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NUREG-1910
Supplement 5

Environmental Impact Statement for the Ross ISR Project in Crook County, Wyoming

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

Draft Report for Comment

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 and byproduct materials provided that 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 the *Code of Federal Regulations* (CFR), Title 10, Part 51, which implement the *National Environmental Policy Act of 1969* (NEPA), issuance of a license to possess and use source and byproduct materials during uranium recovery and milling requires an environmental impact statement (EIS) or a supplement to an EIS (SEIS).

In May 2009, the NRC issued NUREG–1910, *Generic Environmental Impact Statement* (GEIS) *for In-Situ Leach Uranium Milling Facilities*. In the GEIS, the NRC assessed the potential environmental impacts from the construction, operation, aquifer restoration, and decommissioning of in situ recovery (ISR) facilities located in four specific geographic regions of the western U.S. As part of this assessment, the NRC determined which potential impacts would be essentially the same for all ISR facilities and which would result in varying levels of impacts for different facilities and would therefore require further site-specific information to determine potential impacts. The GEIS provides a starting point for the NRC's NEPA analyses for site-specific license applications for new ISR facilities as well as for applications to amend or to renew existing ISR licenses.

By a letter dated January 4, 2011, Strata Energy Inc. (referred to herein as Strata or the "Applicant") submitted a license application to the NRC for a new source and byproduct materials license for the proposed Ross Project. The Ross Project would be located in Crook County, Wyoming, which is in the Nebraska-South Dakota-Wyoming Uranium Milling Region identified in the GEIS. The NRC staff prepared this SEIS to evaluate the potential environmental impacts of the Applicant's proposal to construct, operate, conduct aquifer restoration, and decommission an ISR facility at the Ross Project. This SEIS describes the environment that could be affected by the proposed Ross Project activities, estimates the potential environmental impacts resulting from the Proposed Action and two Alternatives, discusses the corresponding proposed mitigation measures, and describes the Applicant's environmental-monitoring program. In conducting its analysis for this SEIS, the NRC staff evaluated site-specific data and information to determine whether the site characteristics and the Applicant's proposed activities were consistent with those evaluated in the GEIS. The NRC staff then determined relevant sections, findings, and conclusions in the GEIS that could be incorporated by reference, and identified the areas that needed additional analysis. Based on its environmental review, the preliminary NRC staff recommendation is that, unless safety issues mandate otherwise, the source and byproduct materials license be issued as requested.

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 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." Washington, DC: NRC. May 2009. Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML091480244 and ML091480188.

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EXECUTIVE SUMMARY

BACKGROUND

By a letter dated January 4, 2011, Strata Energy Inc. (Strata or the "Applicant") submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new source and byproduct materials license for the proposed Ross Project, an in situ recovery (ISR) project to be located in Crook County, Wyoming. The proposed Ross Project includes a central processing plant (CPP) to produce yellowcake, corresponding injection and recovery wells, deep-disposal wells for liquid effluents, monitoring wells throughout the Ross Project area as well as other various infrastructure (e.g., pipelines, roads, and lighting).

The *Atomic Energy Act of 1954* (AEA), as amended by the Uranium Mill Tailings Radiation Control Act of 1978, authorizes the NRC to issue licenses for the possession and use of source material and byproduct material. The NRC must license facilities, including ISR operations, in accordance with NRC regulatory requirements. These requirements were developed to protect public health and safety from radiological hazards and to protect common defense and security. The NRC's environmental protection regulations are found at Title 10 of the *Code of Federal Regulations* (CFR), Part 51 (10 CFR Part 51); these regulations implement the National Environmental Policy Act of 1969 (NEPA). 10 CFR Part 51 requires that the NRC prepare an environmental impact statement (EIS) or supplement to another EIS (SEIS) or a generic EIS (GEIS) for its issuance of a license to possess and use source and/or byproduct materials for uranium milling (see 10 CFR Part 51.20[b][8]).

In May 2009, the NRC issued NUREG–1910, *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities*. In this GEIS, the NRC assessed the potential environmental impacts of the construction, operation, aquifer restoration, and decommissioning of ISR facilities located in four specified geographic regions of the western U.S. The proposed Ross Project is located within the Nebraska-South Dakota-Wyoming Uranium Milling Region (NSDWUMR) identified in the GEIS. The GEIS provides a starting point for the NRC's NEPA analyses for site-specific license applications for new ISR facilities. This Draft SEIS incorporates by reference information from the GEIS. This document also uses information from the Applicant's license application and subsequent environmental report and its responses to the NRC's requests for additional information as well as other publicly available sources of information.

This Draft SEIS includes the NRC staff's analysis of the environmental impacts from the Proposed Action (i.e., for the NRC to license the Ross Project), the environmental impacts of two Alternatives to the Proposed Action (i.e., the "No-Action" Alternative and the "North Ross Project" Alternative), and the mitigation measures that are intended to either minimize or avoid adverse impacts. It also includes the NRC staff's preliminary recommendation regarding the Proposed Action.

PURPOSE AND NEED OF THE PROPOSED ACTION

The 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 and byproduct materials license to authorize commercial-scale in situ uranium recovery at the Ross Project area. The purpose and need for this Proposed Action is to provide an option that allows the Applicant to recover uranium and to produce yellowcake at the Ross Project area. Yellowcake is the uranium oxide product of the ISR uranium-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 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.

THE PROJECT AREA AND FACILITY

Strata's Proposed Action, the Ross Project, would occupy 697 ha [1,721 ac] in the north half of the approximately 90-km^2 [56-mi^2] Lance District, where the Applicant is actively exploring for additional uranium reserves. Strata has also identified four other uranium-bearing areas that would extend the area of uranium recovery to the north with the Ross Amendment Area 1 and to the south of the Lance District with the Kendrick, Richards, and Barber satellite facilities. These areas are not a component of the Proposed Action in this SEIS.

The Lance District is located on the western edge in the northwest corner of the NSDWUMR. It is situated between the Black Hills uplift to the east and the Powder River Basin to the west. Both of these regional features are described in the GEIS. The environment of the Proposed Action is described in Section 3 of this SEIS.

The Proposed Action includes the ISR facility itself and its wellfields. The ISR facility consists of the following:

- A CPP that houses the uranium- and vanadium-processing equipment, drying and packaging equipment, and water-treatment equipment;
- A chemical storage area as well as other storage, warehouse, maintenance, and administration buildings; and
- Two double-lined surface impoundments, a sediment impoundment, and five Class I deep-injection wells.

The Proposed Action includes the option of the Applicant operating the Ross Project facility beyond the life of the Project's wellfields. The facility could be used to process uranium-loaded resins from satellite projects within the Lance District operated by the Applicant, or from other offsite uranium recovery projects not operated by the Applicant (i.e., "toll milling"), or from offsite water-treatment operations. With that option, the life of the facility would be extended to 14 years or more.

The Ross Project would also host 15 – 25 wellfield areas and would consist of a total of 1,400 – 2,000 recovery and injection wells. The wellfield areas would be surrounded by a perimeter ring of monitoring wells.

THE IN SITU URANIUM RECOVERY PROCESS

During the in situ uranium recovery process, an oxidant-charged solution, called a lixiviant, is injected into the ore-zone aquifer (or uranium “ore body”) through injection wells. The ore zone is that portion of the aquifer that has been permanently exempted by the U.S. Environmental Protection Agency (EPA) from requirements as an underground source of drinking water under the *Safe Drinking Water Act*. Typically, a lixiviant uses native groundwater (from the ore-zone aquifer itself), carbon dioxide, and sodium carbonate/bicarbonate, with an oxygen or hydrogen peroxide oxidant. As it circulates though the ore zone, the lixiviant oxidizes and dissolves the mineralized uranium, which is present in a reduced chemical state. The resulting uranium-rich solution, the “pregnant” lixiviant, is drawn to recovery wells by pumping, and then transferred to the CPP via a network of pipes buried just below the ground surface. At the CPP, the uranium is extracted from the solution using an ion exchange process. The resulting “barren” (uranium-depleted) solution is then recharged with the oxidant and re-injected to recover more uranium from the wellfield.

During production, the uranium recovery solutions continually move through the aquifer from outlying injection wells to internal recovery wells. These wells can be arranged in a variety of geometric patterns depending on the ore-body’s configuration, the aquifer’s permeability, and the operator’s selection based upon operational considerations. Wellfields are often designed in a five-spot or seven-spot pattern, with each recovery (i.e., production) well being located inside a ring of injection wells. Monitoring wells surround the wellfield pattern area, terminating in the ore-zone aquifer as well as in both the overlying and underlying aquifers. These monitoring wells are screened in appropriate stratigraphic horizons to detect lixiviant should it migrate out of the production, or ore, zone. The uranium that is recovered from the solution would be processed in the CPP to yellowcake. The yellowcake would be packaged into NRC-and U.S. Department of Transportation (USDOT)-approved 208-L [55-gal] steel drums, and trucked offsite to a licensed uranium-conversion facility.

Once uranium recovery is complete, the ore-zone’s ground water is restored to NRC-approved ground-water protection standards, which are protective of the surrounding ground waters. The facility is decommissioned according to an NRC-approved decommissioning plan and in accordance with NRC-approved standards. Once decommissioning is approved by the NRC, the site may be released for public use.

THE ALTERNATIVES

The NRC environmental review regulations in 10 CFR Part 51, which implement NEPA, require the 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 to the impacts that would result if a given alternative were implemented. This SEIS evaluates the potential environmental impacts of the Proposed Action and two

Alternatives, including the No-Action Alternative and the North Ross Project. Under the No-Action Alternative, the Applicant would neither construct nor operate a uranium recovery facility or wellfields at the proposed Ross Project. In Alternative 3, the proposed Ross Project's facility (i.e., the CPP, surface impoundments, and auxiliary structures) would be constructed at a site north of where it is proposed to be located in the Proposed Action, but the wellfields would remain in the same locations as in the Proposed Action. This alternative facility location would require additional, substantial earth-moving to construct the surface impoundments, but a containment barrier wall (CBW) (described later in this SEIS) would not be required. Alternatives considered and eliminated from detailed analysis include conventional mining and milling, conventional mining and heap leach processing, and alternate lixiviants. These alternatives were eliminated from detailed study because they either do not meet the purpose and need of the proposed Ross Project or would cause greater environmental impacts than the Proposed Action.

SUMMARY OF THE ENVIRONMENTAL IMPACTS

This Draft SEIS includes the NRC staff's analysis, which considers and weighs the environmental impacts resulting from the construction, operation, aquifer restoration, and decommissioning of an in situ uranium recovery facility at the proposed Ross Project area and the two Alternatives. This SEIS also describes mitigation measures for the reduction or avoidance of potential adverse impacts that either: 1) the Applicant has committed to in its NRC license application, 2) would be required under other State or Federal permits or processes, or 3) are additional measures that the NRC staff identified as having the potential to reduce environmental impacts, but the Applicant did not commit to in its license application. The 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 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.

Table ExS.1 provides a summary of the NRC's evaluation of the potential environmental impacts of the construction, operation, aquifer restoration, and decommissioning of the Ross Project, followed by a brief summary of impacts by environmental resource area and lifecycle phase. These potential impacts are more fully described in Section 4 of this SEIS, where the magnitude of impacts by phase of the Ross Project is provided for each resource area.

Table ExS.1
Summary of Environmental Impacts

Resource Area	Alternative 1: Proposed Action — Construction	Alternative 1: Proposed Action — Operation	Alternative 1: Proposed Action — Aquifer Restoration	Alternative 1: Proposed Action — Decommissioning	Alternative 2: No-Action	Alternative 3: North Ross Project
Land Use	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Transportation	SMALL to MODERATE to LARGE With Mitigation: SMALL to MODERATE	SMALL to MODERATE to LARGE With Mitigation: SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE With Mitigation: SMALL to MODERATE	SMALL	SMALL to MODERATE to LARGE with Mitigation: SMALL to MODERATE
Geology and Soils						
▪ Geology	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
▪ Soils	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water Resources						
▪ Surface Water						
Water Quantity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
▪ Wetlands	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
▪ Ground Water	SMALL	SMALL to MODERATE (See OZ Aquifer Below)	SMALL to MODERATE (See OZ Aquifer Below)	SMALL	SMALL	SMALL to MODERATE (Excursions) (Short-Term Drawdowns)
Shallow Aquifers						
Water Quantity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

Table ExS.1
Summary of Environmental Impacts

Resource Area	Alternative 1: Proposed Action — Construction	Alternative 1: Proposed Action — Operation	Alternative 1: Proposed Action — Aquifer Restoration	Alternative 1: Proposed Action — Decommissioning	Alternative 2: No-Action	Alternative 3: North Ross Project
▪ **Ground Water** (Continued)						
Ore-Zone Aquifers						
Water Quantity	SMALL	SMALL	SMALL to MODERATE (Short-Term Drawdown)	SMALL	SMALL	SMALL to MODERATE (Short-Term Drawdown)
Water Quality	SMALL	SMALL (Long-Term) SMALL to MODERATE (Excursion)	SMALL	SMALL	SMALL	SMALL (Long-Term) SMALL to MODERATE (Excursion)
Deep Aquifers						
Water Quantity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water Quality	SMALL	SMALL	SMALL	SMALL		
Ecology					SMALL	SMALL
▪ Vegetation	SMALL	SMALL	SMALL	SMALL		
▪ Wildlife	SMALL	SMALL	SMALL	SMALL		
▪ Aquatic	SMALL	SMALL	SMALL	SMALL		
▪ Protected Species	SMALL	SMALL	SMALL	SMALL		
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Noise	SMALL TO MODERATE (Short Term)	SMALL TO MODERATE (Short Term)	SMALL	SMALL TO MODERATE (Short Term)	SMALL	SMALL TO MODERATE
Historical, Cultural, and Paleontological Resources	SMALL to LARGE	SMALL	SMALL	SMALL	SMALL	SMALL to LARGE

Table ExS.1
Summary of Environmental Impacts

Resource Area	Alternative 1: Proposed Action — Construction	Alternative 1: Proposed Action — Operation	Alternative 1: Proposed Action — Aquifer Restoration	Alternative 1: Proposed Action — Decommissioning	Alternative 2: No-Action	Alternative 3: North Ross Project
Visual and Scenic Resources	SMALL (Long-Term) MODERATE (Short-Term) (First Year) (Nearest Residents)	SMALL	SMALL	SMALL	SMALL	SMALL (Long-Term) MODERATE (Short-Term) (First Year)
Socioeconomics	SMALL to MODERATE (Taxes Paid to Crook County)	SMALL to MODERATE (Taxes Paid to Crook County)	SMALL	SMALL	SMALL	SMALL to MODERATE (Taxes Paid to Crook County)
Environmental Justice	N/A No Minority or Low-Income Groups	N/A No Minority or Low-Income Groups	N/A No Minority or Low-Income Groups	N/A No Minority or Low-Income Groups	N/A No Minority or Low-Income Groups	N/A No Minority or Low-Income Groups
Public and Occupational Health and Safety	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management						
▪ Liquid	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
▪ Solid	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

THE IMPACTS BY RESOURCE AREA AND PROJECT PHASE

Land Use

Construction: Impacts would be SMALL. The Ross Project area comprises a total of 697 ha [1,721 ac] in the north half of the approximately 90-km^2 [56-mi^2] Lance District. This area is currently used for livestock grazing, wildlife habitat, some agriculture, and some oil production. A total of 113 ha [280 ac] of land, which represents 16 percent of the Ross Project area, would be disturbed during the construction of a CPP, surface impoundments, and other auxiliary structures such as storage areas and parking lots. The wellfields would be sequentially developed over the Ross Project lifecycle. All disturbed areas would be fenced and, thus, somewhat limit grazing by livestock, access by wildlife, and recreational opportunities.

Operation: Impacts would be SMALL. Land-use impacts during the operations phase would be similar to, or less than, those during the construction phase because the buildings, surface impoundments, and infrastructure would be in place. Areas where Ross Project uranium-production activities would take place would remain fenced, somewhat limiting grazing and some crop production. No new facilities would be constructed that would result in additional land disturbance during operation, although well drilling would continue as the wellfields would be sequentially developed.

Aquifer Restoration: Impacts would be SMALL. Land-use impacts would be similar to, or less than, those during the construction and operation phases. Wellfield access would continue to be restricted from other uses such as livestock grazing and crop production, as described for the Ross Project's operation phase. No new facilities would be constructed that would result in additional land disturbance.

Decommissioning: Impacts would be SMALL. Land-use impacts during the Proposed Action's decommissioning as well as the site's reclamation would temporarily increase due to the additional equipment that would be used for dismantling and removing Ross Project components such as the CPP, surface impoundments, and wellfields. In addition, the reclamation of the site would involve significant earth moving, land disturbance, and access restrictions. However, these short-term impacts would not be greater than those experienced during the Ross Project's construction phase. At the end of the Ross Project's decommissioning and site reclamation, the preconstruction land uses would be restored.

Transportation

Construction: Impacts would be MODERATE TO LARGE on local and county roads, but would be SMALL on the Interstate-highway system of the U.S. With the identified mitigation measures, the transportation impacts on local and county roads would lessen and they would be MODERATE. The highest traffic volume resulting from the Ross Project would occur during its construction phase, because of the large workforce (200 workers) and frequent supply, building material, and equipment shipments. The increased traffic is expected to be 400 passenger cars and 24 trucks per day, which, when compared to 2010 volumes, represents a traffic increase of approximately 400 percent on the New Haven Road south of the Ross Project area. This significant increase in traffic could result in more traffic accidents as well as potentially significant wear and tear on the road surfaces.

Operation: Impacts would be SMALL to LARGE; however, with mitigation, the transportation impacts during the Ross Project's operation would be SMALL to MODERATE. Impacts such as the local road's deterioration would be less than during construction, because of a smaller workforce (i.e., approximately 60 workers); however, the traffic volume associated with facility and wellfield operation would still be double that of 2010. The effective mitigation measures taken during the construction phase would continue through the operation phase.

***Aquifer Restoration*:** Impacts would be MODERATE, and with the mitigation measures that would be implemented throughout the Ross Project's lifecycle, the transportation impacts of aquifer restoration would also be MODERATE. Transportation impacts during this phase would be similar to those during the operation phase, although the workforce would be smaller (40 workers), but similar volumes of truck traffic would occur as during operation, especially if the CPP is used for recovery of uranium-loaded ion-exchange (IX) resins from four potential satellite areas as well as for toll milling.

