material license for the proposed action be issued as requested. The NRC staff conclude that the applicable environmental monitoring program described in Chapter 7 and the proposed mitigation measures discussed in Chapter 4 will eliminate or substantially lessen potential adverse environmental impacts associated with the proposed action.

The NRC staff conclude that the overall benefits of the proposed action outweigh the environmental disadvantages and costs based on the following:

- Potential adverse impacts to all environmental resource areas are expected to be SMALL, with the exception of

    1. Land use resources during decommissioning. Land disturbance during decommissioning will be MODERATE until vegetation is reestablished in seeded areas (see SEIS Sections 4.2.1.1.4, 4.2.1.2.4, and 4.2.1.3).

    2. Transportation resources during construction and operation. Increases in traffic during construction and operations will have a MODERATE impact on Dewey Road, the road nearest the proposed site (see SEIS Sections 4.3.1.1.1, 4.3.1.2.1, 4.3.1.1.2, 4.3.1.2.2, and 4.3.1.3).

    3. Groundwater resources during aquifer restoration. During aquifer restoration in the Burdock area, drawdown-induced migration of contaminants into the production zone (i.e., the Chilson aquifer) from abandoned open pit mines could adversely affect restoration goals and have a MODERATE impact (see SEIS Sections 4.5.2.1.1.3, 4.5.2.1.2.3, and 4.5.2.1.3).

    4. Ecological resources during construction, operations, aquifer restoration, and decommissioning. Under the land application and combined Class V deep well disposal and land application options, construction, operations, and aquifer restoration activities will have a MODERATE impact on vegetation, small- to medium-sized mammals, raptors, nongame and migratory birds, and reptiles (see SEIS Sections 4.6.1.2.1, 4.6.1.2.2, 4.6.1.2.3, and 4.6.1.3). Under all disposal options, land-disturbing activities during decommissioning will have a MODERATE impact on vegetation until it is reestablished (see SEIS Sections 4.6.1.1.4, 4.6.1.2.4, and 4.6.1.3).

    5. Air quality during construction, operations, aquifer restoration, and decommissioning. During all phases of the ISR lifecycle, there will be the potential for MODERATE air impacts from short-term, intermittent fugitive dust emissions (see SEIS Sections 4.7.1.1.1 through 4.7.1.1.4, 4.7.1.2.1 through 4.7.1.2.4, and 4.7.1.3).

6. Historical and cultural resources during construction. Construction could have a MODERATE or LARGE impact on 18 historic properties—those sites currently listed or eligible for listing on the National Register of Historic Places (NRHP)—and other unevaluated historic, cultural, and religious properties in the project area (see SEIS Sections 4.9.1.1.1, 4.9.1.2.1, and 4.9.1.3).

7. Waste management resources during decommissioning. Impacts from disposal of nonhazardous solid waste could be MODERATE depending on the long-term status of existing local landfill resources (see SEIS Sections 4.14.1.1.4 and 4.14.1.2.4).

- Regarding groundwater, the portion of the aquifer(s) designated for uranium recovery must be exempted as underground sources of drinking water before ISR operations begin. Additionally, the applicant will be required to monitor for excursions of lixiviant from the production zones and to take corrective actions in the event of an excursion. Prior to operations, the applicant will be required to provide detailed hydrologic pumping test data packages and operational plans for each wellfield at the proposed project. The applicant will also be required to restore groundwater parameters affected by ISR operations to levels that are protective of human health and safety.

- The costs associated with the proposed project are, for the most part, limited to the area surrounding the site.

- The regional benefits of building the proposed project will be increased employment, economic activity, and tax revenues in the region around the proposed site.

2.5 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20. “Standards for Protection Against Radiation.” Washington, DC: U.S. Government Printing Office.

10 CFR Part 40. *Code of Federal Regulations*, Title 10, *Energy*, Part 40. “Domestic Licensing of Source Material.” Washington, DC: U.S. Government Printing Office.

10 CFR Part 40 Appendix A. *Code of Federal Regulations*, Title 10, *Energy*, Part 40 Appendix A. “Criteria Relating to the Operation of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily from their Source Material Content.” Washington, DC: U.S. Government Printing Office.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51. “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 61. *Code of Federal Regulations*, Title 40, *Protection of Environment,* Part 61. “National Emission Standards for Hazardous Air Pollutants (NESHAPS).” Washington, DC: U.S. Government Printing Office.

40 CFR Part 144. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 144. “Underground Injection Control Program.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 145. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 145. “State UIC Program Requirements.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 146. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 146. “Underground Injection Control Program: Criteria and Standards.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 192. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 192. “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 261. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 261. “Identification and Listing of Hazardous Waste.” Washington, DC: U.S. Government Printing Office.

40 CFR Part 264. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 264. “Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities.” Washington, DC: U.S. Government Printing Office.

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3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

The proposed Dewey-Burdock *In-Situ* Recovery (ISR) Project is located in Custer and Fall River Counties, South Dakota, in the Nebraska-South Dakota-Wyoming Uranium Milling Region as defined in the generic environmental impact statement (GEIS) (NRC, 2009a). The proposed project area, which encompasses 4,282 ha [10,580 ac] of land, is in a relatively unpopulated rural area consisting of rangeland used primarily for cattle grazing. The nearest population center to the proposed Dewey-Burdock ISR Project is Edgemont, South Dakota, approximately 21 km [13 mi] to the south-southeast. The hamlet of Dewey, South Dakota, is located approximately 3.2 km [2 mi] northwest of the project. Other towns located within 80 km [50 mi] of the proposed project area include Hot Springs and Custer, South Dakota, and Newcastle, Wyoming (see Figure 1.1-1).

This chapter describes the existing site conditions of the proposed Dewey-Burdock ISR Project. The resource areas described in this chapter include land use; transportation; geology and soils; water resources; ecology; meteorology, climatology, and air quality; noise; historic and cultural resources; visual and scenic resources; socioeconomics; public and occupational health; and waste management practices. The descriptions of the affected environment are based on information provided in the Powertech (USA) Inc. (Powertech) (referred to herein as the applicant) license application documents (Powertech, 2009a–c) and responses to NRC requests for additional information (Powertech, 2010a–c, 2011) and supplemented by additional information the U.S. Nuclear Regulatory Commission (NRC) identified. The information in this chapter forms the basis for assessing the potential impacts (see Chapter 4) of the proposed action and each alternative (see Chapter 2).

3.2 Land Use

The proposed Dewey-Burdock ISR Project is located within the Great Plains physiographic province on the edge of the Black Hills uplift. The proposed project area covers 4,282 ha [10,580 ac] and is composed of two contiguous areas: the Burdock area and the Dewey area (Figure 3.2-1). The Burdock area is located in the following townships and ranges: (i) Township 7 South, Range 1 East, Sections 1, 2, 3, 10, 11, 12, and portions of Sections 14 and 15 and (ii) Township 6 South, Range 1 East, Sections 34, 35, and portions of Section 27. The Dewey area is located in the following townships and ranges: (i) Township 7 South, Range 1 East, Section 5 and portions of Section 4 and (ii) Township 6 South, Range 1 East, Sections 29, 32, and portions of Sections 20, 21, 28, 31, and 33. Approximately 4,185 ha [10,340 ac] of the proposed project area are in the hands of private landowners, while approximately 97 ha [240 ac] are U.S. Government lands managed by U.S. Bureau of Land Management (BLM) (Powertech, 2009a,b).

GEIS Section 3.1.2.2 describes the concept of split estate where different entities own the surface rights and subsurface rights (such as the rights to develop minerals) for a piece of land (NRC, 2009a). This divided ownership pattern occurs at the proposed Dewey-Burdock ISR Project site, where BLM manages federally owned subsurface mineral rights to portions of land whose surface rights are owned by private landowners. In total, the U.S. Government reserved 1,708 ha [4,220 ac] of subsurface mineral estate under the Stock-Raising Homestead Act when the surface was patented. The applicant maintains the unpatented mining claims associated

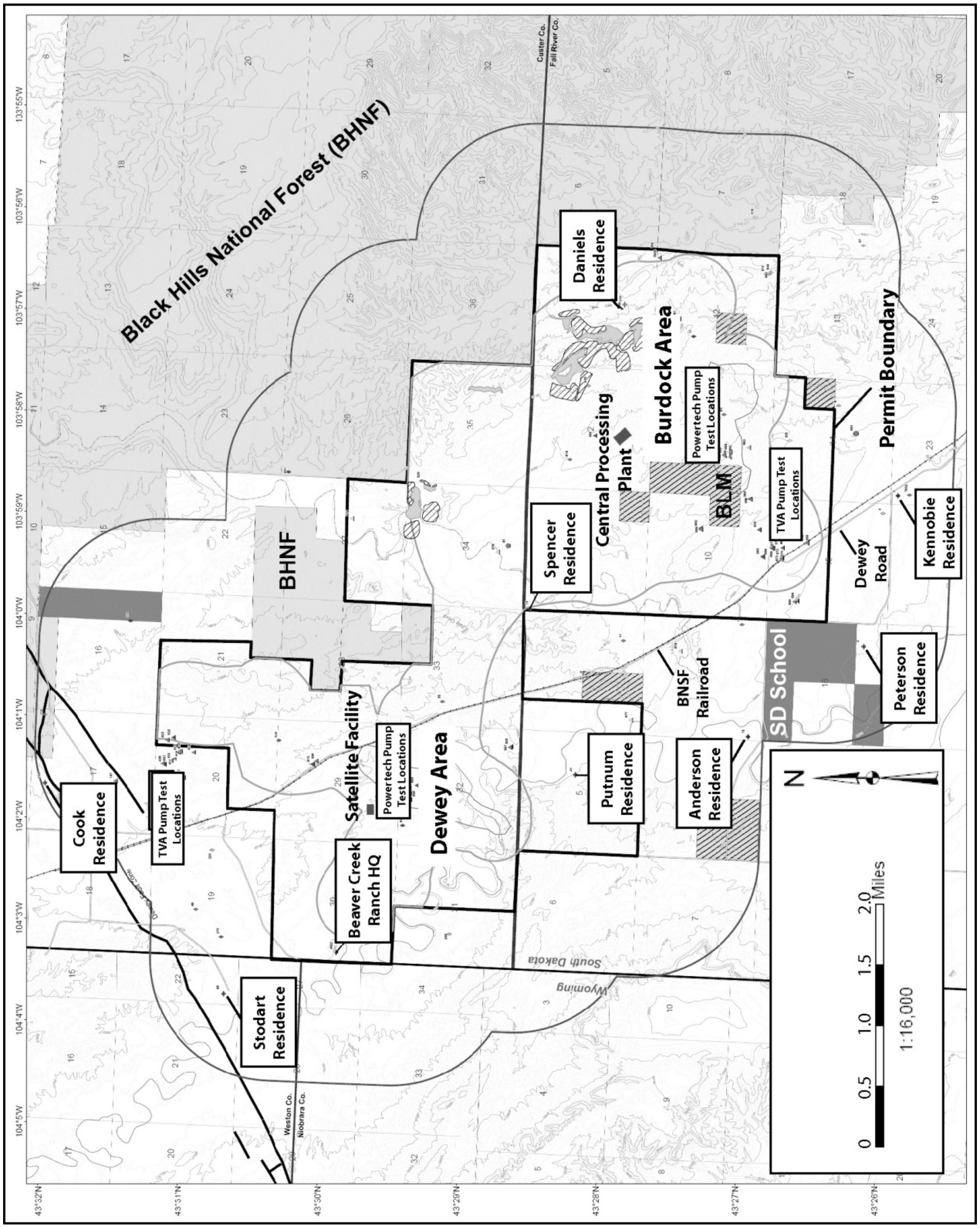

Figure 3.2-1. Map Showing Proposed Dewey-Burdock ISR Project Permit Boundary, Location of BLM-Managed Land, Position of Parcels of the Black Hills National Forest (BHNF) Bordering the Permit Area to the East and North, and Locations of Residences Within the Proposed Permit Area.
Source: Modified From Powertech (2009c).

with the 1,780 ha [4,220 ac] of federal minerals. In addition, the applicant maintains unpatented mining claims on the 97 ha [240 ac] of BLM-managed surface lands.

The land the applicant acquired for uranium resource development within the proposed project area consists of a mixture of leases from private landowners, both surface and subsurface, as well as the mining claims on the 1,780 ha [4,220 ac] of subsurface mineral estate and 97 ha [240 ac] of BLM-managed surface lands (Powertech, 2009a). This land consists of contiguous blocks of property known to contain the majority of discovered and delineated uranium resources that would be permitted for development.

Dwellings located within a 1.6-km [1.0-mi] radius of the proposed project boundary are listed in Table 3.2-1 and mapped on Figure 3.2-1. Two permanently occupied dwellings (the Putnum residence and the Beaver Creek Ranch headquarters), the vacant Spencer residence, and the seasonally occupied Daniels dwelling are located within the proposed project area. The permanent onsite residences, the Putnum dwelling and Beaver Creek Ranch headquarters, are located approximately 1.3 km [0.8 mi] south and 0.8 km [0.5 mi] west, respectively, of proposed wellfields in the Dewey area. The closest offsite residences, the Peterson and Kennobie dwellings, are located approximately 1.3 km [0.8 mi] southwest and 1.3 km [0.8mi] south, respectively, of proposed wellfields in the Burdock area.

The project area and surrounding region has been used as rangeland, as wildlife habitat, for recreation and hunting, in uranium exploration and mining, in oil and gas development, and for wind energy generation since historic times. SEIS Section 3.6.1 describes wildlife and vegetation in the project area. A small portion of the project area currently covered by stands of ponderosa pine has been logged selectively for pulpwood; however, timber is not currently and historically has not been a significant industry in the region surrounding the proposed project area (Powertech, 2010d).

3.2.1 Rangeland

Land use within the proposed Dewey-Burdock ISR Project area and adjacent lands is primarily agricultural (Powertech, 2009a), mainly for grazing cattle and a small number of horses. The National Agriculture Statistics Service reports 75,250 head of cattle in Fall River and Custer

Table 3.2-1. Dwellings Within the Proposed Dewey-Burdock ISR Project Area and a 1.6-km [1.0-mi] Radius of the Proposed Permit Boundary

Dwelling Name	Status	Number of Permanent Occupants	Location*
Peterson	Occupied	9	T7S, R1E, Section 16
Kennobie	Occupied	2	T7S, R1E, Section 23
Spencer	Vacant		T7S, R1E, Section 4
Daniels	Seasonal		T7S, R1E, Section 1
Anderson	Occupied	3	T7S, R1E, Section 9
Putnum	Occupied	2	T7S, R1E, Section 5
Stodart	Vacant		T41S, R60E, Section 22
Cook	Vacant		T6S, R1E, Section 17
Beaver Creek Ranch Headquarters	Occupied	1	T6S, R1E, Section 30

Source: Powertech (2010a).
*T = Township; R = Range; S = South; E = East

Counties in 2007 (USDA, 2009). No commercial crop production takes place within the permit area; however, approximately 157 ha [389 ac] of land along Beaver Creek in Section 32, Township 6 South, Range 1 East is irrigated for hay production for use by the grower (Powertech, 2009a).

The approximately 97 ha [240 ac] of BLM-managed lands within the project area are located in Fall River County entirely within the Burdock area (Figure 3.2-1); these lands are surrounded by private land and have limited public access. Additional small parcels of BLM-managed land are located outside the proposed project area in Fall River County. The majority of land under BLM management in South Dakota is grassland (BLM, 1985). The forage produced on these lands is a public resource and historically has been used for livestock grazing. Area ranchers lease grazing privileges and derive economic benefits from the public lands proportional to the amount of grassland under lease. In its current resource management plan for South Dakota, BLM has categorized most grazing allotments of BLM lands in Fall River County, including those within the proposed project area, as “custodial” (BLM, 1985). The objective of this category is to manage and protect the existing resource value of the land (BLM, 1985).

3.2.2 Hunting and Recreation

Within the proposed project area, recreational use is limited primarily to big game hunting. Pronghorn antelope, mule deer, white-tailed deer, and elk are the predominant big game species hunted (Powertech, 2009a). Hunting is currently open to the public within the project area on approximately 2,307 ha [5,700 ac] including the 97 ha [240 ac] of BLM-managed land (Powertech, 2011). In addition, South Dakota Game, Fish, and Parks (SDGFP) leases around 1,214 ha [3,000 ac] of privately owned land within the project area and designates this acreage as walk-in hunting areas (WIA) (Powertech, 2011). The amount of land designated as WIAs changes from year to year because landowners lease their lands annually to SDGFP.

Recreational lands are present in Custer, Fall River, and Pennington Counties within an 80-km [50-mi] radius of the proposed project. Major attractions include Mount Rushmore National Memorial, Wind Cave National Park, and Jewel Cave National Monument, all managed by the U.S. Department of the Interior. These attractions are within the Black Hills National Forest (BHNF) and are located approximately 71 km [44 mi] northeast, 47 km [29 mi] east, and 37 km [23 mi] north of the project area, respectively (Figure 3.2-2). BHNF borders the proposed project to the north, northeast, and east, and the Buffalo Gap National Grassland is located approximately 4.8 km [3 mi] south of the proposed project (Figure 3.2-2). The U.S. Forest Service (USFS) manages these lands, which provide a variety of recreational activities, such as sightseeing, hiking, camping, fishing, and hunting (USFS, 2009, 1997).

3.2.3 Minerals and Energy

Historically, industrial activity within and in the region surrounding the proposed Dewey-Burdock ISR Project has consisted primarily of uranium exploration and mining and oil and gas development. There are no coal mines or coal bed methane operations in Fall River and Custer Counties (NRC, 2009a). However, information gathered during a site visit meeting with the U.S. Bureau of Land Management (BLM) staff indicated small bituminous coal deposits located east and south of the proposed project area were developed in the past (NRC, 2009b). This information is consistent with isolated coal fields located approximately 3 km [2 mi] southeast of the proposed project area and approximately 6 km [4 mi] southeast of the city of Edgemont (Figure 3.2-2).

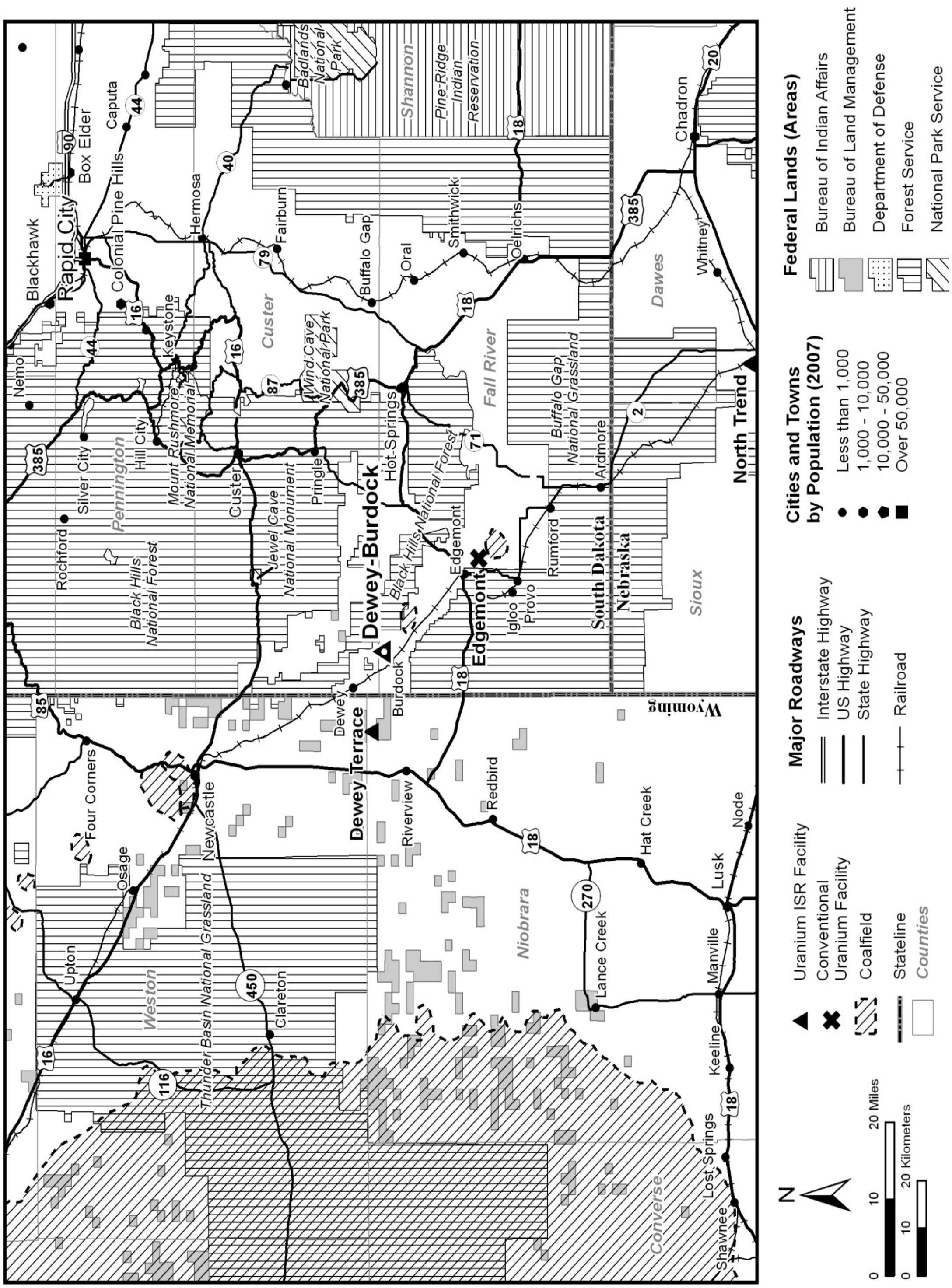

Figure 3.2-2. Recreational Areas, Federal Lands, Coal Fields, and ISR Facilities Near the Proposed Dewey-Burdock ISR Project.
Sources: ESRI (2008); National Atlas of the United States (2009).

The proposed project site is located within the Edgemont Uranium District in Fall River and Custer Counties, South Dakota. Uranium was first discovered in the Edgemont District in 1951, and open pit mines produced uranium until 1972 (Powertech, 2009a). Surface and underground uranium mines were operated in the Burdock area along the eastern boundary of the proposed project area (Figure 3.2-3). Surface mines consist of seven open pits: Triangle Pit, Darrow Mine, Darrow Pit 1, Darrow Pit 2, Darrow Pit 3, Darrow Pit 4, and Darrow Pit 6 (Figure 3.2-3). The underground mine workings consist of four shallow mines (Triangle Underground, Darrow Underground, Freezeout 1, and Freezeout 2 mines) and two open pit adits (tunnels) driven into the highwalls of Darrow Pit 2 (Figure 3.2-3) (Powertech, 2011). The underground mines were constructed as declines (downward sloping ramps) ranging in depth from 0 to 24.4 m [0 to 80 ft] below ground surface. Both the underground and open pit mines extracted uranium from shallow sandstone orebodies within the Fall River Formation (Powertech, 2011). Existing mine waste overburden from the underground and open pit mines remains in the eastern portions of the Burdock area (Figure 3.2-3). The Tennessee Valley Authority (TVA) acquired the land encompassing the proposed project area in 1978 and conducted uranium exploration activities until 1986. In total, TVA drilled more than 4,000 exploration drill holes within and in the vicinity of the proposed project.

Operating uranium recovery facilities are located within the broader regional area. The nearest operational ISR facility is the Crow Butte ISR facility, which is located approximately 105 km [65 mi] to the south-southeast in Dawes County, near Crawford, Nebraska (NRC, 2009a). The applicant identified uranium reserves at two potential ISR projects at Dewey Terrace and Aladdin in Wyoming (Powertech, 2009b). The potential Dewey Terrace project is located 13 km [8 mi] west of the proposed Dewey-Burdock ISR Project in Weston and Niobrara Counties, Wyoming (Figure 3.2-2). The mineralized trends in the Dewey Terrace project area are a continuation of the mapped trends from the Dewey-Burdock ISR Project. The potential Aladdin project is located approximately 129 km [80 mi] to the north in Crook County, Wyoming, near the Wyoming/South Dakota border. Development of these potential ISR facilities is dependent upon further site investigations, as well as the viability of the uranium market (Powertech, 2009b). To this date, the applicant has not submitted a letter of intent for either Aladdin or Dewey Terrace.

There are no former or actively producing oil and gas wells within the proposed Dewey-Burdock ISR Project permit area or within 2 km [1.2 mi] of the proposed project boundary (Powertech, 2011). However, three known plugged and abandoned oil and gas test wells are located in the proposed Burdock area and another nine plugged and abandoned tests wells are within 2 km [1.2 mi] of the proposed project boundary (Figure 3.2-4) (Powertech, 2010a, 2011). In Fall River County, the producing oil well nearest to the proposed project is approximately 11 km [7 mi] to the southeast in the Cheyenne Bend oilfield (SDDENR, 2012a). Other producing oil wells are located southwest of the city of Edgemont. In Custer County, producing oil wells are in the Barker Dome oilfield, approximately 6 km [4 mi] east of the project area (SDDENR, 2012b). The Powder River Basin in Wyoming, to the west of the proposed project, contains some of the largest coal bed methane and natural gas deposits in the United States. Weston and Niobrara Counties in Wyoming to the west and northwest of the proposed project contain significantly more active oil and gas production wells than Fall River and Custer Counties (Wyoming Oil and Gas Conservation Commission, 2012). The majority of oil and gas production and exploration are concentrated in the southwestern part of Weston County and the northwestern part of Niobrara County, closer to the Powder River Basin. The producing wells nearest to the proposed project are in the Plum Canyon oilfield in Wyoming, approximately 5 km [3 mi] to the northwest in Weston County (see Figure 5.1-3 in this SEIS).

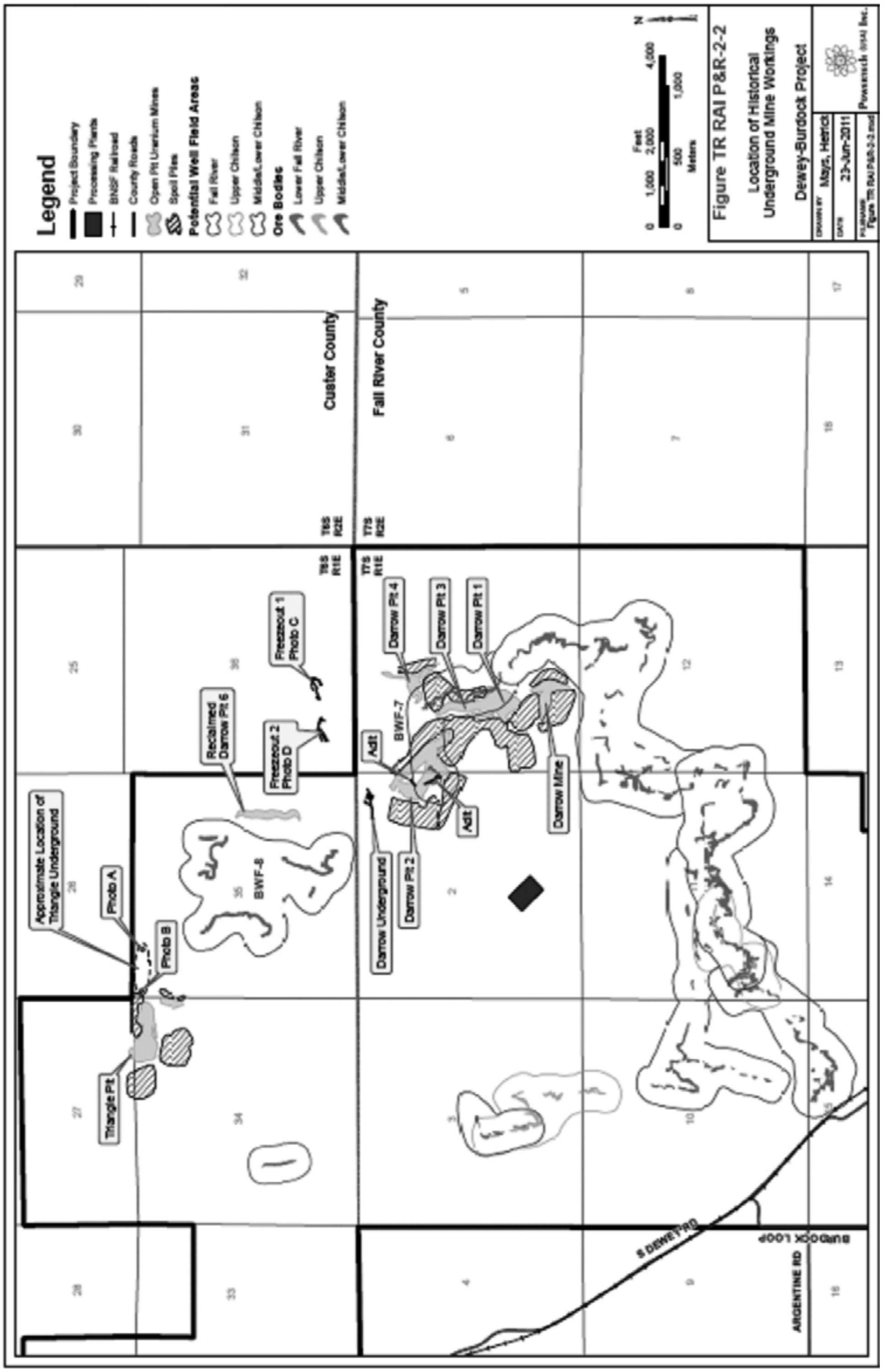

Figure 3.2-3. Map Showing Locations of Historical Underground and Open Pit Mine Workings in the Eastern Part of the Proposed Dewey-Burdock ISR Project Site. Source: Powertech (2011).

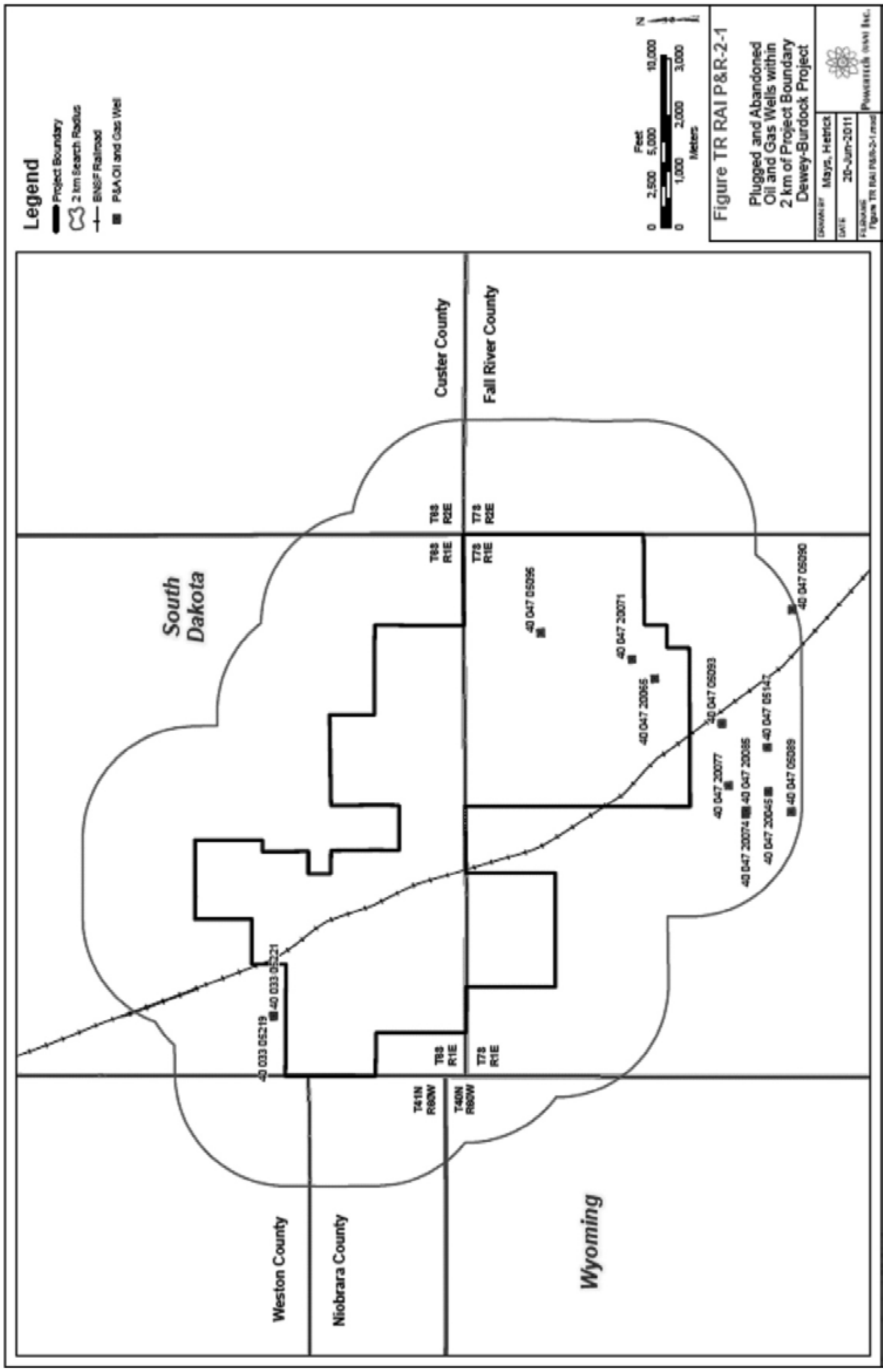

Figure 3.2-4. Map Showing Plugged and Abandoned Oil and Gas Test Wells Within 2 km [1.2 mi] of the Proposed Dewey-Burdock ISR Project Boundary. Source: Powertech (2011).

At this time no pending or potential oil and gas land leases are within the proposed project area. Furthermore, demand for oil and gas leasing on available land in the vicinity of the proposed project is low. Most active oil and gas development in the region is located on USFS-managed land, primarily in the Buffalo Gap National Grassland, located west and south of Edgemont. Sixteen oil and gas drilling permits were issued in Fall River County since 2005 (SDDENR, 2012c). In Custer County, no oil and gas drilling permits have been issued since 2005 (SDDENR, 2012c). Seven known oil and gas lease tracts are on USFS-managed land in the immediate vicinity of the proposed project area; however, these tracts are currently not available for bid (BLM, 2009a). These tracts are located in Custer County within Township 6 South, Range 1 East; two of the tracts (SDM79010BO and SDM79010BN) border the permit boundary of the proposed project (Figure 3.2-5).

At present, no wind farms are located in the vicinity of the proposed project; however, a landowner group, the Dewey-Burdock Wind Association, LLC is exploring the viability of wind power (Powertech, 2010a). The land designated as a potential wind farm includes privately owned land inside and surrounding the proposed project area. Most of the landowners involved in the potential wind farm are also involved in the proposed Dewey-Burdock ISR Project (Powertech, 2010a). The wind farm is currently in the conceptual phase.

3.3 Transportation

This section describes the transportation infrastructure and conditions in the region surrounding the proposed Dewey-Burdock ISR Project. As described in Section 2.1.1.1.7 of this SEIS, the applicant has proposed to use trucks to ship equipment, supplies, and produced materials, including wastes, during the lifecycle of the proposed action. The applicant does not anticipate using the Burlington Northern Santa Fe (BNSF) railroad as a transportation option for any of the proposed project operations. There are no navigable waterways within close proximity that provide transportation access to the proposed project.

The proposed Dewey-Burdock ISR Project site is located in Fall River and Custer Counties in a remote area of southwestern South Dakota near the eastern border of Wyoming, approximately 21 km [13 mi] northwest of Edgemont, South Dakota. Figure 3.3-1 shows the transportation corridor of the region surrounding the proposed site, and Figure 3.2-1 provides a closer view of the immediate proposed site area and the existing transportation infrastructure. Access to the proposed site from Edgemont is from the southeast on Fall River County Road 6463 (locally known as Dewey Road). Within Custer County, Dewey road is also called Custer County Road 769. Figure 3.2-1 shows Dewey Road, an unpaved, gravel-covered road that is narrower than a standard two-lane road of 6 to 7 m [20 to 24 ft] and runs adjacent to the BNSF rail line (BLM, 2009a). County records indicate repairs to Dewey Road were needed due to flooding 15 times since 1987 (BLM, 2009a). The main access road to the proposed central processing plant (CPP) facilities and well fields in the Burdock area of the proposed project would be constructed off Dewey Road in Township 7 South, Range 1 East, Section 10 (see Figure 2.1-10). The main access road to the proposed satellite facility (SF) in the Dewey area of the proposed project would be constructed off Dewey Road in Township 6 South, Range 1 East, Section 20 (see Figure 2.1-10).

U.S. Highway 18 travels northeast from Edgemont to Hot Springs, South Dakota, and to State Highway 79, which travels north to Rapid City and Interstate 90 (see Figure 3.3-1). U.S. Highway 18 also connects Edgemont to State Highway 89 that runs north to Custer, South Dakota. Table 3.3-1 presents traffic counts for regional roads based on available data.

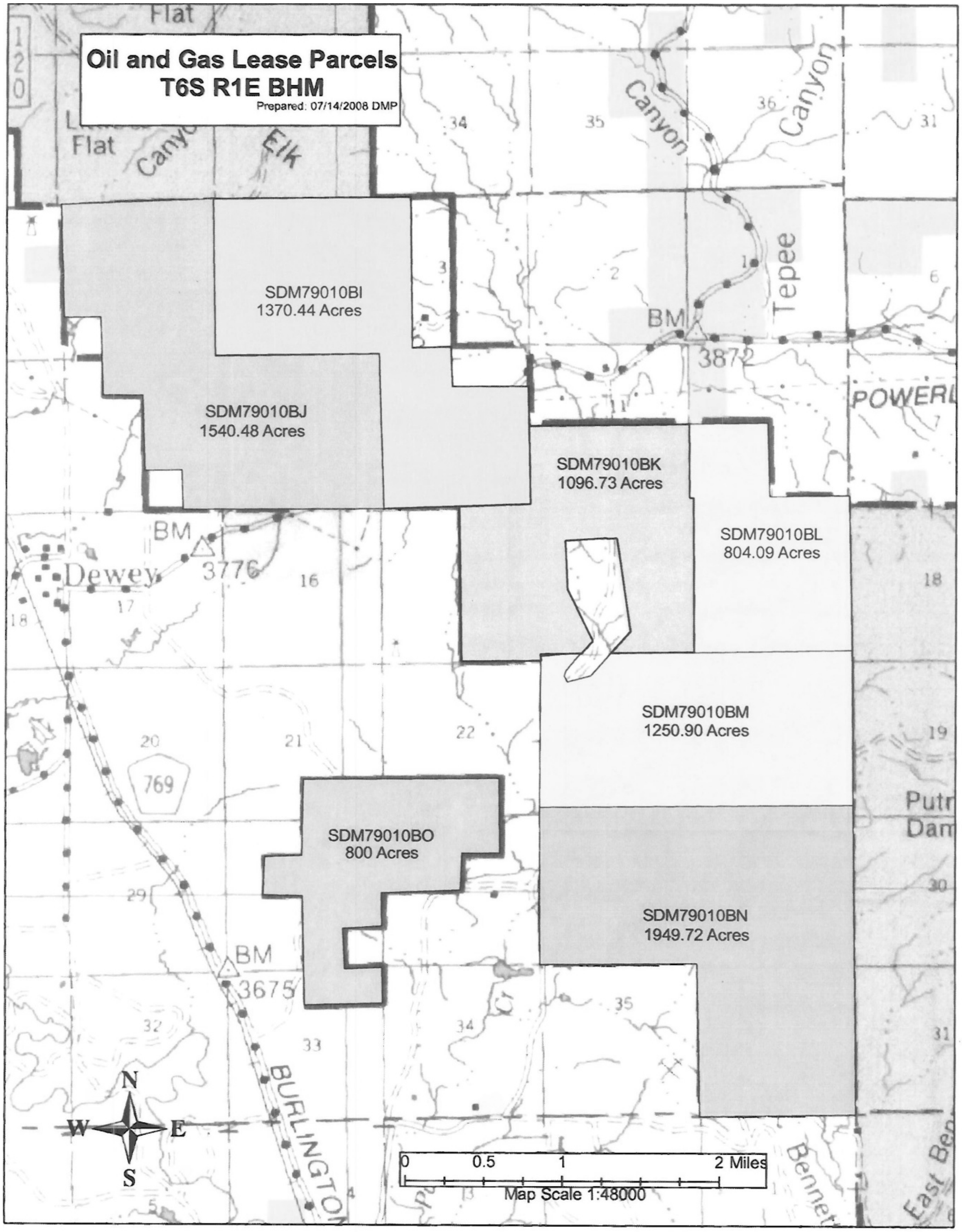

Figure 3.2-5. Pending Oil and Gas Lease Tracts in Custer County, South Dakota. Source: BLM (2009a).