***Decommissioning*:** Impacts would be MODERATE, and with the continuing mitigation measures of the other lifecycle phases as well as the declining workforce, the impacts would be SMALL to MODERATE. The traffic volume during the decommissioning phase would be dominated by waste shipments for offsite disposal. Because of the reduced traffic volumes associated with this phase compared to the operations phase, there would be a reduced risk of transportation accidents. However, once the Ross Project has been fully decommissioned, all transportation impacts would be eliminated.

<u>Geology and Soils</u>

***Construction*:** Impacts to both geology and soils would be SMALL. Although the Ross Project's design for its CPP would include a CBW, the impacts of the wall's construction would be SMALL due to the relatively small and localized effects on the bedrock below it. The impacts on soils would occur largely during this phase of the proposed Ross Project, when most of the ground disturbance takes place. Potential soils impacts include soils loss (by wind and water erosion), soils compaction, increased salinity, soils-productivity loss, and soils contamination. Surface-disturbing activities would expose the soils and subsoils at the Ross Project area and would temporarily increase the potential for soil loss because of wind and water erosion. The Applicant, however, has proposed to remove vegetation only where necessary and would stockpile soils for reclamation during decommissioning. The Applicant has proposed to mitigate erosion by minimizing the required land disturbances, ensuring timely re-vegetation and reclamation of affected soils, and installing drainage controls. Finally, the Applicant has proposed to mitigate wind erosion by limiting traffic speeds, spraying unpaved roads, and implementing timely disturbed-area reclamation.

***Operation*:** Impacts to local geology and soils would be SMALL. The removal of uranium from the target sandstone (aquifer) during ISR operation would change the mineralogical composition of uranium-bearing rock formations. However, no significant matrix compression or ground subsidence would be expected during in situ uranium recovery. Because the proposed operation would result in small changes in the reservoir pressure, the operation would be unlikely to activate any geologic faults. The potential for spills during transfer of uranium-bearing lixiviant to and from the CPP would be mitigated by implementing onsite best management practices (BMPs), standard operating procedures, and compliance with NRC license and WDEQ permit requirements. The potential impacts from soil loss would be

minimized by proper design and operation of surface-runoff features and implementation of BMPs.

Aquifer Restoration**:** Impacts would be SMALL. During aquifer restoration, the process of ground-water sweep, ground-water transfer, ground-water treatment, and recirculation would not remove rock matrix or structure. The formation pressure would be managed during restoration to ensure that the direction of ground-water flow is into the wellfields to reduce the potential for lateral migration of constituents. The change in pressure would not be significant enough to result in matrix compression, ground subsidence, or to reactivate the fault. The spill response and leak detection activities would be the same as described during the operation phase.

Decommissioning**:** Impacts would be SMALL. The potential impacts to the geology depend upon the density of plugged and abandoned drillholes and wells. At the end of decommissioning, the wellfields (whether recently operated or decommissioned some time ago) would contain approximately 3,000 drillholes and wells; these would include those drillholes from Strata's ore-zone delineation efforts and geotechnical investigations, ground-water monitoring wells used for site characterization, the injection and recovery wells from uranium-recovery activities, and Nubeth Joint Venture (Nubeth) drillholes and wells. This would represent an average density of approximately 4.3 wells/ha [1.7 wells/ac], which would be a low density with little geological impact. All areas of the Ross Project would be reclaimed and restored, so that the Project's impacts on the soils would be small as well.

Water Resources (Surface Water and Wetlands)

Construction**:** Impacts would be SMALL to both surface water quantity and quality as well as to wetlands. The Applicant intends to use surface water from either the Oshoto Reservoir or the Little Missouri River for dust control and construction. This equates to an annual use that is significantly less than the currently permitted annual appropriation for Oshoto Reservoir. Thus, the potential impacts of the Proposed Action's construction to surface-water quantity would be SMALL. Suspended-sediment concentrations in storm water at the Ross Project area could be increased due to vegetation removal and soil disturbance during construction of the Proposed Action. However, given the site-specific mitigation measures to be implemented by the Applicant, the potential impacts of the Ross Project's construction to surface-water quality would be SMALL. The potential impacts of the proposed Ross Project's construction to wetlands would also be SMALL.

Operation**:** Impacts would be SMALL. Release of process solutions from uranium-recovery wellheads, pipelines, module buildings, or process vessels; accidental discharge from surface impoundments; or release of yellowcake or IX resin during a transportation accident could result in surface-water contamination if the release(s) reached a surface-water body. Given mitigation measures that the Applicant would employ, however, the potential impacts to surface-water quality during the operation of the Ross Project would be SMALL. Surface-water monitoring and spill response would limit the impacts of potential surface spills to SMALL; however, impacts of spills to surface waters that are connected to shallow aquifers would be SMALL to MODERATE, depending upon the specifics of an incident. The Applicant's compliance with its permit conditions, use of BMPs, and implementation of other required mitigation measures, however, would reduce the impacts of the Ross Project's operation from MODERATE to SMALL, depending upon local conditions.

***Aquifer Restoration*:** Impacts would be SMALL. Potential risk of surface-water contamination associated with releases of process solutions and/or waste liquids as well as spills of other materials during aquifer restoration would be comparable to the operation phase of the Ross Project, but the uranium concentrations in such solutions would decline. Thus, the potential impacts of aquifer restoration to surface-water quantity and quality would be SMALL. The potential impacts during aquifer restoration to the wetlands on the Ross Project area would be the same as discussed under the Ross Project's construction and they would be SMALL.

***Decommissioning*:** Impacts would be SMALL. For the decommissioning of the Ross Project, the Applicant would use surface water from either the Oshoto Reservoir or the Little Missouri River for dust control during demolition activities. Potential surface-water contamination could occur from spilled or leaked fuel or lubricants from construction equipment and passenger vehicles that would be operated during decommissioning activities, although the equipment would generally be located away from surface-water bodies. The potential impacts from the Ross Project's decommissioning to surface-water quantity and quality would be SMALL. As during all of the earlier phases, the potential impacts to wetlands from the Ross Project's decommissioning would be SMALL.

Water Resources (Ground Water)

***Construction*:** Impacts would be SMALL. Potential impacts to the quantity of water in the shallow aquifers during construction of the Ross Project would be related to the quantity taken from the Oshoto Reservoir and the quantity involved in the installation of the CBW surrounding the facility. Any changes in ground-water levels due to water usage from Oshoto Reservoir would be small and restricted to the area around the Reservoir. Thus, the potential impacts during construction of the Ross Project to ground-water quantity in the shallow aquifers would be SMALL. Also, the potential impacts of the Proposed Action's construction to ground-water quality in the shallow aquifers would be SMALL. Based upon yields from regional baseline wells and other wells, ground-water modeling indicates that the ore-zone aquifer could support this level of withdrawal with little drawdown. Thus, the potential construction impacts on the ground-water quantity available from the confined aquifers (ore-zone, overlaying, and underlying aquifers) would be SMALL. Wells installed for further hydrologic studies, pre-licensing baseline site characterization (see SEIS Section 2.1.1.1), and production infrastructure would pass mechanical integrity testing (MIT) prior to use. Consequently, the potential impacts during construction on the ground-water quality in the confined aquifers would be SMALL. The potential impacts of construction on both the quantity and quality of ground water available from the deep aquifers would be SMALL.

***Operation*:** The impact would range from SMALL to MODERATE (depending upon whether excursions occur). Potential impacts from operation to ground-water quantity in the shallow aquifers would be similar to those as during the construction phase and would be SMALL. The Applicant would implement spill control, containment, and cleanup measures in the CPP and surface-impoundment areas (i.e., the facility). These measures would include secondary containment for process-solution vessels and chemical storage tanks, a geosynthetic liner beneath the CPP's foundation, dual liners with a leak-detection system for the surface impoundments, and a sediment impoundment to capture storm-water runoff. To reduce the risk of pipeline failure, the Applicant would hydrostatically test all pipelines prior to use and install leak-detection devices in manholes along the pipelines. The Applicant's

implementation of BMPs during Ross Project operation would reduce the likelihood and magnitude of spills or leaks and facilitate expeditious cleanup. The potential impacts from the Ross Project's operation to ground-water quantity in the confined aquifers would be SMALL.

The potential impacts of ISR operation to ground-water quality in the confined aquifers above and below the ore zone would be SMALL. However, the short-term potential impacts of lixiviant excursions from uranium-recovery operation to the ore-zone aquifer outside the active ISR area would be SMALL to MODERATE. With respect to the deep aquifers where injection of liquid byproduct wastes would occur, regular monitoring of the water quality of the injected brine is required by the permit; thus, the potential impacts of the Ross Project's operation to ground-water quantity and quality in the deep aquifers would be SMALL.

***Aquifer Restoration*:** Impacts would be SMALL to MODERATE (due to potential significant drawdown in the ore-zone and confined aquifers, reducing ground-water quantity). The potential impacts to water quality would be reduced when compared to the Ross Project's operation because no lixiviant would be used in the injection stream and the concentration of chemicals in the recovered ground water would be significantly less than during ISR operations. The Applicant's implementation of BMPs during aquifer restoration would continue, and the other ground-water mitigation measures would be the same as those described for the operation of the Ross Project. Thus, the potential impacts of aquifer restoration to ground-water quantity and quality of the shallow aquifers would be SMALL. A conservative regional ground-water modeling analysis predicts a reduction in the available head in wells used for stock, domestic, and industrial use. These effects would be localized and short-lived. Consequently, the potential impacts of the Proposed Action's aquifer-restoration phase to ground-water quantity of the confined aquifers would be SMALL to MODERATE. In the deep aquifers, the volume of waste injected would be greater during the aquifer-restoration phase than during the Ross Project's operation phase, but the potential impacts would be similar. The impacts from aquifer restoration to ground-water quantity and quality of the deep aquifers would, therefore, be SMALL.

***Decommissioning*:** Impacts would be SMALL. After uranium-recovery operation is complete, unidentified, improperly abandoned wells (i.e., from previous subsurface explorations not associated with the Applicant or its activities could continue to impact aquifers above the ore-zone and adjacent aquifers by providing hydrologic connections between aquifers. Thus, the impacts to shallow aquifers during the Proposed Action's decommissioning would be SMALL. As decommissioning proceeds at the Ross Project area, and the concomitant land reclamation and restoration activities proceed, all monitoring, injection, and production wells would be plugged and abandoned as noted above. The wells would be filled with cement and/or bentonite and then cut off below plow depth to ensure ground water does not flow through the abandoned wells. Proper implementation of these procedures would isolate the wells from ground-water flow. Thus, the impacts to the ore-zone and adjacent confined aquifers would be SMALL. The Applicant estimates that very little brine and other liquid byproduct wastes would be disposed in the injection wells during the decommissioning (i.e., most wastes that would be generated during this phase would be solid). This small quantity would minimize potential impacts to ground-water quantity and quality during Ross Project's decommissioning and they would be SMALL to the deep aquifers.

Ecology

***Construction*:** Impacts would be SMALL. Potential environmental impacts to ecology of the Ross Project area, including both flora and fauna, could include removal of vegetation from the Ross Project area; reduction in wildlife habitat and forage productivity, and an increased risk of soil erosion and weed invasion; the modification of existing vegetative communities as a result of uranium-recovery activities; the loss of sensitive plants and habitats; and the potential spread of invasive species and noxious weed populations. Impacts to wildlife could include loss, alteration, or incremental fragmentation of habitat; displacement of and stresses on wildlife; and direct and/or indirect mortalities. Aquatic species could be affected by disturbance of stream channels, increases in suspended sediments, pollution from fuel spills, and habitat reduction. However, construction of the Ross Project would be phased over time, reducing the amount of surface area disturbed at any one time. Thus, the impacts to terrestrial vegetation and terrestrial wildlife would be SMALL. Because aquatic habitats would be avoided if at all possible during construction, impacts to reptiles, amphibians, and fish during the Ross Project's construction would also be SMALL.

***Operation*:** Impacts would be SMALL. Impacts would be similar to but less than those experienced during the construction phase because fewer earth-moving activities would occur and traffic would be less. Due to the Applicant's implementation of mitigation measures, such as wellfield perimeter and surface-impoundment fencing, leak-detection protocols, and wildlife protection and monitoring plans, the operation of the Ross Project would cause SMALL impacts to terrestrial vegetation and wildlife, including protected species, and to aquatic wildlife.

***Aquifer Restoration*:** Impacts would be SMALL. The potential impacts to ecological resources from aquifer-restoration activities would be similar to those experienced during the Ross Project's operation phase; therefore, the potential impact to vegetation and wildlife would be SMALL.

***Decommissioning*:** No loss of vegetative communities beyond that disturbed during the construction phase would occur. Pipeline removal would impact vegetation that could have re-established itself, although this, too, would be temporary as the disturbed areas are reseeded. Thus, the impacts of the Ross Project's decommissioning would not be expected to be greater than those experienced during its construction and would consequently be SMALL.

Air Quality

***Construction*:** Impacts would be SMALL. Combustion-engine emissions from diesel- and gas-powered equipment operation would occur during all phases of the Ross Project. The heaviest use of such equipment, however, would be the construction and decommissioning phases of the Ross Project. Fugitive dusts would also be generated by both construction, land-clearing activities as well as by commuters and delivery trucks. The largest workforce of the Ross Project's lifecycle would be employed on the Project's construction, and their respective commutes increase local traffic quite significantly. Combustion-engine emissions and fugitive dust would be generated by all of this traffic. However, the predominant winds (in terms of both speed and direction) in the region, the remote location of the Ross Project area, and the air-quality control systems and the BMPs that would be implemented by the Applicant would all minimize the air-quality impacts of the Ross Project's construction. In

addition, the requirements of the Applicant's Air Quality Permit would require the Applicant to implement other specified mitigation measures as well, moderating the air emissions of the Ross Project. All anticipated gaseous-emission and fugitive-dust impacts would be limited in duration during the construction phase. Thus, the impacts of the Ross Project on air quality during construction would be SMALL and short-term.

Operation: Impacts would be SMALL. Air-quality impacts during the Ross Project's operation phase would potentially include the same as those identified earlier for its construction phase (i.e., combustion-engine and fugitive-dust emissions). However, the quantity of the released air emissions would be reduced due to the reduced number of workers during ISR operation. Also, construction-equipment operation would decrease because most of the Ross Project area would have been cleared and graded during construction, so little earth movement would occur during operation; only the installation of wellfields would continue to generate fugitive dust. During uranium-recovery operation, several point sources of non-radioactive gaseous emissions would be located at the CPP. These would include process-pipelines, process-vessel, and storage-tank vents; emergency generators and space heaters; and other sources such as storage vessels and tanks containing acids and bases. However, these would all be very small point sources.

Aquifer Restoration: Impacts would be SMALL. The emissions associated with the use of combustion-engine equipment would be limited in duration and result in small, short-term effects during the aquifer-restoration phase of the Ross Project. Vehicular traffic would be limited to delivery of supplies and commuting personnel; however, the workforce at the Ross Project would decrease to only 20 workers during aquifer restoration and, thus, the vehicular emissions of commuting traffic would substantially decrease. A significant decrease in the frequency of offsite yellowcake shipments would also occur as aquifer restoration proceeds.

Decommissioning: Impacts would be SMALL. In the short term, emissions could increase somewhat, especially particulates because of decommissioning activities would generate particulate emissions such as fugitive dust. For example, the Applicant's dismantling and demolition of buildings, structures, surface impoundments, and process equipment; removing contaminated soils; moving construction equipment to the different areas where decommissioning activities would take place; and the grading and re-contouring during site reclamation and restoration could all generate air emissions, particularly fugitive dust. Combustion-engine emissions would also be produced by heavy equipment as well as vehicles transporting workers to and from the Ross Project, where the workforce would increase at the initiation of the decommissioning phase.

Noise

Construction: Impacts would be SMALL to MODERATE. The nearest residents to the Ross Project area are substantially closer than those anticipated in the GEIS. Noise would be generated during construction activities as well as by vehicle traffic. Approximately 85 percent of the overall construction workforce (i.e., 200 workers) would commute to the Ross Project area. Heavy-equipment operation within the Ross Project area would peak during the Applicant's construction of the CPP, surface impoundments, wellfields, and associated infrastructure. In addition, the relocation of construction equipment to and from the Ross Project area and to and from different locations at the Ross Project area would generate noise. Impulse or impact noises from certain equipment, such as impact wrenches and pneumatic attachments on rock breakers, could be particularly loud as well. All of this noise

could occasionally be annoying to the closest nearby residents. The overall noise impacts during the Proposed Action's construction would be SMALL to the general population, but the four closest residences to the Ross Project would experience MODERATE, but short-term, exposures to noise.

Operation**:** Impacts would be SMALL to MODERATE, with noise generated by construction activities greatly diminishing. The truck traffic associated with yellowcake, vanadium, and waste shipments would begin during the operation phase of the Ross Project; however, commuter-traffic noise would decrease due to the smaller workforce required during ISR operations (200 vs. 60 workers). However, because the county roads to and from the Ross Project area currently have very low average daily and annual traffic counts, there would be a continuing high relative increase in vehicular traffic and, thus, noise impacts to nearby residents would be MODERATE; the more distant local communities would experience only small, temporary impacts. The Applicant's compliance with the Occupational Safety and Health Administration's (OSHA's) noise regulations would minimize impacts to workers.

Aquifer Restoration**:** Impacts would be SMALL. During the Ross Project's aquifer-restoration phase, potential noise impacts would diminish to SMALL and would be only temporary for nearby residences. The workforce employed during aquifer restoration would be smaller (i.e., 20 worker) than during construction and operation phases of the Ross Project and, thus, there would be fewer workers, less traffic, and fewer noise-producing activities. The Applicant's continued compliance with OSHA's noise regulations would minimize impacts to workers.

Decommissioning**:** Impacts would be SMALL to MODERATE. Noise levels during the decommissioning phase of the Ross Project would be similar to those identified for the construction phase, for both onsite and offsite receptors. Most potential impacts to nearby residential receptors would occur as a result of the anticipated significantly increased commuter and truck traffic to and from the Ross Project area during decommissioning (i.e., 90 workers and additional waste shipments). At the Ross Project, despite the temporary nature of the decommissioning activities onsite, the short distance to the closest residences would make the noise impacts MODERATE.

Historical and Cultural Resources

Construction**:** Impacts would be SMALL to LARGE. Archaeological and historical sites may potentially be disturbed by construction. Within the area of potential effect at the proposed Ross Project, 25 sites are being treated as eligible for listing on the National Register of Historic Places (NRHP) for the purposes of this NEPA analysis. Avoidance of sites that are not within the proposed disturbance areas is recommended. For sites within the proposed disturbance areas, avoidance and mitigation, such as fencing and data recovery excavations are recommended.

Prior to an NRC license being granted, an agreement between the NRC, the Wyoming State Historic preservation Office (WY SHPO), BLM, interested Native American Tribes, the Applicant, and other interested parties will be established outlining the mitigation process for each affected resource. Additionally, prior to construction, the Applicant will 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 Tribes have not been completed. Thus, the NRC cannot determine effects to these properties at this time. Section 106 consultation between NRC, WY SHPO, BLM, Tribal representatives, and the Applicant regarding potential impacts to these sites is ongoing.

Operation**:** Impacts would be SMALL. Minimal impacts will result during the operation phase because impacts to cultural resources will be mitigated before 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.

Aquifer Restoration**:** Impacts would 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 aquifer restoration, the Unexpected Discovery Plan will be implemented. Work would stop in the immediate area, and appropriate agencies would be notified.

Decommissioning**:** Impacts would 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 decommissioning, the Unexpected Discovery Plan will be implemented. Work would stop in the immediate area, and appropriate agencies would be notified.

Visual and Scenic Resources

Construction**:** Impacts would be SMALL to MODERATE. The largest visible surface features of the Ross Project that would emerge during the construction phase would include wellhead covers and header houses; electrical and other utility distribution lines, which are mounted on 6-m [20-ft] wooden poles; more roads; the CPP; and the surface impoundments. There are protected visual resources near the Ross Project; the nearest such area is the Devils Tower National Monument, which is approximately 16 km [10 mi] east of the Ross Project. Although the Project itself would not be visible at the lower park portion of the Tower, climbers ascending to the top of the Tower may be able to see some of the Project's largest attributes as well as, in the night sky, the lights of the Project. These lights would also be visible at residences near the Ross Project. The short-term visual contrasts with the characteristic landscape of the Ross Project area would result from construction activities. However, the construction activities proposed for the Ross Project would be consistent with the U.S. Bureau of Land Management (BLM) visual classification of this area. The management objective of Visual Resource Management (VRM) Class III is to partially retain the existing character of the landscape so that the level of change to the characteristic landscape can be moderate. Also, prior to construction of the Ross Project, the Applicant would conduct baseline monitoring for potential light pollution and develop a light-pollution monitoring plan that would finalize the locations for both continuous and intermittent light sources. The short-term construction activities at the proposed Ross Project would result in SMALL to MODERATE visual impacts to the nearest four residences, each of which has a view of the Ross Project area. For the remaining 7 of the 11 nearby residences, the visual impacts would be SMALL.

Operation: Impacts would be SMALL. The overall visual impacts of an operating wellfield and the ISR facility itself would be small. In addition, the Ross Project would be located in gently rolling topography, where the visibility of aboveground infrastructure would vary and would be relative, depending upon the location and elevation of an observer as well as on nearby topography, total distance, and lighting characteristics. Lighting from the Ross Project would be visible from five of the residences to the east and from various locations directly to the west, north, and southeast. Mitigation measures for local light-pollution impacts would be the same as those described above for the construction phase of the Ross Project.

Aquifer Restoration: Impacts would be SMALL. Aquifer restoration activities would take place sequentially in the wellfields and last approximately two years per wellfield. There would be no modifications to either scenery or topography during aquifer restoration. Much of the same equipment and infrastructure used during operation would be employed during aquifer restoration, so that impacts to the visual landscape would be expected to be similar to or less than the impacts during the Proposed Action's operation phase. The mitigation measures presented above for both the Proposed Action's construction and operation phases would continue to be implemented during the aquifer-restoration phase, and these would continue to limit potential visual impacts.

Decommissioning: Impacts would be SMALL. The Ross Project would not result in significant impacts to the landscape that would persist after facility decommissioning and site restoration are completed. Most visual impacts during decommissioning would be temporary and diminish as structures, equipment, and other facility components are removed; the disturbed land surface is reclaimed and restored; and the vegetation is re-established.

Socioeconomics

Construction: Impacts would be SMALL to MODERATE. The Ross Project would employ approximately 200 people during construction, and this influx of workers would be expected to result in socioeconomic impacts, the greatest for communities with small populations. However, due to the short duration of construction, these workers would have only a limited effect on public services and community infrastructure. The Applicant is also committed to hiring locally—90 percent of the construction workforce would be local hires—so the overall socioeconomic impacts during the construction phase of the Ross Project would be SMALL. However the tax revenues paid to Crook County would be significant and, thus, that benefit would be a MODERATE impact of the Ross Project.

Operation: Impacts would be SMALL to MODERATE. If the majority of the operation workforce is local, the potential impacts to population and public services would continue to be SMALL. Because the Applicant is committed to hiring locally—80 percent of the operation workforce is expected to be local hires—the overall socioeconomic impacts during the Ross Project's operation phase would continue to be SMALL, with MODERATE impacts associated with the additional tax revenues that would accrue to Crook County.

Aquifer Restoration: Impacts would be SMALL. The Applicant indicates that there would be a smaller workforce of only approximately 20 workers during the aquifer-restoration phase, without concurrent operations. The need for regulatory, management, and health and safety personnel would continue throughout aquifer restoration, but this need would be met

by personnel transitioning from operation-phase work to aquifer restoration and no new personnel would necessarily be required. Thus, the impacts of the Ross Project's aquifer-restoration phase would likely be at most the same, or, more likely, less than those noted above for the Ross Project's operation phase.

***Decommissioning*:** Impacts would be SMALL. Because the size of the workforce during the Ross Project's decommissioning phase would be initially be higher, but would subside as the decommissioning proceeds, there would be no significant socioeconomic impacts. In addition, socioeconomic impacts would no longer include tax revenues to Crook County during the decommissioning phase of the Ross Project and, thus, the earlier phases' moderate impacts would be eliminated.

Environmental Justice

***All Phases*:** No minority or low-income populations were identified in the vicinity of the proposed Ross Project. Therefore, there would be no disproportionately high and adverse impacts to minority and low-income populations from the construction, operation, aquifer restoration, and decommissioning of the Ross Project.

Public and Occupational Health and Safety

***Construction*:** Impacts would be SMALL. Construction activities, including the use of construction equipment and vehicles, would disturb the topsoil and create fugitive dust emissions. Fugitive dust generated from construction activities would 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 would not result in a significant radiological dose to workers or the public. Construction equipment would be diesel powered and would exhaust particulate diesel emissions. The potential impacts and potential human exposures from these emissions would be SMALL because of the short duration of the release and because the emissions would be readily dispersed into the atmosphere.

***Operation*:** The radiological impacts from normal operations would 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] would not be exceeded at any property boundary. The remote location of the proposed Ross Project site and the use of the proposed ISR technology coupled with the Applicant's proposed procedures to minimize exposure would cause the potential impact on public and occupational health and safety from facility operation to be SMALL. The radiological impacts from accidents would 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, would be SMALL if handling and storage procedures are followed.

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

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

Waste Management

Construction: Impacts would be SMALL. No significant liquid wastes would be generated during the construction of the Ross Project. Most of the solid wastes expected to be generated during the construction phase would be general construction debris including paper, wood, plastic, and scrap metal. These nonhazardous solid wastes would be disposed of at a permitted solid-waste facility. Hazardous wastes, such as organic solvents, paints, and paint thinners, would be disposed of in accordance with the requirements in the *Resource Conservation and Recovery Act* (RCRA). No radioactive (byproduct) wastes would be generated during this phase at the Ross Project, although technologically enhanced naturally occurring radioactive material (TENORM) wastes would be generated during well drilling and these wastes would be managed onsite.

Operation: Impacts would be SMALL. Wastes generated during the operation of the Ross Project would primarily be liquid waste streams consisting of process bleed, where, after reverse-osmosis treatment, some excess permeate early in the Project's operation and brine would be disposed of onsite at the five already permitted underground deep-injection wells. In addition, other liquid byproduct effluents would be generated as spent eluate, process-drains liquids, contaminated reagents, filter-backwash liquids, wash-down water, and decontamination shower water. State permitting actions, NRC license conditions, and NRC inspections would ensure that proper waste-management practices are implemented by the Applicant to comply with safety requirements to protect workers and the public. Nonhazardous solid waste such as facility trash, tires, piping, valves, and instrumentation, would be reused, recycled, or disposed of at a nearby landfill or other waste-disposal facility, each of which has available disposal capacity. Domestic wastes would be treated and disposed of in an onsite sewage-treatment system.

Aquifer Restoration: Impacts would be SMALL. Water from aquifer restoration would be treated through a combination of ion exchange and reverse osmosis (RO) and then would be re-injected into the ore-zone aquifer to limit the volume of water permanently withdrawn. Concentrated liquid effluents generated by these activities would be disposed of via deep well disposal. Ordinary trash would continue to be shipped offsite for disposal.

Decommissioning: Impacts would be SMALL. The goal of decommissioning is to reduce potential impacts by removing contaminants to allowable (regulatory) levels and restoring the land of the Ross Project area to pre-licensing baseline conditions. The Applicant proposes to decontaminate and recycle much of the process equipment or to reuse it at other uranium-recovery facilities. The Applicant would remove sludge from the storage ponds and liners and dispose of this material at a properly licensed radioactive-waste facility. Pre-operational agreements with a licensed radioactive-waste disposal facility to accept byproduct material would ensure the availability of sufficient disposal capacity for decommissioning activities. If hazardous waste is generated by decommissioning activities, it would be handled in accordance with applicable requirements.

SUMMARY OF THE CUMULATIVE IMPACTS

The cumulative impacts on the environment that would result from the incremental impact of the proposed Ross Project, when added to other past, present, and reasonably foreseeable future actions, was also considered. The NRC staff determined that the SMALL to LARGE incremental impacts of the Ross Project would not contribute perceptible increases to the SMALL to LARGE cumulative impacts, due primarily to the extensive exploration taking place in the area for uranium, oil, and gas, and from coal mining.

SUMMARY OF THE 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 Ross Project would be increased employment, economic activity, and tax revenues to the region around the proposed Ross Project area (i.e., Crook County). Costs associated with the Ross Project are, for the most part, limited to the area immediately surrounding the Ross Project area and include small visual, air-quality, and noise impacts. The NRC staff determined that the benefit from constructing and operating the uranium-recovery facility would outweigh the environmental and social costs.

COMPARISON OF THE ALTERNATIVES

Under the No-Action Alternative, Alternative 2, the NRC would not approve the license application for the proposed Ross Project. The No-Action Alternative would result in the Applicant not constructing, operating, restoring the aquifer of, or decommissioning the proposed ISR project. However, even if the proposed Ross Project is not licensed, the Applicant has already accomplished certain preconstruction activities (those activities that do not require an NRC license) at the Ross Project area. These previously completed preconstruction activities are evaluated as part of Alternative 2: No Action.

Under Alternative 3, the NRC would issue the Applicant a license for the construction, operation, aquifer restoration, and decommissioning of the proposed ISR project at the Ross Project, except that the entire ISR facility, including all buildings, other auxiliary structures, and the surface impoundments would be located north of where it is to be situated for the Proposed Action. This alternate location for the ISR facility, referred as the "north site" by the Applicant (and referred to herein as the "North Ross Project"), was considered, but eliminated, by the Applicant in its license application. The north site is about 900 m [3,000 ft] northwest of where the facility would be located in the Proposed Action (referred to by the Applicant as the "south site"). An unnamed surface water drainage feature generally divides the north site. To avoid the floodplain of the drainage the Applicant would likely place the CPP and other buildings on one side of the drainage and the surface impoundments on the other side.

PRELIMINARY RECOMMENDATION

After weighing the impacts of the Proposed Action and comparing the Alternatives, the NRC staff, in accordance with 10 CFR Part 51.71(f), sets forth its 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 materials license for the Proposed Action be issued as requested. The NRC staff concludes that the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 4 will eliminate or substantially lessen the potential adverse environmental impacts associated with the Proposed Action.

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

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

    1. Transportation resources during all phases of the proposed action. Increases in traffic during construction and operation would have a MODERATE to LARGE impact. Impacts would be MODERATE with mitigation for construction, operation, aquifer restoration, and decommissioning (See SEIS Sections 4.3.1.1, 4.3.1.2, 4.3.1.3, and 4.3.1.4).

    2. Groundwater resources during operation and aquifer restoration. During operations there would be a MODERATE impact to ore-zone aquifer water quality due to excursions; however with measures in place to detect and resolve the excursions, the impacts would be reduced. During aquifer restoration there would be a MODERATE impact to ore-zone aquifer water quantity due to short-term drawdown (See SEIS Sections 4.5.1.2 and 4.5.1.3).

    3. Noise resources during construction, operations, and decommissioning. During these phases of the Ross Project there would be MODERATE impacts due to increased noise levels, however they would be intermittent and short term (See SEIS Sections 4.8.1.1, 4.8.1.2 and 4.8.1.4).

    4. Historical and cultural resources during construction. Section 106 consultation and efforts to identify and determine the eligibility of historical and cultural resources that could be adversely affected by the proposed Ross Project are currently ongoing. Therefore, to be conservative in this draft SEIS, the NRC staff considers that construction could have a MODERATE to LARGE impact on historic properties, 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 Section 4.9.1.1). However, once identification efforts are complete, mitigation efforts, which could require an MOA, would be developed to reduce impacts. The final SEIS will include the outcome of Section 106 consultation and would discuss mitigation measures, including an MOA, if one is developed.

    5. Visual and scenic resources during construction. There would be MODERATE impacts to residents near the Ross Project for the first year, however over the long term, impacts would be reduced (See SEIS Section 4.10.1.1).

    6. Socioeconomic resources during construction and operations. There would be MODERATE impacts to Crook County during these phases of the Ross Project because taxes from the Project will be paid to the county (See Sections 4.11.1.1 and 4.11.1.2).

- 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, Strata would 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 would be required to provide detailed hydrologic pumping test data packages and operational plans for each wellfield at the Ross Project. Strata would also be required to restore groundwater parameters affected by the ISR operations to levels that are protective of human health and safety.

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

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

LIST OF ABBREVIATIONS/ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACL	Alternate Concentration Limit
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
ALARA	As Low As Reasonably Achievable
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
AQD	Air Quality Division (Wyoming Department of Environmental Quality)
ARPA	Archaeological Resources Protection Act of 1979
ASTM	ASTM International (formerly American Society for Testing and Materials)
BACT	Best Available Control Technology
BGS	Below Ground Surface
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management (U.S. Department of the Interior)
BLMSS	BLM’s Sensitive Species
BLS	Bureau of Labor Statistics (U.S. Department of Labor)
BMP	Best Management Practice
CAA	Clean Air Act
CBM	Coal-Bed Methane
CBW	Containment Barrier Wall
CCS	Center for Climate Strategies
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESQG	Conditionally Exempt Small Quantity Generator
CFR	Code of Federal Regulations
CO	Carbon monoxide
CO_2	Carbon dioxide
CPP	Central Processing Plant
CR	County Road
CWA	Clean Water Act
dBA	A-Weighted Decibels
DM	Deep-Monitoring Zone or Unit
DOC	U.S. Department of Commerce
DOI	U.S. Department of the interior
EC	Electrical Conductivity
EIA	Energy Information Administration (U.S. Department of Energy)
EIS	Environmental Impact Statement
EMR	Emergency Medical Responder
EMT	Emergency Medical Technician
EO	Executive Order
EOR	Enhanced Oil Recovery
EPA	U.S. Environmental Protection Agency
ER	Environmental Report

LIST OF ABBREVIATIONS/ACRONYMS
(*Continued*)

ESA	Endangered Species Act
FHWA	Federal Highway Administration (U.S. Department of Transportation)
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
HASP	Health and Safety Plan
HDPE	High-Density Polyethylene
HEC	Hydrologic Engineering Center
HMS	Hydrologic Modeling System
ISL	In situ Leach
ISR	In situ Recovery
IX	Ion Exchange
LOI	Letter of Intent
LQD	Land Quality Division (Wyoming Department of Environmental Quality)
LSA	Low Specific Activity
MARSSIM	Multi-Agency Radiation Survey & Site Investigation Manual
MCL	Maximum Contaminant Level
MIT	Mechanical Integrity Testing
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service (U.S. Department of Agriculture)
NRHP	National Register of Historic Places
NSDWUMR	Nebraska-South Dakota-Wyoming Uranium Milling Region
Nubeth	Nubeth Joint Venture
NWI	National Wetlands Inventory
NWP	Nationwide Permit (U.S. Army Corps of Engineers)
NWS	National Weather Service
OSHA	Occupational Safety & Health Administration (U.S. Department of Labor)
OSLI	(Wyoming) Office of State Lands and Investments
OZ	Ore Zone (Monitoring Interval or Aquifer)
Pb	Lead
PCB	Polychlorinated Biphenyl
PFYC	Potential Fossil Yield Classification System

LIST OF ABBREVIATIONS/ACRONYMS
(*Continued*)

pH	Hydrogen Ion Activity
PM_{10}	Particulate Matter 10 Microns or Less
$PM_{2.5}$	Particulate Matter 2.5 Microns or Less
PPE	Personal Protective Equipment
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
PSHA	Probabilistic Seismic Hazard Analysis
PVC	Polyvinyl Chloride
R	Range or Roentgens
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act
rem	Roentgen Equivalent Man
RFFA	Reasonably Foreseeable Future Actions
RMP	Resource Management Plan
RO	Reverse Osmosis
RPP	Radiation Protection Program or Plan
SA	Surficial Aquifer
SAR	Sodium Adsorption Ratio
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SHPO	State Historic Preservation Office
SM	Shallow-Monitoring Zone
SMC	USFWS's Migratory Bird Species of Management Concern in Wyoming
SOP	Standard Operating Procedure
SOW	Scope of Work
Strata	Strata Energy, Inc.
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
THPO	Tribal Historic Preservation Office
TLD	Thermo Luminescent Dosimeter
TR	Technical Report
TSCA	Toxic Substances Control Act
UCL	Upper Control Limit
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau (U.S. Department of Commerce)
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USDW	Underground Source of Drinking Water

LIST OF ABBREVIATIONS/ACRONYMS
(*Continued*)

USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW	University of Wyoming
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WDAI	Wyoming Department of Administration and Information
WDEQ	Wyoming Department of Environmental Quality
WEUMR	Wyoming East Uranium Milling Region
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Commission
WQD	Water Quality Division (Wyoming Department of Environmental Quality)
WSEO	Wyoming State Engineer's Office
WSGS	Wyoming State Geological Survey
WSOC	Wyoming Species of Concern
WWC	WWC Engineering
WWDC	Wyoming Water Development Commission
WYCRO	Wyoming Cultural Records Office
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database
WYPDES	Wyoming Pollutant Discharge Elimination System

SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions From SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		Length		
cm	centimeters	0.39	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		Areas		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
Ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		Volume		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
m^3	cubic meters	0.0008107	acre-feet	acre-feet
		Mass		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
		Temperature (Exact Degrees)		
^{0}	Celsius	1.8C + 35	Fahrenheit	^{0}

*SI is the symbol for the International System of Units. Appropriate rounding should be performed to comply with Section 4 of ASTM International's "Standard for Metric Practice Guide." West Conshohocken, Pennsylvania: ASTM International. Revised 2003.