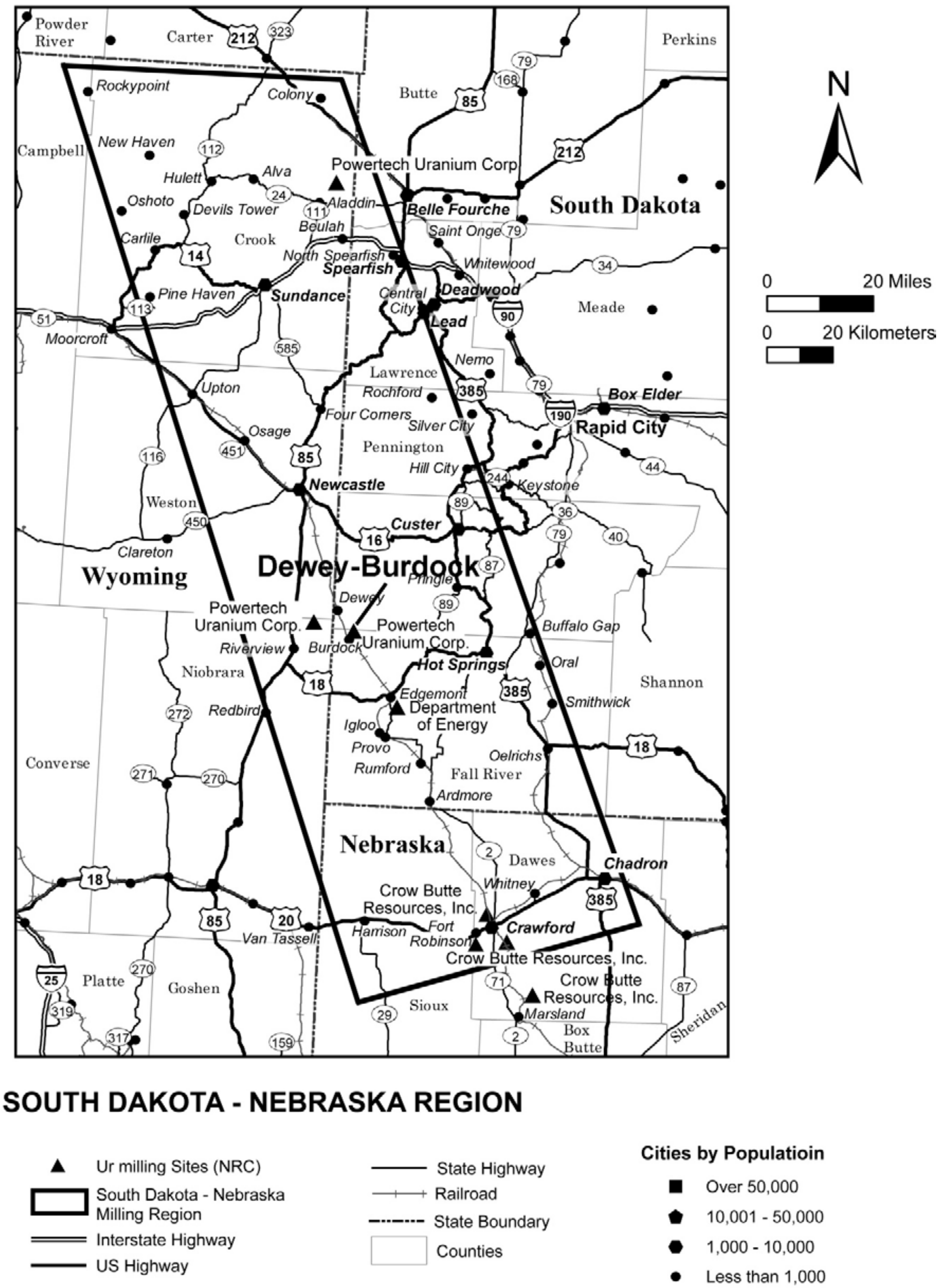

Figure 3.3-1. Transportation Corridor of the South Dakota-Nebraska-Wyoming Uranium Milling Region Surrounding the Proposed Dewey-Burdock ISR Project. Source: NRC (2009a).

Table 3.3-1. Annual Average Daily Traffic in the Vicinity of the Proposed Dewey-Burdock ISR Project

Road Segment	2011 Traffic Count*		
	All Vehicles	Auto	Truck
Dewey Road	25	25	—
US 18 (Edgemont to US 89)	1,782	1,361	421
US 18 (Hot Springs to SR 79)	5,075	4,725	350
SR 89 (US 385 to US 18)	659	604	55
SR 79 (at US 18)	3,172	2,569	603

Sources: BLM (2009a); SDDOT(2011)
*Traffic counts are annual average daily traffic for both directions of travel. Data for all roads are for year 2011 and are from SDDOT (2011), except the Dewey count is from 2009 (BLM, 2009a). NRC staff calculated the auto counts as the difference between the reported all-vehicle and truck counts.

No road capacity studies of local transportation routes were identified. However, insights to rural road capacities were based on (i) published estimates for a single freeway lane capacity of 13,900 vehicles per day derived by the South Dakota Department of Transportation (SDDOT, 2000) and (ii) a rural 2-lane highway hourly capacity estimate (1,375 vehicles per hour) that accounts for nonideal travel conditions (Kadrmas, et al., 2010) that the NRC staff converted to a daily value of 7,237 vehicles per day using the method and assumptions SDDOT (2000) reported and assuming equal traffic in each direction.

3.4 Geology and Soils

The proposed Dewey-Burdock Project is located in the Black Hills of southwestern South Dakota within the Nebraska-South Dakota-Wyoming Uranium Milling Region evaluated in GEIS Section 3.4.3.1 (NRC, 2009a). GEIS Section 3.4.3.1 provides a regional description of the geology and soils of the Black Hills. A summary of the geology of the Black Hills region and site-specific discussions of the geology and soils within and in the vicinity of the proposed Dewey-Burdock ISR Project are provided in the following sections.

3.4.1 Geology

3.4.1.1 The Black Hills (Western South Dakota–Northeastern Wyoming)

The Black Hills are an asymmetrical domal uplift elongated in the northwest direction (Figure 3.4-1). Economically significant uranium discoveries in the Black Hills are contained within strata of the Inyan Kara Group (Chenoweth, 1988). Prior to 1968, three uranium districts (Hulett Creek, Carlile, and Edgemont) produced the bulk of the uranium production tonnage mined from the Black Hills area in Wyoming and South Dakota (Hart, 1968). The proposed Dewey-Burdock ISR Project is located within the Edgemont uranium district in Custer and Fall River Counties, South Dakota (Figure 3.4-1).

Ore-bearing stratigraphic units present in the Black Hills represent the Cretaceous, Jurassic, and Triassic Periods [65–145 million years ago (mya), 149-199 mya, and 200-251 mya, respectively] (Figure 3.4-2). In the Dewey-Burdock ISR Project area, the Inyan Kara Group is Lower Cretaceous (99-145 mya) in age and consists of subequal amounts of complexly interbedded sandstone and claystone (Renfro, 1969). The Inyan Kara Group is bounded below

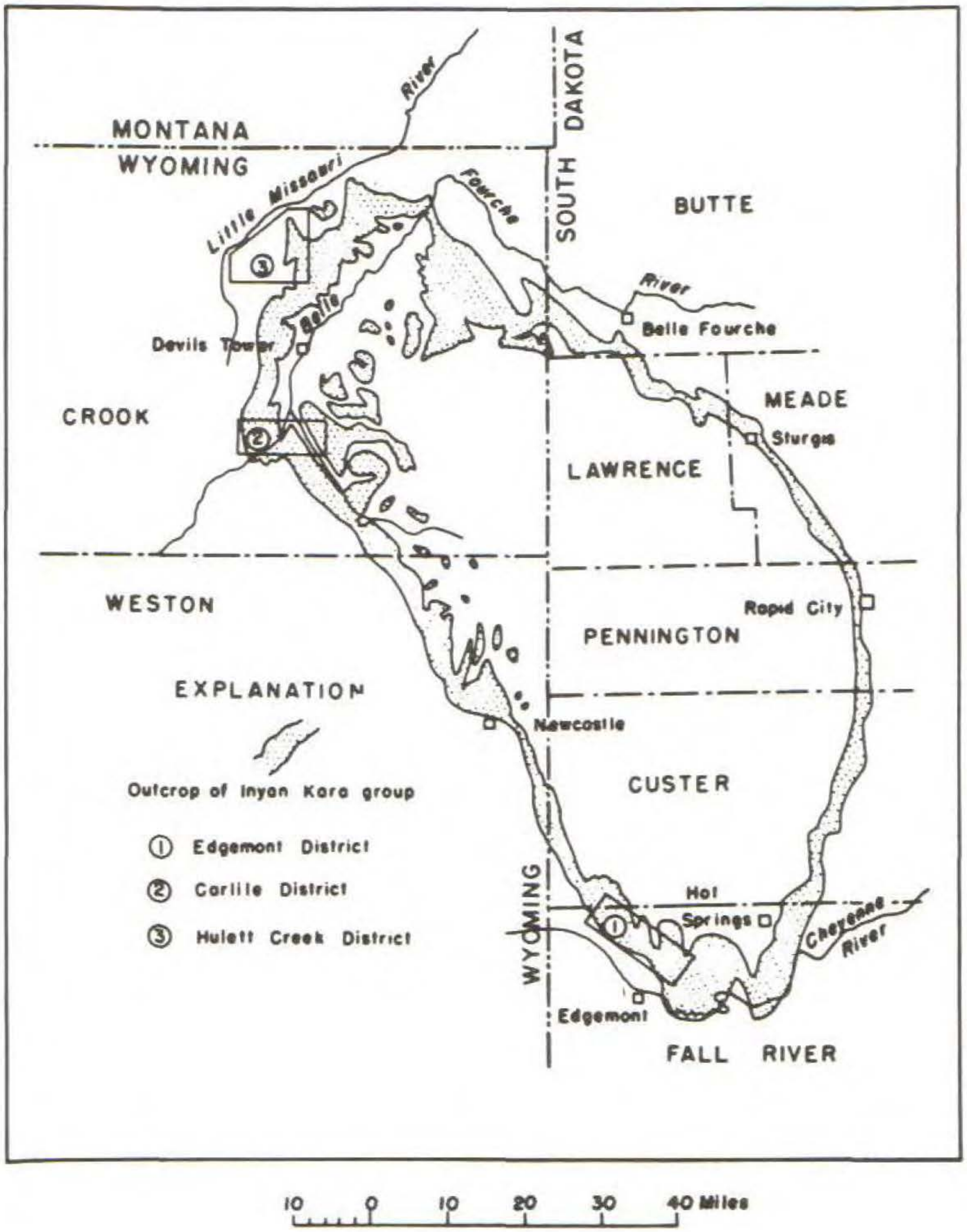

Figure 3.4-1. Outcrop Map of the Inyan Kara Group in the Black Hills of Western South Dakota and Northeastern Wyoming Showing the Locations of Principal Uranium Mining Districts.
Source: Modified From NRC (2009a).

Black Hills Area

System	Series	Group	Formation
Tertiary	Pliocene		Ogallala Formation
	Miocene		Arikaree Formation
	Oligocene		White River Formation
	Eocene		(Absent)
	Paleocene		Fort Union Formation
Cretaceous	Upper		Hell Creek Formation
			Fox Hills Sandstone
			Pierre Shale
			Niobrara Formation
			Carlile Shale
			Greenhorn Formation
		Graneros Group	Belle Fourche Shale
	Lower		Mowry Shale
			Newcastle Sandstone
			Skull Creek Shale
		Inyan Kara Group	Fall River Formation
			Lakota Formation
Jurassic			Morrison Formation
			Unkpapa Sandstone
			Sundance Formation
			Gypsum Spring Formation
Triassic			Spearfish Formation
Permian			Minnekahta Limestone
			Opeche Shale
			Minnelusa Formation
Pennsylvanian			
Mississippian			Madison Formation
			Englewood Formation
Devonian			
Ordovician			Whitewood Formation
			Winnipeg Formation
			Deadwood Formation
Cambrian			

Figure 3.4-2. Principal Stratigraphic Units in the Black Hills Area of Western South Dakota and Northeastern Wyoming.
Sources: Modified From Driscoll, et al. (2002) and NRC (2009a).

by continental Jurassic sediments of the Morrison Formation and is overlain by the marine sediments of the Graneros Group, which includes the Skull Creek Shale, the Newcastle Sandstone, the Mowry Shale, and the Belle Fourche Shale. Resistant sediments of the Inyan Kara Group form the outermost ring of hogback ridges that crop out in a roughly oval pattern around the flanks of the Black Hills (Figure 3.4-1). Major sandstone-hosted uranium deposits occur from 2 to 8 km [1 to 5 mi] downdip from the main Inyan Kara escarpment at depths ranging from 30 to 183 m [100 to 600 ft].

The Inyan Kara Group is formally subdivided into the Lakota Formation and the Fall River Formation. Source sediment for both formations is considered to include all pre-Cretaceous sediments to the south and east of the Black Hills (Renfro, 1969).

The Lakota Formation is generally accepted to be continental in origin. The Lakota Formation represents a sequence of coastal-plain deposits of fine-grained, poorly sorted sandstone and mudstone; channel-fill deposits of cross-bedded sandstone; natural levee and overbank deposits of lenticular fine-grained, carbonaceous sandstone and siltstone; and floodplain deposits of bedded siltstone, mudstone, and claystone (Maxwell, 1974). The Lakota Formation ranges in thickness from 15 to 91 m [50 to 300 ft] and thickens regionally from northwest to southeast (Chenoweth, 1988).

The Fall River Formation overlies the Lakota Formation, ranges in thickness from 30 to 46 m [100 to 150 ft], and thickens regionally from southeast to northwest (Dondanville, 1963). The Fall River Formation is divided into deltaic and marine facies. The deltaic facies consist of channel sandstone, interchannel sandstone and mudstone, and blanket sandstone. The marine and marginal marine facies consist of offshore and lagoonal mudstone and shale, and bar and spit sandstone.

Uranium deposits in the Inyan Kara Group are present as roll-front deposits. The formation and characteristics of roll-front uranium deposits in the western United States, which includes the Nebraska-South Dakota-Wyoming Uranium Milling Region, are described in GEIS Section 3.1.2.1 (NRC, 2009a). In the uranium deposits within the Inyan Kara Group, uranium minerals coat sand grains, fill interstices between grains, and are disseminated in organic matter (Renfro, 1969). The specific source of uranium is unknown. Two proposed uranium sources include uranium indigenous (i.e., native) to the Lakota and Fall River sediments (Renfro, 1969) and uranium leached by groundwater from tuffaceous beds of the Tertiary White River Group that were unconformably deposited across the eroded Black Hills uplift (Hart, 1968).

3.4.1.2 Dewey-Burdock Geology

Surface geology across the proposed Dewey-Burdock ISR Project area is shown in Figure 3.4-3. The Fall River Formation outcrops across the eastern part of the proposed project area, the Skull Creek Shale and Mowry Shale outcrop across the central part of the proposed project area, and the Belle Fourche Shale outcrops across the western part of the proposed project area. At the site the shales present are all part of the Graneros Group. Formations within the project area dip gently 2 to 6 degrees to the southwest. The most recent sedimentary units deposited within the project area are Quaternary age alluvium deposits. Alluvium consisting of silt, clay, and gravel is present in the major stream drainages and their tributaries. There is faulting and folding in areas surrounding the proposed project. The Dewey Fault, a northeast-to-southwest-trending fault zone, is present approximately 1.6 km [1 mi] north and

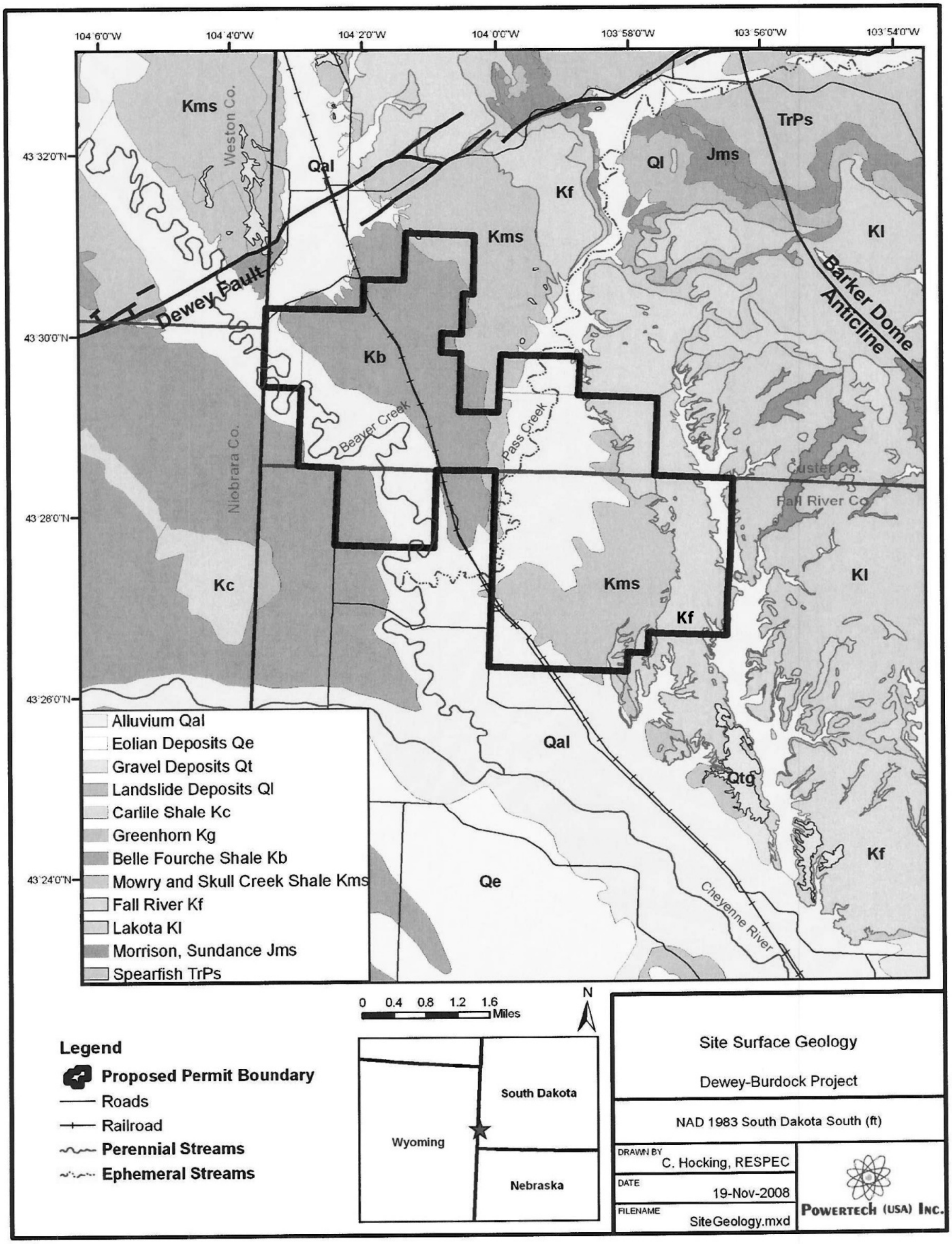

Figure 3.4-3. Map Showing Site Surface Geology Within and Surrounding the Proposed Dewey-Burdock ISR Project Area.
Source: Powertech (2009a).

northwest of the project area. The Barker Dome, a northwest-to-southeast-trending anticline, is present east of the project area (Figure 3.4-3).

Stratigraphic units of interest for the proposed Dewey-Burdock ISR Project include the Morrison Formation, the Inyan Kara Group (Lakota and Fall River Formations), the Skull Creek Shale, and the Mowry Shale (Figure 3.4-4). The Inyan Kara Group is host to all the uranium mineralization for the proposed project (Powertech, 2009a). The Morrison Formation and the Skull Creek Shale coupled with the Mowry Shale form the lower and upper confining units for uranium mineralization at the Dewey-Burdock site, respectively. The combined Skull Creek–Mowry Shale is often referred to as the Granerous Group. Structure contour maps and cross sections delineating the extent and character of the stratigraphic units at the proposed Dewey Burdock site were compiled with data obtained from TVA downhole electric logs of thousands of exploration drill holes and from drill cuttings data (Powertech, 2009a,c). As described in SEIS Section 3.5.3.2, aquifer pumping tests have provided data indicating a hydraulic connection between the Lakota and Fall River Formations through the intervening Fuson Shale in the Burdock area resulting from unidentified structural features or old unplugged exploration holes.

<u>Morrison Formation</u>

The Upper Jurassic Morrison Formation consists of floodplain deposits having an average thickness of approximately 30 m [100 ft]. This lower confining unit is composed of calcareous, noncarbonaceous massive shale with limestone lenses and a few thin fine-grained sandstones. Analyses of core samples indicate that Morrison clays have very low vertical permeabilities {on average 2.0×10^{-8} cm/s [6.0×10^{-5} ft/day]} (Powertech, 2009a).

Dewey-Burdock Site Stratigraphy

System	Series	Formation		
Cretaceous	Upper		Belle Fourche Shale	
Cretaceous	Lower	Graneros Group	Mowry Shale	
Cretaceous	Lower	Graneros Group	Skull Creek Shale	
Cretaceous	Lower	Inyan Kara Group	Fall River Formation	
Cretaceous	Lower	Inyan Kara Group	Lakota Formation	Fuson Member
Cretaceous	Lower	Inyan Kara Group	Lakota Formation	Chilson Member
Jurassic		Morrison Formation		
Jurassic		Unkpapa Sandstone		
Jurassic		Sundance Formation		

Figure 3.4-4. Stratigraphic Units Present at the Proposed Dewey-Burdock ISR Project Site.
Sources: Modified From Driscoll, et al. (2002) and NRC (2009a).

Inyan Kara Group: Lakota Formation and Fall River Formation

The Lakota Formation consists of three members (from lower to upper): the Chilson Member, also known as the Lakota Sandstone; the Minnewasta Limestone Member; and the Fuson Member. Only the Chilson and Fuson Members are present at the proposed project site (see Figure 3.4-4).

The Chilson Member consists of two units: a basal carbonaceous mudstone and an overlying unit of channel sandstones interbedded with shale. Core sample analyses indicate the sandstones have horizontal permeabilities ranging from 2.6×10^{-3} to 4.1×10^{-3} cm/sec [7.4 to 11.6 ft/day] (Powertech, 2009a). The thickness of the Chilson Member sandstone within the proposed Dewey-Burdock ISR Project area varies from 27.4 to 73.2 m [90 to 240 ft] (Powertech, 2009a).

The Fuson Member is the uppermost member of the Lakota Formation and is used to divide the Lakota Formation and the Fall River Formation. The Fuson Member is composed of shale-siltstone with discontinuous sandstone units at the base and top of the member. The shale-siltstone portion of the Fuson Member has low vertical permeability ranging from 7.9×10^{-14} to 2.3×10^{-12} cm^2 [0.008 to 0.228 millidarcies] (Powertech, 2009a). The Fuson Member ranges in thickness from 6 to 24 m [20 to 80 ft] within the proposed project area (Powertech, 2010a).

The Fall River Formation is composed of carbonaceous interbedded siltstone and sandstone, channel sandstones, and a sequence of interbedded sandstone and shale. The Fall River Formation ranges in thickness from 37 to 49 m [120 to 160 ft] within the proposed project area (Powertech, 2009a). The Fall River Formation is exposed at the surface in the eastern half of the Burdock area at the proposed Dewey-Burdock site (Figure 3.4-3).

The sandstones of the Fall River and Lakota Formations contain the uranium deposits at the proposed project site. Mineralized sands occur at depths of less than 30 m [100 ft] in the outcrop area of the Fall River Formation in the eastern part of the Burdock area and at depths of up to 244 m [800 ft] in the Lakota Formation in the Dewey area (Powertech, 2009a). The depths of ore zones in the initial wellfields at the proposed project range from approximately 122 to 244 m [400 to 800 ft] bgs in the Dewey area and approximately 61 to 122 m [200 to 400 ft] in the Burdock area (Powertech, 2009c). The calculated average thickness of individual ore zones is 1.86 m [6.1 ft] with an average ore grade of 0.21 percent U_3O_8 (Powertech, 2009a). The primary uranium minerals in the deposits are very fine-grained pitchblende and coffinite, which coat sand grains and fill interstices between grains.

Skull Creek Shale

The Skull Creek Shale directly overlies the Fall River Formation and consists predominantly of dark-gray to black shale and organic material. The Skull Creek Shale forms the upper confinement for the uranium mineralization and has a thickness of approximately 61 m [200 ft]. The Skull Creek Shale has a vertical permeability of approximately 6.9×10^{-14} cm^2 [0.007 millidarcies] (Powertech, 2009a). The Skull Creek Shale has been eroded and is absent in the eastern part of the Burdock area (Figure 3.4-3).

Mowry Shale

The Mowry Shale, together with the Skull Creek Shale, is also considered to be part of the upper confining unit for the target mineralization zone at the proposed Dewey-Burdock ISR Project. The Newcastle Sandstone, usually present between the Skull Creek and the Mowry Shale, is absent within the proposed project area as shown in Figure 3.4-4. The combined thickness of the Skull Creek Shale–Mowry Shale is approximately 122 m [400 ft] in the western part of the proposed project site (i.e., the Dewey area) (Powertech, 2009a). In the eastern part of the Burdock area, these shale units have been eroded and are absent (Figure 3.4-3).

3.4.2 Soils

GEIS Section 3.4.3.1 describes the soils of the Black Hills as a product of weathering of surficial sedimentary rocks of the Black Hills range (NRC, 2009a). To provide site-specific soil characteristics, the applicant had a soil survey conducted within the Dewey-Burdock permit area in accordance with procedures of the National Cooperative Soil Survey (Powertech, 2009a). The survey included a total of 3,222 ha [7,960 ac] with 1,240 ha [3,065 ac] of that total to be disturbed soil areas. The soils in the proposed site are typical for semiarid grasslands and shrublands of the Western United States and are classified as Aridic Argiustolls, Aridic Ustorthents, and Aridic Haplusterts.

The soil survey results indicated that soils within the proposed permit area generally have a clayey or very fine texture with patches of sandy loam on upland areas and fine, clay-textured soils in or near drainages. Deep soils were found on level upland areas, and shallow and very shallow soils were found on hills, ridges, and breaks. Salvage depths ranged from 0 to 1.5 m [0 to 5 ft] (Powertech, 2009a). The clayey texture of the surface horizon found throughout most of the proposed project area results in soils more susceptible to erosion from water than wind (Powertech, 2009a).

3.4.3 Seismology

The Dewey Fault is located approximately 1.6 km [1 mi] north of the proposed Dewey-Burdock permit area (Figure 3.4-3). The Dewey Fault is a nearly vertical northeast-to-southwest-trending normal fault with a combined displacement and drag of approximately 152 m [500 ft] on the north side. Given the location and displacement characteristics of this fault, there will be no effect on proposed site activities. The Long Mountain Structural Zone located 11 km [7 mi] southeast of the proposed project area contains several small, shallow faults in the Inyan Kara Group. No faults have been identified within the proposed permit area (Powertech, 2009a). Additionally, according to the U.S. Geological Surveys (USGS) Quaternary Fault and Fold Database, no capable faults (active faults) with surface expression occur within a 100-km [62-mi] radius from the center of the proposed site, demonstrating a historically low seismic potential (USGS, 2006a). The most significant seismic hazard within and in the vicinity of the proposed project area is a “floating” earthquake. In accordance with 10 CFR Part 40, Appendix A, a floating earthquake is one that is considered to occur randomly within a tectonic province. According to the applicant, the maximum magnitude of such an earthquake is 6.1. Within the period from 1872 to 2010, fourteen earthquakes of Richter Scale magnitudes ranging from 2.3 to 4.1 were recorded in Custer and Fall River Counties (SDGS, 2010). The Modified Mercalli scale intensities for these magnitudes are II (e.g., felt by few at best) to IV (e.g., felt indoors and outdoors), respectively. Eight earthquakes had epicenters located north of Hot Springs near Wind Cave National Park in Custer County, and two earthquakes had epicenters near Hot Springs in Fall River County. The closest earthquake to the proposed Dewey-Burdock site occurred January 5, 2004, with a recorded magnitude 2.8 with an epicenter located approximately 8 km [5 mi] north of the hamlet of Dewey in Custer County. The remaining 3 of the 14 earthquakes had epicenters located in southwestern, central, and eastern Fall River County.

Artificial Penetrations

According to the environmental report, there are 4,000 exploration drill holes representing historic exploration activities (Powertech, 2009a). The applicant has drilled approximately 115 exploration holes, including 20 monitoring wells in the project area. While the applicant cannot confirm that all historic borings were properly plugged and abandoned, the applicant has made commitments to ensure that unplugged drill holes will not impact human health or the environment during operations (Powertech, 2009b, 2011). In the technical report (Powertech, 2009b), the applicant stated that little evidence of unplugged boreholes has been observed given infrared photography data. However, an infrared map of a portion of the Burdock area shows an alkali pond area (Powertech, 2011). The applicant states unplugged borings appear to explain the presence of this pond area. No other pond areas or springs appear in infrared photography data of the Dewey-Burdock site. There is no other evidence indicating that previously unplugged borings are current groundwater flow pathways (Powertech, 2011).

3.5 Water Resources

3.5.1 Surface Waters

As described in GEIS Section 3.4.4.1, uranium deposits in Fall River and Custer Counties in southwestern South Dakota are present within the Beaver Creek and Angostura Reservoir watersheds (Figure 3.5-1). The proposed Dewey-Burdock ISR Project area lies within the Beaver Creek watershed and is drained by Beaver Creek, Pass Creek, and their tributaries (Powertech, 2009a). The Beaver Creek watershed covers an area of 3,522 km^2 [1,360 mi^2], excluding the Pass Creek subwatershed and lies within Weston, Niobrara, and Crook Counties in Wyoming and within Pennington, Custer, and Fall River Counties in South Dakota. The Pass Creek subwatershed comprises most of the east-southeast portion of the Beaver Creek watershed and covers an area of 596 km^2 [230 mi^2] within Custer, Fall River, and Pennington Counties in South Dakota and a very small portion of Weston County in Wyoming.

Beaver Creek, a perennial and shallow stream with ephemeral tributaries, flows northwest to southeast through the northwestern and western portions of the Dewey area (Figure 3.5-2). The average discharge rate for Beaver Creek, measured at Newcastle, Wyoming, is 0.34 m^3/s [12 ft^3/s] (stream gage 06392950; USGS, 2010). Pass Creek is dry for most of the year, except for short periods of high runoff following major storms (Powertech, 2009a). Pass Creek flows southerly through the central portion of the proposed project area and joins Beaver Creek southwest of the proposed project area. No permanent stream flow gages are stationed along Pass Creek. Beaver Creek and Pass Creek were not classified as domestic water supplies in beneficial uses of surface waters categorized by the State of South Dakota near the proposed area (SDDENR, 2008), although water from Beaver Creek is used for hay irrigation. Approximately 4 km [2.5 mi] south of the confluence of Beaver and Pass Creeks, Beaver Creek flows into the Cheyenne River (Figure 3.5-2). The average flow of the Cheyenne River at Edgemont, South Dakota, is 1.1 m^3/s [39 ft^3/s] (stream gage 06395000; USGS, 2010).

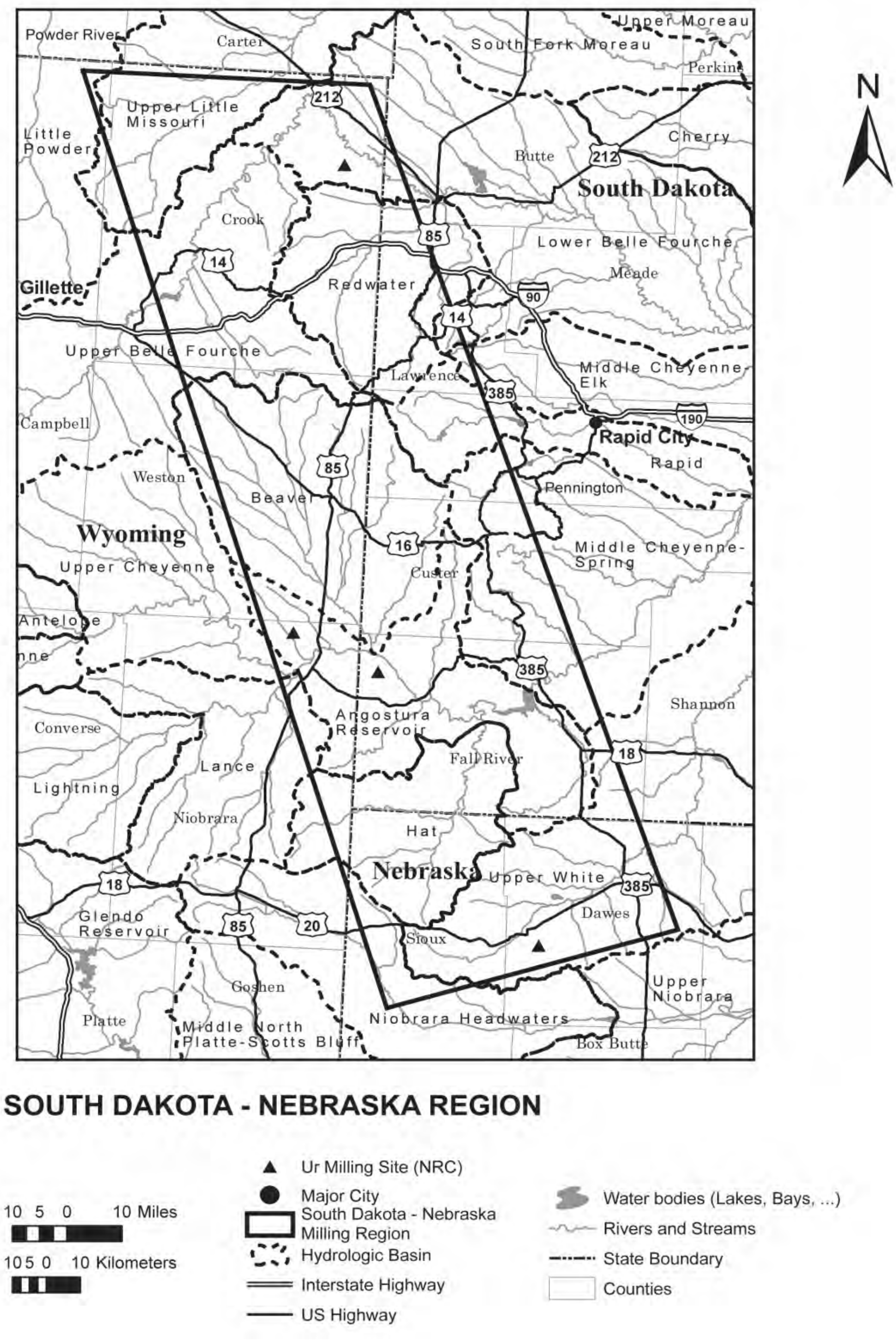

Figure 3.5-1. Watersheds Within the Nebraska-South Dakota-Wyoming Uranium Milling Region.
Source: NRC (2009a).

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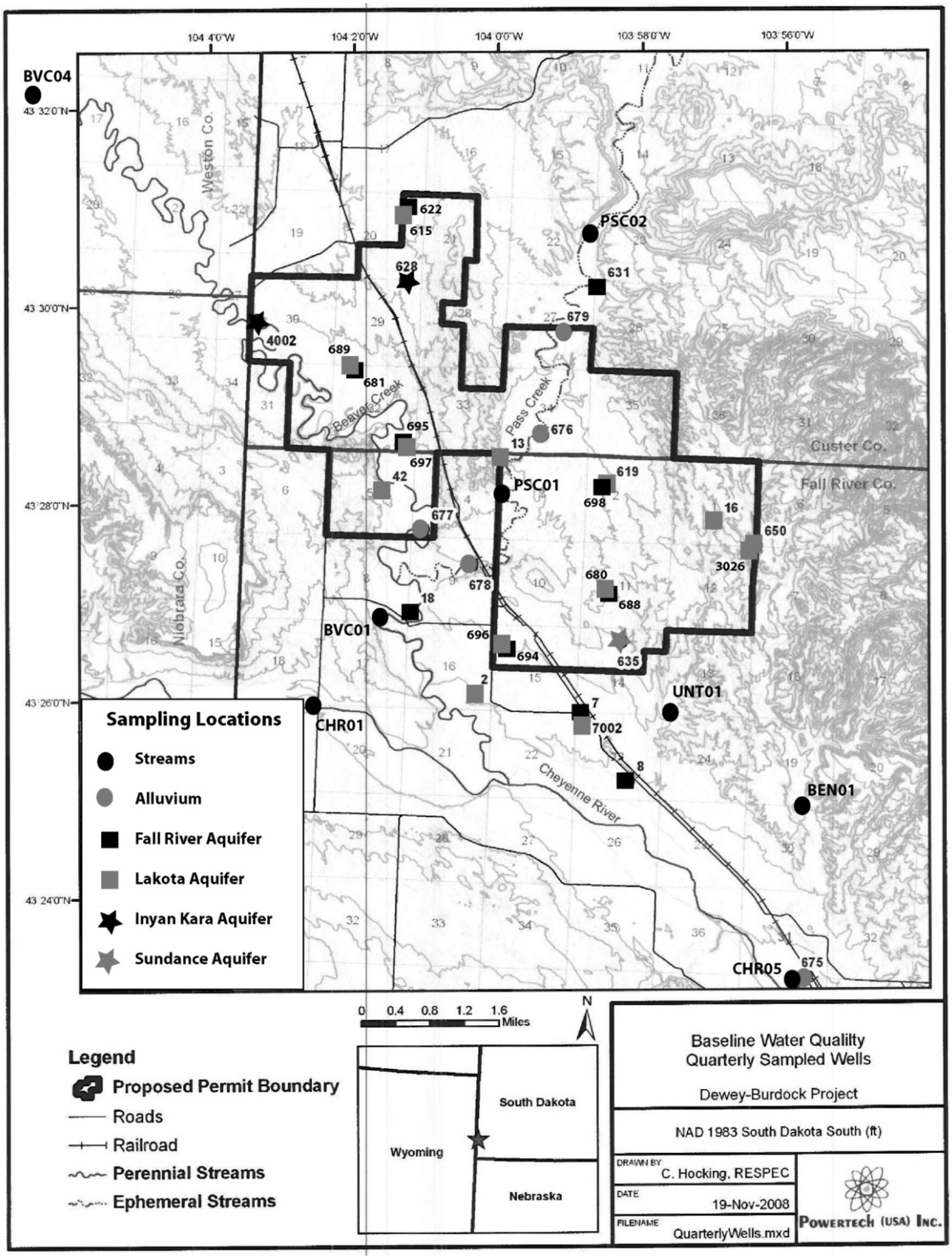

Figure 3.5-2. Map Showing Locations of Beaver Creek, Pass Creek, and the Cheyenne River in Relation to the Proposed Dewey-Burdock ISR Project and Water Quality Sampling Locations for Surface Water and Groundwater. Source: Modified From Powertech (2009a).

There are no known natural springs within the proposed Dewey-Burdock ISR Project area (Powertech, 2011). There is one area in the southwest corner of the Burdock area, known as the “alkali flats” or the “alkali area,” where groundwater is discharging to the ground surface from the Fall River aquifer and Chilson aquifer (Chilson Member of the Lakota Formation) through improperly plugged exploratory boreholes (Powertech, 2011). Two springs are present along the Dewey Fault near the town of Dewey approximately 2 km [1.2 mi] northwest of the proposed project boundary.

The applicant performed floodplain modeling on the stream channels of Beaver Creek, Pass Creek, and smaller ephemeral drainages within the proposed project area to determine the extent of inundation from a simulated 100-year flood and evaluate potential adverse impacts to facilities from flooding (Powertech, 2009b, 2011). Results of the modeling showing the areal extent of a 100-year flood with respect to proposed facilities and wellfields are illustrated in Figure 3.5-3. The modeling indicates that, with the exception of the plant-to-plant pipeline and small parts of some proposed wellfields, most of the proposed facilities, infrastructure, potential land application areas, and wellfields would be located outside the 100-year flood inundation boundaries of Beaver Creek and Pass Creek. For example, the 100-year floodplain boundary of Beaver Creek would be 668 m [2,190 ft] from the proposed satellite facility in the Dewey area and 664 m [2,180 ft] from the proposed central processing plant in the Burdock area. Conversely, some wellfields and storage ponds in the Dewey area and some wellfields, the main access road, and the plant-to-plant pipeline in the Burdock area are located within the 100-year floodplain boundary of ephemeral drainages (Figure 3.5-3).

There are a number of abandoned open pit mines (depression zones) within the project area stretching from the eastern to the northern boundaries of the site in the Burdock area (see Figure 3.2-3). With the exception of Darrow Pit #2, the other Darrow pits are usually dry but occasionally contain water that collects from runoff events (Powertech, 2011). The usual presence of water in Darrow Pit #2 suggests that the base of the pit may be below the potentiometric surface of the Fall River Formation. The Triangle Pit, which lies up dip of the proposed Burdock area wellfields, has permanent water storage at a depth greater than 30 m [100 ft]. The bottom of the Triangle Pit is below the potentiometric surface of the Fall River and is, therefore, hydraulically connected to the Fall River Formation.

Surface Water Quality

Water quality in Beaver Creek, Pass Creek, and the Cheyenne River varies considerably and is dependent on flow regime. These streams often experience extended periods of low or no flow. During periods of high flow, relatively high amounts of sediment and low dissolved solids occur in the streams, while less turbid waters with higher dissolved solids occur during periods of low flow. Upstream and downstream of the proposed Dewey-Burdock ISR Project in South Dakota, the Cheyenne River is classified as having the following beneficial water uses: (i) warm water semipermanent fish life propagation; (ii) limited contact recreation; (iii) fish and wildlife propagation, recreation, and stock watering; and (iv) irrigation (SDDENR, 2008). According to the State of South Dakota 2006 303(d) list, from Beaver Creek to the Angostura Reservoir, the Cheyenne River is listed as supporting the beneficial use of limited contact recreation, but is listed as impaired for the other three beneficial water uses due to high total dissolved and suspended solids, high salinity, and high conductivity. Beaver Creek in South Dakota is classified as suitable for the same uses as the Cheyenne River, except it is classified as

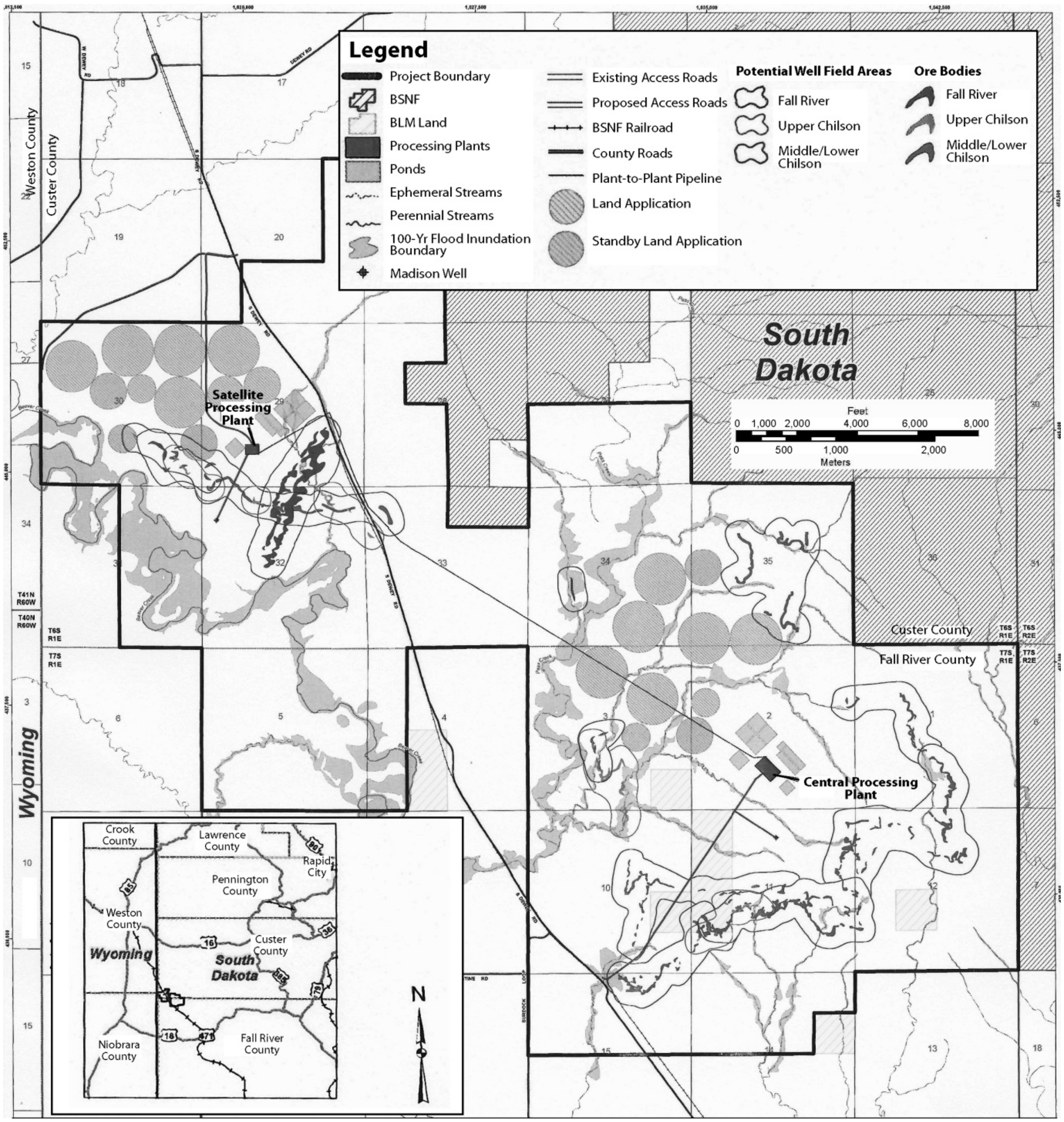

Figure 3.5-3. Map Showing Modeled 100-Year Flood Inundation Boundary of Stream Channels Within the Proposed Dewey-Burdock ISR Project Area.
Source: Modified From Powertech (2011).

suitable for cold water marginal fish life propagation rather than warm water fish life propagation (SDDENR, 2008). Both Beaver Creek and Pass Creek are classified as having the beneficial uses of fish and wildlife propagation, recreation, stock watering, and irrigation near the project site. Beaver Creek is also classified as having the beneficial uses of coldwater marginal fish life propagation and limited contact recreation near the project site (SDDENR, 2008). These creeks, however, are not classified as having the beneficial use of domestic waters.