1 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) prepared this Supplemental Environmental Impact Statement (SEIS) in response to an application Strata Energy, Inc. (Strata) (referred to herein as the Applicant) submitted on January 4, 2011, to develop and operate the proposed Ross In Situ Uranium Recovery (ISR) Project (herein referred to as Ross Project), located in Crook County, Wyoming (Strata, 2011a; Strata, 2011b). The Applicant is a wholly owned subsidiary of Peninsula Minerals, Ltd. Figure 1.1 shows the geographic location of the proposed project. This site-specific SEIS supplements the Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities (herein referred to as GEIS) and was prepared in accordance with the process described in GEIS Section 1.8 (NRC, 2009) and as detailed in Section 1.4.1 of this SEIS. 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.

The GEIS uses the terms "*in-situ* leach (ISL) process" and "11e.(2) byproduct material" to describe this uranium milling technology and the waste stream generated by this process. For the purposes of this SEIS, ISR is synonymous with ISL. The 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 Part 40.4.

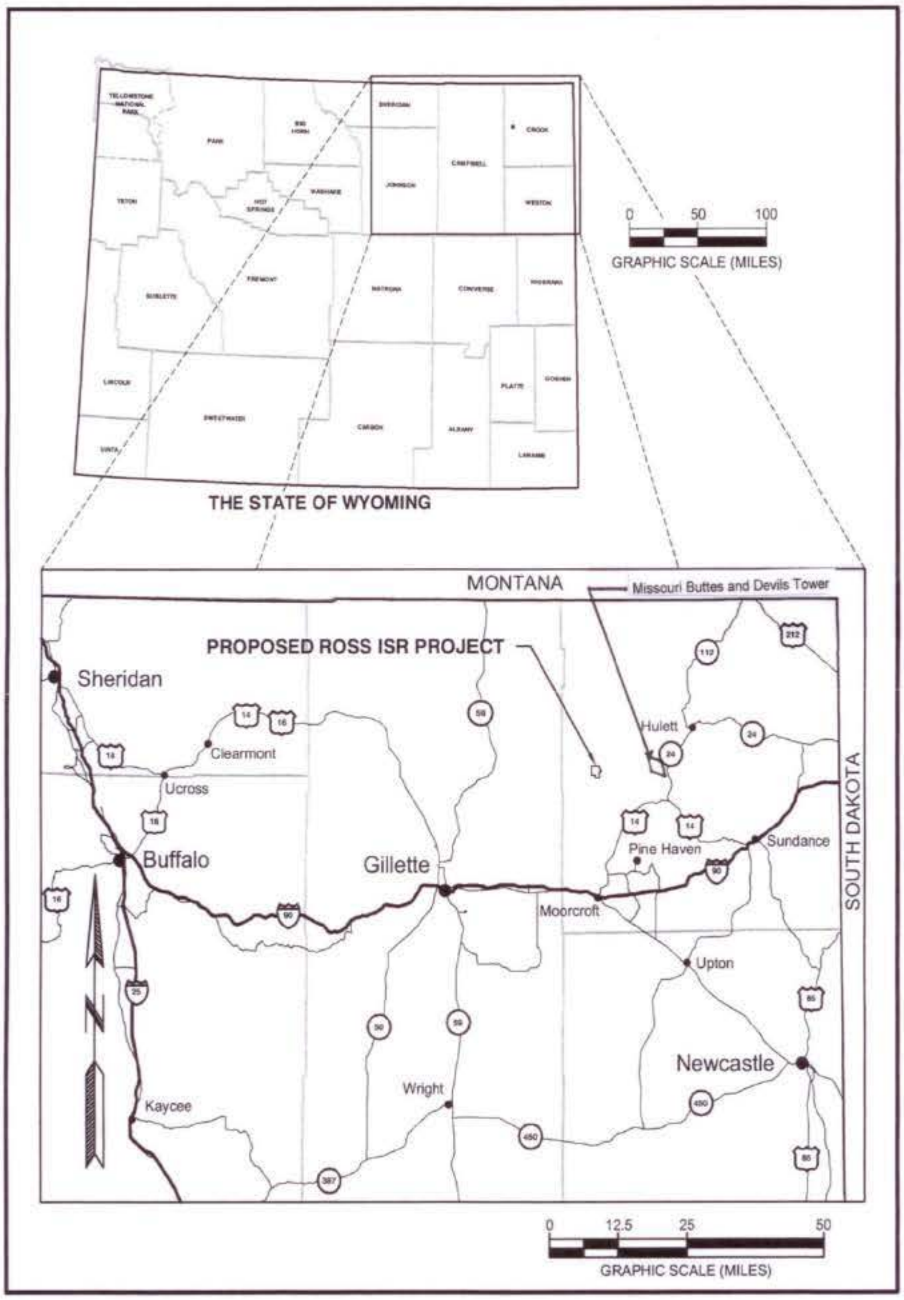
1.2 Proposed Action

On January 4, 2011, Strata submitted an application for an NRC source and byproduct material license to construct and operate an ISR facility at the proposed Ross Project site and to conduct aquifer restoration, site decommissioning, and reclamation activities. Based on the application, the NRC's federal action is the decision to either grant or deny the license. The Applicant's proposal is described in detail in SEIS Section 2.1.1.

1.3 Purpose and Need of the Proposed Action

The 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 at the proposed Ross Project site. The purpose and need for the proposed action is to provide an option that allows the Applicant to recover uranium and to produce yellowcake slurry at the Ross 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.



Source: Strata, 2011a.

Figure 1.1 Ross Project Location

1

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 Ross Project area contains BLM-administered public lands open to mineral entry, and the Applicant has filed mining claims on them. The BLM federal decision is either to approve the Applicant's 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 (Strata) has the right to mine and to 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

The 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 the irreversible and irretrievable commitments of resources.

1.4.1 Relationship to the GEIS

As described in Section 1.1, this SEIS supplements the GEIS, which was published as a final report in May 2009 (NRC, 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 Ross Project is located in the Nebraska/South Dakota/Wyoming Uranium Milling Region. Table 1.1 summarizes the expected environmental impacts by resource area in the Nebraska-South Dakota-Wyoming Uranium Milling Region based on the GEIS analyses.

The NRC conducted scoping activities for the purposes of defining the scope of GEIS and any future supplements to the GEIS. NRC staff accepted public comments on the scope of the GEIS from July 24, 2007, to November 30, 2007, and held three public scoping meetings, one of which was in the State of Wyoming. Additionally, NRC held eight public meetings to receive comments on the draft GEIS, published in July 2008. Three of these meetings were held in the State of Wyoming and one in nearby (Spearfish) South Dakota. Comments on the draft GEIS were accepted between July 28, 2008, and November 8, 2008. Comments received during scoping and on the draft GEIS were made available on the NRC website (http://www.nrc.gov/reading-rm/adams.html). Transcripts of the scoping meeting and draft GEIS comment meetings in Wyoming are available at http://www.nrc.gov/materials/uranium-recovery/geis/pub-involve-process.html.

Table 1.1
ISL 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 and Occupational Health and Safety	S	S to M	S	S
Waste Management	S	S	S	S
S: SMALL impact M: MODERATE impact L: LARGE impact Source: NRC, 2009				

A scoping summary report was provided as GEIS Appendix A and GEIS Appendix G and provides responses to public comments on the draft GEIS (NRC, 2009).

In addition to the scoping activities conducted by NRC during preparation of the GEIS, NRC published ads, soliciting scoping comments on the Ross Project SEIS, in four local newspapers (*Moorcroft Leader*, *Casper Star Tribune*, *Gillette News Record*, and *Sundance Times*). The newspaper ad ran on December 2, 2011 in the Casper Star Tribune and December 1, 2011 for the other three papers. Scoping comments were received until December 30, 2011. In total, 19 scoping comment letters were received containing a total of 53 individual comments.

This SEIS was prepared to fulfill the requirement at 10 CFR Part 51.20(b)(8) to prepare either an environmental impact statement (EIS) or supplement to an EIS (SEIS) for the issuance of a source material license for an ISR facility (NRC, 2009). The GEIS provides a starting point for the NRC's NEPA analyses for site-specific license applications for new ISR facilities, as well as for applications to amend or renew existing ISR licenses. As described 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). The NRC staff applied these criteria to the site-specific conditions at the proposed Ross Project. This SEIS tiers from, and incorporates by reference, the GEIS relevant information, findings, and conclusions concerning environmental impacts. The extent to which NRC staff incorporates the GEIS impact conclusions depends on the consistency between: (i) the Applicant's proposed facilities and activities, and conditions at the Ross Project site; and (ii) the reference facility description, and activities, and information in the GEIS. NRC staff determinations regarding potential environmental impacts and the extent to which GEIS impact conclusions were incorporated by reference are described in Section 4 of this SEIS. GEIS Section 1.8.3 describes the relationship between the GEIS and a site-specific SEIS (NRC, 2009).

1.4.2 Public Participation Activities

As part of the preparation of this SEIS, NRC staff met with Federal, State, and local agencies and authorities, as well as public interest groups during a visit to the proposed Ross Project site and surrounding region in August 2011 (NRC, 2011a). The purpose of the meetings was to gather additional site-specific information to assist the NRC's environmental review.

The NRC staff published a Notice of Opportunity for Hearing on the proposed Ross Project license application in the *Federal Register* (FR) on July 13, 2011 (76 FR 41308). A hearing request from Petitioners Natural Resources Defense Council and Powder River Basin Resource Council was received on October 27, 2011. The NRC staff published a Notice of Intent (NOI) to prepare this SEIS on November 16, 2011 (76 FR 71082). In addition to the opportunities provided through the NEPA process, the NRC provided multiple opportunities for public involvement during the NRC staff's safety review. Specifically, the NRC staff held 10 public meetings or teleconferences with the Applicant from 2010 through 2012.

1.4.3 Issues Studied in Detail

To meet its NEPA obligations related to its review of the Ross Project license application, the NRC staff conducted an independent, detailed, comprehensive evaluation of the environmental impacts from construction, operation, aquifer restoration, and decommissioning of an ISR facility at the proposed Ross Project site and from reasonable alternatives. As described 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 (i.e., the same or similar) at all ISR facilities (or those with specified facility or site characteristics); and (iii) determined 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 site-specific 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 1.1).

Based on the GEIS analyses, this SEIS provides a site-specific analysis of the following resource areas:

- Land Use
- Transportation
- Geology and Soils

- Transportation
- Surface Water
- Groundwater
- Ecology
- Threatened and Endangered Species
- Air Quality
- Noise
- Visual and Scenic Resources
- Historic and Cultural Resources
- Socioeconomics
- Environmental Justice
- Public Health and Safety
- Waste Management

Furthermore, certain site-specific analyses not conducted in the GEIS, such as assessment of cumulative impacts, were considered in this SEIS. Additionally, the NRC considers the potential effects from implementing the proposed action on global climate change by estimating the facility's greenhouse gas emissions, and also describes the potential effects of global climate change on the proposed action.

1.4.4 Issues Outside the Scope of the SEIS

Some issues and concerns raised during the scoping process on the GEIS (NRC, 2009, 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 [EAs] and environmental impact statements [EISs]) and other documents were reviewed and used in the development of this SEIS. The related documents are described below:

- **NUREG–1910, Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities, Final Report (NRC, 2009)**. As described previously, 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 U.S. including the Nebraska/South Dakota/Wyoming Uranium Milling Region, where the proposed Ross Project would be located. The environmental analysis in this SEIS both tiers from the GEIS and incorporates it by reference.

- **NUREG–0706, Final Generic Environmental Impact Statement on Uranium Milling (NRC, 1980)**. This Generic EIS provides a detailed evaluation of the impacts and effects of anticipated conventional uranium milling operations in the United States through the year 2000, including an analysis of tailings disposal programs. NUREG–0706 concluded the environmental impacts from 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 detailed analysis.

- **NUREG–1508, Final Environmental Impact Statement To Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico (NRC, 1997)**. This EIS evaluates 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.

- **NRC's Safety Evaluation Report**. The NRC is preparing a Safety Evaluation Report (SER) for the proposed Ross Project that evaluates the Applicant's proposed facility design, operational procedures, and radiation protection programs and whether the Applicant's proposed action can be accomplished in accordance with the applicable provisions in 10 CFR Part 20, 10 CFR Part 40, and 10 CFR Part 40, Appendix A. The SER also provides the NRC staff analysis of the Applicant's initial funding estimate to complete site decommissioning and reclamation.

- **Newcastle Resource Management Plan EIS (BLM, 2000).** This management plan addresses the Comprehensive Analysis of Alternatives for the Planning and Management of Public Land and Resources Administered by the U.S. Bureau of Land Management (BLM), Crook, Weston and Niobrara Counties, Wyoming. This EIS identifies activities occurring in the region surrounding the Ross Project site that could either affect or be affected by the proposed Ross Project.

1.5 Applicable Regulatory Requirements

NEPA establishes national environmental policy and goals to protect, maintain, and enhance the environment and provide a process for implementing these specific goals for those Federal agencies responsible for an action. This SEIS was prepared in accordance with NRC NEPA-implementing regulations in 10 CFR Part 51 and other applicable 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, aquifer restoration, and decommissioning of an ISR facility. GEIS Sections 1.6.3.1 and 1.7.5.1 summarize the State of Wyoming'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, 2009).

1.6 Licensing and Permitting

NRC has statutory authority through the AEA and the Uranium Mill Tailings Radiation Control Act of 1978 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, local and Tribal governmental agencies. The NRC licensing process for ISR facilities is described in GEIS Section 1.7.1. GEIS Sections 1.7.2 through 1.7.5 describe the role of the other Federal, Tribal, and State agencies in the ISR permitting process (NRC, 2009). This section of the SEIS describes the NRC license application review process and summarizes the status of the NRC licensing process at the proposed Ross Project and the status of the Applicant's permitting with respect to other applicable Federal, Tribal, and State requirements.

1.6.1 NRC Licensing Process for the Ross Project

By letter dated January 4, 2011, the Applicant submitted a license application to NRC for the proposed Ross Project (Strata, 2011a; Strata, 2011b). As described 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 Ross Project license application for detailed technical review by letter dated June 28, 2011 (NRC, 2011b).

The NRC's detailed technical review of the license application is composed of both a safety review and an environmental review. These two reviews are conducted in parallel (see GEIS Figure 1.7-1). The focus of the safety review is to assess 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. A Notice of Intent to prepare this SEIS was published in the Federal Register on November 16, 2011 (76 FR 71082).

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 licensing actions. NRC published a Notice of Opportunity for Hearing related to the Ross Project license application on July 13, 2011 (76 FR 41308). NRC received a combined request for hearing from the Natural Resources Defense Council (NRDC) and Powder River Basin Resource Council (PRBRC) (collectively referred to as "Petitioners") on October 27, 2011 (NRDC and PRBRC, 2011).

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. Petitioners based their claim of standing on the possibility that the Ross Project would jeopardize the economic and environmental interests of at least one of their members (NRDC and PRBRC, 2011).

On February 10, 2012, the ASLB ruled that Natural Resources Defense Council (NRDC) and the Powder River Basin Resource Council (PRBRC) demonstrated standing to be parties to the licensing proceeding. The ASLB granted the petitioners' request for a hearing and admitted four contentions (ASLB, 2012).

1.6.2 Status of Permitting With Other Federal, Tribal, and State Agencies

In addition to obtaining a source material license from NRC prior to conducting ISR operations at the proposed Ross Project site, 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 1.2 lists the status of the required permits and approvals.

1.7 Consultations

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 Ross Project are summarized in Sections 1.7.1 and 1.7.2. A list of the consultation correspondence is 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. Section 7 of the ESA requires consultation with the U.S. Fish and Wildlife Service (USFWS) to ensure that actions it authorizes, permits, or otherwise carries out would not jeopardize the continued existence of any listed species or adversely modify designated critical habitats.

By letter dated August 12, 2011, NRC staff initiated consultation with USFWS requesting information on endangered or threatened species and critical habitat in the proposed Ross Project area. NRC received a response dated September 13, 2011, from the USFWS Ecological Services Cheyenne, Wyoming Field Office that: (i) listed the threatened and endangered species that may occur in the project area; (ii) provided recommendations for protective measures for threatened and endangered species; and (iii) provided recommendations concerning migratory birds (USFWS, 2011).

NRC staff also met with the Wyoming Game and Fish Department (WGFD) Sheridan Office on August 23, 2011, to discuss site-specific issues (NRC, 2011a). The Sheridan Office staff expressed concern about the potential impacts to water fowl, migratory birds, big game and small mammals, as well as sage grouse, a USFWS wait-list species for consideration as either threatened or endangered. WGFD staff also expressed concern about invasive species and impacts to wildlife due to power lines, evaporation ponds, and increased traffic. Impact mitigation measures were discussed. By letter dated, September 22, 2011, WGFD provided NRC with comments regarding the above concerns as follow up to the site visit (WGFD, 2011).

1.7.2 National Historic Preservation Act of 1966 Consultation

Section 106 of the 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.

Table 1.2
Environmental Approvals for the Proposed Ross Project

Issuing Agency	Description	Status
Wyoming Department of Environmental Quality	UIC Class III Permit (WDEQ, Title 35-11)	Received approval as part of Permit #802
	Underground Injection Control Class I (Deep Disposal Wells) (WDEQ, Title 35-11)	Application submitted June 2010 to UIC program in Cheyenne, Wyoming; TFN #WYS-011-00031, Approved April 2011, Permit #10-263
	Permit to Construct Domestic Wastewater System	To be prepared by Strata
	Storm Water Discharge Permit (industrial/mining)	To be prepared by Strata
	Storm Water Discharge Permit (construction)	Approved January 2013, Permit #WYR104738
	Storm Water Discharge Permit (discharge during well testing)	Approved April 2012, Permit #WYG720229, renewed December 2012
	Permit to Mine	Application submitted January 2011 to WDEQ District 3, Sheridan, Wyoming, TFN #5 6/110, Approved November 2012, Permit #802
	Mineral Exploration Permit (WDEQ, Title 35-11)	Approved #384DN
	Air Quality Permit	Approved CT-12198; September 2011
	Wastewater Pond Construction Permit (lined retention ponds and sediment pond)	To be prepared by Strata
	Public Water Supply System – Permit to construct	To be prepared by Strata
U.S. Bureau of Land Management	Plan of Operation	Submitted to BLM by Strata, January 2011; accepted for review July 2011, case file WYW170151
	Right of Way (roads)	To be prepared by Strata
	Notice of Intent to Explore	To be prepared by Strata
U.S. Nuclear Regulatory Commission	Source and Byproduct Materials License (10 CFR Part 40)	Application under review (submitted January 2011; accepted June 2011)

Table 1.2
Environmental Approvals for the Proposed Ross Project (Continued)

Issuing Agency	Description	Status
U.S. Environmental Protection Agency	Aquifer Exemption Permit for Class I Injection Wells (40 CFR 144, 146)	See WDEQ permits; Wyoming has primacy for the UIC program
	Aquifer Reclassification for Class III Injection Wells (WDEQ, Title 35-11)	
	Permit application to construct holding (storage) ponds (40 CFR 61.07)	
	Public Water Supply System	To be prepared by Strata
U.S. Army Corps of Engineers	Verification of Preliminary wetlands	Application submitted September 2010; Verification received December 2010
	Nationwide Permit Coverage authorization	Pre-construction notification submitted January 2013
Wyoming State Land & Farm Loan Office	Uranium Minerals Mining Lease	Approved #0-40979
Wyoming Department of Environmental Quality and State Engineer's Office	Permit to Appropriate Groundwater for ISR Wellfield	Under review, submitted December 2012
	Permit to Appropriate Groundwater for Mine Wells	Approved Permit #'s 191679-191702; 192703-192705 (regional baseline monitor wells) To be prepared for ISR monitor wells
	Permits to Appropriate Surface Water and/ or Lined Retention Ponds and Sediment Pond	To be prepared by Strata
Crook County	County Development Permits (access road approach and emergency services agreement)	Memorandum of Understand between Crook County and Strata executed April 2011.

Source: WWC Engineering, 2013

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 Wyoming SHPO in the Section 106 process is to advise and assist Federal agencies in carrying out their Section 106 responsibilities.

NRC initiated consultation with the Wyoming SHPO by letter dated August 19, 2011, requesting information from the SHPO to facilitate the identification of historic and cultural resources that could be affected by the proposed project (NRC, 2011c). The NRC staff continues to consult with the Wyoming SHPO to evaluate the effects of the proposed project on historic and cultural resources.

NRC is also consulting with potentially affected Native American Tribes as part of the Section 106 consultation process per 36 CFR Part 800.2(c). These interactions are detailed in Section 1.7.3.3 of the SEIS.

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

The NRC staff interacted with 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 ISR facility at the Ross Project site. The consultation and coordination process included discussions with BLM, National Park Service (NPS), Tribal governments, the Wyoming Department of Environmental Quality (WDEQ), WGFD, the Wyoming State Engineer's Office (SEO), and local organizations (PRBRC, City of Moorcroft First Responders, and Crook County).

1.7.3.1 Coordination with the Bureau of Land Management

In its letter dated January 27, 2011, U.S. Bureau of Land Management (BLM) indicated its intent to serve as a cooperating agency in the NEPA assessment and licensing process for the proposed Ross Project, with the NRC serving as the lead agency. The proposed Ross Project site contains approximately 16 ha [40 ac] of BLM-administered surface lands. Additionally, BLM has jurisdiction over locatable mineral rights within the proposed project area. As discussed in Section 1.3, 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. A Memorandum of Understanding between NRC and BLM (75 FR 1088), signed by BLM on October 16, 2009 and by NRC on November 30, 2009, provides the framework for the cooperating agency relationship.

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 these situations, operators on mining claims, including ISR facilities, must submit a Plan of Operations and obtain BLM approval before beginning operations beyond those for casual use {for surface disturbance of more than 2 ha [5 ac]}.

The NRC has coordinated with BLM during preparation of this SEIS. Regular conference calls and meetings have been held. The NRC staff met with the staff of BLM Newcastle, Wyoming field office on August 24, 2011 to discuss the Applicant's Plan of Operations for the proposed Ross Project. BLM familiarized the NRC staff with the Plan of Operations review process and

shared some of the comments and the concerns BLM had received from individuals commenting on the Plan of Operations.

1.7.3.2 Interactions with Tribal Governments

Pursuant to Section 106 of the NHPA, the NRC staff initiated discussions with potentially affected Native American Tribes that possess heritage and cultural interest to the proposed Ross Project area. On November 19, 2010, NRC sent a letter to 14 Tribes, notifying them of Strata's intent to submit an application for a license for the Ross Project and soliciting input from the Tribes (NRC, 2010). NRC sent letters, dated February 9, 2011, to the following 24 Tribes, inviting the Tribes to participate in formal consultations for the proposed Ross Project (NRC, 2011d):

- Apache Tribe of Oklahoma
- Blackfeet
- Cheyenne and Arapaho Tribes of Oklahoma
- Cheyenne River Lakota
- Crow
- Crow Creek Sioux
- Eastern Shoshone
- Flandreau Santee Lakota
- Fort Belknap Community
- Fort Peck Assiniboine/Sioux
- Kiowa Tribe of Oklahoma
- Lower Brule Lakota
- Northern Arapaho
- Northern Cheyenne
- Oglala Lakota (Sioux)
- Rosebud Sioux
- Salish, Pend d'Oreille and Kootenai Tribes
- Santee Sioux Nation
- Sisseton-Wahpeton Lakota
- Spirit Lake
- Standing Rock Sioux
- Three Affiliated Tribes (Mandan, Hidatsa, and Arikara Nation)
- Turtle Mountain Band of Chippewa Indians
- Yankton Lakota

The 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.

On April 15, 2011, the Rosebud Sioux Tribe notified the NRC via email that it was interested in consultation and had concerns about the proposed project (Rosebud Sioux Tribe, 2011). On April 29, 2011, the Standing Rock Sioux Tribe notified NRC via email of its desire to consult (Standing Rock Sioux Tribe, 2011). On May 5, 2011 the Northern Cheyenne Tribe notified NRC via email of its interest to consult (Northern Cheyenne Tribe, 2011). On May 17, 2011, the Cheyenne River Sioux Tribe notified NRC via email of its interest to consult on the proposed project (Cheyenne River Sioux Tribe, 2011).

By letter dated April 14, 2011 the Tribal Historic Preservation Officer (THPO) for the Turtle Mountain Band of Chippewa Indians, informed NRC that it does not likely have any traditional cultural properties that would be of National Register significance at the Ross Project site (Turtle Mountain Band of Chippewa Indians, 2011). NRC was notified by email on August 19, 2011 that the Apache Tribe of Oklahoma, was not interested in consultation on the Ross Project (Apache Tribe of Oklahoma, 2011). The Salish, Pend d'Oreille and Kootenai Tribes notified NRC by email on December 29, 2011 that it would defer to nearer Tribes for consultation on the Ross Project (Salish, Pend d'Oreille and Kootenai Tribes, 2011).

The NRC staff, along with BLM staff, and the Applicant, conducted a site visit with representatives from the Northern Arapaho, the Northern Cheyenne, and the Fort Peck Assiniboine Sioux Tribes on September 13, 2011. The NRC staff and the BLM staff participated in a consultation meeting with the Northern Arapaho and the Northern Cheyenne Arapaho Tribes on September 14, 2011. On November 2, 2011, the NRC staff along with BLM staff, NPS staff for Devils Tower National Monument, and the Applicant conducted a second site visit with representatives from the Chippewa Cree, Crow Creek Sioux, Santee Sioux Nation, and the Fort Peck Assiniboine Sioux Tribes. On November 3, 2011, the NRC staff, BLM staff, and NPS staff participated in a consultation meeting with representatives from the Crow Creek Sioux, Santee Sioux Nation, and the Fort Peck Assiniboine Sioux Tribes. The Chippewa Cree Tribe expressed interest in consulting during planning for the second consultation meeting.

During the September 2011 and November 2011 consultation meetings, the Tribes requested that a survey for properties of religious and cultural significance [or a Traditional Cultural Property (TCP) survey] of the Ross Project area be conducted. During the November 2011 site visit, Strata indicated that it would be willing to support such a survey. On December 6, 2011, the NRC sent a letter to Strata requesting a written proposal to acquire TCP information. Strata responded with a letter, dated January 12, 2012, in which it stated that in lieu of submitting a proposal for a TCP assessment of the Ross Project area, Strata would like to issue a Request for Proposals from consultants to prepare the TCP assessment. During conversations with several THPOs, the NRC staff was informed that the Tribes did not want to work with a third-party consultant hired by the Applicant. Therefore, the NRC staff enlisted support from its own third-party consultant to work with the Tribes to obtain information on TCPs.

At this time, the NRC staff was also working with many of the same Tribes to obtain TCP information for other ISR projects under NRC review. The Tribes consulting on the Ross Project suggested using a Scope of Work (SOW) that was being prepared for one of the other ISR projects under NRC review and revising it to be applicable for the Ross Project. The Tribes requested background information on the Ross Project area to assist them in developing a draft SOW for the Ross Project. This information was provided to the Tribes via email on July 25, 2012. In August 2012, the NRC's third-party consultant began reaching out to Tribes via phone and email to invite them to meet in Bismarck, North Dakota in early September to discuss the SOW as many of the Tribes were planning to be Bismarck at that time for a meeting with another agency. Strata provided a draft SOW to the NRC to be shared with the Tribes during the meeting. Sixteen Tribal representatives indicated that they would attend the meeting.
On September 4, 2012, the NRC's third-party consultant met with representatives from the Standing Rock Sioux Tribe and the Three Affiliated Tribes in Bismarck, North Dakota. The Standing Rock Sioux Tribe representative indicated during this meeting that the Tribes did not want to use the SOW developed by Strata and would develop a draft SOW for the Ross Project. The Tribal representatives also indicated that a separate cost proposal would need to be developed for the TCP survey. In October and November 2012, the NRC staff worked with the representative from the Standing Rock Sioux Tribe to revise the SOW provided to the NRC by

the Tribes for another ISR project under NRC review to be applicable for the Ross Project. Also, on October 23, 2012, Strata hosted three representatives from the Makoche Wowapi company at the Ross Project site to facilitate the company's preparation of a cost proposal for the TCP survey. The Makoche Wowapi company had submitted a cost proposal for a TCP survey for another ISR project under NRC review and many of the THPOs were discussing naming the company as the preferred consultant to conduct the TCP survey at the Ross Project site.

On November 13, 2012 and November 14, 2012, the NRC staff provided the draft SOW for the TCP survey to the THPOs and Strata, respectively, via email for review and comment. The THPOs held a teleconference to discuss the draft SOW on November 14, 2012 and invited the NRC staff to participate to answer questions. During the November 14, 2012 teleconference several THPOs indicated that the draft Scope of Work was acceptable and recommended that the Makoche Wowapi company was their preferred consultant to conduct the survey.

The NRC staff shared the final SOW with the consulting THPOs via email on November 30, 2012. After no comments were received, the NRC staff also shared the final SOW with the Makoche Wowapi company on December 4, 2012. On December 12, 2012, the Makoche Wowapi company submitted a cost proposal for the survey to the NRC. Strata notified the NRC staff, by email dated February 15, 2013, that its negotiations with Makoche Wowapi had come to an end and an agreement had not been reached. The NRC staff iscurrently consulting with the Tribes and Strata on an alternative approach to conduct a TCP survey. The survey is expected to be conducted during spring 2013.

The Section 106 consultation process is ongoing. Results of the consultation will be presented in the final SEIS.

1.7.3.3 Coordination with National Park Service

NRC staff met with NPS staff at Devils Tower on August 25, 2011 (NRC, 2011a). NPS staff discussed the use of the monument by Tribes for cultural activities and prayers. NPS staff shared concerns about the night-sky viewshed and noise as well as potential impacts to groundwater quality. NPS is a "commenting agency" for this SEIS.

1.7.3.4 Coordination with the Wyoming Department of Environmental Quality

NRC staff met with WDEQ in Sheridan, Wyoming, on August 23, 2011, to discuss the WDEQ role in the NRC environmental review process for ISR facilities (NRC, 2011a). WDEQ staff participating in the meeting included representatives from the Land Quality Division (LQD), Water Quality Division (WQD), and the Air Quality Division (AQD). Topics discussed during the meeting included the WDEQ air quality review and permitting as well as other required permits. The WDEQ expressed concern regarding the proposed location of the Central Processing Plant (CPP) and the evaporation ponds along with fugitive dust and emissions.

NRC staff also met with personnel from the WDEQ in Casper, Wyoming on August 24, 2011 (NRC, 2011a). WDEQ staff participating in the meeting included representatives from the WQD as well as the Solid and Hazardous Waste Division. The WDEQ explained the permitting process for land application of waste water and discussed solid waste management.

1.7.3.5 Coordination with the Wyoming Game and Fish Department

WGFD is responsible for controlling, propagating, managing, protecting, and regulating all game and nongame fish and wildlife in Wyoming under Wyoming Statute (W.S.) 23-1-301-303 and 23-1-401. Regulatory authority given to WGFD allows for the establishment of hunting, fishing, and trapping seasons, as well as the enforcement of rules protecting nongame and state-listed species.

NRC staff met with a representative of the Sheridan Regional WGFD office on August 23, 2011 (NRC, 2011a). As discussed in Section 1.7.1, WGFD staff expressed concerns about big game animals, raptors, migratory birds, and small mammals that may be affected by the proposed Ross Project and suggested mitigation strategies to minimize or eliminate impacts.

1.7.3.6 Coordination with the City of Moorcroft First Responders

NRC staff met with the City of Moorcroft First Responders on August 25, 2011 (NRC, 2011a). The City of Moorcroft First Responders briefed the NRC on the availability of local emergency equipment, personnel, and medical facilities. The emergency personnel discussed their need for additional training. The availability of land use plans and socioeconomic data was also discussed.

1.7.3.7 Coordination with the Powder River Basin Resource Council

NRC staff met with PRBRC on August 23, 2011 (NRC, 2011a). PRBRC shared several concerns regarding the proposed Ross Project including concerns about the Applicant's experience, potential direct and cumulative impacts to water quality, air quality, and ecology from operations, the potential for accidents and long-term effects, and restoration and excursion monitoring.

1.7.3.8 Coordination with Localities

NRC staff met with Crook County officials and staff on August 25, 2011, including representatives from the Crook County Sheriff's Office, Crook County Attorneys, Crook County Road & Bridge, Crook County Natural Resource District, Crook County Weed & Pest, Crook County Commissioner, Crook County Growth & Development, and Crook County Emergency Management (NRC, 2011a). The Crook County officials and staff shared several concerns and asked many questions about the proposed Ross Project. Topics discussed included the chemical and radiological hazards associated with the project, the management of boreholes and the potential for drinking water contamination, water use, financial assurance, solid waste management, invasive species, decommissioning, and cumulative impacts.

1.8 Structure of the SEIS

As noted in Section 1.4.1 of this document, the GEIS (NRC, 2009) 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.

SEIS Section 2 describes the proposed action and reasonable alternatives considered for the proposed Ross Project, Section 3 describes the affected environment, and Section 4 evaluates the environmental impacts from implementing the proposed action and alternatives. Cumulative impacts are discussed in Section 5, while Section 6 describes the environmental measurement and monitoring programs proposed for the Ross Project. A cost-benefit analysis is provided in Section 7, and the environmental consequences from the proposed action and alternatives are summarized in Section 8.

1.9 References

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2 IN SITU URANIUM RECOVERY AND ALTERNATIVES

This section describes the Proposed Action, which is to issue a U.S. Nuclear Regulatory Commission (NRC) source and byproduct material license to Strata for the proposed Ross Project in northeastern Wyoming. Strata would use its NRC license in connection with the construction, operation, aquifer restoration, and decommissioning of the proposed Ross Project. This section also discusses alternatives to the proposed action, including the No-Action alternative as required under the National Environmental Policy Act of 1969 (NEPA).

> **What is source material?**
>
> "Source material" means either the element thorium or the element uranium, provided that the uranium has not been enriched with the radioisotope uranium-235.
>
> **What is byproduct material?**
>
> "Byproduct materials" are tailings or wastes generated by extraction or concentration of uranium or thorium processed ores, as defined under Section 11e.(2) of the Atomic Energy Act (AEA).

Figure 2.1 indicates the proposed location of the Ross Project. Section 2.1 of this Supplemental Environmental Impact Statement (SEIS) describes the Alternatives that are included for detailed analysis, including the Proposed Action; Section 2.2 describes those alternatives that were considered but eliminated from detailed analysis; Section 2.3 summarizes the potential environmental impacts of the Proposed Action and the two Alternatives; and Section 2.4 discusses the NRC staff's preliminary recommendation that the NRC issue a source and byproduct materials license for the Proposed Action unless safety issues mandate otherwise.