The applicant collected surface water samples monthly between July 2007 and June 2008 from perennial and ephemeral streams upstream and downstream of the proposed Dewey-Burdock ISR Project (Powertech, 2009a). Figure 3.5-2 shows the locations of stream sampling locations. Perennial stream sampling locations included two sites on Beaver Creek (BVC01 and BVC04) and two sites on the Cheyenne River (CHR01 and CHR05). Ephemeral stream sampling locations included two sites on Pass Creek (PSC01 and PSC02), a site in Bennett Canyon (BEN01), and an unnamed downstream tributary (UNT01). Due to the sporadic nature of rainfall at the proposed site, passive samplers were installed at the ephemeral stream sampling sites to collect samples during flow events (Powertech, 2009a). Table 3.5-1 summarizes results for key parameters and constituents of concern in surface water at the stream sampling sites, and Table 3.5-2 summarizes results for radionuclides of concern.

Results of the stream sampling indicated exceedances of State of South Dakota surface water standards {Administrative Rules of South Dakota (ARSD), Chapter 74:51:01} for field parameters (pH, dissolved oxygen, and specific conductance) at Beaver Creek and the Cheyenne River, while other field parameters

Table 3.5-1. Summary of Key Parameters and Constituents of Concern in Surface Waters in Streams at the Proposed Dewey-Burdock ISR Project

Stream ID	pH	Dissolved Oxygen mg/L	Specific conductance uS/cm	Total Dissolved Solids mg/L	Sulfate mg/L	Chloride mg/L	Arsenic mg/L	Selenium mg/L
BVC01								
N	9	10	10	11	11	11	11	11
Mean	8.33	10.79	3680	2875	1359	500	0.0058	0.0012
Min	7.94	6.86	860	609	317	38	<0.001	<0.001
Max	8.91	13.57	7678	5860	2540	1370	0.048	0.003
BVC04								
N	10	10	10	11	11	11	11	11
Mean	8.07	10.64	4066	3144	1384	721	0.0041	0.0016
Min	7.52	6.54	733	516	286	9	<0.001	<0.001
Max	8.82	13.74	7186	5700	2670	1730	0.023	0.004
CHR01								
N	8	8	8	9	9	9	9	9
Mean	8.10	8.63	4522	4157	2616	129	0.0044	0.0012
Min	7.47	3.74	350	219	86	2	<0.001	<0.001
Max	8.44	13.08	7847	7040	4520	249	0.024	0.003
CHR05								
N	11	9	11	12	12	12	12	12
Mean	8.03	10.20	3863	3425	1919	376	0.004	0.0015
Min	7.42	7.63	510	365	180	17	<0.001	<0.001
Max	8.24	12.92	6986	6450	4160	912	0.029	0.003
PSC01								
N	1	1	1	2	2	2	2	2
Mean	8.12	10.26	1844	1765	1188.5	2.4	0.017	0.0013
Min	8.12	10.26	1844	1510	977	2.0	0.003	<0.001
Max	8.12	10.26	1844	2020	1400	2.8	0.031	0.002
PSC02								
N	1	1	1	2	2	2	2	2
Mean	8.1	9.51	1696	1204	777	1.8	0.0105	0.0018
Min	8.1	9.51	1696	998	645	1.6	0.003	<0.001
Max	8.1	9.51	1696	1410	909	2.0	0.018	0.003
UNT01								
N	0	0	0	1	1	1	0	1
Mean				369	278	1.0		0.03
Min				369	278	1.0		0.03
Max				369	278	1.0		0.03

Source: Powertech (2011).

Table 3.5-2. Summary of Key Radionuclides of Concern in Surface Waters in Streams at the Proposed Dewey-Burdock ISR Project

Stream ID	Gross Alpha pCi/L	U (Diss)* mg/L	U (Total) mg/L	Ra-226 (Diss) pCi/L	Ra-226 (Susp)* pCi/L	Pb-210 (Diss) pCi/L	Pb-210 (Susp) pCi/L	Po-210 (Diss) pCi/L	Po-210 (Susp) pCi/L	Th-230 (Diss) pCi/L	Th-230 (Susp) pCi/L
BVC01											
N	11	9	11	8	9	6	6	6	6	9	9
Mean	17.95	0.0124	0.0121	0.31	0.26	2.7	3.38	1.13	1.6	0.1	0.66
Min	5.9	0.002	0.004	< 0.2	< 0.2	< 1.0	< 1.0	< 1.0	< 1.0	< 0.2	< 0.2
Max	65.8	0.0269	0.0262	2.0	3.1	11.0	15.3	2.6	3.0	0.3	3.4
BVC04											
N	11	9	11	8	9	6	6	6	6	9	9
Mean	14.5	0.0126	0.0121	0.12	0.66	5.1	3.15	1.2	1.72	0.27	0.47
Min	2.3	0.0017	0.003	< 0.2	< 0.2	< 1.0	<1.0	< 1.0	< 1.0	< 0.2	< 0.2
Max	34.7	0.023	0.0239	0.5	2.5	26.0	8.6	3.0	3.7	1.7	2.1
CHR01											
N	9	7	9	6	7	4	4	4	4	7	7
Mean	22.56	0.0189	0.021	0.29	0.71	1.18	1.48	1.08	1.85	0.11	1.1
Min	5.1	0.0024	0.0043	< 0.2	< 0.2	< 1.0	< 1.0	< 1.0	< 1.0	< 0.2	< 0.2
Max	35.3	0.0324	0.0365	0.6	4.0	3.2	4.4	1.7	4.1	0.3	3.8
CHR05											
N	12	10	12	9	10	6	6	6	6	10	10
Mean	19.62	0.0162	0.017	0.24	0.6	2.45	6.3	0.85	1.18	0.09	0.49
Min	4.0	0.0028	0.0043	< 0.2	< 0.2	< 1.0	< 1.0	< 1.0	< 1.0	< 0.2	< 0.2
Max	29.9	0.0368	0.0378	1.4	3.8	6.6	22.0	2.4	3.8	< 0.2	2.2
PSC01											
N	2	1	2	1	1	1	1	1	1	1	1
Mean	7.65	0.005	0.0176	0.1	0.1	2.2	0.9	0.7	0.3	0.0	0.5
Min	6.5	0.005	0.01	0.1	0.1	2.2	0.9	0.7	0.3	0.0	0.5
Max	8.8	0.005	0.0252	0.1	0.1	2.2	0.9	0.7	0.3	0.0	0.5
PSC02											
N	2	1	2	1	1	1	1	1	1	1	1
Mean	3.05	0.0007	0.0035	0.0	0.0	1.7	0.0	0.2	0.3	0.0	0.2
Min	1.9	0.0007	0.0012	0.0	0.0	1.7	0.0	0.2	0.3	0.0	0.2
Max	4.2	0.0007	0.0057	0.0	0.0	1.7	0.0	0.2	0.3	0.0	0.2
UNT01											
N	1	1	1	1	1	0	0	0	0	1	1
Mean	6.1	0.0002	0.0009	0.2	0.03					0.0	0.0
Min	6.1	0.0002	0.0009	0.2	0.03					0.0	0.0
Max	6.1	0.0002	0.0009	0.2	0.03					0.0	0.0

Source: Powertech (2011).
*Diss = Dissolved; Susp = Suspended

were within State of South Dakota surface water quality limits. At Beaver Creek, pH levels were higher than the 8.8 standard in 16 percent (3 of 19) of the measurements, but were not below the 6.5 standard for coldwater marginal fish life. At the Cheyenne River, pH measurements complied with state standards. Dissolved oxygen measurements were in compliance at Beaver Creek, but fell below the state standard for warm water semipermanent fish life {5 mg/L [5 ppm]} in one sample from the Cheyenne River. Specific conductance values exceeded the fish, wildlife, and stock daily maximum standard of 7,000 uS/cm in 15 percent (3 of 20) of the measurements at Beaver Creek and 5 percent (1 of 19) of the measurements at the Cheyenne River. Specific conductance also exceeded the irrigation daily maximum standard of 4,375 uS/cm in 50 percent (10 of 20) of the measurements at Beaver Creek and 42 percent (8 of 19) of the measurements at the Cheyenne River.

The U.S. Environmental Protection Agency (EPA) regulations in 40 CFR Part 141 (National Primary Drinking Water Regulations) establish the secondary maximum contaminant levels (SMCLs) for constituents that alter the color, taste, and odor of water (e.g., total dissolved solids, sulfate, and chloride) and the maximum contaminant levels (MCLs) for radionuclides and hazardous constituents (e.g., gross alpha, uranium, Ra-226, Pb-210, arsenic, and selenium) in drinking water. The SMCLs and MCLs established in 40 CFR Part 141 are the same as State of South Dakota drinking water standards (ARSD, Chapter 74:04:12). Results of the stream sampling indicated that almost all the samples exceeded the SMCL for total dissolved solids (TDS) {500 mg/L [500 ppm]} with values ranging from 219 to 7,040 mg/L [219 to 7,040 ppm]. Almost all samples (46 of 48) also exceeded the SMCL for sulfate {250 mg/L [250 ppm]} with values ranging from 86 to 4,520 mg/L [86 to 4,520 ppm]. About half of the samples (23 of 48) exceeded the SMCL for chloride {250 mg/L [250 ppm]} with values ranging from 1 to 1,730 mg/L [1 to 1,730 ppm]. About 15 percent of the samples (7 of 48) exceeded the MCL for arsenic {0.01 mg/L [0.01 ppm]} with values ranging from <0.001 to 0.048 mg/L [<0.001 to 0.048 ppm]. None of the stream samples exceeded the MCL for selenium {0.05 mg/L [0.05 ppm]}. Selenium values ranged from <0.001 to 0.004 mg/L [<0.001 to 0.004 ppm].

For radionuclides, the majority of samples (26 of 48) exceeded the MCL for gross alpha {555 Bq/m^3 [15 pCi/L]}, with exceedances occurring in both Beaver Creek and the Cheyenne River. Total uranium concentrations ranged from 0.0009 to 0.0378 mg/L [0.0009 to 0.0378 ppm]; four samples from the Cheyenne River exceeded the MCL of 0.03 mg/L [0.03 ppm]. Total Ra-226 concentrations ranged from 0 to 192 Bq/m^3 [0 to 5.2 pCi/L]; one sample from Beaver Creek and one sample from the Cheyenne River exceeded the MCL of 185 Bq/m^3 [5.0 pCi/L]. Pb-210 doesn't have an approved individual MCL based on radiation exposure and is not regulated under current drinking water standards. However, EPA has proposed an MCL of 37 Bq/m^3 [1.0 pCi/L] for Pb-210 (EPA, 2000). The proposed MCL of 37 Bq/m^3 [1.0 pCi/L] for Pb-210 was exceeded in four samples from Beaver Creek, three samples from the Cheyenne River, and the two samples collected from Pass Creek.

3.5.2 Wetlands and Waters of the United States

The applicant conducted a wetland delineation survey of the proposed Dewey-Burdock ISR Project site in 2007 (Powertech, 2009a). The proposed project area is situated in the uplands areas of the two main drainages (Beaver Creek and Pass Creek) and includes several old mine pits and depressed areas. Wetlands were identified throughout the Beaver Creek drainage and near an old flowing well on Pass Creek at the southern boundary of the proposed project area. In addition, wetlands were identified in a majority of the old mine pits in the eastern portion of the Burdock area and in depressed areas throughout the project area. Table 3.5-3 summarizes the 2007 wetland delineation results. Based on the wetland delineation results, the total estimated wetland area in the proposed project area is 14.21 ha [35.11 ac] (Powertech, 2009a).

The entire stretch of Beaver Creek, totaling 5.41 ha [13.38 ac] located in the northwest part of the proposed project area, was designated as a Riverine Lower Perennial Emergent (R2EM) wetland. Vegetation along the upper banks of Beaver Creek comprises mainly big sagebrush (*Artemisia tridentata*), greasewood (*Sarcobatus vermiculatus*), and western wheatgrass (*Elymus smithii*). The wetland indicator status of big sagebrush and greasewood is upland (UPL). The wetland indicator status of western wheatgrass is facultative upland (FACU).

Common vegetation identified along the drainage of Beaver Creek included prairie cordgrass (*Spartina pectinata*), Baltic rush (*Juncus balticus*), and common threesquare (*Schoenoplectus pungens*). The wetland indicator status of prairie cordgrass and Baltic rush is facultative wet (FACW). The wetland indicator status of common threesquare is obligate (OBL).

Table 3.5-3. Summary of 2007 Wetland Delineation Survey Results

Number of Features	Classification*	Ha [Ac]
2	Wetland Channel (PEM)	0.306 [0.756]
2	Wetland Channel (R2EM)	5.420 [13.393]
1	Wetland Channel (R4SB7)	0.001 [0.002]
2	Wetland Channel (R4US)	0.019 [0.048]
4	PEM Isolated Pond	0.827[2.043]
1	PEMC Isolated Pond	0.002 [0.005]
1	PABJh Isolated Pond	0.105 [0.260]
1	PUSA Isolated Pond	0.012 [0.030]
3	PUB Isolated Depression	2.124 [5.248]
3	PUS Isolated Depression	1.095 [2.706]
5	Mine Pits PUB, PEM, OW	4.300 [10.626]
	Total	**14.210 [35.114]**

Source: Powertech (2009)a.
*Explanation of Classification: PEM (Palustrine Emergent); R2EM (Riverine Lower Perennial Emergent); R4SB7 (Riverine Intermittent Streambed Vegetated); R4US (Riverine Intermittent Unconsolidated Streambed); PEMC (Seasonally Flooded); PABJh (Palustrine Aquatic Bed Intermittently Flooded Diked); PUSA (Palustrine Unconsolidated Shore Temporarily Flooded); PUB (Palustrine Unconsolidated Bottom); PUS (Palustrine Unconsolidated Shore); and OW (Open Water).

Pass Creek, which runs through the central part of the proposed project area, contains wetland areas near an old, open flowing well at the southern boundary of the project area. The wetland totals 0.20 ha [0.50 ac] and is classified as Palustrine Emergent (PEM). Common vegetation found within the wetland was prairie cordgrass and common threesquare, with a wetland indicator status of FACW and OBL, respectively.

Approximately 0.47 ha [1.17 ac] of wetlands and 3.82 ha [9.45 ac] of open water (OW) are present in the old mine pits at the eastern and northeastern edges of the Burdock area (Figure 3.2-3). Two of the Darrow pits in Section 1, Township 7 South, Range 1 East are classified as Palustrine Unconsolidated Bottom (PUB) wetland. Darrow Pit #2 in Section 2, Township 7 South, Range 1 East is classified as both PEM and OW wetland. The PEM is located along the bank of the Darrow Pit #2 and OW in other parts of the pit. The Triangle Pit located in Section 34, Township 6 South, Range 1 East was classified as OW wetland and totaled 3.09 ha [7.63 ac]. Other old mine pits in the Burdock area were classified as non-wetland due to lack of hydrophytic vegetation and/or hydrology.

The applicant has recommended all topographic depressed areas identified as wetlands in its 2007 wetland delineation survey be classed as nonjurisdictional, based on their isolated nature (Powertech, 2009a). These wetlands were primarily classified as PEM, Seasonally Flooded (PEMC), Palustrine Aquatic Bed Intermittently Flooded Diked (PABJh), Palustrine Unconsolidated Shore (PUS), Palustrine Unconsolidated Shore Temporarily Flooded (PUSA), and PUB wetlands based on hydrology conditions. Approximately 4.16 ha [10.29 ac] of wetland depressions and ponds were identified within the proposed project area.

The U.S. Army Corps of Engineers (USACE), Ohama District, completed a jurisdictional Waters of the United States determination of wetlands on the proposed Dewey-Burdock site in January 2009 (Powertech, 2009a, Appendix 3.5–H). USACE identified 20 wetland sites, and 4 of these were considered jurisdictional: Beaver Creek, Pass Creek, and an ephemeral tributary to each drainage. The jurisdictional ephemeral tributary to Beaver Creek has wetlands present near its confluence with Beaver Creek; it is located in Section 32, Township 6 South, Range 1 East (see Figure 4.5-1). The jurisdictional ephemeral tributary to Pass Creek has wetlands present near its confluence with Pass Creek; it is located in Section 3, Township 7 South, Range 1 East (see Figure 4.5-1).

3.5.3 Groundwater

3.5.3.1 Regional Aquifer Systems

The geological sequence of the regional aquifers presented in the applicant's license application (Powertech, 2009a–c) is consistent with the information on the hydrologic setting of the Black Hills area by Driscoll, et al. (2002) and Fahrenbach, et al. (2009). On the regional scale, the major aquifers in the Black Hills area include (from top to bottom) the Inyan Kara Group, Minnekahta, Minnelusa, Madison, and Deadwood aquifers (Figure 3.5-4). These aquifers are separated by confining layers with low permeability except at their outcrop areas. The hydrologic setting in the Black Hills area also involves minor aquifers, which include the Sundance/Unkpapa, Newcastle, and alluvial aquifers. These minor aquifers yield small volumes of water locally for domestic and livestock uses. A hydrostratigraphic section showing aquifers present at the Dewey-Burdock site is presented in Figure 3.5.5.

Aquifer characteristics and hydraulic properties of the major aquifers, from shallow to deep, are discussed in this section. The Inyan Kara Group aquifer is the first major aquifer below the ground surface. It ranges from 76 to 152 m [250 to 500 ft] in thickness and contains 2 subaquifers: the Fall River aquifer and Chilson aquifer, which are separated by the Fuson Shale confining unit (see Figure 3.5-5). The Inyan Kara Group aquifers are highly heterogeneous, display transmissivities in the range of 0.1 to 557 m^2/day [1 to 6,000 ft^2/day], and are capable of yielding high volumes of water (Driscoll, et al., 2002). The effective porosity of the Inyan Kara aquifer is 0.17 and is generally the highest of the major aquifers (Rahn, 1985). Effective porosity is the porosity of the rock consisting on interconnected pores. The Inyan Kara aquifer is recharged primarily by precipitation at the outcrop.

The Inyan Kara Group aquifer is overlain by the Graneros Group (the combined Skull Creek–Mowry–Belle Fourche shales) except at outcrop areas. Within the Graneros Group, the Newcastle Sandstone contains an important minor aquifer known as the Newcastle aquifer. As noted in SEIS Section 3.4.1.2, the Newcastle Sandstone is absent within the proposed Dewey-Burdock project area. The Inyan Kara Group aquifer is separated from the underlying Minnekahta aquifer by a sequence of (from shallow to deep) Morrison Formation, Sundance/Unkpapa aquifer (minor aquifer), and the Gypsum Spring Formation.

The Minnekahta aquifer is a major aquifer in the Black Hills area and ranges in thickness from 7.6 to 19.8 m [25 to 65 ft] (Strobel, et al., 1999). The Minnekahta aquifer is a thin to medium-bedded, fine-grained laminated limestone (Driscoll, et al., 2002). Information on the hydraulic properties of the Minnekahta aquifer is limited. The Minnekahta aquifer is typically very permeable; however, due to its limited thickness, wells yields can be small. In northeast Wyoming, the effective transmissivity and specific capacity of the Minnekahta aquifer were reported to be 4.2 m^2/day and 0.5 m^3/day [45 ft^2/day and 19 ft^3/day], respectively (Northeast Wyoming River Basins Water Plan, 2002).

The Minnelusa aquifer ranges in thickness from 114 to 358 m [375 to 1,175 ft] in the Black Hills area (Driscoll, et al., 2002). The Minnelusa aquifer is composed of layers of sandstone,

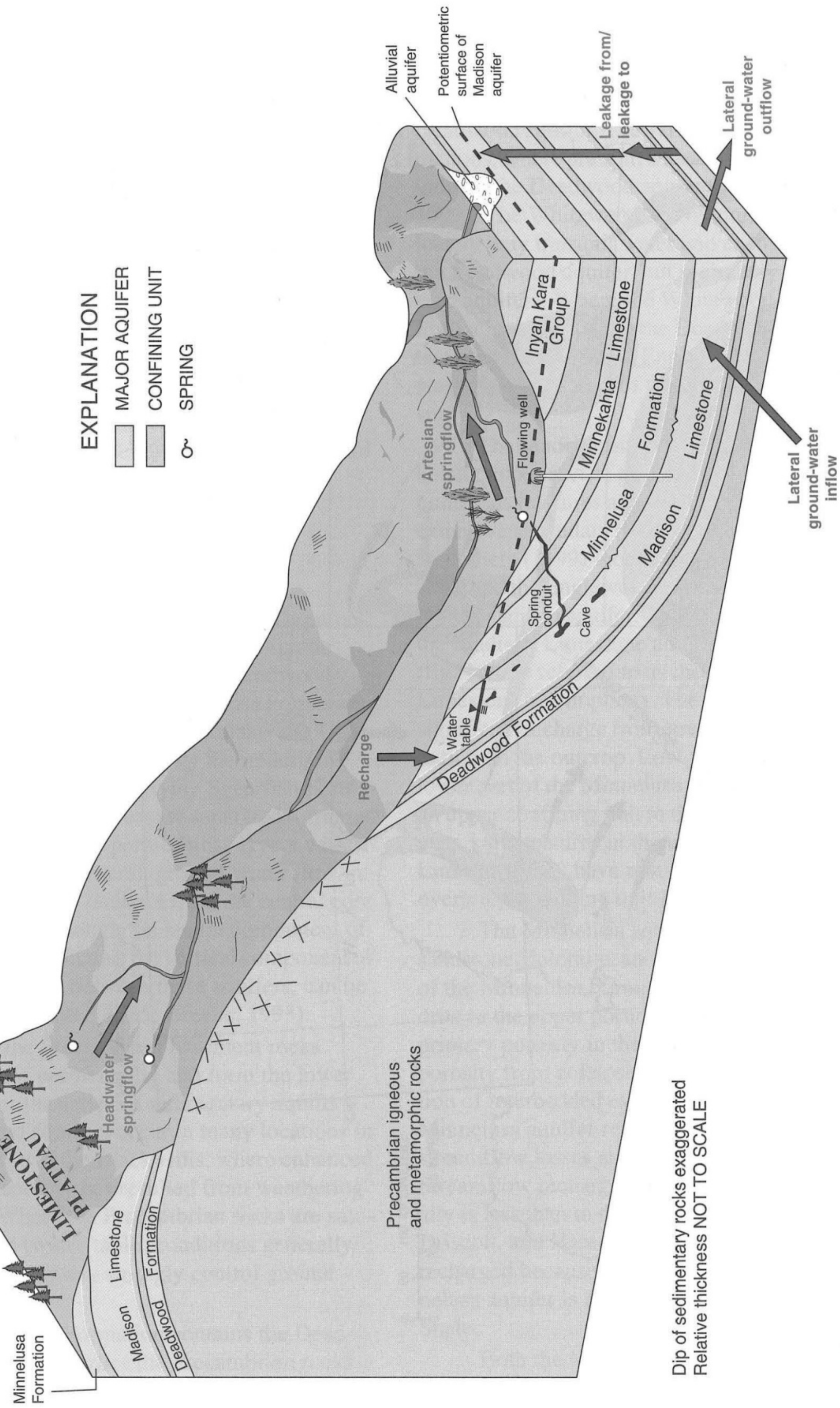

Figure 3.5-4. Schematic Diagram Showing Simplified Hydrogeologic Setting of the Black Hills Area. Source: Driscoll, et al. (2002).

Dewey-Burdock Site Hydrostratigraphy

System	Series	Formation		
Cretaceous	Upper	Graneros Group	Belle Fourche Shale	
	Lower		Mowry Shale	
			Skull Creek Shale	
		Inyan Kara Aquifer	Fall River Aquifer	
			Lakota Formation	Fuson Shale
				Chilson Aquifer
Jurassic		Morrison Formation		
		Unkpapa Aquifer		
		Sundance Aquifer		
		Gypsum Spring Formation		
Triassic		Spearfish Formation		
Permian				
		Minnekahta Aquifer		
		Opeche Shale		
		Minnelusa Aquifer		
Pennsylvanian				
Mississippian		Madison Aquifer		
Devonian		Englewood Formation		
Ordovician		Whitewood Formation		
		Winnipeg Formation		
Cambrian		Deadwood Aquifer		

Figure 3.5-5. Hydrostratigraphic Units Present at the Proposed Dewey-Burdock ISR Project Site.
Source: Modified from Driscoll, et al. (2002).

dolomite, and anhydrite in the Minnelusa Formation. Porosity within the Minnelusa is predominantly primary porosity associated with void space present during rock formation, although secondary porosity is present in association with fractures and dissolution features after rock formation. The effective porosity of the Minnelusa is 0.05 (Rahn, 1985). It is a heterogeneous aquifer with transmissivity in the range of 0.1 to 1,115 m^2/day [1 to 12,000 ft^2/day]. The Minnelusa is separated from the Minnekahta aquifer by the Opeche Shale, which acts as the intervening confining layer. There are confining layers at the base of the Minnelusa Formation. Locally, these confining layers may be absent or provide ineffective confinement; this could enhance hydraulic connection between the Minnelusa aquifer and the underlying Madison aquifer (Naus, et al., 2001), which is the source of municipal water in some communities including Rapid City and Edgemont (Powertech, 2009a). On the regional scale, the Minnelusa Formation has been considered to be in hydraulic connection with the Inyan Kara aquifer through breccia pipes (Gott, et al., 1974). Breccia pipes are collapsed structures caused by dissolution of gypsum (calcium sulfate, $CaSO_4 \bullet H_2O$) and anhydrite (anhydrous calcium sulfate, $CaSO_4$) within the Minnelusa Formation in the Black Hills area.

The applicant conducted detailed geologic mapping throughout proposed operating areas at the proposed Dewey-Burdock site and found no indication for the presence of breccia pipes (Powertech, 2009c, 2011). This finding is in agreement with Gott, et al. (1974), who reported that breccia pipes do not occur at the Dewey-Burdock site.

The Madison Formation, which ranges in thickness from 61 to 305 m [200 to 1,000 ft], is mainly a dolomite unit characterized by extensive secondary porosity resulting from fractures and karst (caves and sinkholes) features. The effective porosity of the Madison aquifer is 0.05 (Rahn, 1985). It is the source of municipal water for numerous communities, including Rapid City and Edgemont. It is a highly heterogeneous aquifer with transmissivity in the range of 121 to 5,203 m^2/day [1,300 to 56,000 ft^2/day]. The aquifer is separated from the underlying Deadwood aquifer by the low-permeability Whitewood and Winnipeg formations (see Figure 3.5-5). The Englewood Formation also underlies the Madison Formation. The Madison and Minnelusa aquifers are sources of large artesian springs in the Black Hills area, and groundwater flowpaths and velocities in both aquifers are influenced by hydraulic properties caused by secondary porosity (Driscoll, et al., 2002).

The Deadwood aquifer is 0 to 152 m [0 to 500 ft] thick and consists of basal conglomerate, sandstone, limestone, and mudstone. It exhibits transmissivity in the range of 23 to 93 m^2/day [250 to 1,000 ft^2/day]. The Deadwood aquifer is used mainly by domestic and municipal users near its outcrop area. Regionally, Precambrian rocks underlying the Deadwood act as a lower confining unit. The Whitewood and Winnipeg Formations, where present, act as overlying semiconfining units to the Deadwood aquifer (Strobel, et al., 1999). Where the Whitewood and Winnipeg Formations are absent, the Deadwood aquifer is overlain by the Englewood Formation. Previous studies have included the Englewood Formation, which Strobel, et al. (1999) included as part of the Madison aquifer (Strobel, et al., 1999; Driscoll, et al., 2002).

Regionally, groundwater flows radially outward from the Black Hills toward the surrounding plains. Groundwater recharge paths for aquifers in the Black Hills include precipitation, streamflow losses, and water flow across aquifers where confining layers are absent or ineffective. Rainfall ranges from 30 to 71 cm/yr [12 to 28 in/yr] in the Black Hills. Approximately 2 percent of precipitation recharges the aquifers of the southwestern Black Hills, and the rest is accounted for by evapotranspiration and surface runoff (Powertech, 2009a). In general, streamflow recharge to groundwater is limited to relatively shallow aquifers in close proximity to streams. Regionally, water elevations increase with depth, which provides an upward hydraulic gradient for groundwater flow across the major aquifers and limits the potential for downward recharge.

3.5.3.2 Aquifer Systems in the Vicinity of the Proposed Dewey-Burdock Project

Alluvial aquifers (formed by unconsolidated or loosely consolidated sediments) with thicknesses of 0 to 15 m [0 to 50 ft] are observed in the vicinity of the proposed project area along Beaver Creek, Pass Creek, and the Cheyenne River (Powertech, 2009a, 2011). They are typically unconfined, but may be confined locally. Based on an alluvial drilling program completed in May 2011, the alluvium in the Pass Creek drainage is up to 15 m [50 ft] thick and the alluvium in the Beaver Creek drainage is up to 9 m [30 ft] thick (Powertech, 2011). Many of the borings drilled into the alluvium along Beaver Creek and Pass Creek in May 2011 were dry; however, the thickness of saturated alluvium in three borings completed as alluvial monitoring wells ranged from 3 to 4 m [10 to 12 ft] (Powertech, 2011). Alluvial aquifers are separated from the underlying Fall River Formation by the low permeability Graneros Group confining unit (see Figure 3.5-5). Results of the alluvial drilling program did not indicate any areas of discharge to the alluvium along Beaver Creek and Pass Creek from the underlying Fall River aquifer (Powertech, 2011). Within the proposed project area, the Skull Creek shale of the Graneros Group has an average thickness of 61 m [200 ft], except in parts of the Burdock area where it has eroded leaving the Fall River aquifer exposed at the surface. The Skull Creek Shale has low vertical hydraulic conductivities of approximately 10^{-9} cm/sec [10^{-11} ft/sec].

The Skull Creek Shale is underlain by the Fall River aquifer, which has an average thickness of 46 m [150 ft] within the project area. The Fall River Formation crops out in the eastern part of the project area (see Figure 3.4.3), where it is geologically unconfined and partially saturated (i.e., the water table is below the top of the formation). The transmissivity of the Fall River varies in the range of 5 to 24 m^2/day [54 to 255 ft^2/day] in the Dewey area, and its storativity is on the order of 10^{-5} cm/sec [10^{-7} ft/sec] (Powertech, 2009a).

The Fall River aquifer is separated from the underlying Chilson aquifer by the Fuson Shale, which varies from approximately 6 to 24 m [20 to 80 ft] in thickness across the project area (Powertech, 2010a, 2011). Based on pumping tests conducted in the Burdock area in 1979, the Fuson Shale has estimated vertical hydraulic conductivities of 1×10^{-7} to 4.6×10^{-8} cm/sec [3.3×10^{-9} to 1.5×10^{-9} ft/sec] (Boggs and Jenkins, 1980). Based on the 1979 aquifer tests, Boggs and Jenkins (1980) suggested there may be a direct connection between the Fall River and Chilson aquifers through the Fuson resulting from unidentified structural features or old unplugged exploration holes. Additional aquifer pumping tests conducted in the Burdock area in 2008 also demonstrated a hydraulic connection between the Fall River and Chilson aquifers through the intervening Fuson Shale (Powertech, 2010a). Interpretations of both the 1979 and 2008 pumping test results were found to be consistent with a leaky-confined aquifer model (Powertech, 2010a). Exploratory drilling data and isopach contours of the Fuson Shale in the Burdock area identified an approximate 1.6 km [1.0 mi]-wide, northwest-trending channel within the basal Fall River aquifer that has scoured the underlying Fuson Shale (Figure 3.5-6) (Powertech, 2010a). The existing drilling data indicate the thinnest section of the Fuson Shale {i.e., less than 9 m [30 ft]} is approximately 305 m [1,000 ft] outside the northern boundary of the initial Burdock area wellfield (BWF-1) (Figure 3.5-6).

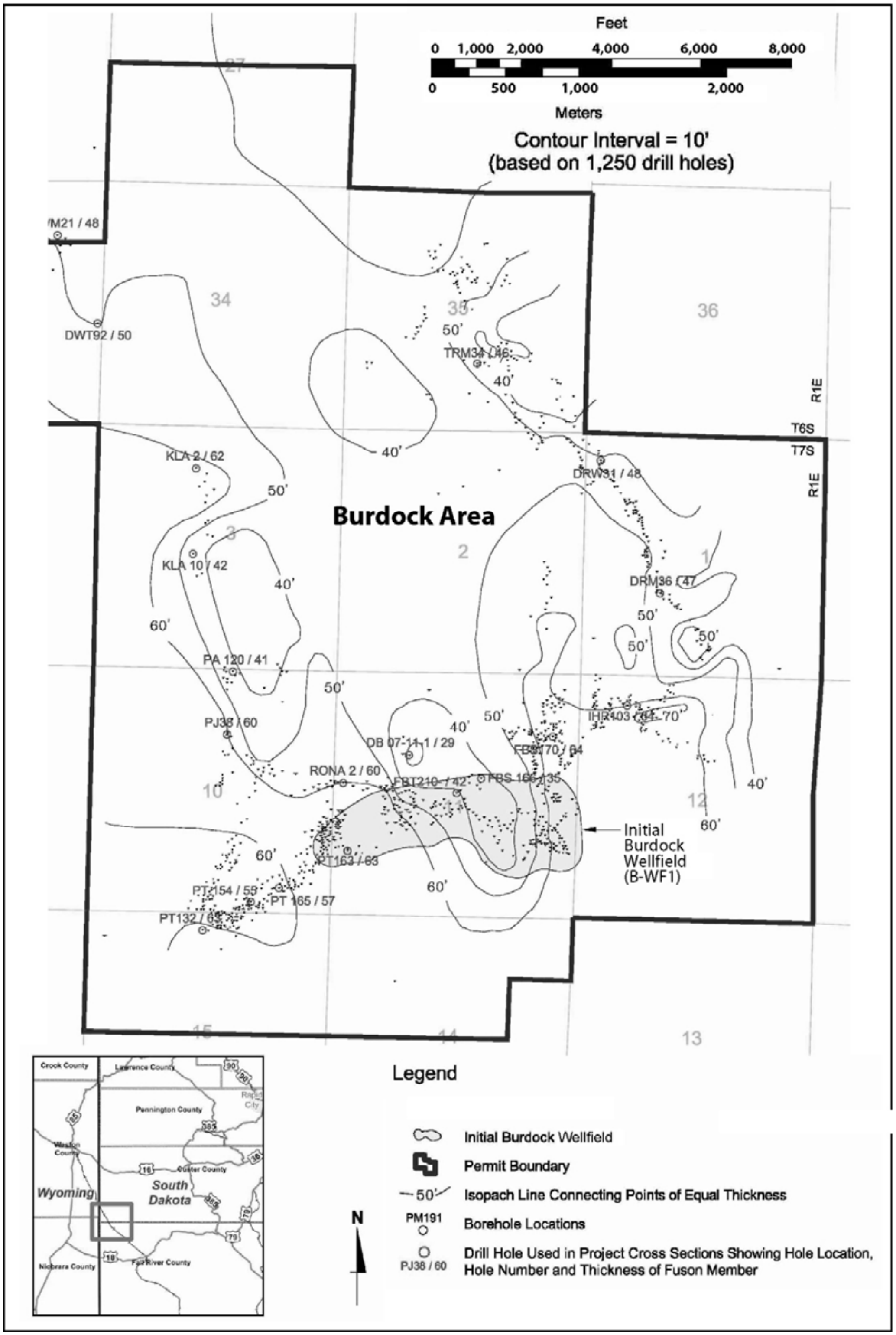

Figure 3.5-6. Isopach Map of the Fuson Shale at the Proposed Dewey-Burdock ISR Project.
Source: Modified From Powertech (2010a).

The Fuson Shale is underlain by the Chilson aquifer, which varies in thickness from 37 to 61 m [120 to 200 ft]. Its transmissivity ranges from 18 to 55 m^2/day [190 to 590 ft^2/day] in the Burdock area, and its storativity is on the order of 10^{-4} cm/sec [10^{-6} ft/sec] (Powertech, 2009a).

Underlying the Chilson aquifer is the Morrison Formation with an average thickness of18.3 to 42.7 m [60 to 140 ft] across the project area (Powertech, 2011). The Morrison Formation is the lower confining unit for the Inyan Kara Group aquifer system and has low vertical hydraulic conductivities of 10^{-9} cm/sec [10^{-11} ft/sec] (Powertech, 2009a).

The Morrison Formation is underlain by the Unkpapa then the Sundance aquifers. There is no intervening confining unit between the Unkpapa and Sundance aquifers (see Figure 3.5-5). They are considered to be minor aquifers and are a source of water within the proposed project area (Powertech, 2009a). These aquifers are separated from the underlying Minnekahta aquifer by the low permeability Spearfish Formation, which consists of shale and siltstone. The Spearfish Formation has an average thickness of 98 m [320 ft]. The applicant reported that the Minnekahta aquifer does not supply water for domestic, livestock, or agricultural uses in the proposed Dewey-Burdock ISR Project area (Powertech, 2010a).

Potentiometric surfaces for the Fall River and Chilson aquifers indicate groundwater flows from northeast to southwest (Powertech, 2009b). The directional groundwater flow at the proposed site is consistent with regional groundwater flow; regional flow moves outward radially from the Black Hills southwesterly toward the plains. Potentiometric surfaces also indicate that the hydraulic gradient is upward from the Chilson aquifer to the Fall River aquifer in the Dewey area. At the Dewey pumping test area, the potentiometric surface difference between the Chilson and Fall River aquifers in the Dewey area is approximately 12 m [40 ft] (Powertech, 2010a). Potentiometric surfaces for the Fall River and Chilson aquifers, however, are nearly equal in the Burdock area, suggesting that these two aquifers could be hydraulically connected through the intervening Fuson shale (Powertech, 2009b). There is no evidence from exploratory drilling information (e.g., borehole and geophysical log) that supports the thickness of the Fuson shale as being less than 6 m [20 ft] in the Burdock area (Powertech, 2010a,b).

3.5.3.3 Uranium-Bearing Aquifers

The Chilson and Fall River aquifers, as part of the Inyan Kara Group aquifer, contain the uranium mineralization that the proposed project would extract (Powertech, 2009a). The initial wellfield in the Dewey area would be located in the mineralization zone of the Fall River Formation, and the initial wellfield in the Burdock area would be located in the mineralization zone of the Chilson member of the Lakota Formation (Powertech, 2009c). The Fall River Formation crops out in the eastern part of the project area, where it is geologically unconfined and partially saturated (i.e., the water table is below the top of the formation). The approximate boundary between fully saturated and partially saturated conditions in the Fall River is shown in Figure 3.5-7. The applicant has indicated that there are no plans to conduct ISR operations in Fall River orebodies in the eastern portion of the project area where the Fall River is geologically unconfined and partially saturated (Powertech, 2011). This would restrict the proposed ISR operations in confined portions of the underlying hydrogeologic system.

The applicant is planning to conduct ISR operations in partially saturated portions of the underlying Chilson aquifer in the eastern part of the project area (Powertech, 2010a, 2011). The approximate boundary between fully saturated and partially saturated conditions in the Chilson is shown in Figure 3.5-7. Partially saturated portions of the Chilson along the eastern

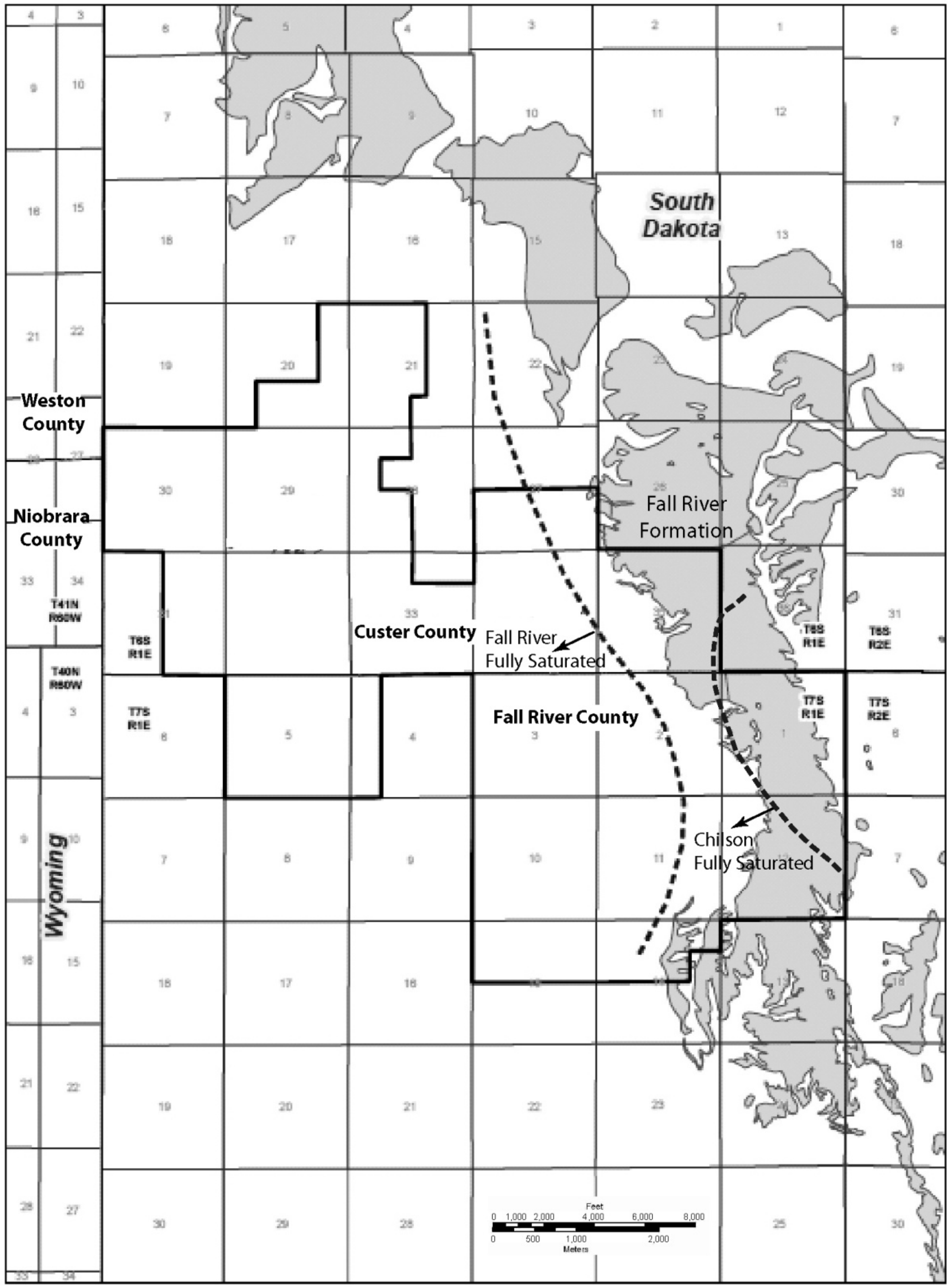

Figure 3.5-7. Map of the Proposed Dewey-Burdock ISR Project Area Showing the Approximate Locations of Fully Saturated Portions of the Fall River Formation and Chilson Member of the Lakota Formation. Shaded Areas Are Where Fall River Formation Is Exposed at the Ground Surface.
Source: Modified from Powertech (2011).

edge of the project area are not confined under pressure beneath the relatively impermeable Fuson Shale. Therefore, although the Chilson is geologically confined in this area, the partially saturated portions are considered hydrologically unconfined. The applicant has committed, as part of the license condition, to conduct additional hydrogeological investigations (e.g., delineation drilling and pump testing) prior to wellfield development to accurately measure and identify partially saturated portions of the Chilson aquifer to confirm sufficient potentiometric head {greater than 15.2 m [50 ft]} is available to perform normal ISR operations (Powertech, 2010a, 2011).

3.5.3.4 Other Surrounding Aquifers for Water Supply

The Madison aquifer is the most important aquifer in the region supplying municipal water for numerous communities, including Rapid City and Edgemont, South Dakota. Powertech reported that the Sundance and Unkpapa aquifers are minor aquifers, supplying local domestic and livestock water within the proposed project area (Powertech, 2009a, 2011).

3.5.3.5 Groundwater Quality

The applicant conducted initial baseline groundwater sampling of wells at the proposed Dewey-Burdock ISR Project from July 2007 through June 2008 (Powertech, 2009a). The baseline study sampled 19 groundwater wells quarterly: 14 were existing wells and 5 wells were newly drilled. Eight domestic wells and six stock watering wells were sampled, and three of these existing wells are located upgradient of the proposed uranium recovery areas. Groundwater sampling was undertaken in a number of aquifers: four wells in the Fall River Formation, seven wells in the Lakota Formation (Chilson Member), two wells in the Inyan Kara Group made up of the Fall River or Chilson, one well in the Sundance formation, and five wells in the alluvium were tested. The applicant conducted monthly sampling of an additional 12 wells from March 2008 to February 2009. Six of these wells were located in the Dewey area and six in the Burdock area. A set of Fall River and Chilson wells was sampled within an upgradient and downgradient of proposed uranium recovery areas in both the Dewey and Burdock areas. The locations of all groundwater sampling sites are shown in Figure 3.5-2.

The initial baseline groundwater sampling results found that 28 out of 31 groundwater samples exceeded the MCLs for primary drinking water standards as provided by EPA regulations at 40 CFR Part 141. Wells with groundwater samples exceeding primary drinking water standards for arsenic (40 CFR Part 141, Subpart B), lead (40 CFR Part 141.86), uranium, Ra-226, and gross alpha (40 CFR Part 141.66) are shown in Table 3.5-4. This table provides data on constituent concentrations of inorganic chemicals, uranium, Ra-226, and gross alpha particle radioactivity and identifies the well and aquifer sampled. Of 25 groundwater samples collected from the proposed ore-bearing aquifer, 23 exceeded the MCLs for primary drinking water standards as provided by EPA regulations at 40 CFR Part 141; hence, groundwater from the proposed ore-bearing aquifer within the permit boundaries would not be used as public water systems.

Samples collected from wells 615 and 3026, which are within the Chilson aquifer, exceeded the MCL for arsenic {0.01 mg/L [0.01 ppm]}; wells 650 and 689, also within the Chilson aquifer, exceeded the MCL for lead {0.015 mg/L [0.015 ppm]}. Samples from well 622 in the Fall River aquifer and from wells 676 and 679 in alluvial aquifers along Pass Creek exceeded the MCL for both arsenic and lead. In addition, samples from wells 688 and 695 in the Fall River aquifer exceeded the MCL for arsenic. The MCL for uranium (0.03 mg/L) was exceeded in samples

Table 3.5-4. Baseline Groundwater Samples With Values Exceeding the MCLs for Arsenic (0.01 mg/L), Lead (0.015 mg/L), Uranium (Total, 0.03 mg/L), Ra-226 (Dissolved, 5 pCi/L), and Gross Alpha (Total, 15 pCi/L)

Well ID	Aquifer	Arsenic (mg/L)	Lead (mg/L)	Uranium (mg/L)	Ra-226 (Dissolved) (pCi/L)	Gross Alpha (pCi/L)
2	Chilson					
7	Fall River					15.5
8	Fall River					
13	Chilson					19.5
16	Chilson				6.4–26.2	28.3–85.7
18	Fall River					15.7–31.7
42	Chilson				96.5–102	371–558
615	Chilson	0.021–0.024			7.2	15.1–38.3
619	Chilson				99.7–120	341–438
622	Fall River	0.027	0.023–0.03		7.9	15–1470
628	Inyan Kara				6.1–20.7	29.9–83.9
631	Fall River				9.5–22.1	46.5–162
635	Sundance					
650	Chilson		0.05			
675	Alluvial			0.0387–0.0502		18.3–55.2
676	Alluvial	0.021	0.06	0.0591–0.0687		31.9–95.5
677	Alluvial			0.0414–0.0471		38.7–129
678	Alluvial			0.0379–0.0387		18.9–54.7
679	Alluvial	0.011	0.015–0.022			18.4–22.4
680	Chilson			0.0541	1,110–1,440	4,090–6,730
681	Fall River				357–434	656–2220
688	Fall River	0.015			6.7	17.3–29.8
689	Chilson		0.017		5.4–7.9	23.9–64.3
694	Fall River					15.1–25.9
695	Fall River	0.016			5.2–10.4	18.7–44.0
696	Chilson					20.2–23.9
697	Chilson				5.6	18.2–21.7
698	Fall River			0.101–0.132	347–429	36.3–2110
3026	Chilson	0.022–0.044		0.0322	5.9–10.1	36.0–116
4002	Inyan Kara				52.3–63.6	120–314
7002	Chilson				8–8.8	29.5–91.4

Source: Powertech (2011).

obtained from four of five wells in the alluvial aquifers. Samples from wells 680 and 3026 in the Chilson aquifer and well 698 in the Fall River aquifer also exceeded the MCL for uranium; these wells are within the Burdock area. The MCL for other metals, such as selenium {0.05 mg/L [0.03 ppm]}, was not exceeded in any of the groundwater samples.

More than 60 percent of the samples in the both Fall River and Chilson aquifers exceeded the MCL for dissolved Ra-226 [185 Bq/m_3 [5 pCi/L]}. Ra-226 levels exceeding the MCL ranged between 192 and 53,274 Bq/m^3 [5.2 and 1,440 pCi/L]. Approximately 75 percent of the wells sampled in the Fall River, Chilson, and alluvial aquifers produced samples that exceeded the MCL for gross alpha {555 Bq/m^3 [15 pCi/L]}. Gross alpha levels exceeding the MCLs in alluvial wells ranged between 677 and 4,772 Bq/m_3 [18.3 and 129 pCi/L]; however, gross alpha levels exceeding MCLs in the Fall River and Chilson aquifers were higher, ranging from 555 to

248,983 Bq/m^3 [15 to 6,730 pCi/L]. Wells 680 and 681 demonstrated Ra-226 levels exceeding 11,099 Bq/m^3 [300 pCi/L] and gross alpha concentrations exceeding 36,996 Bq/m^3 [1,000 pCi/L]; these wells are directly within mapped orebodies in the Chilson and Fall River aquifers. Another well (698) downgradient of abandoned open pit mines within the Fall River aquifer demonstrated uranium, Ra-226, and gross alpha levels in the range of 0.113 to 0.123 mg/L [0.113 to 0.123 ppm], 13,688 to 15,871 Bq/m^3 [370 to 429 pCi/L], and 44,765 to 78,061 Bq/m^3 [1,210 to 2,110 pCi/L], respectively, exceeding the corresponding MCLs.

Baseline groundwater samples also measured levels that exceeded the SMCLs for bulk water quality properties including pH, total dissolved solids (TDS), and other major constituents such as sodium and sulfate (Powertech, 2009a, 2011). Samples from six wells exceeded the SMCL for pH (6.5–8.5) with values ranging from 8.6 to 10.3. All the samples exceeded the SMCL for TDS {500 mg/L [500 ppm]} with values ranging from 670 to 9,700 mg/L [670 to 9,700 ppm]. The highest TDS values were obtained from alluvial aquifer samples. The SMCL for sodium {200 mg/L [200 ppm]} was exceeded in approximately half of the samples; measured values ranged from 201 to 2,140 mg/L [201 to 2,140 ppm]. Samples taken from alluvial aquifers produced the highest values for sodium. All samples taken from wells exceeded the SMCLs for sulfate {250 mg/L [250 ppm]}; wells in the alluvial aquifers measured the highest sulfate values {greater than 3,000 mg/L [3,000 ppm]}.

At the present time, a primary drinking water standard for Rn-222 has not been established; however, EPA has proposed a limit of 11,099 Bq/m^3 [300 pCi/L] (EPA, 2000). Only well 650, of all the wells tested during baseline groundwater sampling, produced samples that did not exceed the proposed EPA limit; well 650 in the Chilson aquifer lies upgradient of historic uranium mining activities (Powertech, 2009a, 2011). Well samples exceeding the EPA's proposed limit for Rn-222 produced values ranging from 11,247 to 17,092,120 Bq/m^3 [304 to 462,000 pCi/L]. Wells 680 and 42, located in the mapped orebodies in the Chilson aquifer, and well 681 in the Fall River aquifer have the highest concentrations of Rn-222. Well 42 provides water for domestic and stock water.

Before ISR operations begin, the portion of the aquifer(s) designated for uranium recovery must be exempted from the underground source of drinking water (USDW) designation, in accordance with the Safe Drinking Water Act and pursuant to 40 CFR Part 146. A USDW is defined as an aquifer or its portion that supplies any public water system, or that contains a sufficient quantity of groundwater to supply a public water system and currently supplies drinking water for human consumption, or contains fewer than 10,000 mg/L [10,000 ppm] total dissolved solids, and which is not an exempted aquifer. An aquifer or aquifer portion that meets the criteria for a USDW may be determined to be an "exempted aquifer" if it does not currently serve as a source of drinking water and it cannot now and will not in the future serve as a source of drinking water because it is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class III operation to contain minerals that, considering their quantity and location, are expected to be commercially producible. The applicant, therefore, must obtain an aquifer exemption from EPA as a precondition to initiating ISR operations.

3.6 Ecology

The Nebraska-South Dakota-Wyoming Milling Region, as fully described in GEIS Section 3.4.5, encompasses the Middle Rockies, Northwestern Great Plains, Western High Plains, and the Nebraska Sand Hills ecoregions (NRC, 2009a). The proposed Dewey-Burdock ISR Project is located within the Black Hills Foothills and Sagebrush Steppe ecoregions (Figure 3.6-1). GEIS Section 3.4.5.1 provides the following description of these ecoregions:

- The Black Hills Foothills ecoregion is composed of the Hogback Ridge and the Red Valley. The Hogback Ridge forms a ring of foothills surrounding the Black Hills. The Red Valley encircles most of the Black Hills dome and acts as a buffer between the Hogback Ridge and the Black Hills. Natural vegetation within this region includes ponderosa pine (*Pinus ponderosa*), woodlands and open savannas with an understory of western wheat grass (*Elymus smithii)*, needle-and-thread grass (*Stipa comata*), little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis)*, buffalo grass

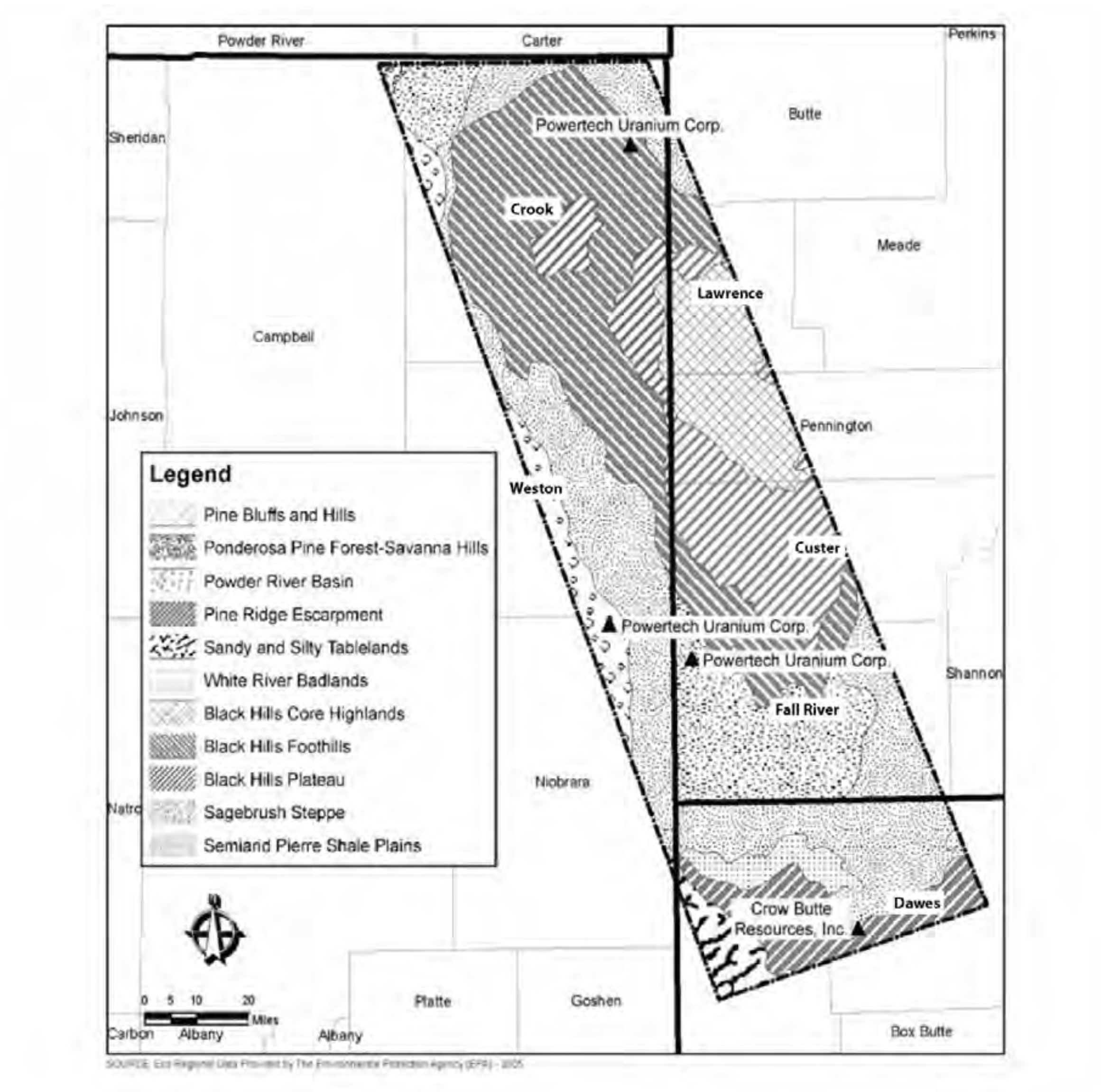

Figure 3.6-1. Ecoregions for the Nebraska-South Dakota-Wyoming Uranium Milling Region.
Source: NRC (2009a).

(*Hierochloe odorata*), and leadplant (*Amorpha canescens*). In addition, some burr oak (*Quercus macrocarpa*) is found in the north and Rocky Mountain juniper (*Juniperus scopulorum*) occurs in the south (Chapman, et al., 2004).

- The Sagebrush Steppe ecoregion is found in Montana and in the Dakotas with only a small area extending into Wyoming. Vegetation types in this region consist of big sagebrush, Nuttall saltbush (*Atriplex nuttallii*), and short grass prairie. The sparse sagebrush communities consist of dusky gray sagebrush (*Artemisia arbuscula* ssp. *Arbuscula)*, dwarf sage (*Artemisia columbiensis*), and big sagebrush (*Artemisia tridentata*). Prairie vegetation that can be found includes western wheatgrass, green needlegrass (*Nassella viridula*), blue grama, Sandberg bluegrass (*Poa secunda*), junegrass (*Koeleria macrantha*), rabbit brush (*Chrysothamnus*), fringed sage (*Artemisia frigid)*, and buffalo grass. The shrub vegetation of this ecoregion is transitional between the grasslands of the Montana Central Grassland and the woodland of the Pine Scoria Hills (Bryce, et al., 1996).

The applicant conducted ecological baseline studies from July 2007 through August 2008 at the proposed Dewey-Burdock site to fulfill the objectives specified in NUREG–1569 (NRC, 2003) and to meet applicable South Dakota Department of Environmental and Natural Resources (SDDENR), SDGFP, and U.S. Fish and Wildlife Service (FWS) guidelines (Powertech, 2009a). These studies include vegetation and wildlife surveys, which are detailed in the following sections. As stated in SEIS Section 3.1, the information in this section forms the basis for assessing the potential ecological impacts (see Chapter 4) of the proposed action and each alternative (Chapter 2).

3.6.1 Terrestrial Ecology

The proposed project area is located within the geomorphologic Cheyenne River drainage basin and contains 4,282 ha [10,580 ac] of wildlife habitat, which supports medium- and small-sized mammals, as well as avian species within the Black Hills Foothills and Sagebrush Steppe ecoregions described previously. SEIS Figure 3.6-1 shows the ecoregions in the vicinity of the proposed project area. The area is characterized as semiarid continental to steppe environment, with a dry winter season with little precipitation (USGS, 1998). Two main drainages are within the proposed project area: Beaver Creek, a perennial stream, and Pass Creek, an intermittent stream, although dry stream channels and numerous ephemeral drainages are also present (see SEIS Section 3.5.1). Beaver Creek experiences low flow in most years resulting in a lack of deep-water habitat, which limits the number of water-dependent species found in the proposed project area. All natural drainages flow south and drain into the Cheyenne River, which is approximately 4 km [2.5 mi] south of the project area. The topography is primarily gently rolling in the western quadrant (more varied terrain with dry drainages and shrubland patches dissecting groups of pine tree in the central portion), and the highest elevation is in the eastern portion at the edge of the Black Hills (Powertech, 2009a).

3.6.1.1 Vegetation

Seven vegetation communities account for 96.7 percent of the 4,282-ha [10,580-ac] proposed project area (Powertech, 2009a). The remaining 3.3 percent of the project area is composed of disturbed areas, abandoned mine pits, shale outcrops, and open water. Table 3.6-1 summarizes the total area of each vegetation community. The survey results identified five

Table 3.6-1. Total Acreage of Vegetation Communities and Percentage of Permit Area

Vegetation Community/ Land Use	Permit Area (Hectares)	Permit Area (Acres)	% of Permit Area
Big Sagebrush Shrubland	1,012.34	2,501.56	23.70
Greasewood Shrubland	886.44	2,190.45	20.75
Upland Grassland	885.27	2,187.56	20.72
Ponderosa Pine Woodland	883.74	2,183.76	20.69
Agricultural Land	315.97	780.79	7.40
Cottonwood Gallery	97.37	240.60	2.28
Silver Sagebrush Shrubland	48.35	119.49	1.13
Disturbed	5.95	14.70	0.14
Existing Mine Pits	132.33	326.99	3.10
Shale Outcrop	0.89	2.19	0.02
Water	3.62	8.94	0.08
TOTAL	**4,272.27**	**10,577.03**	**100.00**
Source: Powertech (2009a).			

native plant communities: big sagebrush shrubland, upland grassland, greasewood shrubland, ponderosa pine woodland, and cottonwood gallery (Powertech, 2009a). Agricultural land used for crop production is also present within the proposed project area.

The plains cottonwood (*Populus deltoides* ssp. *monilifera*) grows naturally along the riverbanks of Beaver and Pass Creeks and on the higher elevation hilltops within the proposed project area. Although not identified within the study area, American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), willows, and bur oak are common in riparian corridors in western South Dakota (BLM, 1985). The plains cottonwood was the only tree species the applicant's vegetation surveys identified along watered drainages; it is most prevalent in the Pass Creek drainage. Rocky Mountain juniper is present as individual trees or in small stands in some of the dry drainages (Powertech, 2009a). Ponderosa pines (*Pinus ponderosa*) are dominant at higher elevations, on hilltops, and within gaps in vegetation in the central and eastern portions of the project area.

Threatened and endangered plant species were not encountered during the applicant's vegetation survey of the project area or within a 0.8-km [0.5-mi] perimeter around the area (Powertech, 2009a). The FWS South Dakota Field Office indicates threatened or endangered vegetative species have not been reported in Custer or Fall River Counties (FWS, 2010).

A noxious weed is any plant a federal, state, or county government designates as injurious to public health, agriculture, recreation, wildlife, or property (BLM, 2009b). Nonnative plant or invasive plants include not only noxious weeds, but also other plants not native to the United States. As a result, these plants have no natural enemies to limit reproduction and spread. Some invasive plants can produce significant changes to vegetation, composition, structure, or ecosystem function.

The South Dakota Department of Agriculture (SDDOA) (SDDOA, 2011) identifies six noxious weed state species that could be present in both Custer and Fall River Counties. The applicant's vegetation survey identified the presence of one of the six noxious weeds important on the state level, Canada thistle (*Cirsium arvense)*, within the Cottonwood Gallery vegetation community (Powertech, 2009a). Canada thistle invades open habitats, including prairies, savannas, fields, pastures, wet meadows, and open forests, forming dense stands, which shade out and displace native vegetation (Colorado State University, 2008). Once established it spreads rapidly and becomes difficult to eradicate.

In addition to state noxious weeds, SDDOA identifies 15 noxious weeds locally important that could occur either in Custer or Fall River Counties. Two of the 15 local noxious weeds, field bindweed (*Convolvulus arvensis*) and houndstongue (*Cynoglossum officinale*), were documented during the vegetation surveys (Powertech, 2009a). Field bindweed was observed within the greasewood shrubland vegetative community, but its extent was not reported (Powertech, 2009a). Bindweed can quickly create a dense ground cover with intertwining stems and prevent other plants and crops from growing (Zollinger, 2000). Established bindweed is very persistent and difficult to control (Zollinger, 2000). Small or isolated bindweed plants can be controlled by tilling shortly after growth begins (Zollinger, 2000). Houndstongue was documented in the big sagebrush shrubland vegetative community near Beaver Creek (Powertech, 2009a). Houndstongue has a deep taproot, making it drought tolerant, and it is able to quickly establish in areas that have been previously disturbed (Zouhar, 2002). It is poisonous to horses and cattle (Zouhar, 2002). Preventing the dispersal of seeds is the best way to control the spread of houndstongue (Zouhar, 2002). The presence of other noxious weeds or invasive plants SDDOA (2011) listed was not reported during the vegetation surveys conducted for the proposed project.

3.6.1.2 Wildlife

The applicant conducted wildlife surveys of terrestrial species for the proposed Dewey-Burdock ISR Project area (Powertech, 2009a). The applicant drew information from these surveys, as well as several additional reports and studies prepared by SDGFP, Wyoming Game and Fish Department (WGFD), BLM, FWS, and USFS and a draft environmental statement TVA prepared for the Edgemont uranium mine to prepare its application (Powertech, 2009a, Sections 3.5.5.3.1 and 9.3.5; TVA, 1979). Site-specific wildlife surveys targeted bald eagle winter roost sites, sage-grouse leks, nesting raptors (including eagles), big game, small mammal vertebrates (bats, mice, and rabbits), and other vertebrate species of concern.

3.6.1.2.1 Big Game

Pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), and elk (*Cervus elaphus*) are the four big game species present in the proposed project area; pronghorn antelope is the most common species (Powertech, 2009a). GEIS Section 3.4.5.1 references a comprehensive listing of species in South Dakota compiled as part of the South Dakota GAP Analysis Project (South Dakota State University, 2012). NRC staff reviewed distribution maps provided as part of the South Dakota GAP Analysis Project that identify the presence of bighorn sheep (*Ovis canadensis*) and mountain lions (*Felis concolor)* predicted in the vicinity of the proposed project area. SDGFP reports no crucial big game habitats or migration corridors have been identified within a 1.6-km [1-mi] radius of the study area (Powertech, 2010a). Crucial areas are those that need to be protected or managed to maintain viable healthy populations of wildlife. GEIS Section 3.4.5.1 provides maps of areas that are important for winter survival, called wintering areas, for pronghorn antelope, mule deer, white-tailed deer, elk, and bighorn sheep, as well as for moose (*Alces alces)*; however, no wintering areas for big game are located in the vicinity of the proposed project area. NRC staff compiled the GEIS maps from information drawn from WGFD and SDGFP. In addition, BLM (BLM, 2011) reports there are no crucial birthing (parturition) or wintering habitats for pronghorn antelope, mule deer, white-tailed deer, elk, bighorn sheep, or moose west of the Dewey-Burdock site in Wyoming.

3.6.1.2.2 Avian Species

This section of the SEIS describes bird species identified at the proposed Dewey-Burdock ISR Project from surveys (Powertech, 2009a) and independent sources.

Upland Game Birds

The wild turkey (*Meleagris gallopavo*) and mourning dove (*Zenaida macroura*), both relatively common species, were the only upland game bird species regularly observed within the proposed project area during the applicant wildlife surveys. Three grouse species, including the Greater sage-grouse *(Centrocercus urophasianus)*, could potentially occur in the proposed project area. The Greater sage-grouse is a species of great concern in the arid west where sagebrush habitat occurs. The sage-grouse is listed as a federal candidate species (75 FR 13909), or a species that is being considered for listing as endangered or threatened, and it is discussed in more detail in SEIS Section 3.6.3. Sage-grouse were not observed during the applicant surveys (Powertech, 2009a). One sage-grouse lek, or breeding area, is located within 8 km [5 mi] of the western site boundary in Wyoming (Hodorff, 2005; BLM, 2011; WGFD, 2011). Figure 3.6-2 shows the sage-grouse nesting areas in the vicinity of the proposed project. Figure 3.6-3 more closely shows the occupied sage-grouse leks within and close to 8 km [5 mi] of the site (WGFD, 2011; Hodorff, 2005). Sharp-tailed grouse (*Tympanuchus phasianellus*) and ruffed grouse (*Bonasa umbellus*) are not known to breed in the project vicinity. Sharp-tailed grouse are more likely to potentially occur in the proposed project area than ruffed grouse because sharp-tailed grouse inhabit short grass prairies of western South Dakota, while ruffed grouse are found in limited numbers in the forests of the Black Hills (Peterson, 1995; SDGFP, 2012b; South Dakota State University, 2012).

Raptors

Suitable habitat for several raptor species occurs in the proposed project area and within a 1.6-km [1-mi] radius of the site. Raptor species observed during the applicant's wildlife surveys included the bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), turkey vulture (*Cathartes aura*), Cooper's hawk (*Accipiter cooperii*), rough-legged hawk (*Buteo lagopus*), merlin (*Falco columbarius*), great horned owl (*Bubo virginianus*), and long-eared owl (*Asio otus*) (Powertech, 2009a).

The bald eagle, red-tailed hawk, American kestrel, and northern harrier were the most commonly seen raptor species in the proposed project area (Powertech, 2009a). The red-tailed hawk is one of the most common hawks in North America that nests in trees in a variety of open and wooded habitats near ravines or open water. The red-tailed hawk is an opportunistic feeder and finds its prey, consisting mostly of rodents, from an elevated perch or while soaring (NPWRC, 2006a). The American kestrel is the smallest and most common falcon and nests in either natural or manmade crevices. The kestrel requires perches and open space for hunting small animals and insects (NPWRC, 2006b). The northern harrier prefers prairies and wetlands with plenty of room to glide across open country in search of small mammals, reptiles, frogs, insects, and birds. Northern harriers nest on the ground in marshes or areas with low vegetation (NPWRC, 2006c).

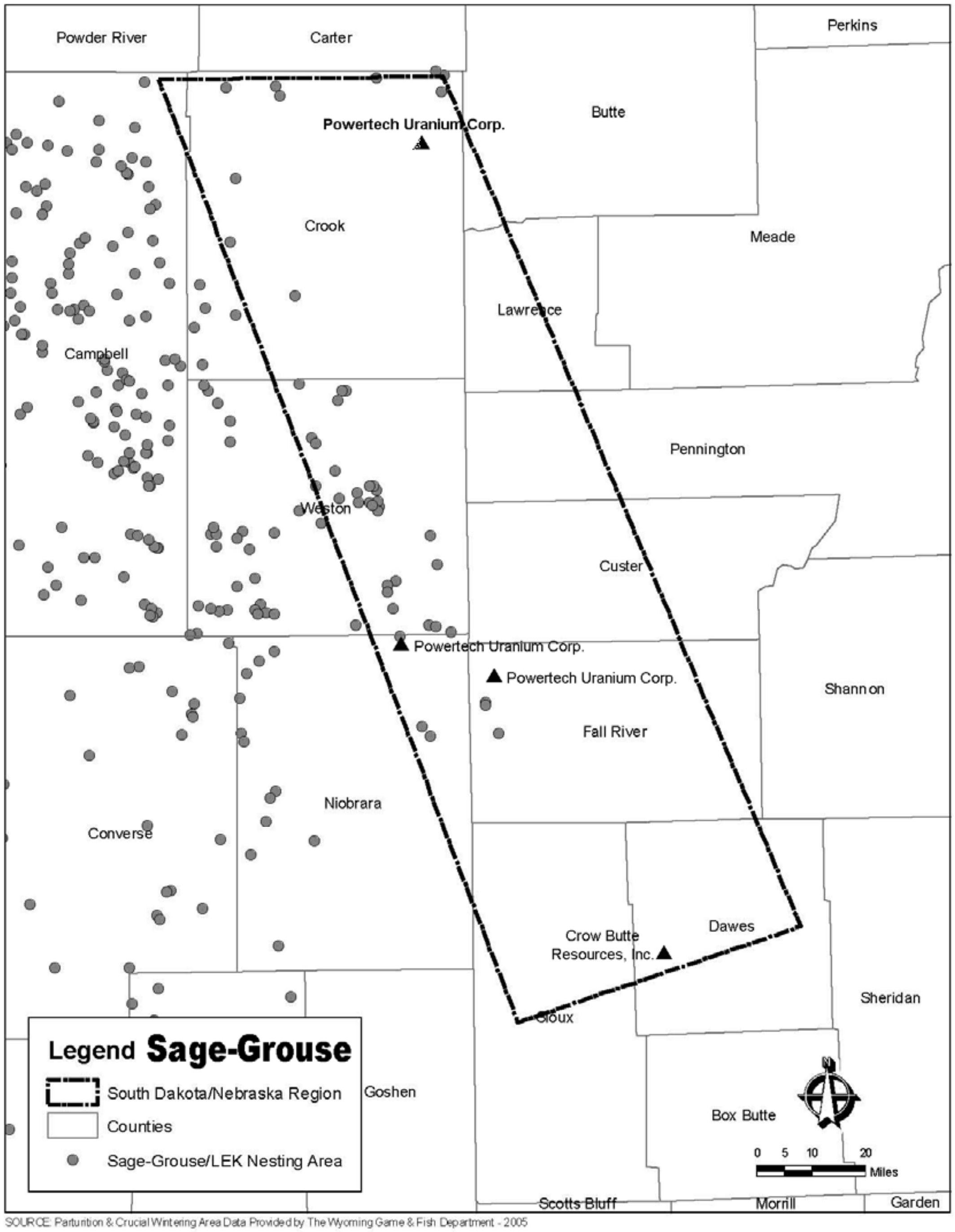

Figure 3.6-2. Sage-Grouse Lek Areas for the Nebraska-South Dakota-Wyoming Uranium Milling Region.
Source: NRC (2009a).

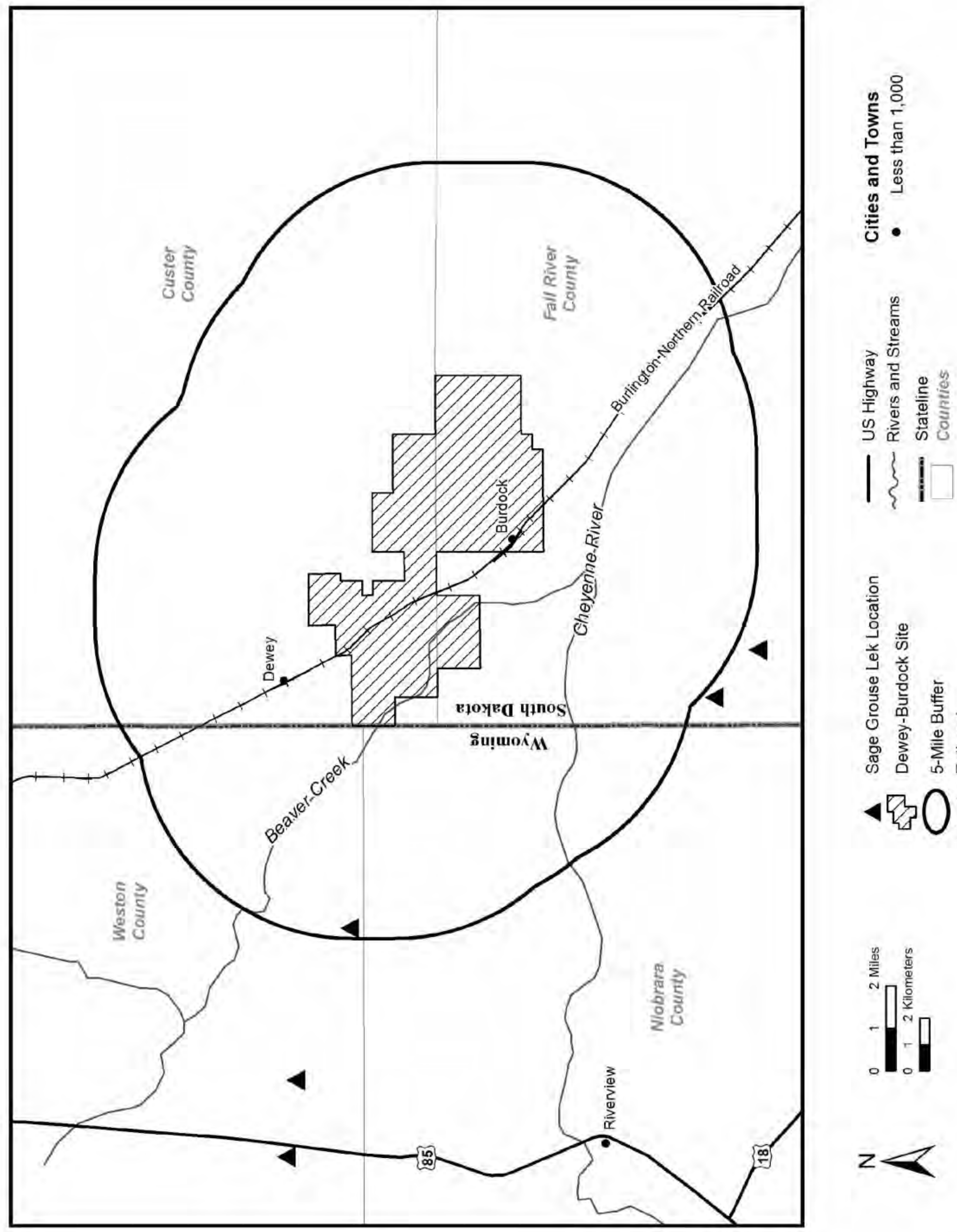

Figure 3.6-3. Occupied Sage-Grouse Leks Near the Proposed Dewey-Burdock Project. Source: NRC (WGFD, 2011; Hodorff, 2005; BLM, 2011).

Although additional raptor species may be present in the survey area, particularly as seasonal migrants, no additional species were identified. The South Dakota Breeding Bird Atlas reports the burrowing owl (*Athene cunicularia*), northern saw-whet owl (*Aegolius acadicus*), and Sharp-shinned Hawk *(Accipiter striatus)* have been recorded in the vicinity of the proposed project area (Peterson, 1995). The South Dakota SDGFP Natural Heritage Program (SDNHP) collects information about these raptors (SDGFP, 2010). SDNHP inventories, protects, and manages state species that are rare, imperiled, candidate, threatened, or endangered. SDNHP classifies the burrowing owl, northern saw-whet owl, and sharp-shinned hawk as rare.

Five confirmed, intact raptor nests and one potential nest site were observed within the proposed project area, and the applicant identified two additional nests within a 1.6-km [1-mi] radius of the study area (Powertech, 2009a). The bald eagle, a state-listed threatened species, and the long-eared owl, a SDNHP rare species, successfully nested in the proposed project area. A merlin, another SDNHP rare species, was recorded at one of the potential nest sites within a 1.6-km [1-mi] radius of the proposed project area. SDNHP inventories, protects, and manages native plant and animal species and habitats as part of efforts to sustain the biological diversity of South Dakota. All eight nests are listed in Table 3.6-2; information on their locations, their status, and productivity at the time of the nest surveys in 2007 and 2008 is included. Occurrences of the bald eagle, golden eagle, ferruginous hawk, Cooper's hawk, long-eared owl, merlin, and other sensitive or protected species observed at the project site are detailed in Section 3.6.3.

Table 3.6-2. Raptor Nest Locations and Activity Observed for the Proposed Dewey-Burdock Project (July 2007–August 2008)

Species	16-ha [40-ac] Block, and Section, Township, Range	Habitat	Status	Location (Area)
Long-Eared Owl	SESW 35, 6 South, 1 East	Ponderosa Pine	1 Owl Fledged	Permit Area (Burdock)
Red-Tailed Hawk (2 Nests)	SENE 29, 6 South, 1 East	Ponderosa Pine	1 Hawk Fledged	Permit Area (Dewey)
Red-Tailed Hawk	SESW 34, 6 South, 1 East	Cottonwood-riparian	2 Hawks Fledged	Permit Area (Burdock)
Bald Eagle	Mid-SW 30, 6 South, 1 East	Cottonwood-riparian	1 Eagle Fledged	Permit Area (Dewey)
Bald Eagle*	NENE 31, 6 South, 1 East	Cottonwood-riparian	1 eagle fledged (2010); active but no fledglings (2011)	Permit Area (Dewey)
Merlin	NWSW 36 6 South/1 East	Ponderosa Pine	Nest Defense But No Confirmed Young	Within 1/2 mi of Perimeter (Burdock)
Great Horned Owl	SWNE 5 7 South/1 East	Lone, Live Cottonwood Tree	Status Unknown†	Permit Area (Dewey)
Unidentified Hawk	NESW 28 41 North/60 West (Wyoming)	Lone, Dead Cottonwood Tree	Inactive	Within 1 mi of Perimeter (Dewey)

Source: Powertech, 2009a; SDGFP, 2010; SDGFP, 2012c
*Surveys conducted in 2010 and 2011 by SDGFP
†One adult great horned howl was observed in the nest tree, but no chicks, feathers, droppings, or prey items were observed in or on the nest, or on the ground under the nest.

SDGFP provided NRC with eagle surveys conducted on the proposed Dewey-Burdock project site from 2009 to 2011. SDGFP confirmed the bald eagle nest that Powertech reported as successful (produced fledgling) on the site during its 2009–2011 surveys was successful with one fledgling in 2009, but was not active (not occupied by a breeding pair) in 2010 and 2011. Approximately 1.2 km [0.75 mi] southeast of this nest along Beaver Creek, SDGFP observed an additional active nest with one successful fledgling in 2010. This nest remained active in 2011 but did not produce a fledgling (SDGFP, 2012c).

Waterfowl and Shorebirds

The proposed project area provides limited seasonal habitat for waterfowl and shorebirds, mainly along Beaver Creek and Pass Creek and the few scattered stocked reservoirs. Limited precipitation in the area results in little year-round reliable nesting and brood-rearing habitat for these species. Therefore year-round residence is rare for species present during the spring migration period. Eight avian species associated specifically with water and/or wetlands were observed during the applicant baseline surveys: the American white pelican (*Pelecanus erythrorhynchos*), great blue heron (*Ardea herodias*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), American wigeon (*Anas americana*), killdeer (*Charadrius vociferus*), long-billed curlew (*Numenius americanus*), and upland sandpiper (*Bartramia longicauda*) (Powertech, 2009a). Based on the wetland survey results presented in SEIS Section 3.5.2, the proposed project may affect a total of 14.2 ha [35.1 ac] of wetland channels, isolated ponds, isolated depressions, and open water**.** The pelican, heron, and curlew are listed in the table in Section 3.6.3 (Protected Species) as BLM-sensitive species and in a table in Section 3.6.3 as rare species in South Dakota.