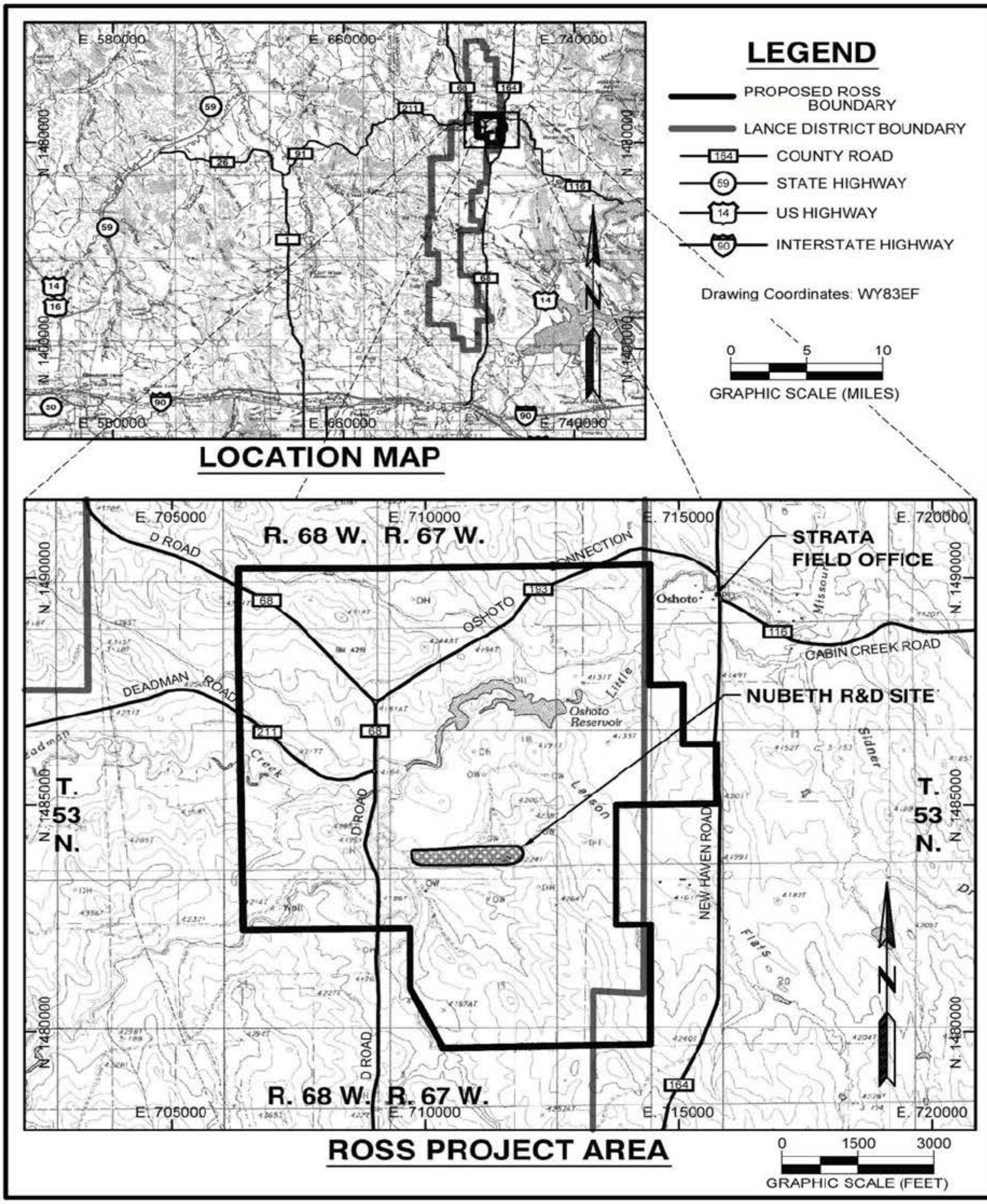
2.1 Alternatives Considered for Detailed Analysis

In addition to the Proposed Action, two alternatives to the Ross Project are also considered in this SEIS. All alternatives are evaluated with regard to the four phases of an uranium-recovery operation: construction, operation, aquifer restoration, and decommissioning. The range of alternatives has been established based on the purpose and need statement as described in Section 1.3 of this SEIS. In addition, this SEIS adopts many of the conclusions reached in the GEIS that was prepared for in situ recovery (ISR) projects (NRC, 2009).

Alternatives examined in this SEIS are:

- Alternative 1 is the Proposed Action, as described in the Applicant's license application. The Proposed Action is described in SEIS Section 2.1.1.
- Alternative 2 is the No-Action Alternative, as required by the *National Environmental Policy Act* (NEPA), where the Applicant would not construct, operate, restore the aquifer, or decommission the Ross Project. Alternative 2 is described in SEIS Section 2.1.2.
- Alternative 3 is the same as the Proposed Action, except that the Ross Project facility (i.e., the central processing plant [CPP], auxiliary and support buildings and structures, and the surface impoundments) would be situated at a different location to the north of the Proposed Action (i.e., at the "north site"). Alternative 3 is identified in this SEIS as the "North Ross Project" and is described in SEIS Section 2.1.3.

The sources of information used in the development of this SEIS include the following: the Applicant's license application, including its *Environmental Report* (ER) (Strata, 2011a) and its *Technical Report* (TR) (Strata, 2011b) as well as its Responses to Requests for Additional



Source: Strata, 2012a.

Figure 2.1

Ross Project Within the Lance District

Information (RAIs) (Strata, 2012a; Strata, 2012b); the information and scoping comments gathered during the NRC staff's and NRC consultants' site visit in August 2011 (NRC, 2011); information independently researched by the NRC staff from publicly available sources; multidisciplinary discussions held among NRC staff and various stakeholders; and the Generic Environmental Impact Statement (GEIS) itself (NRC, 2009).

2.1.1 Alternative 1: Proposed Action

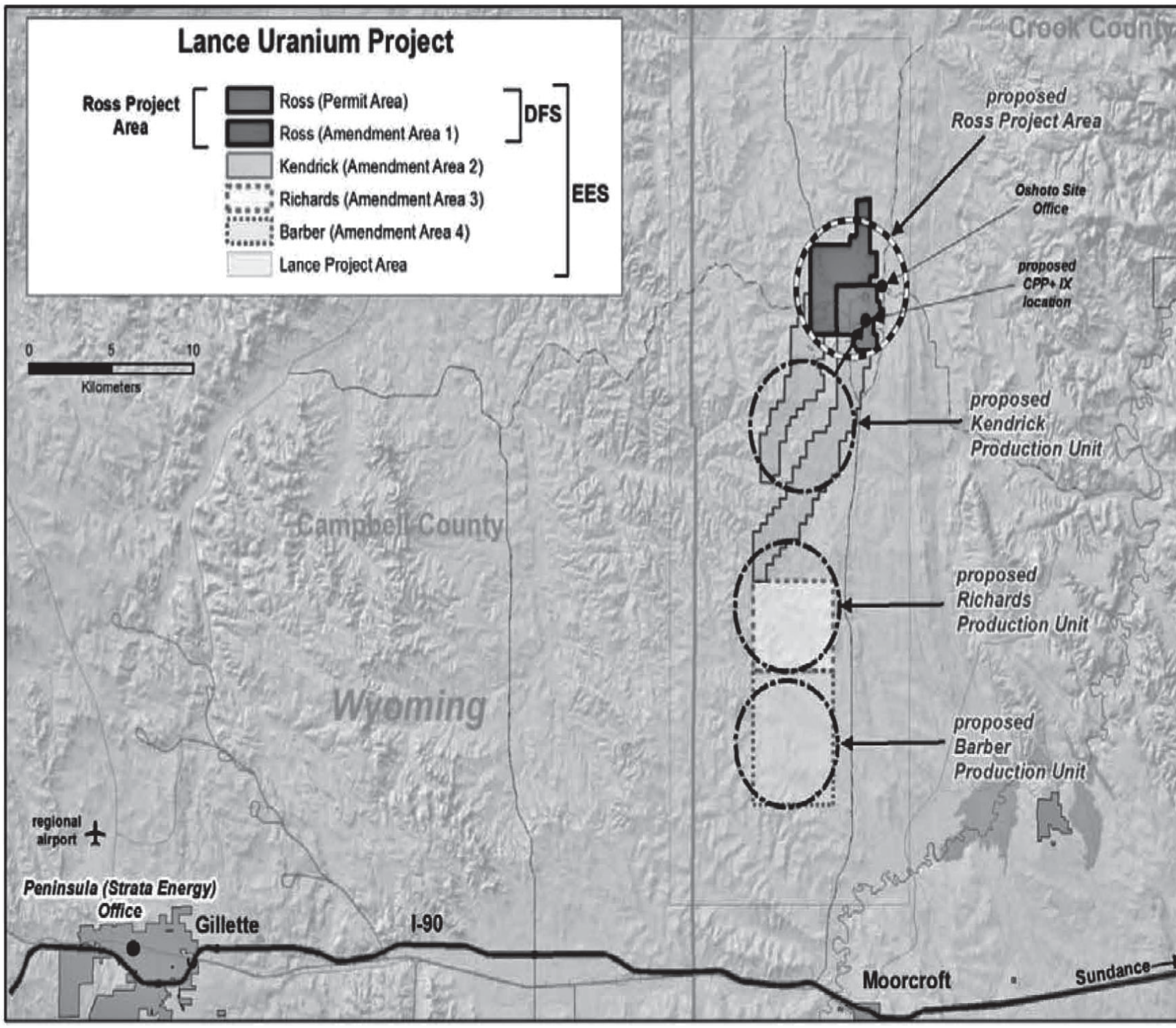
Under the Proposed Action, the NRC would issue the applicant a source material license. The Applicant would use its NRC license in connection with the construction, operation, aquifer restoration, and decommissioning of the ISR facility at the Ross Project area as described in its license application (Strata, 2011a; Strata, 2011b). Also, under the proposed action, the U.S. Bureau of Land Management (BLM) would approve the Applicant's Plan of Operations (POO). The Ross Project would occupy 697 ha [1,721 ac] in the north half of the approximately 90-km^2 [56-mi^2] Lance District, an area where the Applicant is actively exploring to determine whether there are additional uranium deposits. As Figure 2.2 shows, Strata has also identified four other uranium-bearing areas that would extend the area of uranium recovery to the north with the Ross Amendment Area 1 and to the south of the Lance District with the Kendrick, Richards, and Barber satellite facilities (Strata, 2012a).

The Lance District is located on the western edge in the northwest corner of the Nebraska-North Dakota-Wyoming Uranium Milling Region (NSDWUMR) (see Figure 2.3). It is situated between the Black Hills uplift to the east and the Powder River Basin to the west (Strata, 2011a). Both of these regional features are described in the GEIS (NRC, 2009). However, the Powder River Basin has been described as part of the Wyoming East Uranium Milling Region (WEUMR) and the Black Hills uplift as part of the NSDWUMR. The uranium ore zone at the Ross Project is situated in the upper Cretaceous Fox Hills and Lance Formations. Although these stratigraphic units are not specifically described in the GEIS, they share key attributes that are important for ISR with the uranium-hosting Wasatch Formation in the Powder River Basin described for the WEUMR and the Inyan Kara Group described for the NSDWUMR (NRC, 2009). These key attributes include alternating layers of sandstone, which allow hydraulic circulation, and shale, which prevent hydraulic circulation. The environment of the Proposed Action is described in Section 3 of this SEIS.

The Proposed Action includes the ISR facility itself and its wellfields (see Figures 2.4 and 2.5). The ISR facility consists of the following:

- A CPP that houses the uranium- and vanadium-processing equipment, drying and packaging equipment, and water-treatment equipment.
- A chemical storage area as well as other storage, warehouse, maintenance, and administration buildings.
- Two double-lined surface impoundments, a sediment impoundment, and five Class I deep-injection wells.

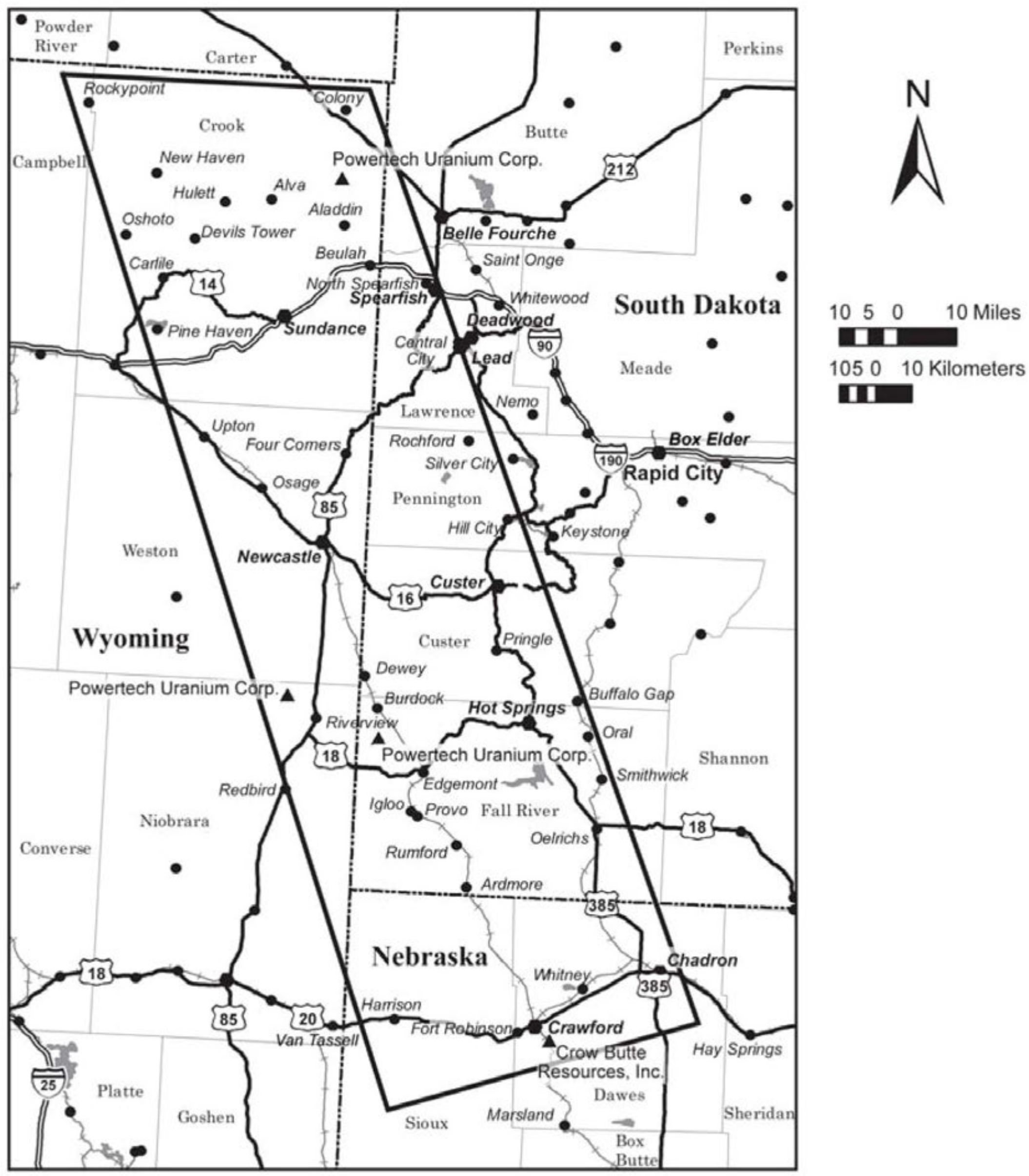
The schedule for the Proposed Action is shown in Figure 2.6. The Proposed Action includes the option of the Applicant's operating the Ross Project facility beyond the life of the Project's wellfields.



Source: Strata, 2012a.