Nongame and Migratory Birds

Other avian species were observed flying over the proposed project area during wildlife surveys (Powertech, 2009a). The Clark's nutcracker (*Nucifraga columbiana*) was recorded flying over the proposed project area, but known nesting or other activities were not observed. A total of 36 avian species were observed during targeted breeding bird surveys within the proposed project area. The long-billed curlew was the only rare SDNHP species of the 36 observed during the breeding bird surveys, and it was suspected, although not observed, to have nested in the project area. The western meadowlark (*Sturnella neglecta*) was the most common species observed, followed by the mourning dove. Nest activity and locations of breeding birds observed during the applicant's wildlife surveys are summarized in Table 3.6-3.

The South Dakota Breeding Bird Atlas reports that the common poorwill (*Phalaenoptilus nuttallii*), Lewis' woodpecker (*Melanerpes lewis*), black-backed woodpecker (*Picoides arcticus*), pygmy nuthatch (*Sitta pygmaea*), sage thrasher (*Oreoscoptes montanus*), brewer's sparrow (*Spizella breweri*), and Cassin's finch (*Carpodacus cassinii*) have been recorded in the vicinity of the proposed project area (Peterson, 1995). SDNHP also designates these birds as rare (SDGFP, 2010).

3.6.1.2.3 Other Mammals, Reptiles, and Amphibians

Small- and medium-sized mammalian species surveyed in southwest South Dakota and that could occur in the vicinity of the proposed project area include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), skunk (*Mephitis mephitis)*, porcupine

Table 3.6-3. Breeding Bird Species Observed Within the Proposed Dewey-Burdock Project Area in June 2008

	Average Number of Birds Per Habitat Type						
Species*	**BB**	**COT GAL**	**G**	**GW**	**P-SB Edge**	**PP**	**AVG #/PLOT**
Western Meadowlark (*Sturnella Neglecta*)	3.0	1.7	2.9	7.0	2.0	—	2.8
Mourning Dove (*Zenaida Macroura*)	5.0	1.7	1.9	0.7	0.3	2.0	1.9
Long-Billed Curlew (*Numenius Americanus*)	**—**	**—**	**1.9**	**—**	**—**	**—**	**0.9**
Chipping Sparrow (*Spizella Passerina*)	—	—	—	0.3	4.0	1.6	0.6
Lark Sparrow (*Chondestes Grammacus*)	3.7	—	—	—	1.7	—	0.6
Grasshopper Sparrow (*Ammodramus Savannarum*)	—	—	0.1	4.3	—	—	0.5
Northern Flicker (*Colaptes Auratus*)	—	4.3	—	0.3	—	—	0.5
Mountain Bluebird (*Sialia Currucoides*)	—	—	—	—	2.3	2.0	0.5
Brewer's Blackbird (*Euphagus Cyanocephalus*)	—	3.7	—	—	—	—	0.4
Spotted Towhee (*Pipilo Maculatus*)	—	1.3	—	0.3	0.7	1.0	0.4
American Kestrel (*Falco Sparverius*)	0.3	2.3	0.2	—	—	—	0.4
Brown-Headed Cowbird (*Molothrus Ater*)	—	0.3	—	—	2.0	1.0	0.4
House Wren (*Troglodytes Aedon*)	—	2.7	—	—	—	—	0.3
Yellow Warbler (*Dendroica Petechia*)	—	2.0	—	—	—	—	0.2
Say's Phoebe (*Sayornis Saya*)	—	0.3	—	—	1.3	—	0.2
Bullock's Oriole (*Icterus Bullockii*)	—	1.7	—	—	—	—	0.2
Unknown Flycatcher	—	—	—	—	—	1.7	0.2
Eastern Kingbird (*Tyrannus Tyrannus*)	—	1.3	—	—	—	—	0.1
Red-Tailed Hawk (*Buteo Jamaicensis*)	—	0.3	0.1	0.3	—	—	0.1
Black-Capped Chickadee (*Poecile Atricapillus*)	—	0.3	—	—	—	0.7	0.1

Table 3.6-3. Breeding Bird Species Observed Within the Proposed Dewey-Burdock Project Area in June 2008 (continued)

	Average Number of Birds Per Habitat Type						
Species*	**BB**	**COT GAL**	**G**	**GW**	**P-SB Edge**	**PP**	**AVG #/PLOT**
Yellow-Rumped Warbler (*Dendroica Coronata*)	—	0.3	—	—	—	0.7	0.1
European Starling (*Sturnus Vulgaris*)	—	1.0	—	—	—	—	0.1
Great Horned Owl (*Bubo Virginianus*)	—	1.0	—	—	—	—	0.1
Vesper Sparrow (*Pooecetes Gramineus*)	—	—	0.3	—	—	—	0.1
American Crow (*Corvus Brachyrhynchos*)	—	—	0.1	—	—	0.3	0.1
Red-Headed Woodpecker (*Melanerpes Erythrocephalus*)	—	0.7	—	—	—	—	0.1
Rock Wren (*Salpinctes Obsoletus*)	0.7	—	—	—	—	—	0.1
Western Kingbird (*Tyrannus Verticalis*)	I	0.7	—	—	—	—	0.1
American Robin (*Turdus Migratorius*)	—	0.3	—	—	—	—	<0.1
Common Nighthawk (*Chordeiles Minor*)	—	I	—	—	—	0.3	<0.1
Indigo Bunting (*Passerina Cyanea*)	—	0.3	—	—	—	—	<0.1
Killdeer (*Charadrius Vociferous*)	—	—	0.1	—	—	—	<0.1
Lazuli Bunting (*Passerina Amoena*)	—	0.3	—	—	—	—	<0.1
Western Wood Pewee (*Contopus Sordidulus*)	—	—	—	—	0.3	—	<0.1
Yellow-Breasted Chat (*Icteria Virens*)	—	0.3	—	—	—	—	<0.1
Red-Winged Blackbird (*Agelaius Phoeniceus*)	—	—	I	—	—	—	I
Turkey Vulture (*Carthartes Aura*)	I	I	—	—	—	—	I
Average # Birds/Transect	12.3	29.0	7.7	13.3	15.3	10.7	12.4
TOTAL SPECIES	5	23	10	7	10	10	36

Source: Powertech (2009a)
AVG = average; BB = Bentonite Breaks; COT GAL = Cottonwood Gallery; G = Grassland; GW = Greasewood; P-SB = Pine-Sagebrush; PP = Ponderosa Pine; I = Incidental flyover during breeding bird survey (not counted in totals).
***Bold** Long-billed curlew is tracked by the South Dakota Natural Heritage Program—South Dakota Department of Game, Fish, and Parks (SDGFP, 2010) and was suspected, although not observed, to nest within the proposed project area.

(*Erethizon dorsatum*), and weasel (*Mustela* spp.) (South Dakota State University, 2012). Smaller mammal species, including rodents (mice, rats, moles, voles, shrews, minks, gophers, squirrels, chipmunks, prairie dogs), jackrabbits (*Lepus* spp.), and cottontails (hares) (*Sylvilagus* spp.), inhabit the area and are often prey for larger mammals (South Dakota State University, 2012). During the wildlife surveys, small mammals were most frequently observed near Beaver Creek in the northwestern portion and Pass Creek in the central portion of the proposed project area (Powertech, 2009a). Results of mammal surveys and trapping events are presented in Table 3.6-4. Results of spotlight lagomorph (rabbits and hares) surveys are presented in Table 3.6-5.

One black-tailed prairie dog (*Cynomys ludovicianus*) colony was observed during wildlife surveys in the northwestern corner of the proposed project area (Section 31, T6S, R1E), and two others were observed within 1.6 km [1 mi] southwest of the project area (Powertech, 2009a). SDGFP mapped the prairie dog town within the project boundaries in 2008 and provided NRC with the results of its size and location. For landowner privacy purposes, a map of the prairie dog town is not presented in this report. The prairie dog town covers

Table 3.6-4. Small Mammal Abundance Based on Trappings During Baseline Studies Conducted for the Proposed Dewey-Burdock Project in September 2007

	Captures Per 100 Trap-Nights*						
Species	**UG**	**PP**	**GW**	**CG**	**CB**	**P/S**	**Total**
Deer Mouse (*Peromyscus Maniculatus*)	6.67	22.86	5.71	16.19	17.14	15.24	11.53
Olive-Backed Pocket Mouse (*Perognathus Fasciatus*)	0.71	—	—	—	—	—	0.32
Northern Grasshopper Mouse (*Onychomys Leucogaster*)	0.24	—	—	—	—	—	0.11
Western Harvest Mouse (*Reithrodontomys Megalotis*)	0.24	—	0.95	—	—	—	0.21
Total Abundance	7.86	22.86	6.67	16.19	17.14	15.24	12.17
Total No. of Species	4	1	2	1	1	1	4

Source: Powertech (2009a)
*Excludes recaptures.
CB = Clay Breaks; CG = Cottonwood Gallery; GW = Greasewood; PP = Ponderosa; P/S = Pine/Sage Edge; UG = Upland Grassland

Table 3.6-5. Total Lagomorphs Observed During Spotlight Surveys and Abundance Indices Within the Proposed Dewey-Burdock Project in September 2007

	Species		
	White-Tailed Jackrabbit	**Cottontail**	**Totals**
Total Count*	12	28	40
Lagomorphs/Survey Mile†	1.5	3.4	4.9

Source: Powertech (2009a)
*Number given is highest count per species from two survey nights.
†Survey route totaled 13.1 km [8.2 mi].

approximately 321 ha [794 ac] of land in the northwest portion of the project area. The presence of large, closely spaced prairie dog colonies {on the order of hundred hectares [several thousand acres]} could support and sustain a breeding population of black-footed ferrets (*Mustela nigripes*) (BLM, 2009a). According to SDGFP, private landowners and the public are allowed to shoot prairie dogs on private lands to manage the population in the prairie dog town (SDGFP, 2005b). It is reasonable to expect that local ranchers may poison and/or trap prairie dogs for population control. Black-footed ferrets (*Mustela nigripes*) dwell in prairie dog towns and prey almost exclusively on prairie dogs (USGS, 2006b). The black-footed ferret is further discussed in Section 3.6.3.

The boreal chorus frog (*Pseudacris triseriata*), Woodhouse's toad (*Bufo woodhousei*), great plains toad (*B. cognatus*), and western painted turtle (*Chrysemys picta*) were heard and/or seen in Beaver Creek near stock reservoirs in the western portion of the proposed project area during the applicant's biological surveys. The western spiny softshell (*Trionyx spiniferus*) was also recorded in Beaver Creek during fisheries surveys, but not within the proposed project area. The genus *Trionyx* was used prior to the accepted *Apalone* (Somma, 2011). Spiny softshell turtle (*Apalone spinifera*) is a BLM sensitive species listed in Table 3.6-7. It is likely that the observed softshell was a spiny softshell turtle subspecies, the western spiny softshell (*Apalone spinifera hartwegi*). Lizards were often observed sunning themselves on rocks and sandy soil during the summer months. One snake skin, reportedly that of a bullsnake (*Pituophis melanoleucas sayi*), was also observed in the north central portion of the buffer area surveyed outside of the proposed project area (Powertech, 2009a).

The mountain goat (*Oreamnos americanus*) inhabits the Black Hills and prefers steep, rocky terrain (BLM, 2009a). The mountain goat was not observed on the proposed project site, but could inhabit the area east of the site according to South Dakota Gap Analysis Project information (South Dakota State University, 2012).

3.6.2 Aquatic

As discussed earlier in this section, Beaver and Pass Creeks form the two main drainage basins located within the proposed project area. Smaller drainages and depressions holding water adjacent to main drainage corridors provide potential aquatic habitat. The majority of the surface water features within the project area accumulate only as a result of snowmelt or major storm events. Old mine pits throughout the proposed project area are also locations where water accumulates, creating habitat.

The lack of permanent aquatic resources within the proposed project area is a factor limiting the presence of aquatic species. GEIS Section 3.4.5.2 describes the Cheyenne River as one of the major watersheds in South Dakota. The Cheyenne River originates in eastern Wyoming and flows along the southern edge of the Black Hills Uplift. The GEIS indicates approximately 45 fish species are found in the Cheyenne River watershed, including species of bass, catfish, carp, chub, trout, shiner, sunfish, and minnow. GEIS Table 3.4-4 lists the state-designated uses of the Cheyenne River and Beaver Creek as fisheries, fish and wildlife propagation, recreation, agriculture, and aesthetics, indicating that the water is acceptable for fishing, boating, swimming, agricultural irrigation, and growth of aquatic life.

The applicant conducted extensive fishery and habitat surveys that provide baseline information on stream flow and other habitat characteristics, including channel dimensions and features such as pool, riffle, glide, and run habitat types, sediment composition, water clarity, and specific conductivity, as well as aquatic benthic macro-invertebrate community composition, and the variety, condition, and relative abundance of fish species (Powertech, 2009a, Section 3.5.5.5). Radiological monitoring of riverine species was also conducted to establish baseline concentrations of select radionuclides in fish populations. The sampling locations for these studies were primarily in Beaver Creek, although additional sampling was conducted in the Cheyenne River downstream of the proposed project. Pass Creek does not maintain sufficient water to support aquatic life.

Waters classified as impaired are too polluted or otherwise too degraded to meet established water quality standards and fully support state-designated uses. Beaver Creek is identified as an impaired water under the criteria in Section 303(d) of the federal Clean Water Act (33 U.S.C. § 1251 et seq. 1972). The impairments indicate that Beaver Creek may not provide adequate habitat to provide growth of aquatic life (EPA, 2010b). For the 2008 reporting cycle, the four areas of impairment for Beaver Creek are specific conductivity, total dissolved solids, pH, and fecal coliform (EPA, 2010b). An SDDENR-prepared water quality data report points to livestock as the source of fecal coliform (SDDENR, 2008). Pass Creek is not listed on the 303(d) list as an impaired water body (EPA, 2010b). Cattle grazing is the primary land use at and in the vicinity of the project area. Grazing activities contribute water pollutants, such as fecal coliform, and result in increased turbidity. Fecal coliform alters the pH levels and conductivity of water (EPA, 2006a).

Aquatic benthic macroinvertebrate communities, primarily insects, crustaceans, and mollusks, were sampled as part of habitat surveys in Beaver Creek. The results of these surveys indicate degraded water habitat conditions, which supports the EPA impaired classification (Powertech, 2009a). The small number and limited range of macroinvertebrate species collected also points to impaired water conditions. Aquatic insects are food sources for riparian predators, such as spiders, birds, bats, reptiles, and amphibians, and play an important role in the transfer of energy and materials from freshwater to terrestrial food webs. In addition, only a few sensitive species or species unable to tolerate degraded habitat were collected.

Twelve fish species were collected from two collection points in Beaver Creek: BVC04, located upstream of the project area, and BVC01, located downstream of the project area (see Figure 3.5-2). One collection point, CHR05, is located in Cheyenne River downstream of the proposed project area past the confluence of Beaver Creek and Cheyenne River (see Figure 3.5-2). Channel catfish (*Ictalurus punctatus)* is the most abundant fish species in Beaver Creek and the most likely to be caught and eaten by anglers. The 11 other species collected were the sand shiner (*Notropis stramineus)*, creek chub (*Semotilus atromaculatus)*, plains minnow (*Hybognathus placitusa)*, common carp (*Cyprinus carpioa)*, longnosed dace (*Rhynichthys cataractae)*, fathead minnow (*Pimephales promelas)*, river carpsucker (*Carpoides carpio)*, shorthead redhorse sucker (*Moxostoma macrolepidotuma)*, plains topminnow (*Fundulus sciadicus)*, plains killfish (*Fundulus zebrinus)*, and green sunfish (*Lepomis cyanellus)* (Powertech, 2009a). Fish were sampled and tested to identify baseline levels of select radionuclides in fish. The only South Dakota rare fish species collected was the plains topminnow (SDGFP, 2010), encountered in Beaver Creek downstream of the proposed project area. Although fish surveys were not conducted within the project area, NRC staff expect similar fish species encountered upstream and downstream of the site could occur within the project area.

Survey results demonstrated the presence of total uranium in fish species in 2008. The channel catfish was the only fish species with detectable total uranium levels during the first sampling event in April 2008; however, total uranium was detected in all fish samples from the second sampling event conducted in July 2008. Note the laboratory detection limit was lowered for the July 2008 sample. All total uranium concentrations were detected at or below 0.5 mg/kg [0.5 ppm]. Radioactivity from Po-210, Th-230, and Ra-226 was detected in many fish, but at low concentrations. Pb-210 was only detected in one specimen where matrix interference was reported (Powertech, 2009a).

South Dakota issues fish consumption advisories for waterbodies with elevated contaminants that may be harmful to humans. Sampling activities have occurred in Fall River County at Angostura Reservoir and portions of the Cheyenne, and in Custer County at Stockdale Lake from 1994 to 2009. No waterbodies in Custer and Fall River Counties were sampled in 2011. No fish consumption advisories have been issued as a result of fish collection and sampling activities in Custer and Fall River Counties (SDDENR, 2011b).

3.6.3 Protected Species

Table 3.6-6 identifies species present in Custer and Fall River Counties that are listed as federally threatened or endangered (FWS, 2010; Powertech, 2009a). The results of wildlife surveys (Powertech, 2009a) and FWS correspondence (FWS, 2010, 2012b) have not identified federally listed threatened or endangered species on or within a 1.6-km [1-mi] radius of the proposed Dewey-Burdock ISR Project site. NRC staff initially requested information for federally listed species on March 15, 2010 (NRC, 2010c); a response was provided on March 29, 2010 (FWS, 2010). NRC staff requested updated information from FWS via e-mail on August 27, 2012; a response was provided the same day (FWS, 2012b). The bald eagle, which is no longer listed federally as threatened or endangered although it is listed as threatened by South Dakota, is known to be present at the site and was observed during the wildlife surveys (Powertech, 2009a). Endangered and threatened species and designated habitats that may be present in the project area are discussed more fully next.

Table 3.6-6. Threatened or Endangered Animals That Occur in Custer and Fall River Counties or Were Observed in the Proposed Dewey-Burdock ISR Project Area*

Scientific Name	Common Name	Federal Status	State Status	Observed Onsite
Birds				
Centrocerus Urophasianus	Greater Sage-Grouse	Candidate	Not Listed	No
Anthus spragueii	Sprague's Pipit	Candidate	Not Listed	No
Grus Americana	Whooping Crane	Endangered	Endangered	No
Haliaeetus Leucocephalus	Bald Eagle	Delisted	Threatened	Yes
Mammals				
Mustela Nigripes	Black-Footed Ferret	Endangered	Endangered	No
*Sources: FWS, 2010, 2012b; Powertech, 2009a; SDGFP, 2010				

The BLM Montana/Dakotas State Director designates sensitive species within the BLM Montana State Office jurisdiction as those "requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA [Endangered Species Act]" (BLM, 2008). BLM special status species, collectively, are (i) BLM-designated sensitive species and (ii) federally proposed, candidate, and delisted species within 5 years of delisting (BLM, 2008). Because approximately 97.1 ha [240 ac] of the proposed project are under the control of BLM, NRC considered the BLM special status species that may occur in the project area in Table 3.6-7.

Table 3.6-7. BLM Special Status Species That May Occur Within the Project Area

Common Name	Scientific Name	Federal Status	State Status*	General Habitat
Mammals				
Black-Tailed Prairie Dog	*Cynomys ludovicianus*	BLM Sensitive	SE	Grassland
Swift Fox	*Vulpes velox*	BLM Sensitive	ST	Grassland
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	BLM Sensitive	ST	Forest/prairie
Black-Backed Woodpecker	*Picoides arcticus*	BLM Sensitive		Forest
Blue-Gray Gnatcatcher	*Polioptila caerulea*	BLM Sensitive		Shrubland
Burrowing Owl	*Athene cunicularia*	BLM Sensitive		Grassland
Chestnut-Collared Longspur	*Calcarius ornatus*	BLM Sensitive		Grassland
Dickcissel	*Spiza Americana*	BLM Sensitive		Grassland
Veery	*Catharus fuscescens*	BLM Sensitive		Forest
Ferruginous Hawk	*Buteo regalis*	BLM Sensitive		Grassland
Golden Eagle	*Aquila chrysaetos*	BLM Sensitive		Shrubland/grassland
Greater Sage-Grouse	*Centrocercus urophasianus*	BLM Sensitive and Candidate		Shrubland
Loggerhead Shrike	*Lanius ludovicianus*	BLM Sensitive		Shrubland
Long-Billed Curlew	*Numenius americanus*	BLM Sensitive		Grassland
Marbled Godwit	*Limosa fedoa*	BLM Sensitive		Grassland/wetland
Peregrine Falcon	*Falco peregrinus*	BLM Sensitive	SE	Forest
Red-Headed Woodpecker	*Melanerpes erythrocephalus*	BLM Sensitive		Forest
Swainson's Hawk	*Buteo swainsoni*	BLM Sensitive		Grassland
Three-Toed Woodpecker	*Picoides tridactylus*	BLM Sensitive		Forest

Table 3.6-7. BLM Special Status Species That May Occur Within the Project Area (continued)

Common Name	Scientific Name	Federal Status	State Status*	General Habitat
Birds (continued)				
Trumpeter Swan	*Plegadis chihi*	BLM Sensitive		Wetland
Willet	*Cataptrophorus semipalmatus*	BLM Sensitive		Grassland/wetland
Wilson's Phalarope	*Phalaropus tricolor*	BLM Sensitive		Grassland/wetland
Fish				
Banded killifish	*Fundulus diaphanus*		SE	River/stream
Northern Redbelly Dace	*Phoxinus eos*	BLM Sensitive	ST	River/stream
Amphibians				
Plains Spadefoot	*Spea bombifrons*	BLM Sensitive		Grassland/wetland
Northern Leopard Frog	*Rana pipiens*	BLM Sensitive		Wetland
Reptiles				
Snapping Turtle	*Cheldy serpentine*	BLM Sensitive		Wetland
Spiny Softshell Turtle	*Apalone spinifera*	BLM Sensitive		River/stream
Greater Short-horned Lizard	*Phrynosoma hernandesi*	BLM Sensitive		Grassland
Prairie Hognose Snake	*Heterodon nasicus*	BLM Sensitive		Grassland
Sources: SDGFP, 2010; BLM, 2009c; BLM, 2012b *****SE = state endangered species; ST = state threatened species				

The SDGFP list of rare animals includes those that could become candidates for listing, as well as, locally rare species (SDGFP, 2010). Table 3.6-8 lists nine species, all birds, observed at the proposed project area during the applicant-conducted baseline studies, along with their primary nesting habitats and historical occurrence in the general area. SDGFP takes conservation measures to sustain all native plants and animals and associated habitats. By taking a proactive approach to sustaining native species, listing of species as threatened or endangered can often be prevented.

Greater Sage-Grouse

Greater sage-grouse (*Centrocerus Urophasianus)* is a federal candidate species for threatened or endangered status resident in sagebrush shrubland habitats; sagebrush is essential in every phase of the life cycle of this species. Breeding habitat, referred to as leks, and stands of sagebrush surrounding leks are

Table 3.6-8. Species Tracked by the South Dakota National Heritage Program Observed in the Proposed Dewey-Burdock Project Area

Species	Primary Habitat(s)	State Rank During Breeding Season	State Rank During Nonbreeding Season	Occurrence Within Proposed License Area (PLA) or 1.6-km [1-mile] Perimeter
Clark's Nutcracker (*Nucifraga Columbiana*)	Pines, Cliffs, and Canyons	S2	S2	Observed Flying Over PLA
Merlin (*Falco Columbarius*)	White Spruce, Pines, and Shrublands	S3	S3	Observed East of PLA Within 1 Mile, Presumed Breeder
Long-Eared Owl (*Asio Otus*)	White Spruce, Pines, and Shrublands	S3	S3	Observed Within PLA, Breeder
Bald Eagle (*Haliaeetus leucocephalus)*	Forests and Cliffs Near Open Water	S1	S2	Observed Within PLA, Breeder
Golden Eagle (*Aquila Chrysaetos*)	Cliffs, Canyons, and Grassland	S3, S4	S3	Observed Flying Over PLA Once
American White Pelican (*Pelecanus Erythrorhynchos*)	Islands or Sandbars of Large Wetlands	S3	SZ	Observed Flying Over PLA Once
Cooper's Hawk (*Accipiter Cooperii*)	Conifer or Deciduous Woodland	S3	SZ	Observed Flying Over PLA Once
Long-Billed Curlew (*Numenius Americanus*)	Prairie Grassland	S3	SZ	Observed Within PLA, Likely Breeder
Great Blue Heron (*Ardea Herodias*)	Riparian and Wetland	S4	SZ	Observed Flying Over PLA Once
Ferruginous Hawk (*Buteo Regalis*)	Prairie Grassland	S4	SZ	Observed

Sources: SDGFP (2010a); Powertech (2009a); SDGFP (2005a).
S2 = Imperiled because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
S3 = Either very rare and local throughout its range, or found locally (even abundantly at some of its locations) in a restricted range or vulnerable to extinction throughout its range because of other factors; in the range of 21 of 100 occurrences.
S4 = Apparently secure, though it may be quite rare in parts of its range, especially at the periphery. Cause for long-term concern.
SZ = No definable occurrences for conservation purposes, usually assigned to migrants.

used in early spring; they are particularly important habitat because nesting birds often return to the same leks and nesting areas each year. Leks are common in more sparsely vegetated areas, such as ridgelines and disturbed areas adjacent to stands of sagebrush. Threats to the survival of this species include loss of habitat, agricultural practices, livestock grazing, hunting, and land disturbances related to energy/mineral development and the oil and gas industry (Sage-Grouse Working Group, 2006). This species was not identified during the applicant wildlife inventories, and few have ever been documented on or in the vicinity of the proposed site because of the limited habitat.

On March 5, 2010, FWS published a finding in the *Federal Register* that listing of the greater sage-grouse as a threatened or endangered species was warranted but precluded by higher priority listing actions (75 FR 13909). In effect, the species has been put on the federal list of candidate species, which contains plants and animals that are proposed for listing under the Endangered Species Act (ESA) Section 4 (75 FR 13909). FWS generally reevaluates the potential listing of candidate species every 12 months to determine whether the species' status should change to threatened or endangered at that time. However, due to a litigation settlement, a final determination whether the species should be proposed for listing under the ESA in the region is expected by the end of September 2015 (FWS, 2012a).

Although the total area of big sagebrush shrubland within the project area is about 1,012 ha [2,500 ac] (Table 3-6.1), large expanses of contiguous sagebrush that provide optimum coverage for breeding and wintering are not likely to occur within the project area based on USFS-conducted studies (Hodorff, 2005). The USFS studies were conducted for a section of the Buffalo Gap Nation Grassland that begins about 7.2 km [4.5 mi] south of the proposed project and extends south to the Black Hills Army Depot (Hodorff, 2005). FWS and SDGFP currently monitor only one lek in Fall River County that is located more than 13 km [8 mi] south of the site (SDGFP, 2009; Hodorff, 2005). This lek was last reported as active with five males observed in 2006 (SDGFP, 2012b).

Sprague's Pipit

The Sprague's pipit (*Anthus spragueii)* is a small bird and a federal candidate species that nests, breeds, and spends the winter in open grasslands of the United States (FWS, 2011b). The birds breed in northern states and Canada, and spend the winter in the southern states and Mexico (FWS, 2011a). Sprague's pipit primarily eats insects, spiders, and some seeds (FWS, 2011b). Because of its preference to breed in continuous, open grassland about 29 ha [71.6 ac] or more in size that has not been disturbed, habitat loss, conversion, and fragmentation threaten the continued existence of this species (76 FR 66370; FWS, 2011b).

Sprague's pipits were not observed during applicant-conducted surveys (Powertech, 2009a) and have not been reported to occur, but are believed to occur, in Custer and Fall River Counties (USGS, 2006c; FWS, 2012c). Based on results of breeding bird surveys conducted from 1994 to 2003, potential breeding distribution of the species extends north and northeast of the Black Hills (FWS, 2012b).

Whooping Crane

The whooping crane (*Grus Americana*), listed as a state and federal endangered species, feeds and roosts in wetlands and riverine habitats and upland grain fields, and uses central South Dakota for migration and staging areas (FWS, 2009). The current nesting range of the self-sustaining natural wild population is restricted to Wood Buffalo National Park in Saskatchewan, Canada, and the current wintering grounds of this population are restricted to the Texas Gulf Coast at Aransas National Wildlife Refuge and vicinity (NRC, 2009a). FWS correspondence indicates that the agency does not have information to confirm that whooping cranes are present within the proposed project boundaries, but the potential exists for whooping crane disturbances from proposed mining activities during spring and fall migrations (FWS, 2010). Migration periods occur from late September through October, and between the end of March and mid-May. Whooping cranes were not observed during applicant-conducted surveys (Powertech, 2009a); however, FWS recommends vigilant monitoring during proposed mining activities conducted during spring and fall, and immediate FWS notification if a whooping crane is observed (FWS, 2010). FWS recommends ceasing mining activities temporarily if a crane is observed until the bird leaves the area (FWS, 2010).

Bald Eagle

The bald eagle was delisted from the Federal List of Endangered and Threatened Wildlife in July 2007 (72 FR 37346), but continues to be protected under the Bald and Golden Eagle Protection Act, under the Migratory Bird Treaty Act, and at the state level as a threatened species. FWS published its National Bald Eagle Management Guidelines in May 2007 (FWS, 2007) to ensure the continued protection of the species. The bald eagle is a large raptor species with a white head and tail and brown body feathers and is generally associated with lakes and other large, open bodies of water. Bald eagles prey on fish, small mammals, birds, and occasionally carrion. Migrating and wintering eagles congregate near open water areas where concentrations of prey are available, such as carcasses of game animals, and spawning areas for fish (NRC, 2009a). Two bald eagle nests were observed within the proposed project area along Beaver Creek during winter roost surveys conducted from 2007 to 2011 (Powertech, 2009a; SDGFP, 2012c) and produced one fledgling each year in 2008, 2009, and 2010. The first bald eagle nest was observed in 2008 and 2009 approximately 1.6 km [1 mi] west of the proposed Dewey satellite processing plant in a cottonwood tree along Beaver Creek. The second bald eagle nest was observed approximately 1.2 km [0.75 mi] southeast of the first nest along Beaver Creek. Bald eagles spend winter in the Black Hills (SDGFP, 2012a). Project construction would not directly impact any of these nests or roosts. Individual eagles nesting and foraging nearby may experience indirect disturbances from the proposed project, described further in SEIS Section 4.6.

Black-Footed Ferret

The black-footed ferret (*Mustela nigripes*) is federally listed as endangered. The species is native to North America and primarily inhabits the Great Plains region. The black-tailed prairie dog and the black-footed ferret can use the same habitat. The black-footed ferret is found almost exclusively in prairie dog colonies in basin-prairie shrublands, sagebrush-grasslands, and grasslands. The black-footed ferret is a small mammal in the weasel family with a natural to buff-colored body and black face, feet, and tail. It is dependent on prairie dogs for food and all essential aspects of its habitat, especially prairie dog burrows where it spends most of its life underground (USGS, 2006b). Potential suitable habitat for the black-footed ferret is present within the proposed Dewey-Burdock Project area (BLM, 2009a). One black-tailed prairie dog (*Cynomys ludovicianus*) colony is located in the northwestern corner of the proposed site, and two additional colonies are present within 1.6 km [1 mi] southwest of the proposed site boundary (Powertech, 2009a). SDGFP provided NRC staff with a 2008 survey of the prairie dog colony at the site for review; however, the map is not provided in this report to protect landowner privacy.

The colony is approximately 322 ha [795 ac] and is within greasewood shrubland vegetation community where wellfields D-WF3 and D-WF4 and irrigation areas are planned in the Dewey area. The presence of large, closely spaced prairie dog colonies {on the order of several hundred hectares [several thousand acres]} could support and sustain a breeding population of black-footed ferrets (BLM, 2009a). Because the colony is approximately 322 ha [795 ac] in size, it is unlikely the colony is large enough to support a breeding population of black-footed ferrets. However, FWS has reintroduced black-footed ferrets in the Cheyenne River and Conata Basin, South Dakota, located east of the Black Hills (FWS, 2000). Wind Cave National Park, South Dakota, is the closest known population to the proposed Dewey-Burdock Project area (South Dakota State University, 2012). Potential future ferret management decisions in Wind Cave National Park, South Dakota, and the Thunder Basin National Grassland, Wyoming, could expand populations into the project area (BLM, 2009a).

In 2003, FWS eliminated the requirement to conduct black-footed ferret surveys in the state of South Dakota in order to identify unknown ferret populations in black-tailed prairie dog habitat (FWS, 2003a,b). This requirement lift is referred to as an area being “block cleared.” FWS considers incidental takes of individual ferrets in black-tailed prairie dog habitat that is block cleared are not an issue and would not affect any wild population. However, permitted block clearance (no required survey) does not relieve federal agencies of the need to assess a proposed action’s effect on the species’ survival and recovery. In addition, FWS directs federal agencies to assess whether a proposed action could adversely affect the value of prairie dog habitat as a future reintroduction site for the black-footed ferret (FWS, 2003a,b). No black-footed ferrets have been identified on the proposed Dewey-Burdock ISR Project site, nor are they known to occur within the proposed Dewey-Burdock ISR Project area (Powertech, 2009a; FWS, 2000; USGS, 2006b).

3.7 Meteorology, Climatology, and Air Quality

3.7.1 Meteorology and Climatology

The proposed project area is located in southwestern South Dakota adjacent to the southwestern extension of the Black Hills; elevations in the area range between 1,097 and 1,189 m [3,600 and 3,900 ft] (Powertech, 2009a). The area is considered semiarid and experiences abundant sunshine, low relative humidity, and sustained winds.

Diurnal and seasonal temperatures vary greatly, and precipitation is generally light. Storm systems originating in the Pacific lose much of their moisture over the Cascade and Rocky Mountains before reaching the area.

The applicant established a weather station near the center of the proposed project area in July 2007 (Powertech, 2009a). Information collected at this onsite station includes temperature, wind speed/direction, and precipitation. The onsite data were collected over a 1-year period. Onsite data were supplemented with data from a meteorological station in Newcastle, Wyoming, to provide a historical perspective. The Newcastle station, operated by IML Air Science and located approximately 48.3 km [30 mi] north-northwest of the proposed Dewey-Burdock site, has collected hourly meteorological data since 2002. Although not a National Weather Service meteorological station, Newcastle meets the EPA requirements for ambient monitoring guidelines for the Prevention of Significant Deterioration (Powertech, 2011).

Newcastle provides a better comparison to the proposed project area in terms of elevation, surrounding topography, and proximity to the southwestern flank of the Black Hills than the Chadron National Weather Service station located about 105 km [65 mi] south-southeast of the proposed project area (Powertech, 2009a, 2011). Chadron is the closest National Weather Service station to the proposed Dewey-Burdock site that collects hourly wind data. Comparison of wind patterns supports the usage of the Newcastle information because the Dewey-Burdock and Newcastle data are similar and quite different from the Chadron site data (Powertech, 2011).

3.7.1.1 Temperature

As discussed in GEIS Section 3.4.6.1, temperatures fluctuate greatly throughout the year in the southwestern corner of South Dakota (NRC, 2009a). Summers can be quite warm, while winters are typically quite cold. The annual mean temperature from the data collected at the onsite station is 7.50 °C [45.5 ˚F]. July recorded the highest average mean daily temperature at 24.9 °C [76.8 °F]. January recorded the lowest average mean daily temperature at −9.56 °C [14.8 °F] (Powertech, 2011). The proposed Dewey-Burdock site experiences greater mean temperature extremes during the hottest part of the summer and the coldest part of the winter relative to the Newcastle site. Even so, the onsite data compare favorably and falls within the range of the Newcastle historical data. Table 3.7-1 contains both the onsite data and the Newcastle station data. The region's low relative humidity contributes to the large diurnal temperature variations, which range between about −9.4 and −4.4 °C [15 and 24 °F] (Powertech, 2009a). The largest diurnal variation typically occurs in the summer.

3.7.1.2 Wind

As discussed in GEIS Section 3.4.6.1, windy conditions are common within the proposed project area in South Dakota. The average annual wind speed from the data collected from July 2007

Table 3.7-1. Site and Regional Monthly Temperature Information in °C*

Month	Mean Daily Temperature		Mean Daily Minimum Temperature	Mean Daily Maximum Temperature
	Site	Newcastle	Newcastle	Newcastle
January	−9.56	−5.11	−11.4	1.22
February	−4.71	−2.94	−9.44	3.55
March	1.42	1.67	−5.44	7.79
April	6.15	7.17	0.111	14.2
May	11.2	12.9	5.78	20.0
June	17.4	18.3	10.8	25.7
July	24.9	22.9	15.0	30.9
August	24.0	21.8	13.9	29.8
September	17.6	15.8	8.11	23.5
October	9.56	9.00	1.83	16.2
November	1.14	1.05	−5.11	7.22
December	−9.41	−3.67	−9.72	2.39
Annual	7.50	8.22	1.22	15.2

Source: Modified from Powertech (2009c).
*To convert Celsius (˚C) to Fahrenheit (˚F), multiply by 1.8 and add 32.

to July 2008 at the onsite station was 3.89 m/s [8.7 mph]. The average annual wind speed at the Newcastle station over that same year was 3.13 m/s [7 mph] and over the 9-year period from 2002 to 2010 was 3.04 m/s [6.8 mph] (Powertech, 2011). Onsite wind speed averages were slightly higher than the values at Newcastle.

Figure 3.7-1 displays the annual wind rose generated from onsite data. The wind preferentially comes from the southeast.

3.7.1.3 Precipitation

As discussed in GEIS Section 3.4.6.1, the proposed project area is located within a semiarid region that can be quite dry at times (NRC, 2009a). The average annual precipitation from the data collected at the onsite station is 31.54 cm [12.42 in] (Powertech, 2009a). Monthly totals ranged from 0.25 to 9.6 cm [0.10 to 3.8 in]. Historical data from the Newcastle station demonstrated an average annual precipitation of 38.4 cm [15.1 in], which is higher than the onsite value. Onsite data indicated that the wettest month was May, while the driest month was November. About 60 percent of the precipitation accumulates over the 3-month period from May to July. Thunderstorms occur frequently during this period and are responsible for much of the annual rainfall. The greatest daily onsite precipitation total was 3.28 cm [1.29 in], which occurred on May 23, 2008. On this date, the proposed project area received 1.8 cm [0.71 in] of precipitation between the hours of 8 p.m. and 9 p.m., which was the most rainfall within a 1-hour period over the sampled year. The area receives an annual average snowfall of 97 cm [38 in]. Snowfall can be expected from September through June. However, most snowfall occurs in March, with an average snowfall of 22 cm [8.5 in] (Powertech, 2009a).

3.7.1.4 Evaporation

As discussed in GEIS Section 3.4.6.1, the semiarid nature of the proposed project area produces conditions where evaporation rates exceed precipitation (NRC, 2009a). Applicant-conducted literary research determined a mean annual lake evaporation rate of 112 cm [44 in] for the proposed project area (Powertech, 2009c). GEIS Section 3.4.6.1 states the Nebraska-South Dakota-Wyoming Uranium Milling Region annual pan evaporation rate ranges from about 102 to 127 cm [40 to 50 in] (NRC, 2009a). Pan evaporation is a technique used to estimate the evaporation rate of other bodies of water such as lakes or ponds and is applicable to the various settling, outlet, and surge ponds the applicant proposes.

3.7.2 Air Quality

In 40 CFR Part 50, *National Primary and Secondary Ambient Air Quality Standards*, EPA established the National Ambient Air Quality Standards (NAAQS) to promote and sustain healthy living conditions (see GEIS Section 3.4.6.2). These standards define acceptable ambient air concentrations for six common air pollutants: nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), lead (Pb), and particulates (PM_{10} and $PM_{2.5}$). EPA requires states to monitor ambient air quality and evaluate compliance with the NAAQS.

Based on the results of these evaluations, EPA designates areas into various NAAQS compliance classifications (e.g., attainment or nonattainment) for each of the six criteria air pollutants. These classifications provide a characterization of the air quality within a defined area. These defined areas range in size from portions of cities to large Air Quality Control

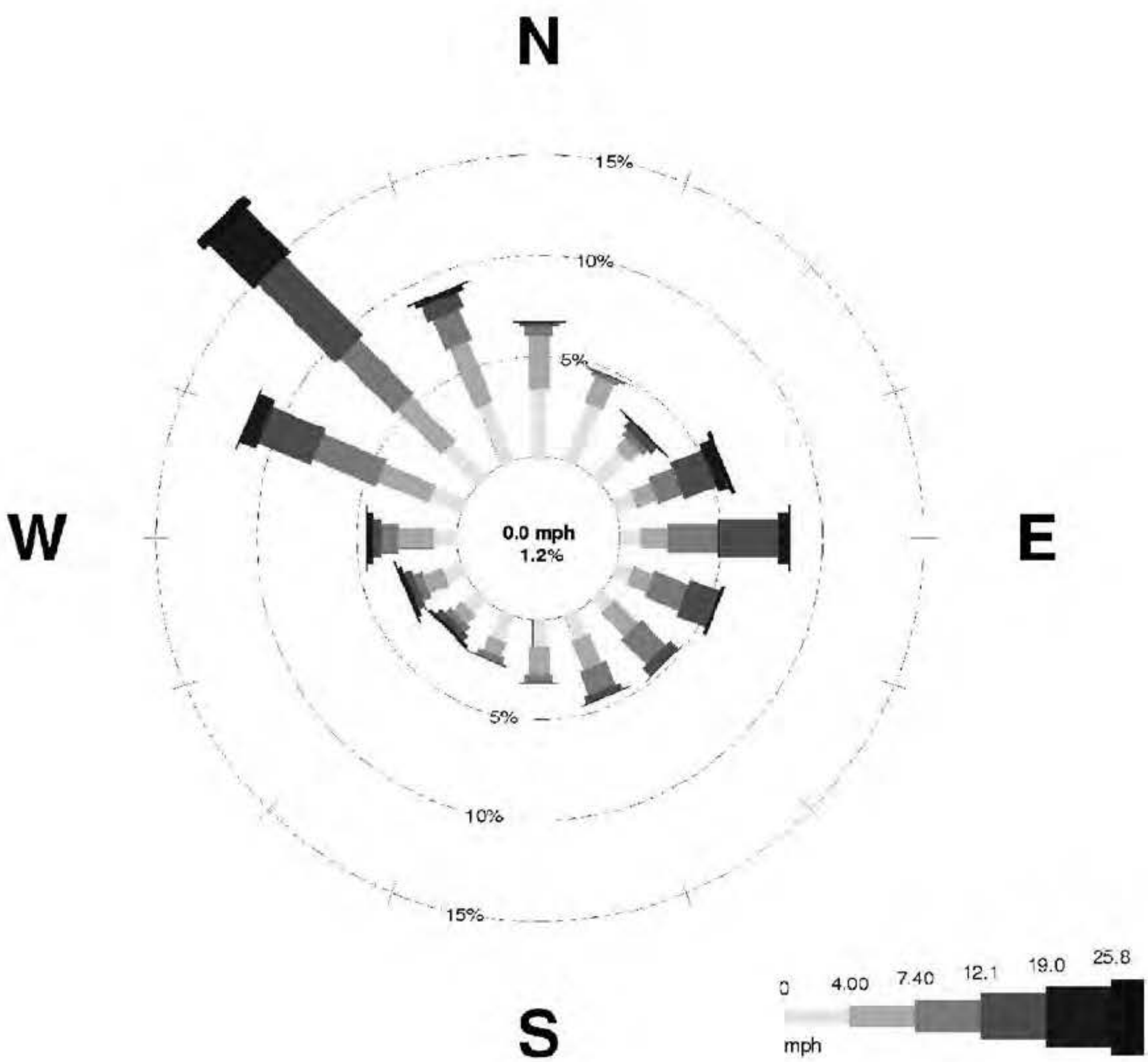

Figure 3.7-1. Annual Wind Rose Generated From Onsite Data.
Source: Modified From Powertech (2011).

Regions composed of many counties. An Air Quality Control Region is a federally designated area for air quality management purposes. The proposed project area is located in the Black Hills-Rapid City Intrastate Air Quality Control Region, which is made up of Butte, Custer, Fall River, Lawrence, Meade, and Pennington Counties, South Dakota. The Black Hills-Rapid City Intrastate Air Quality Control Region meets all of the NAAQS regulations and, therefore, is classified as an attainment area for each criteria pollutant. Based on this attainment classification, the air quality in and around the proposed site can be considered good. Table 3.7-2 contains air pollutant emissions from EPA's National Emission Inventory for the counties within this Air Quality Control Region. The emissions in Table 3.7-2 include both stationary and mobile sources. Table 3.7-3 contains pollutant concentrations that reflect the existing ambient air conditions.

Table 3.7-2. Annual Air Pollutant Emissions in Metric Tons* From the EPA's National Emission Inventory for Counties in the Black Hills-Rapid City Intrastate Air Quality Control Region

Area	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Butte County	2,426	395	1,745	304	61	379
Custer County	3,543	1,076	2,013	352	75	570
Fall River County	1,761	1,050	1,435	268	82	317
Lawrence County	8,750	1,088	3,338	582	163	1,241
Meade County	11,264	1,474	6,209	1,347	200	1,512
Pennington County	36,680	8,672	7,628	1,635	2,484	5,261
All Six Counties†	64,424	13,755	22,368	4,488	3,065	9,280
Custer and Fall River Counties‡	5,304	2,126	3,448	620	157	887

Source: Modified from EPA (2008) accessed on 28 Dec 2009.
*To convert metric tons to short tons, multiply by 1.10231.
†The Black Hills-Rapid City Intrastate Air Quality Control Region consists of these six counties.
‡The proposed site located in these two counties.

Table 3.7-3. Existing Conditions—Ambient Air Quality Monitoring Data

Pollutant*	Averaging Period	Form	2010 Value†*	Percent NAAQS	Location
Carbon monoxide	1 hour	Not to be exceeded more than once per year	0.960 ppm	3	UC #1 site in Union County‡
	8 hour	Not to be exceeded more than once per year	0.276 ppm	3	UC #1 site in Union County
Nitrogen Dioxide	1 hour	98th percentile, averaged over 3 years	3 ppb	3	Wind Cave
	Annual	Annual mean	0.2 ppb	0.4	Wind Cave
Ozone	8 hour	Annual fourth highest daily maximum averaged over 3 years	0.060 ppm	80	Wind Cave
$PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	10.9 $\mu g/m^3$§	31	Wind cave
	Annual	Annual mean, averaged over 3 years	4.8 $\mu g/m^3$	32	Wind Cave
PM_{10}	24 hour	Not to be exceeded more than once per year on average over 3 years	85 $\mu g/m^3$	57	Wind Cave
Sulfur dioxide	3 hour	Not to be exceeded more than once per year	0.008 ppm	2	Wind Cave
	1 hour	99th percentile of 1 hour daily max averaged over 3 years	6 ppb	8	Wind Cave

Source: Modified from SDDENR (2011a).
*Lead is currently not monitored for because of historically low levels in the state. The proposed Dewey-Burdock project is not considered to be a source for airborne lead.
†2010 values represent the appropriate value for NAAQS compliance as described in the "form" column, which in some cases is an average over a 3-year period of measured values. The 3 years of measurement data are not presented here, but are provided in the source document.
‡Wind Cave in Custer County, located 46.7 km [29 mi] from the proposed project area, does not collect carbon monoxide data. The UC#1 site, located in Union County in the southeastern portion of the state, is the only South Dakota station reporting carbon monoxide values in the South Dakota Ambient Air Monitoring Annual Network Plan 2011.
§To convert $\mu g/m^3$ to oz/yd^3, multiply by 2.7×10^{-8}.

EPA has revised the NAAQS since the publication of the GEIS. The following information updates the NAAQS as documented in GEIS Table 3.2.8. The ozone 1-hour and sulfur dioxide annual standards are no longer applicable. Additionally, new standards, not identified in GEIS Table 3.2.8, include a nitrogen dioxide 1-hour 100 ppb standard, an ozone 8-hour 0.075 ppm standard, and a sulfur dioxide 1-hour 75 ppb standard. EPA has considered lowering the ozone standard from 0.075 ppm to 0.070 ppm (EPA, 2011a). Table 3.7-4 contains the updated NAAQS. States may develop standards that are stricter or supplement the NAAQS. As described in ARSD 74:36:02:02, *Ambient Air Quality Standards*, South Dakota has not adopted stricter or supplemental standards.

As discussed in GEIS Section 3.4.6.2, EPA also established Prevention of Significant Deterioration (PSD) standards that set maximum allowable concentration increases for particulate matter, sulfur dioxide, and nitrogen dioxide pollutants above baseline conditions in attainment areas (NRC, 2009a). In part, the purpose of this requirement is to ensure that air quality in attainment areas remains good. There are several different classes of PSD areas. Different standards were developed for these different classifications, with Class I areas having the most stringent requirements. The proposed site is located in a Class II area. The closest Class I area near the proposed project is the Wind Cave National Park located in Custer County about 46.7 km [29.0 mi] away. Figure 3.2-2 contains a map displaying the locations of the proposed project, the Wind Cave National Park, and the other Class I area in South Dakota: Badlands National Park.

Table 3.7-4. National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Level	Form
Carbon Monoxide	8 hours	9 ppm	Not to be exceeded more than once per year
	1 hour	35 ppm	Not to be exceeded more than once per year
Lead	Rolling 3 month average	0.15 $\mu g/m^3$*	Not to be exceeded
Nitrogen Dioxide	1 hour	100 ppb	98th percentile, averaged over 3 years
	Annual	53 ppb	Annual mean
Ozone	8 hours	0.075 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter 2.5 µm	24 hours	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
Particulate Matter 10 µm	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	1 hour	75 ppb	99th percentile of 1 - hour daily maximum concentrations, averaged over 3 years
	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: Modified from EPA (2011b).
*To convert $\mu g/m^3$ to oz/yd^3, multiply by 2.7×10^{-8}.

Protection of Class I air quality also includes consideration of visibility and atmospheric deposition. Air pollutants can reduce visibility and therefore negatively impact air quality in Class I areas. Visibility can be expressed by deciviews. A one deciview change is defined as a change in visibility that is just perceptible to an average person. The average annual visibility at Wind Cave National Park for the 20 percent haziest days over the 5-year period from 2000 to 2004 was 5.16 deciviews (SDDENR, 2011a). For the 20 percent clearest days over the same time period, the average annual visibility was 15.84 deciviews (SDDENR, 2011a).

Atmospheric deposition refers to processes in which some air pollutants that contain nitrogen (e.g., nitrate, ammonium, and nitric acid) or sulfur (e.g., sulfate or sulfur dioxide) are deposited into terrestrial or aquatic ecosystems. Examples include (i) wet deposition, where precipitation removes pollutants from the air, and (ii) dry deposition where gravity causes the particulates to settle out of the air. Atmospheric deposition is expressed as the annual mass of material deposited over an area. Total deposition accounts for all of the wet and dry processes. Total deposition is often classified into two categories: total nitrogen deposition (i.e., the deposition from the various nitrogen-containing pollutants) and total sulfur deposition (i.e., the deposition from the various sulfur-containing pollutants). Wind Cave National Park serves as one of the Clean Air Status and Trends Network monitoring stations, which in part collects data on air deposition. The average annual total nitrogen deposition ranged from 3.19 to 4.80 kg/ha [2.84 to 4.27 lb/ac] over the 5-year period from 2006 to 2010, and the total annual sulfur deposition ranged from 0.96 to 1.77 kg/ha [0.85 to 1.58 lb/ac] over that same time period (EPA, 2012).

EPA has revised the PSD standards since publication of the GEIS (documented in GEIS Table 3.2-9) as follows. New $PM_{2.5}$ standards have been added for two different time frames: annual and 24 hours. Table 3.7-5 contains the updated PSD standards.

Temperature and precipitation are two parameters that can be used to characterize climate change. Average U.S. temperatures have increased more than 1.1 °C [2 °F] over the past 50 years and are projected to rise more in the future (GCRP, 2009). From 1993 to 2008, the average temperature in the Great Plains increased by approximately 0.83 °C [1.5 °F] when

Table 3.7-5. Prevention of Significant Deterioration (PSD) Class I and Class II Standards

Pollutant	Averaging Time	Class I Level (µg/m^3)*	Class II Level (µg/m^3)	Form
Particulate Matter 2.5 µm	Annual	1	4	Annual mean
	24 hours	2	9	Not to be exceeded more than once per year
Particulate Matter 10 µm	Annual	4	17	Annual mean
	24 hours	8	30	Not to be exceeded more than once per year
Sulfur Dioxide	Annual	2	20	Annual mean
	24 hours	5	91	Not to be exceeded more than once per year
	3 hours	25	512	Not to be exceeded more than once per year
Nitrogen Dioxide	Annual	2.5	25	Annual mean

Source: Modified from 40 CFR 52.21.
* To convert µg/m^3 to oz/yd^3, multiply by 2.7×10^{-8}.

compared to the 1961 to 1979 baseline (GCRP, 2009). The projected temperature change from 2000 to 2020 in the Great Plains ranges from a decrease of approximately 0.28 °C [0.5 °F] to an increase of approximately 1.1 °C [2 °F]. The proposed Dewey-Burdock site is considered part of the Great Plains in this study. Although GCRP did not incrementally forecast a change in precipitation by decade, it did project a change in spring precipitation from the baseline period (1961 to 1979) to the next century (2080 to 2099). For the region of South Dakota where the proposed Dewey-Burdock ISR Project is located, GCRP forecasts a 10 to 15 percent increase in spring precipitation (GCRP, 2009).

The EPA administrator determined that greenhouse gas (GHG) in the atmosphere may reasonably be anticipated to endanger public health and welfare (74 FR 66496, 2009). As described in the *Federal Register* notice, the primary scientific basis supporting the administrator's endangerment finding were the major assessments by the U.S. Global Climate Research Program, the Intergovernmental Panel on Climate Change, and the National Research Council. The *Federal Register* notice also states that these assessments indicate that ambient concentrations of GHG emissions do not cause direct adverse health effects (e.g., respiratory or toxic effects), but rather cause indirect effects from the associated changes in climate. Based on EPA's determination, NRC recognizes that GHGs may contribute to climate change and that climate change may have an effect on health and the environment.

GHGs, which can trap heat in the atmosphere, are produced by numerous activities, including the burning of fossil fuels and agricultural and industrial processes. GHGs include carbon dioxide, methane, nitrous oxide, and certain fluorinated gases. These gases vary in their ability to trap heat and in their atmospheric longevity. GHG emission levels are expressed as CO_2 equivalents (CO_2e), which is an aggregate measure of total GHG global warming potential described in terms of CO_2 and accounts for the heat-trapping capacity of different gases. The Center for Climate Strategies estimated that GHG-producing activities in South Dakota accounted for approximately 36.5 million metric tons [40.2 short tons] of gross CO_2e emissions in 2005; levels of 39.1 and 46.6 million metric tons [43.1 and 51.4 short tons] are forecasted for years 2010 and 2020, respectively (Center for Climate Strategies, 2007).

EPA is promulgating new rules to address GHG emissions under the Clean Air Act permitting programs (EPA, 2010a). Current requirements are focused on the nation's largest stationary source GHG emitters. New sources as well as existing sources with the potential to emit 90,718 metric tons [100,000 short tons] per year of CO_2e, will become subject to EPA PSD and Title V requirements. Modifications at existing facilities that increase GHG emissions by at least 68,039 metric tons [75,000 short tons] per year of CO_2e will also become subject to Title V requirements.

3.8 Noise

The proposed Dewey-Burdock ISR Project is located in an undeveloped remote location in open rangeland and pastureland. Cattle grazing and wildlife habitat is the primary land use. GEIS Section 3.2.7 estimated that ambient noise levels in this undeveloped, arid, rural area, which is typical of the Nebraska-South Dakota-Wyoming Uranium Milling Region, would range from 22 to 38 decibels (dBA) (NRC, 2009a). Traffic along Dewey Road leading to the site is expected to generate noise; however, almost all of the land adjacent to Dewey Road within and in the vicinity of the proposed project is privately held with limited access (see SEIS Section 3.2 and Figure 3.2-1).

Ambient noise measurements were not part of the applicant's preapplication studies. The applicant reports the majority of existing ambient noise (i.e., background noise) in the vicinity of the proposed Dewey-Burdock ISR Project is generated by light automobile and truck traffic traveling on U.S. Highway 18 and State Highway 89 and freight/coal train operations on the BNSF railroad, which runs northwest to southeast through the project area (see Figure 3.2-1) (Powertech, 2009a, 2010a). The BNSF railroad transports coal from mining operations in the Powder River Basin of Wyoming as well as agricultural, consumer, and industrial products. The Edgemont, South Dakota, train master reports 50 freight trains pass through the project area daily (Powertech, 2010a). Noise levels ranging from 75 to 85 dBA are typical for a train traveling at approximately 80 kph [50 mph] on grade at a distance of 30 m [100 ft] (FRA, 2010). SEIS Section 2.1.1.1.7 described the applicant's plan to transport equipment, materials, supplies, yellowcake product, and waste materials by trucks during the lifecycle of the proposed project. As noted in SEIS Section 3.3, the applicant does not anticipate using the BNSF railroad as a transportation option for proposed project activities. Therefore, train traffic and associated noise are not expected to increase due to construction or operational activities at the proposed site.

Noise associated with the proposed project activities is considered because it may interfere with persons residing in and engaging in recreational activities in the surrounding area. Two permanent onsite residences, the Putnum dwelling and Beaver Creek Ranch headquarters, are located approximately 1.3 km [0.8 mi] south and 0.8 km [0.5 mi] west of proposed wellfields in the Dewey area, respectively (see Figure 3.2-1). The closest offsite residences, the Peterson and Kennobie dwellings, are located approximately 1.3 km [0.8 mi] southwest and 1.3 km [0.8mi] south, respectively, of proposed wellfields in the Burdock area (see Figure 3.2-1). Small communities within 48 km [30 mi] of the proposed Dewey-Burdock ISR Project site include Edgemont and Hot Springs in Fall River County, South Dakota; Custer in Custer County, South Dakota; and Newcastle in Weston County, Wyoming. These communities have populations ranging from 774 to 3,711 (see SEIS Section 3.11.1). Noise levels are expected to be slightly higher in these communities as a result of traffic and human activities. Rapid City in Pennington County, the nearest urban area, is approximately 161 km [100 mi] northeast of the project area. Urbanized communities, such as Rapid City, experience ambient noise levels from street noise, traffic, emergency vehicles, and construction. Noise levels in these types of urban areas range from 45 to about 78 dBA, with lower noise levels at night (WSDOT, 2012).

A number of recreational areas are present in Custer, Fall River, and Pennington Counties that could be sensitive to noise impacts. Major attractions include Mount Rushmore National Memorial, Jewel Cave National Monument, and Wind Cave National Park (see Figure 3.2-2). These attractions are located more than 32 km [20 mi] north and east of the proposed Dewey-Burdock ISR Project. Several USFS and state parks may be sensitive to noise impacts. Parcels of the BHNF border the proposed project area to the east and northeast, and the Buffalo Gap National Grassland is about 4.8 km [3 mi] south of the project boundary (see Figure 3.2-2). These lands are protected from extensive development, and the ambient noise levels would be expected to be similar to undeveloped rural areas (up to 38 dBA) (NRC, 2009a).

Noise associated with project activities can also displace wildlife and interfere with wildlife breeding habits. As described in SEIS Section 3.6.1, the proposed project area supports many medium to small mammals (e.g., coyote, red fox, raccoon, rodents, jackrabbits, and cottontails) and avian species (e.g., wild turkey and mourning dove). Big game species that occur in the proposed project area include pronghorn antelope, mule deer, white-tailed deer, and elk. However, there are no crucial big game habitats or migration corridors in the proposed project area or within 1.6 km [1 m] of the project boundary (Powertech, 2010a). Five confirmed, intact raptor nests and one potential nest site were observed within the proposed project area, and the applicant identified two additional nests within a 1.6-km [1-mi] radius of the study area (Powertech, 2009a). One black-tailed prairie dog colony was observed during wildlife surveys in the northwestern corner of the proposed project area, and two others were observed 1.6 km [1 mi] southwest of the proposed project area (Powertech, 2009a).

There are no federally listed threatened or endangered species within 1.6 km [1 mi] of the proposed Dewey-Burdock ISR Project site. The Greater sage-grouse and black-footed ferret could potentially occur in the area; however, no sage-grouse or black-footed ferret were observed during applicant wildlife surveys (Powertech, 2009a). Of state-listed species, the bald eagle is known to occur on and in the vicinity of the site and two bald eagle nests were observed during wildlife inventories conducted at the site (Powertech, 2009a; SDGFP, 2012c). As described in SEIS Section 3.6.3, the first bald eagle nest was observed in 2008 and 2009 approximately 1.6 km [1 mi] west of the proposed Dewey satellite processing plant in a cottonwood tree along Beaver Creek. A second bald eagle nest was observed approximately 1.2 km [0.75 mi] southeast of the first bald eagle nest along Beaver Creek.

The Federal Highway Administration (FHWA) has noise impact assessment procedures and criteria to help protect the public health and welfare from excessive vehicular traffic noise (FHWA, 2006). Recognizing that different areas are sensitive to noise in different ways, FHWA established noise abatement criteria (23 CFR Part 772) according to land use. These criteria are described in Table 3.8-1.

In situations where existing or expected future sound levels exceed FHWA-set noise abatement criteria, an individual is considered to be impacted by noise. Dewey Road crosses the southwestern portion of the Burdock area and the central portion of the Dewey area (Figure 3.2-1) and is expected to be a source of noise. Vehicular traffic noise levels are estimated to range from 54 to 62 dBA for passenger cars and 50 to 70 dBA for heavy trucks at a distance of 15 m [50 ft] from a receptor (NRC, 2009a). Noise from line sources, such as roads, is reduced by approximately 3 dBA per doubling of the distance from the source (NRC, 2009a).

The maximum sound level of heavy trucks is 70 dBA on roads within the proposed project area, such as Dewey Road; this is expected to be diminished to the level of a Category A Activity

Table 3.8-1. Noise Abatement Criteria: 1-Hour, A-Weighted Sound Levels in Decibels (dBA)

Activity Category	Leq(h)*	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of these qualities is essential if the area is to continue to serve its intended purposes.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	—	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR Part 772
*Leq(h) is an energy weighted, 1-hour, A-weighted sound level in decibels (dBA).

(57 dBA) at a distance of 480 m [1,575 ft] from the source. However, noise-dampening characteristics of topographic interference and vegetation are not part of these calculations (NRC, 2009a). At a distance greater than 480 m [1,575 ft] from Dewey Road, sound levels generated by heavy truck traffic are expected to be approximately 40 dBA. This calculation produces a conservative estimate of a baseline for ambient noise that is slightly higher than the GEIS statement that existing ambient noise levels in this region would be 22 to 38 dBA (NRC, 2009a). GEIS Figure 3.2-17 provides examples of sound levels for common activities (NRC, 2009a).

3.9 Historic and Cultural Resources

GEIS Section 3.4.8 provides a general overview of historic and cultural resources in southwestern South Dakota where the proposed Dewey-Burdock ISR Project is located (NRC, 2009a). The proposed project area is located within the prehistoric cultural subarea known as the Northwestern Plains. This region includes western Minnesota, North and South Dakota, Wyoming, and portions of eastern Idaho and southern Montana. Prehistoric inhabitants of the Northwestern Plains existed for 12,000 years as semi-nomadic hunters and gatherers. During the last 4,000 years, the archaeological record indicates Native Americans living on the Northwestern Plains primarily used bison for food, clothing, and shelter (Frison, 1991). During historic times, missionaries and traders were the first non-Indian people to arrive in the Black Hills followed by settlers, miners, and merchants traveling west to the Oregon Territory or the goldfields in California, Colorado, and Montana. In the late 1880s, the Black Hills were opened to homesteaders and an economy based on mining, logging, and ranching developed (Buechler, 1999).

The National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 CFR 60.4 and include (A) association with significant events in history; (B) association with the lives of persons significant in the past; (C) embodiment of distinctive characteristics of type, period, or construction; and (D) sites or places that have yielded or are likely to yield important information (ACHP, 2012). The historic preservation review process, NHPA Section 106, is outlined in regulations the Advisory Council on Historic Preservation (ACHP) issued in 36 CFR Part 800.

The issuance of a source and byproduct materials license is a federal action that may affect either known or undiscovered historic properties located on or near the Dewey-Burdock ISR Project. In accordance with the provisions of the NHPA, NRC is required to make a reasonable effort to identify historic properties in the area of potential effect (APE). The APE for this review is the area that may be directly or indirectly impacted by the construction, operation, aquifer restoration, and decommissioning of the proposed action. If no historic properties are present or affected, NRC is required to notify the South Dakota State Historic Preservation Office (SD SHPO) before proceeding. If it is determined that historic properties are present, NRC is required to assess and resolve possible adverse effects of the undertaking.

The Archaeological Resources Protection Act of 1979, as amended [Public Law 96-95; 16 U.S.C. 470aa-mm], which regulates the permitting of archaeological investigations on public land, including those managed by BLM and South Dakota laws and regulations for the protection of archaeological resources were followed. Applicable laws and regulations are discussed more fully in GEIS Appendix B.

South Dakota Codified Law (SDCL) 34-27-6, Cemeteries and Burials, specifies the procedures for the treatment and handling of human remains if human remains are found during proposed project activities. The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), as amended [Public Law 101-601; 25 U.S.C. § 3001 et. Seq.] is applicable to burials found on BLM-managed lands. NAGPRA provides for the protection of Native American remains, funerary objects, sacred objects, or objects of cultural patrimony and their repatriation to affiliated tribes following a consultation process between tribes, museums, and/or land managing federal agencies.

The cultural resources investigations for the proposed Dewey-Burdock ISR Project included (i) a review of available archaeological, ethnographic and ethnological literature, (ii) a search and evaluation of archaeological records and collections maintained by the South Dakota Archaeological Research Center (ARC), (iii) archaeological field investigations including evaluative testing, (iv) preparation of an ethnohistoric background study, and (v) and tribal consultation for assistance in the identification of places of religious or cultural importance to Native American tribes. Historic and cultural resources are sites documenting past human activity containing artifacts, features, or architectural structures, and include sacred places important to Native American tribes. Eighteen historic properties listed on or recommended eligible for listing have been located within the proposed Dewey-Burdock ISR Project area (Kruse et al., 2008; Palmer and Kruse, 2008, 2012; Palmer, 2008, 2009; Palmer and Kruse, 2012). An overview of regional cultural history and archaeology and description and evaluation of identified historic and cultural resources within the APE are presented in SEIS Sections 3.9.1 and 3.9.2. In SEIS Sections 3.9.3 an overview of places of religious or cultural significance to Native American tribes is presented. SEIS Section 3.9.4 summarizes NRC consultation efforts with Native American tribes.

3.9.1 Cultural History

The archaeological cultural sequence for the proposed project area is divided between the prehistoric periods (Paleoindian, Plains Archaic, Plains Woodland, and Late Prehistoric/Plains Village) and the more recent Protohistoric and Historic/Euroamerican cultural periods. The prehistoric periods encompass about 11,000 years between 12,000 B.P. (before present; A.D. 950) and 300 B.P. (about A.D. 1700). The Protohistoric and Historic/Euroamerican periods extend from about A.D. 1700 to A.D. 1959.

The proposed Dewey-Burdock ISR Project area is located on the southwestern edge of the Black Hills Uplift within the geographical area known as the Great Plains. The vegetation within and surrounding the project area is a mix of short grasses and shrubs typical of semiarid steppe land along with ponderosa pine forest toward the Black Hills (Powertech, 2009a). The elevation within the project area ranges from approximately 1,097 to 1,189 m [3,600 to 3,900 ft] above mean sea level, with the highest elevations along the pine breaks that overlap its eastern boundary. Topography in the western quarter of the project area consists of gently rolling terrain, while more varied terrain in the pine breaks and dissected hills comprise the rest of the project area. Two main streams pass through the project area: Beaver Creek (perennial) and Pass Creek (intermittent) (see Figure 3.5-2). The primary land use within and in the vicinity of the project area is cattle grazing (Powertech, 2009a).

3.9.1.1 Prehistoric Periods

As mentioned previously, the prehistoric periods are divided into Paleoindian, Plains Archaic, Plains Woodland, and Late Prehistoric/Plains Village. Paleoindian (11,000 to 8,000 B.P.) sites in the region are typically identified by the presence of lanceolate points and date from the Late Glacial, Pre-Boreal, and Boreal climatic episodes. During these episodes, the climate underwent a warming trend and the grasslands and sagebrush steppe expanded at the expense of boreal forests and tundra (Noisat, 1996). Paleoindian groups were nomadic bands of hunters subsisting on big game animals such as mammoth, bison, and muskox. Paleoindian sites are found in diverse settings including protected mountains, foothill areas, and river valleys and in the interior of the Black Hills (BLM, 2009a; Tratebas, 1986). Sites are rarely found on upland prairie and grasslands typical of the Great Plains and Central Plains regions of South Dakota (Frison, 1991). By the end of the Paleoindian period larger game animals were replaced by modern antelope, bison, deer, and elk. These smaller grazers were better adapted to the changing environment that resulted from the onset of warmer and drier conditions in the Holocene era (Hester, 1960).

The Plains Archaic period (8,500 to 1,500 B.P.) in South Dakota is broken into three subperiods: Early, Middle, and Late. The Early Plains Archaic subperiod (8,500 to 5,000 B.P.) is marked by a shift to a warmer and dryer climate (BLM, 2009a). Sites from this period are characterized by semi-subterranean houses that are usually marked by the presence of one or more hearths, firepits, storage pits, and milling basins. These sites suggest that groups in the Early Plains Archaic subperiod participated in seasonal occupation and movement. The presence of various side- and corner-notched projectile points and side-notched knives also suggests a subsistence strategy that included hunting small- and medium-sized game, as well as, exploitation of floral species. Only a few Early Plains Archaic sites have been found in plains, foothill, and mountainous areas of the Black Hills (BLM, 2009a).

During the Middle Plains Archaic subperiod (5,000 to 3,000 B.P.) there was a return to moister, cooler conditions (BLM, 2009a). Middle Plains Archaic groups greatly utilized the Black Hills. Site assemblages reflect a relatively broad spectrum of hunting and gathering strategies, with an emphasis on bison hunting (BLM, 2009a). Site features include prepared pit houses, stone rings, and rock shelters.

The climate during the Late Plains Archaic subperiod (3,000 to 1,500 B.P.) gradually became wetter; grasslands expanded, increasing bison herds (BLM, 2009a). As a result, subsistence strategies shifted toward a more nomadic hunting economy. Recorded communal bison kill sites contain diagnostic Yonkee points (large corner-notched projectile points), which were the preferred method of felling the bison (Winham and Hannus, 1991).

The Woodland Period (2,500 to 1,000 B.P.) throughout the Great Plains is characterized by introduction of new technologies and social practices. In the Black Hills, the Late Archaic and Woodland periods overlapped and Woodland subsistence strategies are similar to those of the Late Plains Archaic period. Gradual changes from the Archaic to Woodland period include a greater reliance on horticulture, the introduction of ceramics, semipermanent dwellings, bow and arrow utilization, and burial mound construction (Grange, 1980; Hill and Kivett, 1940; Hoffman, 1968; Lueck and Winham, 2005). In the Black Hills region, Woodland cultural groups continued a hunting and gathering lifestyle of following bison herds. This nomadic subsistence strategy is evidenced by numerous sites with stone circles (teepee rings), as well as a lack of cultigens or semipermanent dwelling features identified in the archaeological record (Molyneaux, et al., 2000).

The Late Prehistoric/Plains Village period (1,500 to 300 B.P.) heralds the acceptance of new technologies, such as smaller projectile points adapted for use with arrows (Frison, 1991). Prior to the Late Prehistoric period, the points were hafted on spears. Also introduced at this time is earthenware technology, which improves food preparation techniques. Stewing, braising, and boiling were now possible, which significantly broadened the number of floral and faunal species that could be utilized. Peoples of the Late Prehistoric/Plains Village period in South Dakota are similar in many ways to earlier Plains Woodland cultural groups. Very few sites of the Late Prehistoric/Plains Village period have been documented within Custer and Fall River Counties (Buechler, 1999).

3.9.1.2 Protohistoric/Historic Era

The Protohistoric period (A.D. 1700–1840) is characterized by the beginnings of European interaction with the Plains tribal groups. European metal and decorative goods, firearms, and the domesticated horse were introduced into the region (Buechler, 1999; Frison, 1991; Molyneaux, et al., 2000). At the onset of the 18th century, tribes historically associated with the project area include the Crow, Plains Apache, Ponca, Comanche, Kiowa, and Kiowa-Apache (Buechler, 1999). By 230 B.P., groups of the Lakota Sioux, and to a lesser extent, Arapaho and Cheyenne, had forced these previous inhabitants out of the region to the south and west (Buechler, 1999). According to ethnographic accounts written by French Jesuits and fur trappers, from A.D. 1700 to 1800, the Lakota migrated westward from Minnesota, crossed the Missouri River, and transitioned from being hunter-gatherers and part-time farmers to nomadic hunters who primarily relied on bison for food, clothing, and shelter. With the acquisition of the horse, the Lakota became the dominant culture on the Northern Plains between the Missouri River and the Rocky Mountains (Robinson, 1904).

The Historic/Euroamerican period is subdivided into seven periods: Early Historic (A.D. 1801 to 1842), Preterritorial (A.D. 1843 to 1867), Territorial (A.D. 1868 to 1889), Expansion (A.D. 1890 to 1919), Depression (A.D. 1920 to 1939), World War II (A.D. 1940 to 1946), and Post-World War II (A.D. 1947 to 1959). The proposed Dewey-Burdock Project area has been historically used for cattle ranching, farming, and gold prospecting. The establishment of Custer County in 1877 was a direct result of Lieutenant George A. Custer's Black Hills Expedition of 1874, which confirmed the presence of gold within the area (Molyneaux, et al., 2000). The founding of Rapid City in 1876 created an eastern "gateway" into the heart of the Black Hills mining region as well as an important transportation hub. By the early 20th century, smaller communities had sprung up along the various railroad lines that facilitated the import and export of goods and services (Nielsen, 1996).

3.9.2 Historic and Cultural Resources Identified

NRC staff reviewed the Level III cultural resource investigations and evaluative testing reports prepared by the Archaeology Laboratory, Augustana College (ALAC) on behalf of the applicant for the proposed Dewey-Burdock ISR Project (Kruse, et al., 2008; Palmer and Kruse, 2008; Palmer 2008, 2009). The investigations included an archival and historic review of available sources, a search of ARC-maintained records and collections, and review of published field reports. A review of available data shows that six surveys have been conducted within the proposed APE of the proposed Dewey-Burdock site (Kruse, et al., 2008). A total of 57 archaeological sites were previously recorded within the proposed project area (Kruse, et al., 2008).

Recent field investigations were conducted by pedestrian surveys of 4,173 ha [10,311 ac] between April and August 2007 and of an additional 526 ha [1,300 ac] between July and September 2008 of the proposed project area. A pedestrian survey was conducted over the entire APE. The 2007 and 2008 field investigations included evaluative testing at 43 sites. In 2011, evaluative testing was conducted at 20 unevaluated sites located within the APE to provide data for recommendation on NRHP eligibility (Palmer and Kruse, 2012). The results of the evaluative testing determined that one site, 39FA1941, is recommended eligible for listing in the NRHP and 19 sites were recommended ineligible for listing in the NRHP (Palmer and Kruse, 2012).

3.9.2.1 Archaeological Sites

NRC reviewed site data on over 300 archaeological sites recorded within the APE. During the field investigation, a number of small, individual sites were combined into larger, single sites. Two-hundred and twenty sites were determined ineligible for listing in the NRHP when measured against the evaluative criteria found in 36 CFR 60.4. Eighty of these sites are of isolated finds (single tool or few (n<10) items with no possibility of buried or other remains; can be aboriginal or historic; is not eligible by definition [SD ARC, 2006]); these sites lack physical integrity and context. Approximately 140 of these mostly prehistoric sites were located on highly disturbed and eroded landforms and have little potential to possess intact, significant buried cultural deposits.

Seventy-four unevaluated sites are documented within the APE. Unevaluated sites are sites that have not been evaluated for NRHP eligibility. These sites would be subjected to archaeological testing and mitigation, if appropriate, prior to ground-disturbing activities.

Fifteen archaeological sites, including two containing cairns and burials, have been recommended as eligible for listing in the NRHP (Tables 3.9-1 and 3.9-2). As of this date, SD SHPO has not concurred with sites recommended eligible to the NRHP. NRHP-eligible sites, as well as unevaluated archaeological sites with cairn features and burials (Table 3.9-2), are discussed below.

Table 3.9-1. List of Historic Properties Within or Adjacent to the APE That Are Currently Listed in the NRHP or Sites Recommended Eligible for Listing in the NRHP*

Historic Property (Site Number, Structure Identification, or Historic District)	Description	Currently Listed on the NRHP or Recommended Eligible for Listing on NRHP**	Evaluation Criteria—Determination of Eligibility for Listing in NRHP Under Criteria A, B, C, or D
39CU577	Native American/Euroamerican Occupation site; artifact scatter	Eligible	D
39CU2735	Archaic- Prehistoric occupation site	Eligible	D
39CU578	Native American/Euroamerican Dump and occupation site on a ridge slope	Eligible	D

Table 3.9-1. List of Historic Properties Within or Adjacent to the APE That Are Currently Listed in the NRHP or Sites Recommended Eligible for Listing in the NRHP* (continued)

Historic Property (Site Number, Structure Identification, or Historic District)	Description	Currently Listed on the NRHP or Recommended Eligible for Listing on NRHP**	Evaluation Criteria—Determination of Eligibility for Listing in NRHP Under Criteria A, B, C, or D
39CU586	Native American and Late Archaic occupation site on a ridge crest	Eligible	D
39CU588	Native American occupation site on a ridge crest	Eligible	D
39CU2733	Native American hearth and artifact scatter on a ridge slope	Eligible	D
39CU2738	Native American occupation site on a ridge crest	Eligible	D
39CU590	Native American artifact scatter on a ridge saddle	Eligible	D
39CU593	Native American and Euroamerican occupation and artifact scatter on a hill slope	Eligible	D
39CU3592	Native American artifact scatter and hearth site	Eligible	D
39FA1941	Native American artifact scatter and hearth site	Eligible	D
39CU2000	Historic Railroad	Eligible	A and C
39FA2000	Historic Railroad	Eligible	A and C

Sources: Kruse, et al. (2008); Palmer and Kruse (2008, 2012); Palmer (2009)
*Recommended eligible by ALAC and NRC. SD SHPO has not concurred with these recommendations.
**The NRHP criteria for eligibility are listed in Section 3.9 of this SEIS.

Table 3.9-2. Dewey-Burdock Burial, Cairn, and Other Sites Within or Adjacent to the APE

Site Number	Description	Eligibility Designation	Evaluation Criteria—Determination of Eligibility for Listing in NRHP Under Criteria A, B, C, or D*
39CU271	Native American and Archaic artifact scatter and occupation site on a ridge slope with a cairn feature	Eligible	D
39CU584	Native American occupation site and burial on a ridge slope	Eligible	D
39FA1902	Historic site with historic burial and bridge structure	Unevaluated	

Table 3.9-2. Dewey-Burdock Burial, Cairn, and Other Sites Within or Adjacent to the APE (continued)

Site Number	Description	Eligibility Designation	Evaluation Criteria—Determination of Eligibility for Listing in NRHP Under Criteria A, B, C, or D*
39FA778	Historic farmstead site	Unevaluated	
39CU3584	Cairn site	Not Eligible under Criterion D	
39CU3587	Two historic Euroamerican burials	Unevaluated	
39CU530	Cairn site	Unevaluated	
39CU3564	Cairn site	Unevaluated	
39CU3620	Cairn site	Unevaluated	
39FA1862	Cairn site with stone circles	Unevaluated	
39FA1863	Cairn site with stone circles	Unevaluated	
39FA1881	Cairn site	Unevaluated	
39FA1890	Cairn site	Unevaluated	
39FA1927	Cairn site	Unevaluated	

Sources: Kruse, et al. (2008); Palmer and Kruse (2008, 2012); Palmer (2009)
*The NRHP criteria for eligibility are listed in Section 3.9 of this SEIS.
Note: Table may change pending information received through the tribal consultation. Eligibility recommendations other than 39CU271 are pending concurrence from the SD SHPO.

Site 39CU271 was originally recorded in 1981, and was described as an extensive occupation site with at least 184 hearth features, ranging from severely eroded to completely intact (Chevance, 1978; Reher, 1981; Buechler, 1999). In 2007, ALAC relocated this site and expanded the boundaries to include additional 54 hearth features and a cairn feature. Artifacts recovered from the site consist of scrapers, bifaces, points, and other lithic tools. Charcoal samples were collected from seven hearths for radiocarbon dating. The radiocarbon test results revealed the hearths date from the Late Plains Archaic period to the Plains Woodland period. Following testing, Reher (1981) recommended avoidance of 38CU271 and determined that the site is eligible for listing in the NRHP (Kruse et al., 2008). In 2007, ALAC revisited the site and expanded the boundaries to include additional occupation areas, newly discovered hearths, and a cairn feature (Kruse, et al., 2008). While portions of the site have been subjected to wind and water erosion, other areas of the site retain intact soil deposits with the potential to contain intact cultural deposits (Kruse, et al., 2008).

Previously recorded sites 39CU577, 39CU578, 39CU586, 39CU588, 39CU2733, 39CU2738, and 39CU590 are Native American occupation sites, and 39CU2735 is an Archaic site; all were determined eligible for listing in the NRHP under Criterion D (Kruse, et al., 2008). Site 39CU593 is a Native American and Euroamerican occupation and artifact scatter located on a hill slope, determined eligible for listing in the NRHP under Criterion D (Kruse, et al., 2008). Site 39CU584 is a Native American occupation site and contains a burial (affiliation unknown) located on a ridge slope, also recommended eligible for listing in the NRHP under Criterion D (Kruse, et al., 2008).

Sites 39CU2000 and 39FA2000 are historic railroad sites; under South Dakota law all railroads are eligible for listing in the NRHP under Criteria A and C. Sites 39CU2000 and 39FA2000 are separate segments of the Burlington Northern Railroad and part of the original 1889 lines that linked the communities of Edgemont, South Dakota, and Newcastle, Wyoming, for the transportation of coal (Kruse, et al., 2008).

Site 39CU3592 is a sparse Native American artifact scatter with three hearths and a flint knapping activity area dating to the Archaic period. This site was recommended eligible for listing in the NRHP under Criterion D based on evaluative testing performed in 2008 (Palmer and Kruse, 2008).

Site 39FA1941 is a Native American artifact scatter and hearth site located on a ridge top toward the southeast quadrant of the APE. In 2007, ALAC originally recorded the site (Kruse, et al., 2008), which underwent evaluative testing in 2011 (Palmer and Kruse, 2012). Twenty-six, mostly deflated hearth sites were recorded in the testing phase, and radiocarbon dating from one of the hearths indicates the site dates to the Late Archaic period. While the northern half of the site lacks integrity and has been destroyed by erosion, the southern half of the site at Area D possesses intact buried cultural deposits with intact features and associated activity areas. Site 39CU1941 is recommended eligible for listing under Criterion D (Palmer and Kruse, 2012). While numerous Archaic sites have been recorded in the region, very few possess an intact cultural zone with the potential to augment the archaeological record of the region (Palmer and Kruse 2012).

Historic and ethnographic evidence indicates that sites with cairn features served as markers for trails, camps, burials, caches, and ceremonial centers (Kruse, et al., 2008). Sites with burials or cairn features are listed in Table 3.9-2. This information on cairn features and burials was confirmed by tribes during consultation. With the exception of site 39CU3584, none of these sites are located within areas of proposed development. Site 39CU3584 is discussed later in this section.