Figure 2.2

Potential Satellite Areas in the Lance District



Source: NRC, 2009

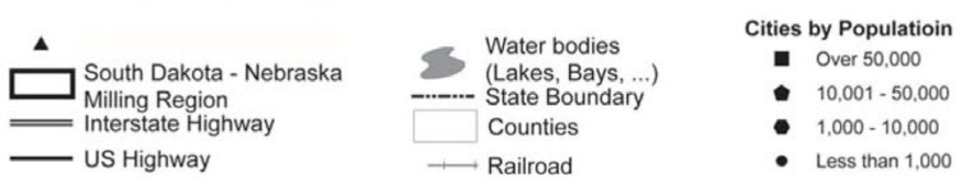
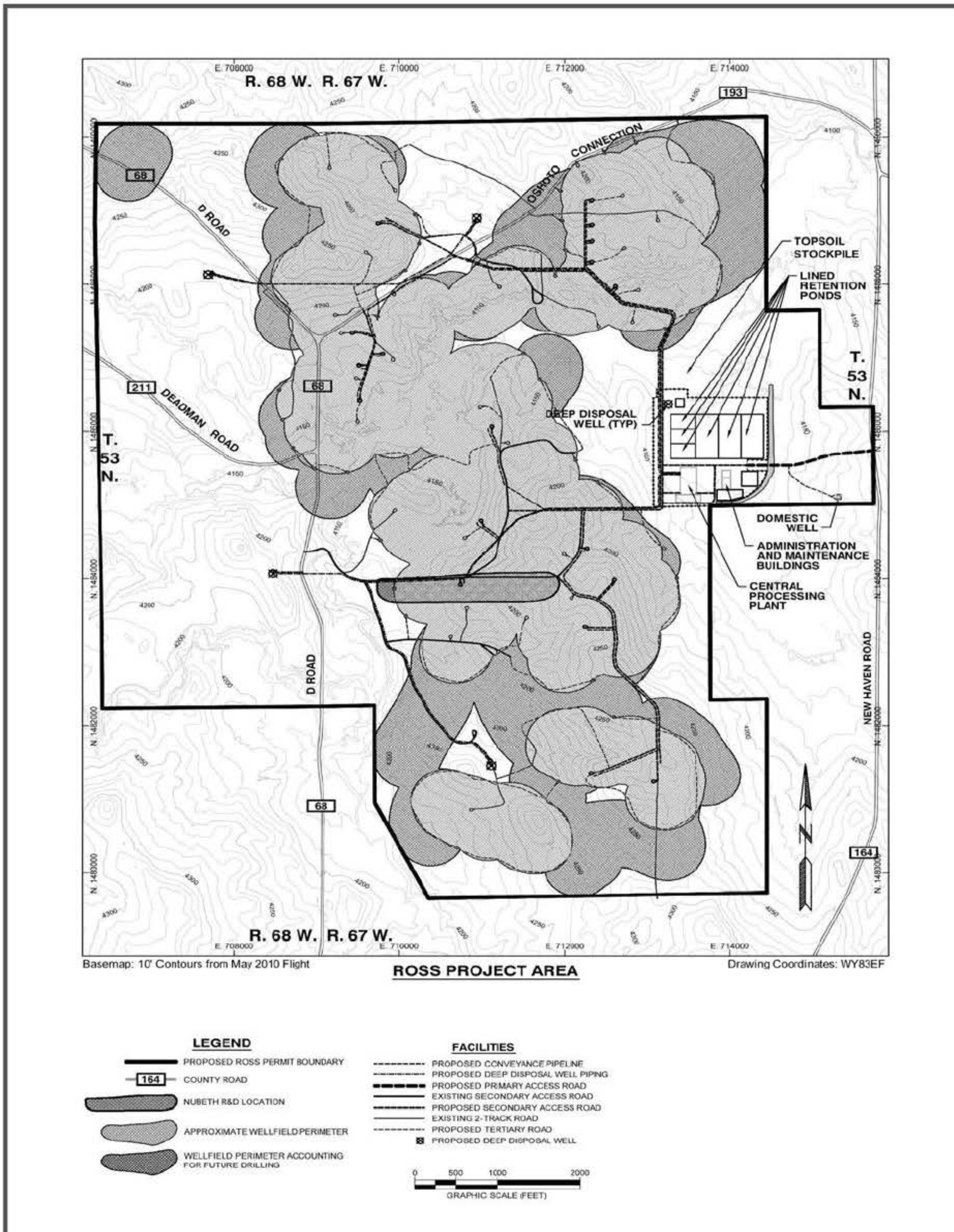


Figure 2.3

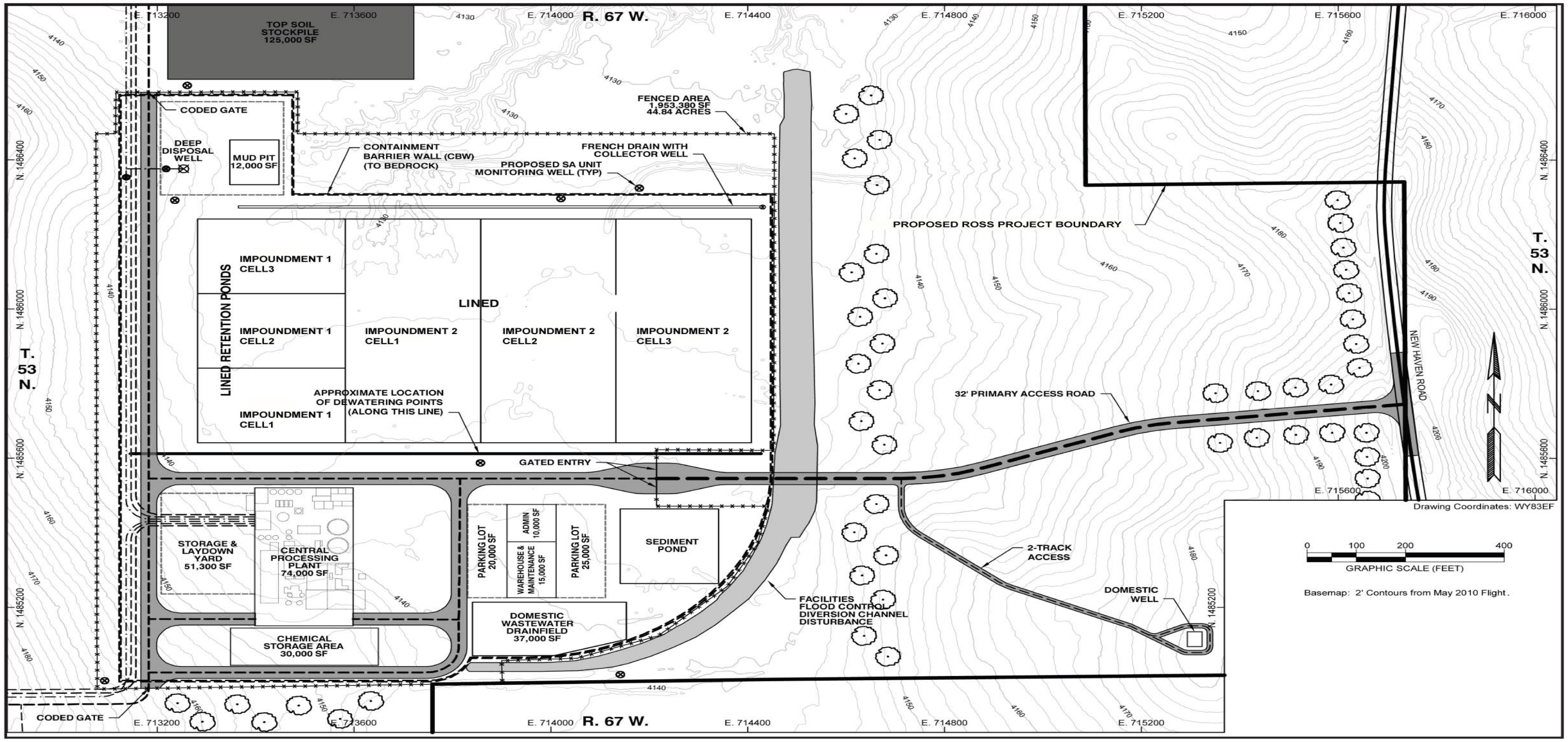
Nebraska-South Dakota-Wyoming Uranium Milling Region



Source: Strata, 2011b.

Figure 2.4

Proposed Ross Project Facility and Wellfields

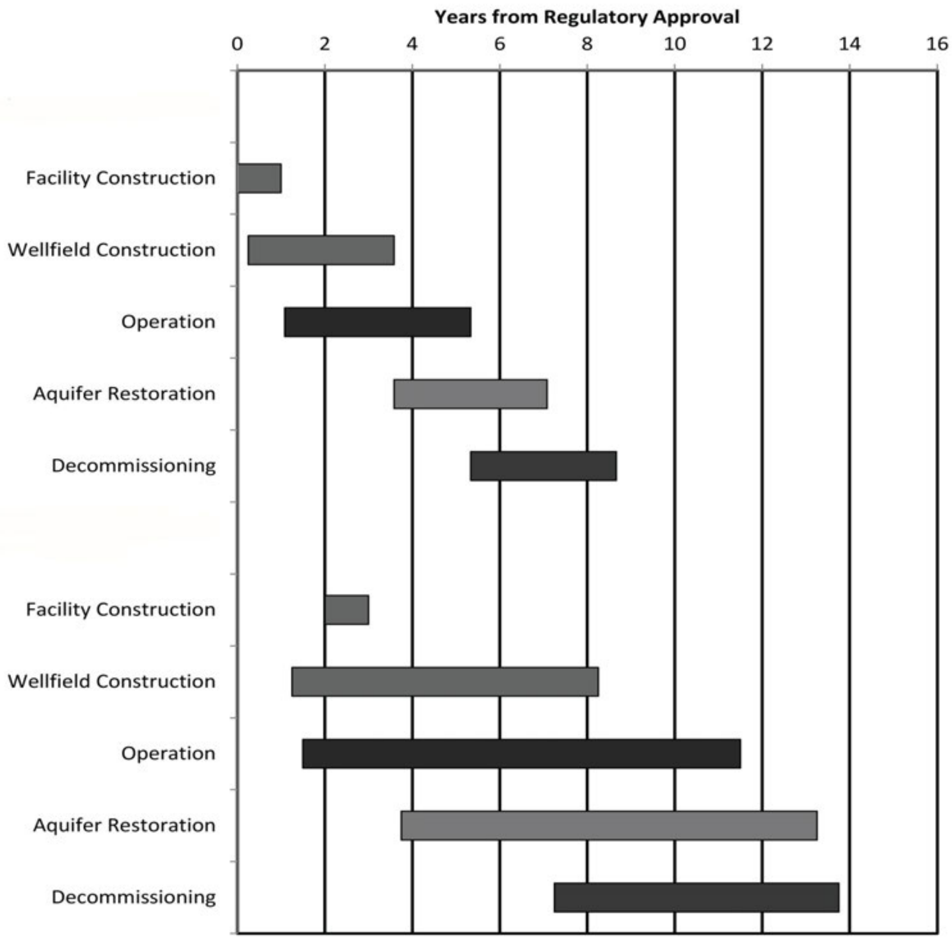


Source: Strata, 2012a.

Figure 2.5

General Layout of Proposed Ross Project Facility

1



Source: Strata, 2012a.

Figure 2.6

Schedule for Potential Lance District Development

The facility could be used to process uranium-loaded resins from satellite projects within the Lance District operated by the Applicant, or from other offsite uranium-recovery projects not operated by the Applicant, or from offsite water-treatment operations. In this case, the life of the facility would be extended to 14 years or more (Strata, 2012a).

The Ross Project would host 15 – 25 wellfield areas and would consist of a total of 1,400 – 2,000 recovery and injection wells (Strata, 2011a). Groups of wells ("well modules") within a wellfield would be connected with piping to a central collection facility called a "module building," or a "header house." The wellfields would also be surrounded by a perimeter ring of monitoring wells.

This type of uranium extraction, in situ uranium recovery, consists of water to which chemicals have been added, referred to as "lixiviant," that is injected into the aquifer bearing the uranium ore (the "ore zone" or "ore body") (see Section 2.1.1.2). The chemicals in the lixiviant dissolve the uranium from the rock within the aquifer. Ground water containing dissolved uranium is then pumped from the ore-zone aquifer, processed through ion-exchange (IX) columns to remove the uranium from the lixiviant, and then the uranium is precipitated into a solid material called "yellowcake" (U_3O_8). Most of the water is then reused for uranium recovery.

> **What is lixiviant?**
> A solution composed of native ground water and chemicals added during the ISR operations. Lixiviant is then pumped underground to mobilize (dissolve) uranium from a uranium-bearing ore zone, or the ore body.

ISR is not hydraulic fracturing or "hydrofracking." Hydrofracking is a technique that is used by oil companies to increase the production of petroleum and natural gas by creating cracks in tight rocks containing oil and gas. A hydraulic fracture is formed by a fracturing fluid that is pumped into a well at a rate sufficient to increase pressure in the well, so that it exceeds the in situ pressure of the rock. The fracturing fluid is a slurry of water, chemicals to aid in cracking, and a proppant, a material such as sand grains or ceramic particulates that keep the fractures open when the injection is stopped and oil recovery occurs. In contrast, ISR operates at much lower pressure in the injection well. In situ pressures in ISR injection wells are only slightly above the in situ aquifer pressure. In addition, ISR is only used in aquifers with sufficient porosity and permeability to allow water flow from an injection well with a slightly positive pressure to the recovery well with a slightly negative pressure. This difference in pressure causes the ground water to move toward the recovery well. Finally, the chemicals in the water injected in ISR are for the purpose of dissolving the uranium, not to affect the porosity or permeability of the rock as are those during hydrofracking.

The Ross Project would be located in Crook County, Wyoming, 35 km [22 mi] north of the town of Moorcroft and Interstate-90 (see Figure 2.1). Other nearby towns and approximate direct distances to the Ross Project area include Pine Haven (27 km [17 mi] southeast), Gillette (53 km [33 mi] southwest), and Sundance (48 km [30 mi] southeast). The Ross Project area is adjacent to the unincorporated ranching community of Oshoto. The Oshoto community includes 11 residences within 3.2 km [2 mi] of the Proposed Action's boundary. Access to the Ross Project area is by either County Road (CR) 68 (D Road) or CR 164 (New Haven Road), both of which proceed north.

The Ross Project encompasses approximately 697 ha [1,721 ac] in portions of Sections 7, 17, 18, and 19, Township 53N, Range 67 West, and portions of Sections 12, 13, and 24, Township 53N, Range 68 West.

Table 2.1 Surface Ownership at Ross Project Area			
Surface Ownership	**Total Acres within Ross Project Area**	**Acres Disturbed During Year Preceding Operation**	**Acres Disturbed Over Life of Proposed Action**
U.S. Bureau of Land Management	40.0	1.3	1.3
State of Wyoming	314.1	40	80
Private	1,367.2	69	199
TOTAL	**1,721.3**	**110.3**	**280.3**

Source: Table 1.2-1 in Strata, 2011a.

Surface ownership within the Ross Project area is primarily private, with small tracts of land owned by the State of Wyoming and the BLM (Strata, 2011a). Approximately 16 ha [40 ac] are BLM land. The Wyoming Office of State Lands and Investments (WOSLI) administers 127 ha [314 ac]. In addition to the surface ownership, the BLM manages the subsurface mineral rights under 65 ha [160 ac] of privately owned land. Table 2.1 indicates the respective landowners of the Ross Project area. Current land uses are discussed in Section 3.2.

The Ross Project area is located in the upper reaches of the Little Missouri River, which flows northeasterly into southeastern Montana, through northwest South Dakota, and into North Dakota where it empties into the Missouri River at Lake Sakakawea. The area is characteristic of northwestern Wyoming: It is sparsely populated rangeland used primarily for grazing and some dry-land agricultural production. Oil development from the Minnelusa Formation in western Crook County began in the 1970s. There are three oil-recovery wells within the Ross Project area; oil production from these wells peaked in 1985 – 1986, but production has generally declined since then (Strata, 2011a).

As noted earlier, uranium targeted for production within the Ross Project is located in permeable sandstones of the Upper Cretaceous Lance and Fox Hills Formations. The uranium in the Oshoto area resides in roll-front deposits typical of those across the Powder River Basin as described in the WEUMR (NRC, 2009). Roll fronts are formed in sandstone formations when uranium-bearing ground water, moving down-gradient, encounters changing conditions. As the aquifer changes from oxygenated to oxygen-deficient, uranium precipitates as a coating on sand grains. The precise geometry of the uranium-ore deposits is controlled by the site-specific characteristics of the host sandstones. At the Ross Project area, the ore zones are generally thicker and more massive in the deeper Fox Hills compared to the deposits in the Lance Formation (Strata, 2011a).

Exploration of uranium deposits in the Lance Formation began in late 1970 (Strata, 2011a). The Nubeth Joint Venture (Nubeth), a joint venture between Nuclear Dynamics (later named ND Resources, Inc.) and Bethlehem Steel, received a License to Explore (No. 19) from the Wyoming Department of Environmental Quality's (WDEQ's) Land Quality Division (LQD) in

August 1976, with subsequent modifications to accommodate research and development activities in 1978 (Strata, 2011a). ND Resources, Inc. filed for an NRC source materials license in November 1977, and the license was approved in April 1978. Nubeth constructed a research and development operation in Section 18 of Township 53 North, Range 67 West, which is located within the Ross Project area (see Figure 2.1).

The research and development operation consisted of a single five-spot well pattern, with four injection wells and one recovery well, and a small facility with an IX, elution, and precipitation circuit capable of producing yellowcake slurry. The research and development facility could process 340 L/min [90 gal/min] of uranium-bearing lixiviant. Hydraulic control during the operation was accomplished with “buffer” wells, which were meant to form a hydraulic barrier to keep the lixiviant within the well pattern. Nubeth operated from August 1978 through April 1979 and recovered small amounts of uranium. No precipitation of a uranium product took place, and all of the recovered uranium was stored as a solution. After uranium-recovery tests were completed, the single five-spot used in the test was restored. Restoration was completed in February 1983 and Nubeth was notified by the WDEQ on April 25, 1983 that the restoration was satisfactory. Final approval for the research and development project’s final operation decommissioning was granted by the NRC and WDEQ/LQD during the time period from 1983 through 1986 (Strata, 2011b).

Undesirable plugging of the aquifer, which was attributed to the build-up of fine particles, restricted injection rates and eventually led to the Nubeth operation’s premature shutdown. A summary report on production feasibility estimated that uranium production could average about 360 kg/d [800 lb/d] in a facility sized to process 11,000 – 15,000 L/min [3,000 – 4,000 gal/min] (Strata, 2011a). However, due to the declining price of uranium at the time, commercial-scale licensing, construction, and operation did not occur. Two of Nubeth’s wells (Well Nos. 789V and 19XX) have been used by oil companies since 1980 (Strata, 2011b); currently, the Merit Oil Company (Merit) is operating these two wells in addition to one more on the Ross Project area.

The Applicant notes that information obtained from the Nubeth research and development project was used in its decision to develop the Ross Project at the location described in this SEIS (Strata, 2011a). Nubeth’s operation contributed the following information:

- Demonstration of the probability of an aquifer exemption of the mineralized zone
- Determination of strong geologic confinement above and below the identified ore body(ies)
- Confirmation of fundamental hydrogeologic hypotheses regarding ground-water flow and behavior
- Validation of information on potential regulatory and operational technical issues
- Determination of site geology, hydrology, soils, ecology, climate, and background radiological conditions
- Decrease of disturbance to both the surface and subsurface based on data collected in the past
- Demonstration of successful ground-water restoration and site reclamation

Peninsula Energy Ltd. (formerly Peninsula Minerals Ltd.) initiated acquisition of mineral rights in the Lance District in 2007 and 2008 (Peninsula, 2011). Exploration drilling programs, which were conducted in 2008 and 2009, confirmed significant uranium resources in the Ross Project area. Strata was incorporated in 2009; in 2010, Strata submitted applications for an NRC

combined source and byproduct materials license, a Permit to Mine to WDEQ/LQD, and a POO to BLM. WDEQ/LQD approved Strata's Permit to Mine application in November 2012. The BLM is currently reviewing Strata's application, as is the NRC through the development of this SEIS and its SER. BLM is participating as a "cooperating agency" to the NRC under a Memorandum of Understanding (MOU) for the Ross Project.

In Section 2 of the GEIS, the four stages in the life of an ISR facility are described: 1) construction, 2) operation, 3) aquifer restoration, and 4) decommissioning (NRC, 2009). The decommissioning phase would include facility decontamination, dismantling, demolition, and disposal as well as site reclamation and restoration. Although NRC recognizes that these four phases could be performed concurrently, and in practice early wellfields would undergo aquifer restoration while other wellfields are being installed, the GEIS determined that describing the ISR process in terms of these stages aids in the discussion of the ISR process and in the evaluation of potential environmental impacts from an ISR facility.