Site 39FA96, located at the south-central portion of the APE, is a large occupation site with components that may date from the Paleolithic through the Historic period. Numerous hearths, artifact scatters, and historic ruins have been identified. Originally recorded as a homestead in 1970s, ALAC revisited the site in 2007 and the boundaries were subsequently expanded to include 16 new cultural locales (Kruse, et al., 2008). In 2011, the site underwent evaluative testing (Palmer and Kruse, 2012). The site is large and extends approximately 1,040 m [3,412 ft] north-south by 1,165 m [3,822 ft] east-west. During the 2011 evaluative testing, the site was divided into eight concentration areas (Area 1 to Area 8) and a total of 68 hearth features and artifact scatters were recorded across the site (Palmer and Kruse, 2012). Samples of charcoal from hearth features in Areas 4 and 6 underwent radiocarbon dating, and both date to the Late Archaic time period (Palmer and Kruse, 2012). Evaluative testing demonstrated that the prehistoric component site is a deflated surface scatter of artifacts and hearths (Palmer and Kruse, 2012). Based on the lack of cultural deposits between the hearth features, the site may represent a series of short-term occupations. The site probably was occupied briefly by mobile social and/or family units foraging in the surrounding area and using the site as temporary residence.

One previously documented possible historic burial was identified at Area 3, located at the center of site 39FA96. During evaluative testing, shovel tests revealed a thin layer of silt followed by charcoal and chicken bones overlaying bedrock. The tests revealed very shallow soils which terminated when bedrock was hit at 15 cm [5.9 in] below surface. No evidence of human bones or remains was encountered. The feature was interpreted as the remains of a modern hunter's campfire with charcoal and chicken bones and is decidedly not a burial (Palmer and Kruse, 2012).

Two log cabins, a cistern, a collapsed outbuilding, a remnant of a foundation, and piles of foundation rubble were also identified at the southeast corner of site 39FA96 at Area 8. Shovel tests excavated around the historic cabin structures produced historic artifacts, but no additional features were identified (Palmer and Kruse, 2012). Additional shovel testing within the historic cabin structures is planned (Powertech, 2012). A search on the General Land Office Records on the BLM web site uncovered a 1915 land patent on 64.7 ha [160 ac] for Emaline Richardson (BLM, 2012a). A copy of the land patent is included in Appendix D.

A small portion of site 39FA96 extends onto BLM surface lands. BLM reviewed ALAC's 2012 evaluative testing report (Palmer and Kruse, 2012) and concurred with findings that the site is heavily deflated and lacks integrity, having been destroyed by natural erosion. Moreover, the site does not display workmanship or feeling, and is not associated with an important event. BLM concurs that the portion of site 39FA96 on BLM-administered lands is not eligible for listing on the NRHP under criteria D (BLM, 2012c). A copy of the BLM letter dated July 20, 2012, is included in Appendix D.

Preliminary information gathered through consultation with the tribes indicate site 39FA96 has the potential to be of religious and cultural importance to the tribes based on the number of hearth features and extensive size of the site. NRC staff is awaiting additional information from the Native American tribes before making a recommendation of eligibility.

Site 39FA1902 is an unevaluated site that consists of Native American and Euroamerican artifact scatters, a well/cistern, a historic bridge, and a possible historic grave located on scrubland and on a short grass pasture. A linear pile of limestone rocks located on the northeast edge of site 39FA1902 is purported to be a historic grave by a local informant. The remnant of a collapsed wooden fence near the rock pile suggests the possible grave was enclosed by a fence at some time in the past (Kruse, et al., 2008). The historic bridge structure is discussed in more detail in SEIS Section 3.9.2.2.

Site 39FA778 is a historic farmstead, originally recorded in 1983, and consists of corrals, root cellars, a well, and a house foundation. Historic artifacts consist of clear bottle glass and scatter of fired brick and milled lumber. The site is unevaluated (Kruse, et al., 2008).

Site 39CU3584 consists of a Native American artifact scatter and two cairns located on a hill top. The artifact scatter dates to the Middle Archaic based on the discovery of one projectile point. This site lies within the proposed land application area at the Dewey site. The site underwent archaeological testing and was recommended ineligible for listing in the NRHP under criteria D, based on a lack of diagnostic artifacts and intact cultural deposits (Kruse, et al., 2008; Palmer and Kruse, 2012). NRC staff is awaiting additional information from the Native American tribes before making a recommendation of eligibility.

Site 39CU3587 is a prehistoric artifact scatter and two Euroamerican burials enclosed by posts from a collapsed fence located on a ridge top south of Beaver Creek. The burials were presumably enclosed by a fence, and only the posts remain. The site is unevaluated (Kruse, et al., 2008).

Site 39CU271 is a Native American occupation site with a total of 238 associated hearth features and a cairn feature and is eligible for listing in the NRHP. The site was discussed previously in more detail.

Site 39CU530 is a Native American artifact scatter with one cairn and 29 hearths located on a forested ridge top and slopes. Areas of the site retain intact soil deposits with the potential to contain intact cultural deposits. The site is unevaluated (Kruse, et al., 2008).

Site 39CU3564 is a Native American lithic quarry site and one cairn located on an eroded hill top. The site is unevaluated (Kruse, et al., 2008).

Site 39CU3620 is sparse Native American lithic scatter, a cairn, and eight hearths located on a ridge slope. The site is unevaluated (Kruse, et al., 2008).

Site 39FA1862 is a prehistoric and Native American artifact scatter with three stone circles and four cairns on an eroded ridge top. The site is unevaluated (Kruse, et al., 2008).

Site 39FA1863 is a prehistoric and Native American artifact scatter with a stone circle, cairn, and stone alignment located on an eroded ridgetop. The site is unevaluated (Kruse, et al., 2008).

Site 39FA1881 is a sparse prehistoric, Native American artifact scatter with a cairn consisting of 10 to 12 large rocks. The site is unevaluated (Kruse, et al., 2008).

Site 39FA1890 is a prehistoric, Native American artifact scatter with a cairn consisting of five visible medium-sized cobbles. The site is unevaluated (Kruse, et al., 2008).

Site 39FA1927 is a Native American site consisting of an alignment of six cairns extending along a grassy ridge top. Ground surface visibility averaged 50 percent, and no artifacts were identified on the ground surface. The site is unevaluated (Kruse, et al., 2008).

3.9.2.2 Historic District, Historic Standing Structures, and Bridge Structure

Historic resources within the APE currently listed or recommended eligible for listing on the NRHP are listed in Table 3.9-3.

The Edna and Ernest Young Ranch Historic District is located south of Beaver Creek in the northwest area of the APE. According to the South Dakota State Historic Preservation Office (SD SHPO) Historic Sites Survey Form, the Edna and Ernest Young Ranch is a designated historic National Register District (90000949), added to the NRHP in 1990, under Criterion A, Exploration and Settlement. This ranch represents the development of "legal homestead ranching" in southwest Custer County, and the period of historical significance is from 1912 to 1940. The ranch is composed of 13 contributing buildings, 1 contributing structure, the Bakewell Ranch (CU00000050), and 1 non-contributing structure on a total of 52.6 ha [130 ac]. The main house of the Bakewell Ranch was constructed from sandstone quarried locally. A copy of the SD SHPO Historic Sites Survey Form for the Edna and Ernest Young Ranch is included in Appendix D.

Table 3.9-3. List of Historic Structures Within the APE That Are Currently Listed in the NRHP or Structures Eligible for Listing in the NRHP

Historic Property (Structure Identification, or Historic District)	Description	Currently Listed on the NRHP or Recommended Eligible for Listing on NRHP	Evaluation Criteria—Determination of Eligibility for Listing in NRHP Under Criteria A, B, C, or D*
Log Barn (Structure CU02500002)	Log barn located at site 39CU3619 was found eligible for listing on NRHP in April 2012 under Criterion A.	Eligible	A
Historic District 90000949- Edna and Ernest Young Ranch	This historic district covers 52.6 ha [130 ac] and is located approximately 4.8 km [3 mi] south of Dewey and south of Beaver Creek. The area of significance is exploration/settlement during the 1900–1924 and 1925–1949. There are 13 contributing buildings, 1 contributing structure and 1 non-contributing structure.	Listed in the NRHP in 1990	A
Bakewell Ranch (Structure CU00000050)	The Bakewell Ranch is located within the Edna and Ernest Young Ranch National Register Historic District	Listed in the NRHP in 1990	A
Sources: Kruse, et al. (2008); Palmer and Kruse (2008, 2012); Palmer (2009) *The NRHP criteria for eligibility are listed in Section 3.9 of this SEIS.			

In 2011, an architectural historian evaluated a log barn structure (CU02500002) that is part of the Richardson Homestead (site 39CU3619) (Palmer and Kruse, 2012). The original Richardson Homestead is located south of Pass Creek and consists of nine buildings: a barn, chicken coop, granary, main house, root cellar, bunkhouse, pump house, and two garages/workshops. Other features that contributed to the setting and feel of the homestead were a cistern, rubble stone walkway, rock garden, garden plot, clothes line post, corral post and fence, and evidence of yard plantings (Palmer and Kruse, 2012). The main house was assessed, determined to lack structural integrity, and recommended as not eligible for listing in the NRHP. Without the inclusion of the main house, the Richardson Homestead did not qualify for listing as a historic district in the NRHP. The log barn structure possesses integrity given that log buildings in the Black Hills typically do not survive as they were not lived-in, permanent dwellings; they were typically abandoned, burned, or torn down. Thus, individually the log barn structure was determined eligible for listing on the NRHP under Criterion A (Palmer and Kruse, 2012).

Historic bridge structure (FA00000151) is located within archaeological site 39FA1902 discussed previously. Site 39FA1902 consists of prehistoric and historic artifact scatters, a well/cistern, a possible historic grave, and a historic wooden bridge that crosses an unnamed intermittent stream. The bridge is approximately 2.4 m [8.0 ft] long by 5.0 m [16.5 ft] wide, and the roadway associated with the bridge was not observed except for the approaches. The bridge appears to have been constructed from locally harvested pine timbers. The NRHP status of the historic bridge structure is currently unevaluated (Kruse, et al., 2008).

3.9.3 Places of Religious or Cultural Significance

Places of religious or cultural significance are resources associated with the cultural practices and beliefs of a living community that are rooted in history and remain important for a group to maintain its cultural heritage. These historic properties may not be represented in archaeological or historic contexts. They are often associated with Native American religious or cultural practices and include traditional gathering areas where particular plants or materials were harvested, a sacred mountain or landscape crucial to a tribe's identity, or burial locations that connect Native Americans with their ancestors. A place of religious or cultural significance to tribes demonstrates traditional cultural value if its significance to Native American beliefs, values, and customs "has been ethnohistorically documented and if the site can be clearly defined" (Parker and King, 1990).

Tribal groups and their descendants, including the historically documented Apache, Arapaho, Arikara, Assiniboine, Cheyenne, Crow, Hidatsa, Kiowa, Mandan, Pawnee, Ponca, Sioux, and Shoshone tribes, have made their homes in the Northern Plains for more than 12,000 years. The Black Hills is considered a place of paramount spiritual importance to tribal groups in the region (SRI, 2012).

A sense of connectedness and duality between the spiritual and earthly worlds in part illustrates the tribal worldview. What is important from a tribal perspective is the interconnectedness between the physical world and spiritual world. For example, in Lakota cosmology, there exists a spiritual realm and earthly realm and what happens in one realm is reflected in the other; the two worlds are interconnected and inform the other (SRI, 2012). Sundstrom (1996) writes that, "The activities and ceremonies conducted in the villages on earth were mirrored by the 'star villages'". Sometimes these realms converge, and the meeting point is reflected in the landscape. Some tribal members are able to interpret a "sacred" landscape or feature and recognize the same spiritual and physical features that made the place sacred to their ancestors. By extension, sacred places are considered sacred to tribal groups today visiting the sacred places and retelling of stories through oral tradition reinforces beliefs.

From the tribal perspective, it is not generally important whose ancestors created the sacred site; therefore, identifying the tribal affiliation of a sacred place is not essential. What is important is that "Indians made the sites, and that their actions are explicable and understandable by contemporary Indians who follow traditional ways. Historic period sites are identified by tribal affiliations when they are known through oral histories." (BLM, 2002)

Past work on the Northern Plains has demonstrated that tribal groups might consider certain types of natural landforms and features culturally and spiritually significant. These landforms and features include mountain tops, cliffs, distinct topographic features, caves, rock shelters, springs and rivers, and especially the intersection between two features. For example, mountain tops may reflect increasing spirituality while cliffs and badlands are considered "Deep Earth" (BLM, 2002)." Bear Butte and/or Bear Butte Lake, Devils Tower (Bear Lodge Peak), Inyan Kara and Harney Peak, and the Race Track are features of significance to one or more of the Northern Plains tribes (Sundstrom 1996). Liebmann (2002) explains that the Big Horn Medicine Wheel, "... is situated at a place in which ... two spiritual realms meet. ... the Big Horn Medicine Wheel lies at the juncture of two supernatural realms—the zenith and nadir; peak and underworld; the connection of spirit domains above and below." According to the BLM Casper Field Office (BLM, 2005), "The presence of flowing water or bodies of water and high isolated locations such as buttes in close proximity to one another were sometimes considered especially powerful or close to the spirits. These kinds of locations were commonly used for fasting or vision quests."

There are several man-made features that are commonly associated with culturally significant places. While a hilltop may be the physical setting for fasting, prayer, or a vision quest, man-made features associated with the sacred place may include vision quest structures, cairns, rock clusters, and stone alignments (SRI, 2012). Hand-laid stone alignments typically function as "directional markers/prayer lines associated with major ceremonial sites ... or drive lines ... to channel ... deer, antelope and bison." (BLM, 2002)

Sundstrom (2006), following Abbott, Ranney, and Whitten (1982), defines a cairn as "a pile of stones on the surface; this may have collapsed into a mosaic [an arrangement of stones in the form of a solid figure or pavement]." Cairns have been found in a variety of contexts, including markers for ceremonial sites, trail markers, memorials to notable events or people, medicine wheels, and to demarcate burials (e.g., Hall, 1985; Liebman, 2002; Sundstrom, 2006; USFS, 2004; BLM, 2002; Surface Transportation Board, 2010; SRI, 2012). Medicine wheels are rock alignments that have a cairn or stone circle at their centers from which stone alignments are laid out like spokes on a wheel (SRI, 2012).

Graves, burials, and cemeteries should be treated with respect and should not be disturbed. Tribal peoples continue to visit graves to pray and make offerings. There are several forms of burials including graves, cairns, and burial mounds. Burial mounds are found in eastern South Dakota and are not present within the APE (Winham and Hannus, 1990).

Physical landforms and landscape features within the APE that might possess cultural significance include (SRI, 2012):

- Bone beds
- Depressions
- Hills (conical shaped, "humped back," or odd shaped)
- Hilltops (ridge and flat top)
- Natural rock formations
- Quarries (fossil, mineral, and rock)
- Prominent knolls
- Promontories
- Rimrock
- Rockshelters
- Rugged, high altitude, isolated topographic features

Examples of man-made features and site types located within the APE that might be considered places of religious and cultural importance to the Northern Plains tribes (SRI, 2012):

- Archaeological sites
- Battle sites
- Burial mounds (not included in regions for Cameco/Powertech project areas)
- Burials
- Eagle catching sites/eagle trapping pits and lodges
- Fasting sites/structures
- Dance locations (e.g., Ghost Dance, Sun Dance)

- Medicine wheels
- Memorials
- Monuments
- Paint sources
- Pilgrimage/trail marker cairns
- Offerings and prayer sites (may include trees, springs, rock art, rivers)
- Rock art/petroglyphs
- Sacred sites (personal religious observations along the lines of the vision quest)
- Stone alignments
- Stone cairns
- Stone circles/rings (very large and very small)
- Sweat lodges
- Vision quest sites/structures

Through continued consultation with the tribes and an onsite field assessment, places that possess cultural and religious significance to the tribes may be identified. Any identification of sacred or traditional places must be verified in consultation with authorized tribal representatives.

3.9.4 Tribal Consultation

The federal government and the State of South Dakota recognize the sovereignty of federally recognized Native American tribes. Pursuant to NHPA Section 106, federal agencies are required to undertake consultation and coordination with each tribal government that may have an interest in a proposed federal action. Consultation with the tribes that have heritage interest in the proposed Dewey-Burdock ISR Project is ongoing. Executive Order 13175 (November 2000), *"Consultation and Coordination with Indian Tribal Governments,"* excludes from the requirements of the order, "independent regulatory agencies, as defined in 44 U.S.C. §3502(5)." However, according to Section 8, "Independent regulatory agencies are encouraged to comply with the provisions of this order." Although the NRC is explicitly exempt from the Order, the Commission remains committed to its spirit. The agency has demonstrated a commitment to achieving the Order's objectives by implementing a case-by-case approach to interactions with Native American tribes. NRC's case-by-case approach allows both NRC and the tribes to initiate outreach and communication with one another.

As part of its obligations under Section 106 of the NHPA and the regulations at 36 CFR 800.2(c)(2)(B)(ii)(A), NRC must provide Indian tribes "a reasonable opportunity to identify its concerns about historic properties, advise on the identification and evaluation of historic properties and evaluation of historic properties, including those of religious and cultural importance, articulate its views on the undertaking's effects on such properties, and participate in the resolution of adverse effects." The NRC identified 20 Native American tribes that attach historical, cultural, and religious significance to sites within the Dewey-Burdock ISR Project area. The NRC continues consultation on historic properties with the following tribes:

- Cheyenne River Sioux Tribe
- Crow Creek Sioux Tribe
- Flandreau Santee Sioux Tribe
- Lower Brule Sioux Tribe
- Oglala Sioux Tribe

- Rosebud Sioux Tribe
- Sisseton-Wahpeton Sioux Tribe
- Standing Rock Sioux Tribe
- Yankton Sioux Tribe
- Three Affiliated Tribes (Mandan, Hidasta, and Arikara Nation)—North Dakota
- Turtle Mountain Band of Chippewa—North Dakota
- Spirit Lake Tribe—North Dakota
- Lower Sioux Indian Community—Minnesota
- Fort Peck Assiniboine and Sioux—Montana
- Northern Cheyenne Tribe—Montana
- Northern Arapaho Tribe—Wyoming
- Eastern Shoshone Tribe—Wyoming
- Ponca tribe—Nebraska
- Crow Tribe—Montana
- Santee Sioux Tribe—Nebraska

NRC staff formally initiated the Section 106 consultation process for the proposed Dewey-Burdock ISR Project by contacting 20 tribal governments by letters dated March 19, 2010 (SEIS Section 1.7.3.5, NRC 2010a). Additional invitations to consult with the NRC concerning the proposed project were sent to tribes on September 10, 2010 and March 4, 2011 (NRC 2010b, NRC 2011). NRC staff invited the tribes to participate as consulting parties in the NHPA Section 106 process and sought their assistance in identifying tribal historic sites and cultural resources that may be affected by the proposed action. SEIS Section 1.7.3.5 describes consultation activities undertaken by NRC with tribal governments. Consultation correspondence associated with the Section 106 process is presented in Appendix A. At this time, consultation concerning the identification of and evaluation for listing in NRHP of properties of religious and cultural significance to the tribes is ongoing.

3.10 Visual and Scenic Resources

As noted in GEIS Section 3.4.9, the Nebraska-South Dakota-Wyoming Uranium Milling Region is located within the Great Plains physiographic province adjacent to the southern end of the Black Hills. Vegetation within and in the vicinity of the proposed Dewey-Burdock ISR Project area is a mix of short grasses and shrubs typical of semiarid steppe land along with Ponderosa Pine forest toward the Black Hills (Powertech, 2009a). Springtime landscape color varies from light brown and green to dark green with wildflowers; dry winter season colors range from light brown to golden. The proposed project area is located in an undeveloped remote location with most of the land currently being used for grazing activities and associated facilities (e.g., fences, stock wells, and a few stock reservoirs). Infrastructure within the project area includes the BNSF Railroad (see Figure 3.2-1) that runs north through Edgemont toward Newcastle, Dewey Road that parallels the BNSF Railroad to the town of Dewey, overhead electricity lines, and several gravel and dirt access roads.

Elevation within the project area ranges from 1,097 to 1,189 m [3,600 to 3,900 ft] above mean sea level, with the highest elevations along pine breaks that overlap the eastern boundary of the project area (Powertech, 2009a). Topography within the project area and surrounding lands is gently rolling in the western quadrant, with more varied terrain in the pine breaks and dissected hills covering the rest of the project area. Two main streams pass through the proposed project area: Beaver Creek (a perennial stream) and Pass Creek (an intermittent stream). Pass Creek joins Beaver Creek southwest of the proposed project area. Approximately 4 km [2.5 mi] south of the confluence of Beaver and Pass Creeks, Beaver Creek converges with the Cheyenne River.

Parcels of BHNF are located east and northeast of the proposed project boundary. The BHNF management plan and subsequent amendments have the objective of maintaining 85 percent of the region for low to moderate scenic integrity (USFS, 1997, 2001, 2005). USFS classifies areas that have not been subject to human-caused disturbances that detract from the character of the dominant landscape (e.g., the forested hillsides, towering rock formations, meadows, and tranquil streams that typify the Black Hills landscape) as having a high level of scenic integrity (USFS, 2005). Wind Cave National Park in South Dakota, which is approximately 47 km [29 mi] east of the proposed Dewey-Burdock ISR Project site, is designated a Prevention of Significant Deterioration Class I area. SEIS Section 3.7.2 states that Prevention of Significant Deterioration Class I areas must meet more stringent air quality standards because air quality may impact visual resources.

Visual Resource Management Classes

BLM evaluates the scenic or visual quality of the land it manages using the Visual Resource Inventory to assess the scenic value of a property and ensure that its value is preserved (BLM, 1986). In compiling the inventory, BLM completed a scenic quality evaluation, a sensitivity-level analysis, and a delineation of distance zones for properties; each property or area is assigned to one of four visual resource management (VRM) classes (BLM, 1984). Class I is most protective of visual and scenic resources, and Class IV is least restrictive.

As described in GEIS Section 3.4.9, BLM has assigned most areas in the Nebraska-South Dakota-Wyoming Uranium Milling Region as VRM Classes II through IV. Currently, BLM has not assigned a VRM classification to the region encompassing the proposed Dewey-Burdock ISR Project area. The South Dakota BLM field office resource management plan identifies the natural vegetation of the region as wheatgrass, grama grass, sagebrush, and pine savanna (BLM, 1985). Areas in Wyoming adjacent to the proposed site are identified as VRM Classes III and IV (BLM, 2000).

The applicant conducted a visual resource inventory to determine the scenic quality rating (SQR) of the proposed project area and surrounding 3.2-km [2-mi] area (Powertech, 2009a). The SQR is determined by rating key visual factors (e.g., landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications) according to form, line, color, texture, scale, and space on a comparative scale from zero to five (BLM, 1986). The visual resource inventory was conducted for two SQR units within the proposed project area that demonstrated similar physiographic characteristics. The total scores of the two SQR units were 11 and 13 (Powertech, 2009a). According to NUREG–1569, if the visual resource evaluation rating is 19 or less, no further evaluation or special management of scenic resources is required (NRC, 2003). Based on the scenic quality inventory and evaluation, the applicant classified the project area and the 3.2-km [2-mi] area surrounding the project area as VRM Class IV (Powertech, 2009a). The objective of this class is to manage activities that might require major modifications of the existing character of the landscape (BLM, 1986). The level of change permitted for this class is the least restrictive and can be high.

USFS has performed visual resource classification in the vicinity of the project area as part of its regional forest and grasslands management plans. USFS (2009) classified almost 95 percent of grasslands in Fall River County as having a low to moderate scenic integrity objective. A region with a low scenic integrity objective has a natural landscape that has been moderately altered (USFS, 1974, 1995). While visual changes that dominate the characteristic landscape are permitted, visual changes must be compatible with the forms, lines, colors, and textures of the existing natural surroundings. Landscapes classified as having a moderate scenic integrity objective have undergone only slight alterations; however, new forms, lines, colors, or textures may be introduced to the landscape only as long as changes are visually subordinate to the natural setting (USFS, 1995, 1974).

3.11 Socioeconomics

The proposed Dewey-Burdock ISR Project is located in the Nebraska-South Dakota-Wyoming Uranium Milling Region. General socioeconomic factors associated with this region are described in GEIS Section 3.4.10 (NRC, 2009a). Socioeconomic region of influence (ROI) is defined as the area where employees and their families would reside, spend their income, and use their benefits, thereby affecting the economic conditions in the region. This section describes current socioeconomic conditions and local community services within the ROI surrounding the proposed site that may be directly or indirectly affected by the proposed project. The proposed ISR facility and the local people and communities that would support it are expected to function (or form) as a dynamic socioeconomic system. Existing communities will provide the people, goods, and services required to construct and operate the facility. The construction and operation of the proposed facility is expected to create demand for employees, goods, and services. Personal income from wages and benefits will be spent on goods and services within other sectors of the communities and create additional opportunities for employment and income.

The proposed project is located in a rural portion of Fall River and Custer Counties, South Dakota. The existing communities that are expected to be part of an expanded socioeconomic system include (i) Edgemont (population 774) in Fall River County, located 21 km [13 mi] southeast of the site; (ii) the city of Hot Springs (population 3,711), located 64 km [40 mi] east in Fall River County; (iii) the city of Custer (population 2,067) in Custer County, located 80 km [50 mi] northwest of site; and (iv) Newcastle (population 3,532) in Weston, Wyoming, located 64 km [40 mi] north-northwest of the site (see Figure 1.1-1). Rapid City in Pennington County, South Dakota, located 100 km [62 mi] northeast of the site, is the closest urban area with a population of 67,956 (USCB, 2012).

Most construction and operations workers for the proposed Dewey-Burdock ISR Project will come from the surrounding communities of Edgemont, Hot Springs, and Custer in South Dakota. Additional workers are expected to come from Newcastle in Wyoming and other smaller communities within an 80-km [50-mi] radius of the proposed project site. An 80-km [50-mi] radius is likely the maximum commuting distance for employees (Powertech, 2009a). It is anticipated the majority of workers will reside near the proposed facility; therefore, Custer and Fall River Counties in South Dakota and Weston County in Wyoming are expected to experience the most significant socioeconomic changes. Rapid City in Pennington County, the largest city in the region, is expected to be an important source of equipment, supplies, services, and workers (Powertech, 2009a). Because Rapid City is 100 km [62 mi] from the project site, it is not expected to be directly within the Dewey-Burdock ROI.

The demographics of income, housing, employment structure, local finance, and education and public services in the ROI surrounding the proposed site are discussed next.

The demographic, income, housing, and other socioeconomic data reported in the GEIS were based on 2000 USCB data. The socioeconomic information in this SEIS incorporates 2000 and 2010 USCB (2012) data, as well as more recent reports; the USCB 2006–2010 American Survey 5-Year Estimates (USCB, 2012); and the USCB State and County QuickFacts (USCB, 2012).

3.11.1 Demographics

Population changes and projections for Custer and Fall River Counties in South Dakota and Weston County in Wyoming are shown in Table 3.11-1.

The population in Fall River County fell approximately 5 percent between 2000 and 2010, in comparison to approximately 9 and 13 percent gains in Weston and Custer Counties, respectively, over the same period. The Weston County population is expected to grow at a similar rate over the next decade (WDAI, 2011). Fall River and Custer Counties are expected to remain relatively stagnant through 2020 (Brooks, 2008). County population densities in 2010 ranged from 1.2 people per km^2 [3.0 people per mi^2] in Weston County to 2.0 people per km^2 [5.3 people per mi^2] in Custer County (Table 3.11-2).

The demographic profile for Custer and Fall River Counties in South Dakota and Weston County in Wyoming is presented in Table 3.11-2. All three counties have predominately white populations. American Indian/Alaskan Native and Hispanic/Latino (of any race) make up the main minority groups, although in small numbers. In 2010, minorities (race and ethnicity combined) comprised between 7 and 14 percent of the 3 counties that lie within the ROI.

3.11.2 Income

Income information for the ROI is presented in Table 3.11-3. According to USCB data, 2010 median household and per capita incomes were higher in Custer County, South Dakota, and Weston County, Wyoming, than in Fall River County, South Dakota (USCB, 2012). The average income levels in all three counties were lower than the statewide averages. Seventeen percent of the Fall River County population and 11 percent of Fall River County families, live at or below the official poverty level (USCB, 2012). Approximately 8 percent of the population of Weston County and 10 percent of the population of Custer County live below the poverty level (USCB, 2012).

Table 3.11-1. Total Population and Percent Growth in Custer and Fall River Counties, South Dakota, and Weston County, Wyoming, 2000 to 2020

	Population			
County/Town	**2000 Census**	**2010 Census**	**Percent change**	**2020 Population Projections**
Custer	7,275	8,216	+12.9	8,186
Custer City	1,860	2,067	+11.1	Not available
Fall River	7,453	7,094	-4.8	7,423
Edgemont	867	774	-10.7	Not available
Hot Springs	4,129	3,711	-10.1	Not available
Weston	6,644	7,208	+8.5	7,900
Newcastle	3,065	3,532	+15.2	3,871
Source: USCB, 2012; Brooks, 2008; WDAI, 2011				

Table 3.11-2. Demographic Profile of the 2010 Population in Custer and Fall River Counties, South Dakota, and Weston County, Wyoming

Population Category	Custer County	Fall River County	South Dakota	Weston County	Wyoming
Race (percent of total population, not Hispanic or Latino)					
White	92.8	87.4	84.7	93.8	85.9
Black/African American	0.2	0.6	1.2	0.2	0.8
American Indian, Alaskan Native	2.8	6.7	8.5	1.2	2.1
Asian	0.3	0.4	0.9	0.3	0.8
Native Hawaiian, Pacific Islander	0.0	0.0	0.0	0.0	0.1
Some other race	0.0	0.0	0.1	0.0	0.1
Two or More Races	1.7	2.6	1.8	1.4	1.5
Ethnicity					
Hispanic or Latino (number of people)	182	159	22,119	216	50,231
Percent of total population	2.2	2.2	2.7	3.0	8.9
Minority Population (including Hispanic or Latino ethnicity)					
Total minority population	592	895	124,678	446	79,752
Percent minority	7.2	12.6	15.3	6.2	14.1
2010 Population Density (per Km²/Mi²)					
	2.0/5.3	1.6/4.1	4.1/10.7	1.2/3.0	2.2/5.8
Source: USCB, 2012					

Table 3.11-3. 2010 Income Information for Counties Within the Region of Influence

	Custer County	Fall County	South Dakota	Western County	Wyoming
Median Household Income (Annual Dollars)	46,743	35,833	46,369	53,853	53,802
Per Capita Income (Annual Dollars)	24,353	21.574	24,110	28,463	27,860
Families living below the poverty level (Percent)	4.3	11.4	8.7	5.8	6.2
Persons Below the Poverty Level (Percent)	9.7	17.4	13.7	7.9	9.8
Source: USCB, 2012.					

3.11.3 Housing

Housing data for the proposed Dewey-Burdock ISR Project ROI, including occupied and vacant units, vacancy rates, and median house values, are provided in Table 3.11-4. Of the more than 12,300 housing units in the ROI, which include single family homes, multifamily housing, mobile homes, and rental units, approximately 10,000 are occupied (USCB, 2012). Average annual vacancy rates in 2010 were approximately 21 percent in Custer and Fall River Counties, up from 18 percent in 2000. Vacancy rates decreased 23 percent in Weston County between 2000 and 2010. The median value of owner-occupied housing units is $160,700 in Custer County, $86,800 in Fall River County, and $115,200 in Weston County (USCB, 2012).

Table 3.11-4. Housing in Custer and Fall Counties County, South Dakota, and Weston County, Wyoming

Custer County			
	2000	**2010**	**Percent Change**
Total	3,624	4,628	+27.7
Occupied Housing Units	2,970	3,636	+22.4
Vacant Units	654	992	+51.7
Vacancy Rate (Percent)	18	21.4	+18.9
Median Value (Dollars)	89,100	160,700	+80.4
Fall River County			
Total	3,812	4,191	+9.9
Occupied Housing Units	3,127	3,272	+4.6
Vacant Units	685	919	+34.2
Vacancy Rate (Percent)	18	21.9	+21.7
Median Value (Dollars)	54,300	86,800	+59.9
Weston County			
Total	3,231	3,533	+9.3
Occupied Housing Units	2,624	3,021	+15.1
Vacant Units	607	512	-15.7
Vacancy Rate (Percent)	18.8	14.5	-22.9
Median Value (Dollars)	66,700	115,200	72.7
Source: USCB, 2012			

Based on the 2010 USCB housing information, Fall River County had an estimated 4,191 housing units, an increase of 10 percent over the 2000 data (USCB, 2012). In comparison, Custer County had an approximate 30 percent increase in total housing units since 2000, with a total of 4,628 units in 2010. The 2010 estimated data for Weston County indicated a slight increase in housing units since the 2000 census, with an increase of 9 percent (302 additional units).

3.11.4 Employment Structure

Based on information from the South Dakota Department of Labor (SDDOL), the total county labor force in April 2012 was estimated to be 4,390 for Custer County and 3,660 for Fall River County (SDDOL, 2012). Weston County had a smaller estimated labor force of 3,308 (Wyoming Department of Workforce Services, 2012). Unemployment rates for Custer and Fall River Counties were 5.0 and 4.7 percent, respectively, which slightly exceeded the statewide rate of 4.3 percent (SDDOL, 2012). The unemployment rate in Weston County was 5.1 percent, which matched the 5.3 statewide rate in Wyoming (Wyoming Department of Workforce Services, 2012).

The largest employment sector for both Custer and Fall River Counties in 2010 was government (local, state, or federal), which accounted for about 32 percent of the covered work force in South Dakota (SDDOL, 2012). Private sector employment involving 10 percent or more of the work force, falls into three major categories: (i) leisure/hospitality, which includes the arts, entertainment, recreation, food service, and accommodations; (ii) trade/transportation/utilities, which includes retail, wholesale, transportation, warehousing, and utilities; and (iii) education and health services (SDDOL, 2012). The largest source of employment in Weston County in 2010 was agriculture, forestry, fishing and hunting, and mining, accounting for 24 percent of all employment. Government-related jobs supported approximately 20 percent of the work force. Private sector retail trade accounted for 11 percent of the work force (USCB, 2012).

3.11.5 Local Finance

South Dakota does not impose a state income tax on its citizens or businesses. The majority of state revenue is generated from the 4 percent statewide sales and use taxes, and county and municipal sales and use taxes. The South Dakota Department of Revenue and Regulation (SDDRR) collects taxes at the state level, including (i) sales, use, and contractor's excise taxes; (ii) special taxes; (iii) motor vehicle fuel taxes; and (iv) motor vehicle fees and taxes (SDDRR, 2011). Towns with a municipal sales and use tax may also impose up to 1 percent gross receipts tax on various sales, including lodging, restaurant meals, alcoholic beverages, and admissions to places of amusement and cultural and sports events, and sales and use tax up to 2 percent which applies to all products and services that are subject to the state sales or use tax (SDDRR, 2011). Local governments are solely responsible for collection of property taxes, which are the primary source of funding for school systems and county, municipal, and other local government units. The 2011 taxable valuation of all property in Custer and Fall River Counties was $763 million and $416 million, respectively (SDDRR, 2012a). Sales and use tax revenues totaled $165 million for Custer County and $134 million for Fall River County (SDDRR, 2012b).

Wyoming does not impose a corporate income or personal income tax. Wyoming has a 4 percent sales tax, and counties may tax lodging services up to 4 percent. Counties have the option of collecting an additional 1 percent sales tax for general purposes. Weston County has a 5 percent sales and use tax (4 percent state base tax and a 1 percent optional county tax) and a 4 percent lodging tax (Wyoming Department of Revenue, 2012). The approximate 2011 taxable valuation for all property in Weston County was $117 million (Weston County Assessor, 2012), and all sales and use tax revenues totaled $11.2 million (Wyoming Department of Revenue, 2012).

In addition to property taxes local governments collect, the states of Wyoming and South Dakota levy taxes on the value of the mineral production (a severance tax). Wyoming levies a uranium mining severance tax of 4 percent (Wyoming Statute, 2011). South Dakota levies an energy minerals severance tax on uranium of 4.5 percent (South Dakota Statute, 2012), as well as an additional conservation tax of 0.24 percent on the taxable value of any mineral produced from mineral extraction operations (South Dakota Statute, 2012).

3.11.6 Education

Five public school districts (kindergarten through 12th grade) are located in Custer and Fall River Counties: Custer School District, Elk Mountain School District, Hot Springs School District, Oelrichs School District, and Edgemont School District (SDDOE, 2010). There are approximately 2,024 students enrolled in Custer and Fall River County schools (kindergarten through 12th grade) (Table 3.11-5).

Table 3.11-5. School Districts in Counties Located Within 80 km [50 mi] of the Proposed Dewey-Burdock ISR Project

School Districts in Custer and Fall River Counties, South Dakota	
Custer	
Number of students enrolled (K-12)	882
Number of schools	6
Student-teacher ratio	12
Elk Mountain	
Number of students enrolled (K-12)	26
Number of schools	1
Student-teacher ratio	10
Hot Springs	
Number of students enrolled (K-12)	840
Number of schools	3
Student-teacher ratio	14
Oelrichs	
Number of students enrolled (K-12)	126
Number of schools	3
School Districts in Custer and Fall River Counties, South Dakota (continued)	
Student-teacher ratio	7
Edgemont	
Number of Students enrolled (K-12)	150
Number of schools	2
Student-teacher ratio	10
School Districts in Weston County, Wyoming	
Weston County #1	
Number of students enrolled (K-12)	778
Number of schools	4
Student-teacher ratio	11
Weston County #7	
Number of students enrolled (K-12)	265
Number of schools	3
Student-teacher ratio	10
Sources: SDDOE, 2010; Wyoming Department of Education, 2010	

Public schools in Wyoming are generally organized at the county or subcounty level by school district. The school districts closest to the proposed project area are Weston County School District #1, with four kindergarten through 12th grade schools located in Newcastle, and Weston County School District #7, with three kindergarten through 12th grade schools located in Upton. There are approximately 1,043 students in county school districts in Weston County (Wyoming Department of Education, 2010).

The nearest postsecondary schools to the proposed project are located in Rapid City, 161 km [100 mi] to the northeast. Western Dakota Technical Institute (WDTI), South Dakota School of Mines and Technology (SDSMT), and the Rapid City Campus of the National American University (NAU) are located in Rapid City.

3.11.7 Health and Social Services

Medical facilities and health services in the ROI are listed in Table 3.11-6. Hospitals are located in Hot Springs, Custer City, and Newcastle. Fall River Hospital in Hot Springs is a 25-bed acute care facility providing emergency, laboratory, and surgical services. Custer Regional Hospital in Custer City is an 11-bed acute care facility that provides 24-hour emergency service, inpatient, and outpatient care. Weston County Health Services in Newcastle has a 21-bed hospital offering inpatient hospital service and acute care services including 24-hour emergency care and complete laboratory services.

Primary and family medical care in the ROI is provided by the Fall River Health Clinic in Hot Springs, the Custer Regional Clinic in Custer City, the Edgemont Regional Clinic in Edgemont, and Weston County Health Services in Newcastle. The South Dakota Department of Health has Offices of Family and Community Health Services in Hot Springs and Custer City. These offices provide primary and preventative programs and services including immunizations, well child checkups and screenings, WIC (Supplemental Nutrition Program for Women, Infants, and Children), family planning and reproductive health, prenatal health, and health screenings for adults. The Wyoming Department of Health has a Public Health Nursing Office in Newcastle. This office provides primary and preventative health services including family planning, immunizations, WIC, and maternal and family health. Behavioral Management Systems in Hot Springs provides a range of behavioral and mental health services and programs for area residents.

Table 3.11-6. Hospitals, Clinics, and Health Services in Hot Springs, Custer City, and Edgemont, South Dakota, and Newcastle, Wyoming

Hospitals	**Location**
Fall River Hospital	Hot Springs, SD
Custer Regional Hospital	Custer City, SD
Weston County Health Services	Newcastle, WY
Clinics	**Location**
Fall River Health Clinic	Hot Springs, SD
Custer Regional Clinic	Custer City, SD
Edgemont Regional Clinic	Edgemont, SD
Weston County Health Services	Newcastle
Health Services	**Location**
Office of Family and Community Health Services	Hot Springs, SD; Custer City, SD
Public Health Nursing	Newcastle, WY
Behavioral Management Systems	Hot Springs, SD

Table 3.11-7. Police, Fire Department, and Ambulance Services in Hot Springs, Custer City, and Edgemont, South Dakota, and Newcastle, Wyoming

Police	**Location**
Fall River County Sheriff	Hot Springs, SD
Hot Springs Police Department	Hot Springs, SD
Custer County Sheriff	Custer City, SD
Weston County Sheriff	Newcastle, WY
Newcastle Police Department	Newcastle, WY
Fire Departments	
Cascade Volunteer Fire Department	Hot Springs, SD
Minnekahta Volunteer Fire Department	Hot Springs, SD
Custer Volunteer Fire Department	Custer City, SD
Edgemont Volunteer Fire Department	Edgemont, SD
Newcastle Volunteer Fire Department	Newcastle, WY
EMS/Ambulance	
Hot Springs Volunteer Ambulance Service	Hot Springs, SD
Custer Ambulance Service	Custer City, SD
Edgemont Ambulance Service	Edgemont, SD
Newcastle Ambulance Service	Newcastle, WY
Weston County Health Services	Newcastle, WY

Police, fire department, and ambulance services in the ROI are listed in Table 3.11-7. Fall River, Custer, and Weston Counties have county sheriff's offices in Hot Springs, Custer City, and Newcastle, respectively. Hot Springs and Newcastle also have police departments. Volunteer fire departments and emergency medical services are located in Hot Springs, Custer City, Edgemont, and Newcastle.

The South Dakota Department of Social Services has local offices in Hot Springs and Custer City. These offices provide assistance with applying for programs including Supplemental Nutrition Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF). These offices also provide assistance with medical eligibility resources for children and families, long-term care, and medical saving programs. The Wyoming Department of Family Services has a local office in Newcastle, which provides assistance for connecting with community resources, reporting child and adult abuse and neglect, and applying for programs including SNAP, TANF, and Medicaid.

3.12 Public and Occupational Health

Baseline radiation levels in and around the proposed Dewey-Burdock ISR Project area are summarized in this section. Descriptions of these levels are known as "preoperational" or "baseline" radiological conditions, and they would be used to evaluate potential radiological impacts associated with ISR operations. This section also describes applicable safety criteria and radiation dose limits established for public protection and occupational health and safety.

Radiation dose is a measure of the amount of ionizing energy that is deposited in the body. Ionizing radiation is a natural component of the environment and ecosystem, and members of the public are exposed continuously to natural radiation. Radiation doses to the general public result from radioactive materials in the Earth's soils, rocks, and minerals. Rn-222 is a radioactive gas found in most soils and rocks that escapes into ambient air as part of the natural decay of uranium and its progeny, Ra-226. Low levels of naturally occurring uranium and radium are present in drinking water and food products. Cosmic radiation from outer space is another natural source of radiation. In addition to natural sources of radiation, there are also artificial or human-made sources that contribute to the dose the general public receives. Medical diagnostic procedures using radioisotopes and x-rays are a primary human-made radiation source. The National Council for Radiation Protection (NCRP) estimates the average annual total effective dose equivalent from natural background radiation sources, including terrestrial and cosmic, is approximately 3.1 millisieverts (mSv) [310 millirem (mrem)] for U.S. residents, although the dose varies by location and elevation (NCRP, 2009). The average dose to the general public from background radiation sources in South Dakota is 6 mSv/yr [600 mrem/yr], due to higher elevation and higher than average concentrations of naturally occurring uranium in the soil in South Dakota (EPA, 2006b). The GEIS, however, reported that although background radiation levels in South Dakota are significantly higher than the national average, background radiation levels in western South Dakota are close to the national average because of lower-than-state-average radon gas levels (NRC, 2009a). The annual average dose to the public from all sources (natural and manmade) is 6.2 mSv [620 mrem] (NRCP, 2009).

3.12.1 Baseline Radiological Conditions

In accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criteria 7 and 7A, the applicant developed and implemented a preoperational monitoring program to establish baseline radiological conditions at the proposed Dewey-Burdock ISR Project site (Powertech, 2009a). Results of the baseline radiological monitoring provide data on radiological conditions that will be used to evaluate future impacts of routine facility operations or accidental or unplanned releases, if a license is issued. The applicant followed guidance in NUREG–1569 (NRC, 2003) and NRC Regulatory Guide 4.14 (NRC, 1980) to establish preoperational radiological baseline conditions at the proposed site (Powertech, 2009a, 2011).

The applicant performed baseline radiological surveys and sampling at the site between August 2007 and July 2008 (Powertech, 2009a). The baseline radiological field investigations consisted of the following activities:

- Global positioning system (GPS)-based unshielded gamma-ray surveys at 100-m [328-ft] transect intervals in historical surface mine areas in the eastern portion of the proposed project area, 100-m [328-ft] transect intervals in proposed land application areas, and 500-m [1,640-ft] intervals in the remainder of the proposed project area (Figure 3.12-1). The purpose of the gamma-ray survey was to map ambient gamma radiation levels across the proposed site and identify areas for biased soil sampling.

- Surface soil 0–15 cm [0–6 in] sampling at 75 random and 5 biased locations spanning the proposed project area, and subsurface soil {15–30 cm [6–12 in] and 30–100 cm [12–39 in]} sampling at 9 random locations.

- Surface soil 0–15 cm [0–6 in] and subsurface soil {15–30 cm [6–12 in] and 30–100 cm [12–39 in]} sampling at 17 random locations in proposed land application areas.

- Sediment and surface water sampling from primary stream drainage areas and surface water impoundments.
- Shallow surface soil {0–5 cm [0–2 in]}, vegetation, and air particulate sampling at eight air monitoring stations {seven onsite stations and one located approximately 3 km [1.9 mi] west of the southwest corner of the proposed project area}.
- Radon monitoring in air at the eight air monitoring stations and eight additional locations within the proposed project area.
- Radon flux measurements at the nine random subsurface soils sampling locations (see second bullet).
- Ambient gamma and radon monitoring using thermoluminescent dosimeters (TLDs) for total ambient gamma and alpha track etch detectors for radon.
- Livestock sampling, consisting of samples from a locally grazing cow.
- Fish sampling at two locations on Beaver Creek (one upstream and one downstream of the proposed project area) and one location on the Cheyenne River downstream of its confluence with Beaver Creek.
- Groundwater sampling at 31 wells within the proposed project area.

3.12.1.1 Soils

The objective of the gamma-ray surveys is to characterize and quantify baseline or preoperational radiation levels and radionuclide concentrations in soils throughout the proposed project area. Results of the gamma-ray surveys are shown in Figure 3.12-1, and summary statistics for surface mine areas, proposed land application areas, and the remainder of the permit area are presented in Table 3.12-1. In the surface mine areas, gamma-ray count rates range from 5,550 to 460,485 counts per minute (cpm) [5.9 to 324 μrem/hr]. The mean count rate is 16,823 cpm [13.8 μrem/hr], and the median count rate is 12,717 cpm [10.9 μrem/hr]. Clusters of higher readings are associated with abandoned open pit uranium mines, waste rock, and drainages in the surface mine area (Powertech, 2009a). In areas where land application is proposed, gamma-ray readings range from 6,798 to 20,422 cpm [6.8 to 16.3 μrem/hr] with a median of 12,523 cpm [10.8 μrem/hr] in the Dewey area and from 8,498 to 24,248 cpm [8.0 to 19.0 μrem/hr] with a median of 12,232 cpm [10.6 μrem/hr] in the Burdock area. In the remainder of the proposed permit area, gamma-ray readings range from 5,883 to 171,243 cpm [6.1 to 121.9 μrem/hr] with a median similar to the proposed land application areas {12,664 cpm [10.9 μrem/hr]}. High count rates {i.e., count rates exceeding 17,000 cpm [13.9 μrem/hr]} are present in an 243-ha [600-ac] area located in the northern portion of the Dewey area and in the area of an artesian well and associated drainage in the southern part of the Dewey area (see Figure 3.12-1). The gamma-ray survey results presented in Figure 3.12-1 and Table 3.12-1 indicate the surface mine areas in the eastern and northeastern portions of the Burdock area have higher radiological measurements due to historic mining activities. Anomalous (i.e., high) gamma-ray readings identified in the southern part of the Dewey area in the area of an artesian well are likely due to discharging groundwater from the Inyan Kara aquifer. Because the prevailing wind direction is from the southeast (see SEIS Section 3.7.2.1), anomalous gamma

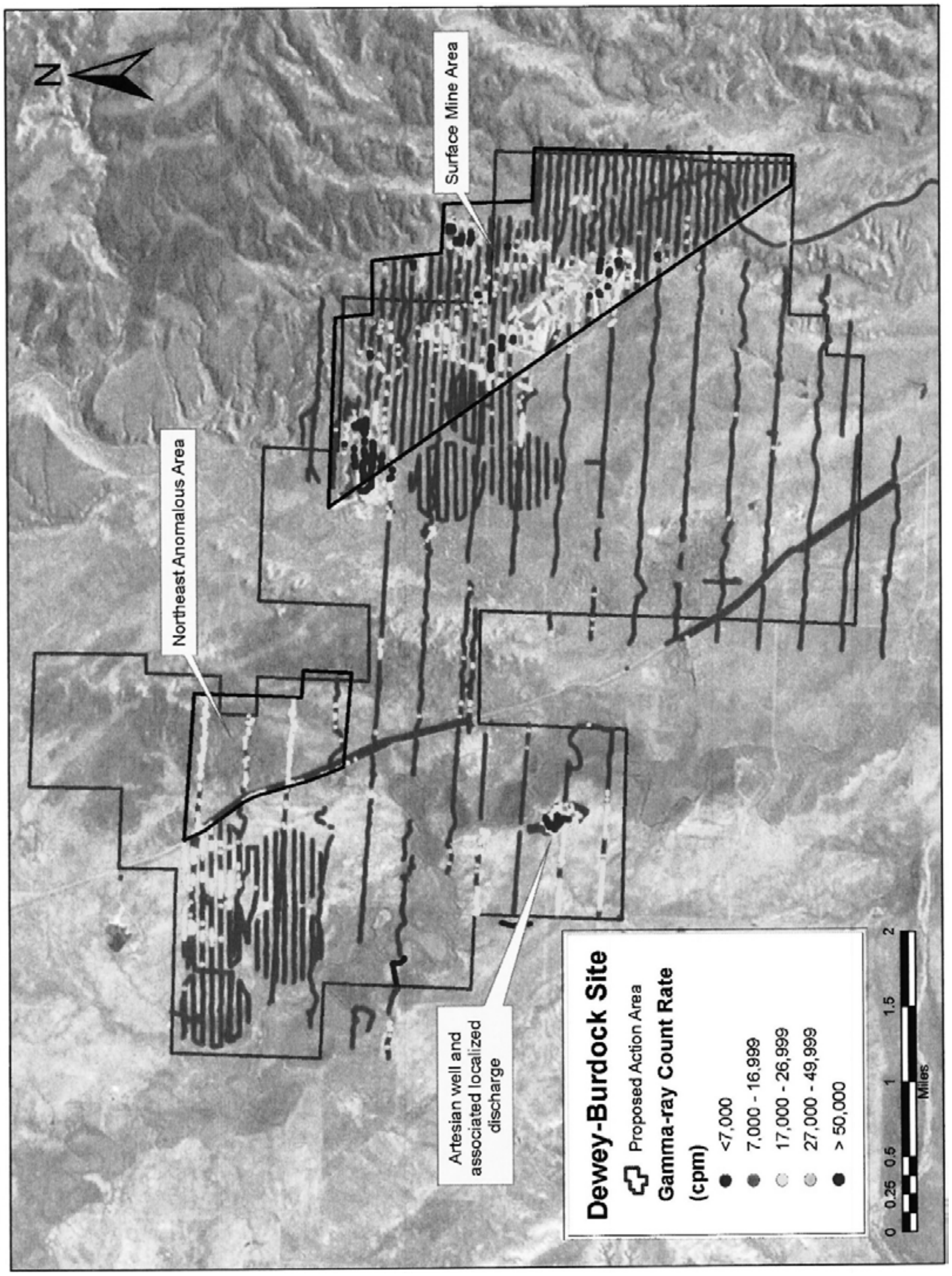

Figure 3.12-1. Map Showing Gamma-Ray Count Rates Obtained From GPS-Based Gamma Survey at the Proposed Dewey-Burdock Project Site.
Source: Powertech (2009a).

Table 3.12-1. Summary Statistics of Gamma-Ray Count Rates in Proposed Land Application Areas, Surface Mine Areas, and the Remainder of the Permit Area at the Proposed Dewey-Burdock Project

Parameter	Land Application Area		Surface Mine Area	Remainder of Permit Area
	Dewey	Burdock		
Mean	12,815	12,308	16,823	13,073
Standard Deviation	1,940	1,318	23,377	2,995
Median	12,523	12,232	12,717	12,664
Mode	11,778 (n=15)	12,266 (n=16)	12,138 (n=31)	12,585 (n=35)
Minimum	6,798	8,498	5,550	5,883
Maximum	20,422	24,248	460,485	171,243
No. of Counts	23,480	13,647	81,757	75,345

Source: Powertech (2009a)

readings in the northern part of the Dewey area are likely caused by the deposition of windblown dust from surface mine areas to the southeast in the Burdock area (Figure 3.12-1).

All surface soil samples were analyzed for Ra-226, and selected samples focusing on roll-front areas and land application areas were analyzed for uranium, Th-230, and Pb-210 (Powertech, 2009a, Table 6.1-5). Over the entire permit area, the mean and median Ra-226 concentrations for surface soils samples are 0.107 and 0.048 Bq/g [2.9 and 1.3 pCi/g], respectively. The median Ra-226 concentration of 25 surface soil samples in surface mine areas was 0.052 Bq/g [1.4 pCi/g]. Five of the surface mine soil samples were outliers exceeding a concentration of 0.22 Bq/g [5.9 pCi/g]. The median Ra-226 concentration of 55 surface soils samples in the remainder of the permitted area was 0.048 Bq/g [1.3 pCi/g]. Based on statistical analysis using the interquartile range (IQR), three of these samples were identified as outliers exceeding a concentration of 0.096 Bq/g [2.6 pCi/g] (Powertech, 2011). The IQR is a measure of statistical dispersion and is equal to the difference between the third quartile (75th percentile) and the first quartile (25th percentile). With outliers removed, both the surface mine data and the wider permit area data sets fit a lognormal distribution. The geometric mean of both data sets is 0.048 Bq/g [1.3 pCi/g], and the data lie within a population range of 0.028 to 0.081 Bq/g [0.76 to 2.2 pCi/g]. For comparison, background Ra-226 levels in soil in the United States typically average 0.037 Bq/g [1.0 pCi/g] (NCRP, 2009). In areas where land application is proposed, Ra-226 concentrations range from 0.015 to 0.163 Bq/g [0.4 to 4.4 pCi/g] and average 0.048 and 0.030 Bq/g [1.3 and 0.8 pCi/g] in the Dewey and Burdock areas, respectively. Results for the other radionuclides indicate a positive relationship between the concentrations of Ra-226 and uranium, Th-230, and Pb-210. Uranium concentrations range from 0.014 to 2.48 Bq/g [0.37 to 67 pCi/g]. Th-230 concentrations range from 0.004 to 1.11 Bq/g [0.1 to 30 pCi/g]. Pb-210 concentrations range from 0.018 to 1.11 Bq/g [0.5 to 30 pCi/g] (Powertech, 2009a). Prior to operations, the applicant has committed to collect 15 additional surface soil samples {0–15 cm [0–6 in]} in the Dewey area to address differences in sample density between the Dewey and Burdock area (Powertech, 2011).

All subsurface soil samples were analyzed for Ra-226, uranium, Th-230, and Pb-210 (Powertech, 2009a, Table 6.1-5). In surface mine areas and within the broader permit area, subsurface Ra-226 concentrations range from 0.026 to 0.207 Bq/g [0.7 to 5.6 pCi/g] and are comparable to those observed in surface samples. In land application areas, Ra-226 concentrations in subsurface soils range from 0.015 to 0.152 Bq/g [0.4 to 4.1 pCi/g] and have a median of 0.037 Bq/g [1.0 pCi/g] in the Dewey area and a median of 0.030 Bq/g [0.8 pCi/g] in the Burdock area. Ra-226 concentrations in subsurface soils in the land application areas are comparable to surface soil samples, with no observed trends with depth (Powertech, 2009a).

3.12.1.2 Sediment and Surface Water

Sediment and surface water samples were collected from upstream and downstream sites on three primary streams (Beaver Creek, Pass Creek, and the Cheyenne River), sites on two ephemeral drainages, and impoundments (including stock ponds and open pit mines) within the proposed project area (Powertech, 2009a, Figure 6.1-12). Sediment samples were analyzed for Ra-226, uranium, Th-230, and Pb-210 (Powertech, 2009a, Table 6.1-8). Uranium concentrations in sediments range from 1.0 to 37 mg/kg [1.0 to 37 ppm] and average 5.5 mg/kg [5.5 ppm]. Ra-226 concentrations range from 0.015 to 0.32 Bq/g [0.4 to 8.6 pCi/g] and average 0.06 Bq/g [1.6 pCi/g]. Th-230 concentrations range from 0.015 to 0.29 Bq/g [0.4 to 7.8 pCi/g] and average 0.06 Bq/g [1.6 pCi/g]. Pb-210 concentrations range from 0.007 to 0.35 Bq/g [0.2 to 9.6 pCi/g] and average 0.08 Bq/g [2.2 pCi/g]. Sediment samples from the Darrow Mine Pit and Triangle Mine Pit (see SEIS Section 3.2.3 and Figure 3.2-3), which are historical open pit uranium mines, exhibit the highest radionuclide concentrations. Sediment samples from the Darrow Mine Pit and Triangle Mine Pit have average uranium concentrations of 34.5 and 18.5 mg/kg [34.5 and 18.5 ppm]; average Ra-226 concentrations of 0.25 and 0.10 Bq/g [6.9 and 2.6 pCi/g]; average Th-230 concentrations of 0.25 and 0.18 Bq/g [6.85 and 4.85 pCi/g]; and average Pb-210 concentrations of 0.25 and 0.11 Bq/g [6.8 and 2.95 pCi/g], respectively (Powertech, 2009a).

Radionuclides measured in surface water samples included gross alpha, Ra-226, uranium, and Pb-210. Summary statistics for these radionuclides at stream sampling locations are listed in Table 3.5-1. More than half of the stream samples from Beaver Creek and the Cheyenne River exceed the EPA-regulated MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} in drinking water, as established in 40 CFR Part 141. Gross alpha concentrations range from 85 to 2,435 Bq/m^3 [2.3 to 65.8 pCi/L]. Total uranium concentrations range from 0.003 to 0.0378 mg/L [0.003 to 0.0378 ppm] with four of the samples from the Cheyenne River exceeding the EPA-regulated MCL for total uranium of 0.03 mg/L [0.03 ppm]. Total Ra-226 concentrations range from 0 to 189 Bq/m^3 [0 to 5.1 pCi/L] with one sample from Beaver Creek and one sample from the Cheyenne River exceeding the EPA-regulated MCL for total Ra-226 of 185 Bq/m^3 [5.0 pCi/L]. EPA's proposed MCL for Pb-210 of 37 Bq/m^3 [1.0 pCi/L] (EPA, 2000) was exceeded in 2 samples from Beaver Creek and 3 samples from the Cheyenne River. With the exception of gross alpha and uranium concentrations in the Darrow Mine Pit and the Triangle Mine Pit, water samples from impoundments at the proposed project demonstrate concentrations at or below EPA's proposed MCLs (Powertech, 2009a, Appendix 6.1–D). Uranium concentrations averaged 5.89 and 0.18 mg/L [5.89 and 0.18 ppm] at the Darrow Mine Pit and Triangle Mine Pit, respectively. Gross alpha concentrations averaged 205,091 and 5,513 Bq/m^3 [5,543 and 149 pCi/L] at the Darrow Pit Mine and the Triangle Mine Pit, respectively (Powertech, 2009a).

The applicant has committed to relocating upstream and downstream sediment and surface water sampling locations on Beaver Creek and Pass Creek closer to the proposed project boundary to better meet guidance in Regulatory Guide 4.14 (Powertech, 2011). Stream sampling sites BVC01, BVC04, PSC01, and PSC02 used for baseline monitoring (see Figure 3.5-2) will be replaced with sampling sites BVC11, BVC14, PSC11, and PSC12, which are located closer to the proposed project boundary (see Figure 7.2-2). Samples for each of these stream sampling sites will be collected monthly for 12 consecutive months prior to ISR operations (Powertech, 2011). The applicant's preoperational and operational surface water monitoring programs are discussed in SEIS Sections 7.2.4 and 7.3.3.

3.12.1.3 Air (Ambient Gamma, Radon, and Particulates)

TLDs were placed at each of the eight air monitoring stations established for the Dewey-Burdock ISR Project to measure ambient gamma dose rates. Based on the gamma dose rate monitoring results, projected exposure rates at the sample locations range from 0.91 to 1.23 mSv/yr [91 to 123 mrem/yr] with an average of 1.09 mSv/yr [109 mrem/yr] (Powertech, 2011, Table TR RAI 2.9-10). These values are within the range of reported background levels from natural radiation sources in the region and the United States, including cosmic radiation, external terrestrial radiation, and naturally occurring radon (NCRP, 2009).

Radtrack passive track etch detectors were placed at each of the eight air monitoring station locations and at eight additional locations to measure ambient Rn-222 concentrations in air. Rn-222 concentrations were measured quarterly over a 1-year period (Powertech, 2009a, Table 6.1-11). Period 1 (August 14 to September 27, 2007) ambient radon concentrations ranged from 37 to 363 Bq/m^3 [1.0 to 9.8 pCi/L] and averaged 89 Bq/m^3 [2.4 pCi/L]. Period 2 (September 27, 2007, to February 1–12, 2008) concentrations ranged from 15 to 67 Bq/m^3 [0.4 to 1.8 pCi/L] and averaged 44 Bq/m^3 [1.2 pCi/L]. Period 3 (February 1 through 12 to May 17, 2008) concentrations ranged from 15 to 122 Bq/m^3 [0.4 to 3.3 pCi/L] and averaged 67 Bq/m^3 [1.8 pCi/L]. Period 4 (May 17 to July 17, 2008) concentrations ranged from 18 to 38 Bq/m^3 [0.5 to 0.8 pCi/L] and averaged 18 Bq/m^3 [0.5 pCi/L]. The reported average ambient Rn-222 concentrations are within the range of background levels reported for the region (NCRP, 2009). Based on the gamma-ray survey results described in SEIS Section 3.12.1.1, radon concentrations adjacent to abandoned mine areas are expected to be higher than in other areas of the site. However, there was only one measurement {363 Bq/m^3 [9.8 pCi/L]} where this was the case, which resulted in the higher average radon concentration of 89 Bq/m^3 [2.4 pCi/L] during Period 1 (August 14 to September 27, 2007).

Radon flux rates were measured at nine locations on three occasions in mapped roll-front areas within the proposed project area. In fall (September) 2007, flux rates ranged from 0.025 to 0.065 Bq/m^2-s [0.68 to 1.77 pCi/m^2-s] and averaged 0.045 Bq/m^2-s [1.22 pCi/m^2-s] (Powertech, 2009a, Table 6.1-14). In spring (April) 2008, flux rates ranged from 0.010 to 0.049 Bq/m^2-s [0.28 to 1.33 pCi/m^2-s] and averaged 0.027 Bq/m^2-s [0.74 pCi/m^2-s]. In summer (July) 2008, flux rates ranged from 0.018 to 0.088 Bq/m^2-s [0.48 to 2.38 pCi/m^2-s] and averaged 0.055 Bq/m^2-s [1.5 pCi/m^2-s]. The flux rates measured at the proposed project site are well below the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) requirements of 0.740 Bq/m^2-s [20 pCi/m^2-s] specified in 10 CFR Part 40, Appendix A, Criterion 6, which applies to uranium mill tailings. Although not applicable to the proposed action, the NESHAPS requirements are useful in demonstrating the relatively low magnitude of radon flux rates measured at the site.

Air particulate samples were collected bi-weekly over a 1-year period (August 2007 to August 2008) at each of the air monitoring station locations. Particulates were collected using high volume air samplers and analyzed for Ra-226, uranium, Th-230, and Pb-210 (Powertech, 2009a, Table 6.1-12). Results of the air particulate sampling are summarized as follows:

- Ra-226 concentrations ranged from below detection limits to a maximum of 1.7×10^{-12} Bq/cm^3 [4.7×10^{-17} uCi/mL]. The maximum concentration is less than 0.1 percent of the effluent release limit of 3.3×10^{-8} Bq/cm^3 [9.0×10^{-13} uCi/mL] specified in 10 CFR Part 20, Appendix B.

- Uranium concentrations ranged from below detection limits to a maximum of 3.4×10^{-10} Bq/cm^3 [9.1×10^{-15} uCi/mL]. The maximum concentration is less than 1 percent of the effluent release limit of 3.3×10^{-7} Bq/cm^3 [9.0×10^{-12} uCi/mL] specified in 10 CFRPart 20, Appendix B.

- Th-230 concentrations ranged from below detection limits to a maximum of 2.1×10^{-12} Bq/cm^3 [5.6×10^{-17} uCi/mL]. The maximum concentration is less than 0.01 percent of the effluent release limit of 1.1×10^{-7} Bq/cm^3 [3.0×10^{-12} uCi/mL] specified in 10 CFR Part 20, Appendix B.

- Pb-210 concentrations ranged from below detection limits to a maximum of 1.5×10^{-9} Bq/cm^3 [4.1×10^{-14} uCi/mL]. The maximum concentration was 6.78 percent of the effluent release limit of 2.2×10^{-8} Bq/cm^3 [6.0×10^{-13} uCi/mL] specified in 10 CFR Part 20, Appendix B.

3.12.1.4 Groundwater

As described in SEIS Section 3.5.3.5, the applicant conducted initial preoperational groundwater sampling of wells at the proposed Dewey-Burdock ISR Project from July 2007 through June 2008 (Powertech, 2009a). This baseline study consisted of 19 groundwater wells (14 existing and 5 newly drilled) sampled on a quarterly basis. An additional 12 wells were sampled on a monthly basis from March 2008 to February 2009. The wells were selected based on type of use, aquifer, and location in relation to orebodies (Powertech, 2009a). The locations of all groundwater sampling wells are shown in Figure 3.5-2, and the formation sampled in each well is listed in Table 3.5-3. Radiological constituents sampled in each well included gross alpha, Ra-226, uranium, and Rn-222 (Powertech, 2009a, Tables 6.1-18 and 6.1-19). Results of preoperational groundwater sampling are discussed in SEIS Section 3.5.3.5 and summarized as follows:

- The MCL for uranium {0.03 mg/L [0.03 ppm]} was exceeded in samples from all but one of the wells (679) in the alluvial aquifers. Within the Burdock area, samples from wells 680 and 3026 in the Chilson aquifer and well 698 in the Fall River aquifer also exceeded the MCL for uranium. The range of uranium exceeding the MCL was 0.0322 to 0.132 mg/L [0.0322 to 0.132 ppm].

- The MCL for dissolved Ra-226 {185 Bq/m^3 [5 pCi/L]} was exceeded in about 50 percent of the wells in the Fall River and Chilson aquifers. The range of Ra-226 exceeding the MCL was 185 to 52,910 Bq/m^3 [5 to 1,430 pCi/L].

- The MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} was exceeded in about 75 percent of the wells. The range of gross alpha exceeding the MCLs in alluvial wells was 677 to 4,773 Bq/m^3 [18.3 to 129 pCi/L], while the range of gross alpha exceeding MCLs in the Fall River and Chilson aquifers was 555 to 240,500 Bq/m^3 [15 to 6,500 pCi/L].

- Two wells (680 and 681) with Ra-226 exceeding 11,100 Bq/m^3 [300 pCi/L] and gross alpha concentrations exceeding 37,000 Bq/m^3 [1,000 pCi/L] are directly within mapped orebodies in the Chilson and Fall River aquifers, whereas another (698) is downgradient of open pit mines within the Fall River aquifer.

- The only well not exceeding the proposed EPA limit for Rn-222 of 11,100 Bq/m^3 [300 pCi/L] (EPA, 2000) was well 650, a Chilson well upgradient of historic uranium mining activities. The Rn-222 values of samples exceeding the proposed limit ranged from 11,248 to 17.1×10^6 Bq/m^3 [304 to 462,000 pCi/L]. The wells with the highest concentration included wells 680 and 681, which are directly in mapped orebodies in the Chilson and Fall River aquifers, respectively, and well 42 in the Chilson aquifer used for domestic and stock water.

3.12.1.5 Vegetation, Livestock, and Fish

Vegetation samples (typically short grasses and clover plants) were collected in August 2007, April 2008, and July 2008 from representative grazing areas near each air monitoring station location. Composite samples of the vegetation were analyzed for Ra-226, uranium, Th-230, Pb-210, and Po-210 (Powertech, 2009a, Table 6.1-30). Results of the vegetation sampling are summarized as follows:

- Ra-226 concentrations ranged from 0.00074 to 0.00333 Bq/g [0.02 to 0.09 pCi/g] and averaged 0.00185 Bq/g [0.05 pCi/g].

- Uranium concentrations ranged from 0.00037 to .00148 Bq/g [0.01 to 0.04 pCi/g] and averaged 0.00074 Bq/g [0.02 pCi/g].

- Th-230 concentrations ranged from 0.00037 to 0.00111 Bq/g [0.01 to 0.03 pCi/g] and averaged 0.00074 Bq/g [0.02 pCi/g].

- Pb-210 concentrations ranged from 0.00222 to 0.0629 Bq/g [0.6 to 1.7 pCi/g] and averaged 0.0444 Bq/g [1.2 pCi/g].

- Po-210 concentrations ranged from 0.00296 to 0.00851 Bq/g [0.08 to 0.23 pCi/g] and averaged 0.00555 Bq/g [0.15 pCi/g].

In comparison to corresponding shallow {0–5 cm [0–2 in]} soil samples collected from air monitoring stations, radionuclide concentrations in the vegetation samples are one to two orders of magnitude lower (Powertech, 2009a). Pb-210 concentrations in the vegetation samples were significantly higher than the other radionuclides and are likely due to the higher relative abundance of Pb-210 in air particulates from radon decay products (Powertech, 2009a).

Three tissue samples, one liver and two meat samples, were collected from a locally grazing cow on June 25, 2008. These samples were analyzed for Ra-226, uranium, Th-230, Pb-210, and Po-210 (Powertech, 2009a, Table 6.1-31). Except for concentration of Po-210 in the liver tissue sample {0.74 Bq/kg [2.0×10^{-5} μCi/kg]}, radionuclide concentrations were at or below the lower limits of detection (see Powertech, 2009a, Table 6.1-31). To satisfy the food sampling requirements of Regulatory Guide 4.14 (NRC, 1980), the applicant collected tissue samples from another locally grazing cow and one free ranging, locally grazing pig in April 2011 (Powertech, 2011). These samples were analyzed for Ra-226, uranium, Th-230, and Pb-210 (Powertech, 2011, Table 2.9-19). The tissue sample from the locally grazing cow had measureable concentrations of uranium {0.085 Bq/kg [2.3×10^{-6} μCi/kg]}, Ra-226 {0.022 Bq/kg

[6.0 × 10^{-7} μCi/kg]}, and Pb-210 {0.043 Bq/kg [1.16 × 10^{-6} μCi/kg]}, while the concentration of Th-230 was below the lower limit of detection. The tissue sample from the locally grazing pig had measureable concentrations of uranium {0.30 Bq/kg [8.1 × 10^{-6} μCi/kg]} and Ra-226 {0.029 Bq/kg [7.9 × 10^{-7} μCi/kg]}, while the concentrations of Th-230 and Pb-210 were below the lower limit of detection. In accordance with food sampling requirements in Regulatory Guide 1.14 (NRC, 1980), the applicant has committed to sampling one additional cow, bringing the total to three, and two additional pigs, bringing the total to three, prior to ISR operations at the Dewey-Burdock Project site (Powertech, 2011).

Twelve fish species (Powertech, 2009a, Table 3.5-27) were collected for radiological analyses in April 2008 and July 2008 from three sampling locations: (i) BVC04—Beaver Creek upstream of the proposed project area; (ii) BVC01—Beaver Creek downstream of the proposed project area; and (iii) CHR05—Cheyenne River downstream of its confluence with Beaver Creek (see Figure 3.5-2). Whole fish samples were analyzed for uranium, Po-210, Pb-210, Th-230, and Ra-226 (Powertech, 2009a, Table 3.5-30). In April 2008, the channel catfish (*Ictalurus punctatus*) was the only species collected that contained detectable uranium {0.05 mg/kg [0.05 ppm] and 3.0 × 10^{-5} μCi/kg [1.11 Bq/kg]}. The channel catfish is the only species collected in the proposed project area that is typically caught for human consumption. In July 2008, uranium was detected in all the fish species collected due to increased sample sizes (see Powertech, 2009a, Table 3.5-30). Uranium concentrations ranged from 0.0066 to 0.04 mg/kg [0.0066 to 0.04 ppm], which is similar to the uranium concentration range of 0.003 to 0.0378 mg/L [0.003 to 0.0378 ppm] in stream samples (see SEIS Sections 3.12.1.2). Uranium radioactivity ranged from 2.7 × 10^{-5} to 4.4 × 10^{-6} μCi/kg [1.0 to 0.16 Bq/kg]. Radioactivity from Po-210, Th-230, and Ra-226 was undetectable or low in most of the fish samples collected in April and July 2008. Pb-210 was detected in only one fish specimen, the plains killifish (*Fundulus zebrinus*) collected in April 2008 at the downstream Beaver Creek location (BVC01). However, due to matrix interference, the precision of this measurement was equal to the detected concentration {0.02 μCi ± 0.02 μCi [740 Bq ± 740 Bq]}.

3.12.2 Public Health and Safety

NRC has the statutory responsibility, pursuant to the Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act, to protect the public health and safety and the environment. NRC's regulations at 10 CFR Part 20 specify annual dose limits to members of the public of 1 mSv [100 mrem] total effective dose equivalent (TEDE) with no more than 0.02 mSv [2 mrem] in any 1-hour period from any external sources. This public dose limit from NRC-licensed activities is a fraction of the background radiation dose as discussed in Section 3.12.1.

Crow Butte is an operational ISR facility located approximately 105 km [65 mi] south-southeast of the Dewey-Burdock ISR Project in Dawes County, Nebraska. Because of its distance from the Dewey-Burdock site, the Crow Butte ISR facility is not considered to represent a source of radiation exposure in and around the proposed project area. Therefore, baseline radiological conditions represent the only radiation exposure to individuals in the area surrounding the proposed Dewey-Burdock ISR Project area.

As discussed in SEIS Section 3.12.1, elevated gamma-ray survey readings are associated with abandoned open pit uranium mines in the eastern and northeastern portion of the Burdock area (see Figure 3.12-1). Elevated gamma readings are also present in the northern part of the Dewey area and are likely due to the deposition of windblown dust from the abandoned surface mine areas to the southeast in the Burdock area (see Figure 3.12-1). A final area of elevated gamma readings is present in the southern part of the Dewey area near an artesian well and is likely due to discharging groundwater from the Inyan Kara aquifer. Other than these areas of elevated radiological readings, the information provided for the proposed Dewey-Burdock ISR Project area does not contain any new or significant findings that are contrary or vary from the information and conclusion presented in the GEIS. The baseline radiological surveys presented in Powertech (2009a and 2011) provide adequate documentation of preoperational conditions for the proposed Dewey-Burdock ISR Project area and would be used as part of the overall baseline data package during operational and decommissioning activities.

The public health in a region is assessed by reviewing health studies conducted in the region over a period of time. In a review of the public health literature, specifically looking at radiological and chemical exposures, the applicant identified a South Dakota study with information specific to the proposed project area (Powertech, 2010a). The South Dakota Department of Health (SDDOH) conducted a study of cancer rates in nine South Dakota counties and reported that the presence of existing uranium mines was not associated with increased cancer death rates (SDDOH, 2006).

3.12.3 Occupational Health and Safety

Radiation Protection Standards at 10 CFR Part 20 are concerned with occupational health and safety risks to workers and provide limits on worker exposure to radiation. The regulations provide annual radiation dose limits for workers and incorporate the principal of maintaining doses “as low as is reasonably achievable” (ALARA) taking into consideration the purpose of the licensed activity and its benefits, technology for reducing doses, and the associated health and safety benefits. A maximum annual occupational dose is determined by the more limiting of two calculated dose equivalents: (i) 0.05 Sv [5 rem] total effective dose equivalent and (ii) the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.5 Sv [50 rem]. The lower dose equivalent calculated is the maximum annual occupational dose. The lens of the eye is limited to a dose equivalent of 0.15 Sv [15 rem], and the skin (of the whole body or any extremity) is limited to a shallow dose equivalent of 0.5 Sv [50 rem]. Radiation safety measures that comply with these 10 CFR Part 20 standards must be implemented at ISR facilities to protect workers and to ensure radiation exposures and doses are below occupational limits as well as ALARA.

Also of concern, with respect to occupational health and safety, are industrial hazards and exposure to nonradioactive pollutants, which for an ISR operation can include normal industrial airborne pollutants associated with service equipment (e.g., vehicles), fugitive dust emissions from access roads and well field activities, and various chemicals used in the ISR process. Industrial safety aspects associated with the use of hazardous chemicals at the proposed Dewey-Burdock ISR Project would be regulated under the State of South Dakota regulations and the South Dakota Occupational Safety and Health Administration. The types of chemicals and impacts are discussed in SEIS Section 4.13.

The Occupational Safety and Health Administration (OSHA) does not compile data on workplace total recordable incident rates and lost-time incident rates specific to the ISR industry (Powertech, 2010a). Statistics for injuries and illnesses for the ISR industry are included in the category “Other Metal Ore Mining,” which includes both underground and surface (open pit) uranium mines (OSHA, 2010). Total recordable incidence rates and total lost-time incidents for the “Other Metal Ore Mining” category for years 2003 to 2008 are listed in

Table 3.12-2. Total recordable incidents are work-related deaths, illnesses, or injuries resulting in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid. A lost-time incident is a recordable incident that results in one or more days away from work, days of restricted work activity, or both, for affected employees. The incident rate is used for measuring and comparing work injuries, illnesses, and accidents within and between industries and can be an indicator of the impacts of operations on occupational health.

OSHA data for specific injury/illness and lost time in the ISR industry is not available, although the applicant provided operation-specific information from one licensed ISR facility in Texas (Powertech, 2010a). Over a 4-year period from 2006 through 2009, the Uranium Resources Inc. ISR facility in Lewisville, Texas, which employs about 100 people, reported 36 injuries or illnesses requiring medical attention, an average of 9 per year. Over the same period, the ISR facility reported four lost-time cases, an average of one per year, and one contractor fatality.

3.13 Waste Management

SEIS Section 2.1.1.1.6 describes the types and volumes of liquid and solid waste that could be generated by operation of the proposed Dewey-Burdock ISR Project. The applicant proposes the following disposal practices: (i) nonhazardous solid waste will be disposed in a sanitary landfill; (ii) solid byproduct material will be disposed at a licensed waste disposal site or a mill tailings facility licensed to receive byproduct material from outside sources; (iii) liquid byproduct material will be disposed using either (a) deep Class V disposal wells, (b) land application, or (c) a combination of deep Class V disposal wells and land application; and (iv) sanitary waste will be disposed in an onsite septic system. The applicant will not generate mixed waste from any of the proposed waste management options. Mixed waste consists of a mixture of hazardous waste (as defined by the Resource Conservation and Recovery Act) and radioactive waste (as defined by the Atomic Energy Act). The applicant expects the proposed Dewey-Burdock ISR Project to be classified as a Conditionally Exempt Small Quantity Generator of hazardous waste under the Resource Conservation and Recovery Act. SDDENR will determine whether that classification applies to the proposed facility (see Section2.1.1.1.6.3). SEIS Section 2.1.1.1.6 describes the annual waste volumes that the proposed project is expected to generate. The present section describes the disposition of waste streams generated by the proposed project.

Table 3.12-2. Total Recordable Incidence Rates and Total Lost-Time Incidents for the Category "Other Metal Ore Mining"*

Year	Recordable Incidence Rate (Per 100 Employees)	Total Lost-Time Incidents (Per 100 Employees)
2008	3.6	2.2
2007	3.5	2.0
2006	3.8	2.6
2005	6.0	4.4
2004	<15 total cases	—
2003	<15 total cases	—

Source: OSHA (2010)
*Includes underground and surface uranium mining.

3.13.1 Liquid Waste Disposal

Liquid wastes generated from operation of the proposed Dewey-Burdock ISR Project will include well development and well test waters; storm water; waste petroleum products and chemicals; sanitary wastewater; and liquid byproduct material including production bleed, process solutions, laboratory chemicals, plant washdown water, and restoration water. Process solutions include process bleed, elution and precipitation brines, and resin transfer wash. The applicant will collect storm water and discharge to surface water in accordance with an SDDENR NPDES permit. Waste petroleum products and chemicals meeting the definition of hazardous waste will be stored in small quantities until disposal in accordance with all applicable local, state, and federal regulatory requirements as described in SEIS Section 2.1.1.1.6.3. The applicant will dispose of sanitary wastewater from restrooms and lunchrooms in an SDDENR-permitted septic system. The applicant will dispose of liquid byproduct material, well development and well test waters via either (i) deep Class V well injection; (ii) land application; or (iii) a combination of deep Class V well injection and land application, as described under the proposed action in SEIS Section 2.1.1.1.6.2. Liquid byproduct material must be treated onsite using a combination of ion exchange, reverse osmosis, and radium settling depending on the disposal option selected as described in Section 2.1.1.1.6.2 (Powertech, 2009a–c). If the applicant uses the deep well disposal option, four to eight Class V wells will be installed, as described in SEIS Section 2.1.1.1.6.2. Figure 2.1-12 shows the proposed land application areas.

3.13.2 Solid Waste Disposal

Solid byproduct material (including radioactively contaminated soils or other media) that does not meet NRC unrestricted release criteria must be disposed of at a licensed facility, as required by 10 CFR Part 40, Appendix A, Criterion 2. As described in SEIS Section 2.1.1.1.6.3, the proposed action will generate solid byproduct material that does not meet NRC criteria for unrestricted release. In addition to the regulatory requirements, if an NRC license is granted, NRC staff will require, by license condition, an agreement to be in place before operations begin to ensure the availability of sufficient disposal capacity. The applicant has identified the White Mesa site as the disposal location for solid byproduct material, but a disposal agreement is not yet in place (Powertech, 2011). The White Mesa site, an operating conventional uranium mill in Blanding, Utah, is permitted to construct an additional 1,452,654 m^3 [1,900,000 yd^3] of tailings impoundment capacity (UDEQ, 2010a); however, in accordance with its license, it must obtain approval from Utah Department of Environmental Quality (UDEQ) to bury ISR waste. Furthermore, it may not receive more than 3,823 m^3 [5,000 yd^3] of ISR wastes from any single source (UDEQ, 2010b).

As discussed in SEIS Section 2.1.1.1.6.3, nonhazardous solid wastes are materials that are not hazardous waste and comply with NRC unrestricted release limits. All proposed phases of the Dewey-Burdock ISR Project will generate nonhazardous solid waste (Powertech, 2009a). The proposed project is expected to generate solid wastes that could include general facility trash, septic system solids, construction/demolition debris, and any solid byproduct material (such as piping, valves, instrumentation, or equipment) that has been decontaminated to meet NRC criteria for unrestricted release.

The applicant has proposed to dispose of nonhazardous solid waste at the Custer-Fall River Waste Management District landfill at Edgemont, South Dakota, approximately 24 km [15 mi] southeast of the proposed Dewey-Burdock site. The Custer-Fall River landfill received

9,964 short tons {approximately 19,060 m^3 [24,910 yd^3]} of solid waste in 2011 and has a remaining permitted solid waste capacity of 154,000 tons {approximately 294,567 m^3 [385,000 yd^3]} (Barker Concrete & Construction, Inc., 2012). The projected average annual rate of waste received at the landfill is 8,160 t/yr [9,000 T/yr] (SDDENR, 2010). The remaining capacity would allow operations of the landfill for an additional 17 years beyond mid-year 2012 (the time of the capacity estimate) if the annual receipt of waste continued at the projected annual average rate.

If additional disposal capacity was needed, the applicant has also proposed to dispose of nonhazardous solid waste at a landfill in Newcastle, Wyoming (Powertech, 2010a), approximately 64 km [40 miles] north of the proposed Dewey-Burdock ISR Project site. The most recent published documentation of landfill characteristics NRC staff identified is from American Engineering Testing, Inc. (AET, Inc.) (2011). The estimated volume of waste the Newcastle landfill receives annually is 12,118 m^3 [15,850 yd^3] (AET, Inc., 2011). The remaining permitted capacity of the Newcastle landfill was reported as 187,452 m^3 [245,000 yd^3] and estimated in 2011 to allow 12 additional years of operation (AET, Inc., 2011). These annual inputs to waste facilities are provided to show how the proposed action's generation rate compares with the regional generation from other sources.

Another more distant and higher capacity landfill serving Rapid City, South Dakota, is projected to be operational until 2050 (HDR Engineering Inc., 2010).

3.14 References

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