2.1.1.1 Ross Project Construction

Construction of the Ross Project would be consistent with the general construction activities described in Section 2.3 of the GEIS (NRC, 2009). The Applicant discusses certain preconstruction activities that could be performed prior to its receiving a license from the NRC (Strata, 2011a); however, for the purposes of this evaluation of environmental and other impacts, this SEIS assumes that these preconstruction activities would occur at the same time as the Proposed Action such that the impacts of the preconstruction activities are considered as part of Alternative 1: Proposed Action. These preconstruction activities could include site excavation and preparation, such as clearing, grading, and constructing design components intended to control drainage and erosion as well as other mitigation measures; erection of fences and other access control measures that are not related to the safe use of, or security of, radiological materials; support-building construction; infrastructure construction, such as paved roads and parking lots, exterior utility and lighting systems, domestic-sewage facilities, and transmission lines; and other activities which have no measurable relationship to radiological health and safety nor common defense and security. In addition, the Applicant has indicated its intent to construct one Class I deep-injection well to better characterize the hydrologic and geochemical properties of the targeted geologic formation (i.e., ore zone) (Strata, 2011a). No radioactive materials would be present at the Ross Project during preconstruction activities.

After some or all of these activities, actual construction of the Proposed Action would begin and include: 1) the ISR facility that would consist of the CPP as well as administration, warehouse, and maintenance buildings, including storage and other structures, and lined surface impoundments; 2) wellfields including piping and module buildings; and 3) deep-disposal wells (see Figure.2.5) (Strata, 2011b; Strata, 2012b).

The Applicant anticipates construction of the facility and initial wells within one year of receiving an NRC license (see Figure 2.6). Main access roads would be constructed at the same time as the facility (Strata, 2011a). Secondary wellfield access roads would be constructed as necessary, as each wellfield is developed. It is estimated that the facility would encompass 21 ha [51 ac] (Strata, 2011b). A total of 44 ha [110 ac] would be disturbed by construction activities during the year preceding ISR facility operation and 113 ha [280 ac] over the life of the Proposed Action (see Table 2.1) (Strata, 2011a).

The Ross Project would employ approximately 200 people during construction. The Applicant anticipates that most employees would be from Crook and Campbell Counties (Strata, 2011a).

Further information on employment and other socioeconomic issues are described in Section 3.11.

Ross Project Facility

The Applicant proposes to construct and operate a single facility to serve the Ross Project as well as other potential ISR satellites (i.e., wellfields) within the Lance District. It could also process uranium-loaded resins from other ISR and water-treatment operations, which would be trucked into the facility (Strata, 2011a). The facility would include an administration building of 900 m^2 [10,000 ft^2], 1,400 m^2 [15,000 ft^2] of warehouse and maintenance space, 1,800 m^2 [20,000 ft^2] of parking, and a 3,400 m^2 [37,000 ft^2] for a domestic waste-water drainfield as well as the CPP mentioned earlier.

The proposed CPP would be a large, 6,900 m^2 [74,000 ft^2] pre-engineered metal building. The size of the CPP is about twice the size of a typical processing facility described in the GEIS (NRC, 2009). Adjoining the CPP would be 2,800 m^2 [30,000 ft^2] of chemical storage space and 4,800 m^2 [51,300 ft^2] of storage and work space (see Figure 2.5). The CPP would contain a control room housing the master-control system to allow remote monitoring and control of ISR process operations, wellfield operations, and deep-well disposal (Strata, 2011b). Operators in the CPP control room, who would be present 24 hours a day, would use a computer-based station to command the control system.

Proposed operations in the CPP would be generally consistent with typical processing involving three primary stages as described in the GEIS (NRC, 2009; Strata, 2011b):

> **What is yellowcake?**
>
> Yellowcake is the product of the uranium-recovery and milling process; early production methods resulted in a bright yellow compound, hence the name "yellowcake." The material is a mixture of uranium oxides that can vary in proportion and in color from yellow to orange to dark green (blackish) depending on the temperature at which the material was dried (level of hydration and impurities). Higher drying temperatures produce a darker, less soluble material. Yellowcake is commonly referred to as U_3O_8 and is assayed as pounds U_3O_8 equivalent. This fine powder is packaged in 208-L [55-gal] drums and sent to a conversion plant that uses yellowcake to produce uranium hexafluoride (UF_6) as the next step in the manufacture of nuclear fuel.

- Uranium would be mobilized by the distribution of "barren" (containing no uranium) lixiviant from the CPP to injection wells and return of "pregnant" (containing dissolved uranium) lixiviant from the recovery wells to the CPP for processing.
- Dissolved uranium would be processed to yellowcake through a multi-step process involving IX resins, elution, precipitation, washing, drying, and packaging which would produce waste water.
- Waste water would be treated as necessary and then recirculated as lixiviant.

This uranium-recovery process would be continued in a particular wellfield until the uranium concentration in the recovered solution becomes uneconomical.

The IX circuit proposed by the Applicant would be designed for a maximum of 28,400 L/min [7,500 gal/min] of pregnant lixiviant from Ross Project wells (Strata, 2011a). The elution, precipitation, and drying and packaging circuits would be designed to process approximately 1.4 million kg/yr [3 million lb/yr] of yellowcake (Strata, 2011b), which is about four times the capacity necessary to recovery uranium from the Ross Project. The excess capacity in the yellowcake

production circuit would allow processing of loaded IX resins brought to the Ross Project from other ISR or water-treatment facilities. Except for the Smith Ranch-Highland operation that has a yellowcake capacity of 2.5 million kg/yr [5.5 million lb/yr], the capacity of the Ross Project exceeds the capacity of other facilities in Wyoming, which range from 0.2 million kg/yr [0.5 million lb/yr] to 0.9 million kg/yr [2 million lb/yr] (EIA, 2012).

The Applicant also proposes a vanadium-recovery circuit within the CPP to recover vanadium from uranium-depleted solutions (Strata, 2011b). The GEIS did not include vanadium recovery in its discussion of a typical uranium-recovery operation (vanadium recovery is discussed in Section 2.1.12 of this SEIS).

In addition to the uranium- and vanadium-recovery circuits, the CPP would house the water-treatment circuit for ground-water restoration. Water treatment would utilize an IX column to remove the uranium, followed by two reverse-osmosis (RO) units in series. The circuit would be designed for a maximum flow rate of 4,200 L/min [1,100 gal/min]. Operation of the first RO stage is expected to return approximately 70 percent of the flow as "permeate" (relatively clean water) and 30 percent of the flow as "brine" (water containing high concentrations of salts, which were mostly introduced to water to form the lixiviant, and contaminants, which were picked up during the lixiviant's residence time in the aquifer). When the remaining brine is run through the second RO stage, it would generate 50 percent permeate and 50 percent brine. Only 15 percent of waste water would be brine after the two-stage RO processing.

The ISR process requires chemical storage and feeding systems to introduce chemicals at various stages in the lixiviant extraction and processing as well as during the waste-treatment processes. Space for chemical storage would be built adjacent to the CPP (see Figure 2.5) (Strata, 2011b). The chemical-storage area would be constructed with secondary containment, which will consist of a concrete berm as part of the floor area that would be able to contain at least 110% of the volume of the largest tank (Strata, 2011b). The space would be divided into two areas, one inside the CPP and one outside. Chemicals stored outside would include oxygen, ammonia, and carbon dioxide. Chemicals stored inside would include some or all of the following: sulfuric acid, hydrochloric acid, sodium hydroxide, hydrogen peroxide, sodium chloride, sodium carbonate, and barium chloride.

The proposed location for the facility is currently on a relatively flat, currently used, dry-land hayfield. To route surface storm-water runoff around the facility, a diversion structure consisting of a berm, concrete-box culvert, and drainage channel would be constructed east of the proposed ISR facility. This system would be designed to manage runoff from a 100-year, 24-hour runoff event (Strata, 2011b; Strata, 2012b).

The Applicant's design calls for paving the areas adjacent to the CPP. Paved areas would be sloped to direct runoff water to slot drains. From the slot drains, storm water would be conveyed through pipes to a smaller, sediment-settling surface impoundment also designed to contain the runoff from a 100-year, 24-hour runoff event. The sediment impoundment would be constructed with the same double-liner and leak-detection configurations as the larger surface impoundments that would be used to store permeate and brine. After a significant storm event, water in the sediment impoundment would be immediately routed to the deep-disposal well (Strata, 2011b).

The facility is proposed to be located in an area of shallow ground water (Strata, 2012b). Shallow ground water directly beneath the facility could present construction and operational issues and create a higher risk of ground-water contamination in the event of a spill. To mitigate

these concerns, the Applicant's proposed facility design would include a containment barrier wall (CBW). The CBW and associated dewatering system would be designed to prevent contaminated liquids from entering and contaminating shallow ground water outside of the facility, in the event of a process solution spill, hazardous-chemical spill, or a disposal-system failure. The CBW would restrict the flow of ground water from traveling beneath the facility and any water that seeps or flows into the area would be drained away. The design calls for the CBW to be constructed around approximately two-thirds of the facility's boundary along the north, east, and south. The CBW would be 0.7 m [2 ft] wide and extend from the ground surface to a minimum of 0.7 m [2 ft] into bedrock. It would be constructed of a soil-bentonite mixture. The configuration of the CBW is shown in Figure 2.5 and is described in Addendum 3.1-A of the TR (Strata, 2012b). Three French drains (i.e., trenches filled with very porous material, such as gravel) would be installed to drain the area within the CBW, when needed (Strata, 2011b; Strata, 2012b). The Applicant proposes approximately eight wells to monitor water levels and water quality inside and outside the CBW (Strata, 2012b). Any seepage and/or spillage collected on the facility side of the CBW would be discharged to the surface impoundments for storage or disposal with excess permeate and brine (Strata, 2011b). Construction of a CBW to mitigate impacts to shallow ground water beneath impoundments is not included in the GEIS's description of a typical ISR facility design (NRC, 2009).

The Proposed Action would also include the construction of two double-lined surface impoundments (retention ponds) over a 6.5 ha [16 ac] area; these impoundments would be used for process-solution and waste-water management (Strata, 2011b). Each surface impoundment would include three cells, built with common containment berms. At full capacity the impoundments' surface area would be about 5.3 ha [13.2 ac]. Interconnected pipes between the cells would allow the controlled transfer of solutions or water between cells. The impoundments would have double geomembrane liners and a leak-detection system. The design for the impoundment, including the liners, leak-detection systems, freeboard requirements, and reserve capacity are in accordance with the GEIS, but the size of the impoundments is about twice the upper range of typical surface impoundment sizes described in the GEIS (NRC, 2009).

The surface impoundments would be designed to meet the requirements of NRC Regulatory Guide 3.11 (NRC, 1980a), all conditions established by the NRC in the Applicant's license, and all requirements found in *Wyoming Water Quality Rules and Regulations*, Chapter 11, for lined waste-water surface impoundments (Strata, 2011b; Strata, 2012b; WDEQ/WQD, 1984).

The Applicant's surface-impoundment design calls for rectangular cells with maximum internal slopes of 3 horizontal to 1 vertical (Strata, 2011b; Strata, 2012b). The impoundments would be 4.6 m [15 ft] deep with 1 m [3 ft] of freeboard and a maximum hydraulic depth of 3.6 m [12 ft]. The primary liner would be impermeable high-density polyethylene (HDPE) or polypropylene, with a minimum thickness of 36 mils (0.9 mm [0.036 in]). The secondary liner would be a geosynthetic material with a minimum thickness of 36 mils (0.9 mm [0.036 in]) or native clay. The leak-detection system would be installed between the primary and secondary liners. The system would consist of a permeable drainage layer such as sand and perforated collection pipes.

The primary purpose of the surface impoundments would be to manage liquid, byproduct material (i.e., the permeate and brine described above) to optimize disposal techniques, and to provide capacity for liquid-waste storage in the event of "upset," or accident, conditions. In addition, the impoundments would provide some evaporation of stored brine. Under normal operating conditions, the water levels in the surface-impoundment cells would be maintained

such that the volume of liquid in any one cell can be transferred to one of the other two cells to facilitate leak repair.

Ross Project Wellfields

Wellfields are the areas over the ore zone(s) where the injection and recovery wells for uranium recovery would be located. The proposed wellfields of the Ross Project are expected to encompass approximately 36.4 ha [90 ac] in portions of Sections 7, 17, 18, and 19, in Township 53N, Range 67W and in portions of Sections 12 and 13 in Township 53N, Range 68W. The Applicant notes that the final areal extent of the constructed wellfields is expected to be greater as additional ore-zone delineation occurs (Strata, 2011b).

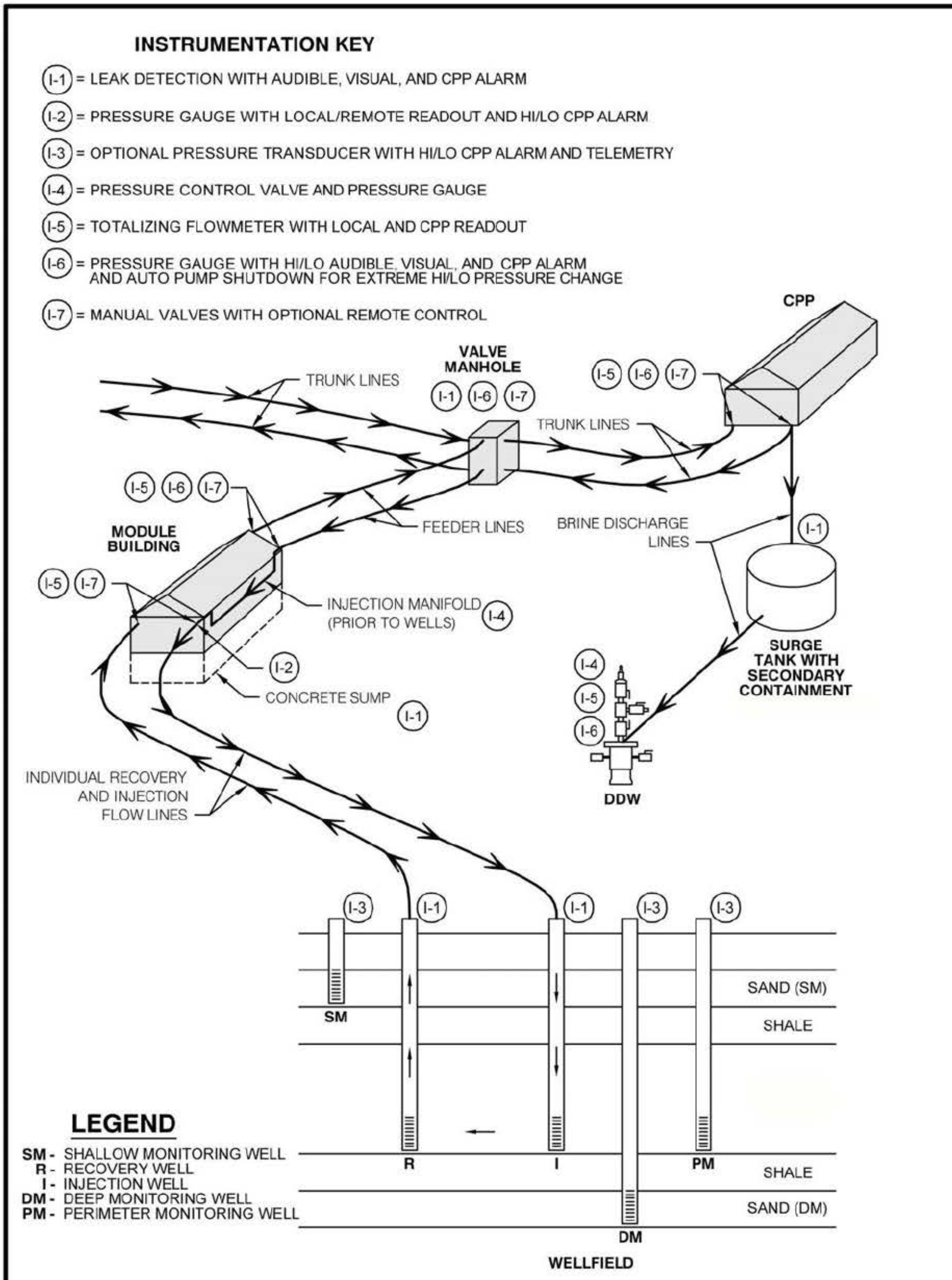
The proposed wellfields would be divided into two units (Strata, 2011b). Each unit would be further divided into 15 to 20 modules with approximately 40 recovery wells per wellfield module (Strata, 2011b). The flow capacity of each wellfield module would range from 2,300 L/min [600 gal/min] to 3,800 L/min [1,000 gal/min]. The wellfields would be fenced to exclude livestock, wildlife, and other intruders.

Wells would be constructed to recover uranium from ore deposits found in permeable sand zones in stacked roll fronts and tabular ore zones described as “stratabound” deposits in the GEIS (NRC, 2009). The geology of the ore zone at the Ross Project area is described in SEIS Section 3.4.1. The average depth to the top of the ore zone ranges from less than 91 m [300 ft] to more than 213 m [700 ft] with an average depth of 149 m [490 ft] (Strata, 2011b). The ore-zone thickness averages 2.7 m [8.9 ft]. The sand units hosting uranium are saturated with ground water and are confined aquifers (Strata, 2011b). The hydrogeology of this area is described in SEIS Section 3.5.3.

The features and design of the wellfields proposed by the Applicant are generally consistent with the wellfields described in the GEIS (NRC, 2009). The primary components of a wellfield module are illustrated in Figure 2.7; these are:

- Injection wells to introduce lixiviant into the ore zone.
- Production (or recovery) wells to recover the uranium-enriched (or pregnant) lixiviant for subsequent processing at the CPP.
- Module buildings (or header houses) to manage the pipes (or “flow lines”) that route the lixiviant between the injection and recovery wells within a module and the “feeder lines” that carry fluids between the module building to a manhole containing a valve.
- Valve manholes to manage the pipes to the module buildings, to the CPP, and to other value manholes (or “trunk lines”).
- Perimeter monitoring wells to detect excursions of lixiviant outside the exempted portion of the aquifer from which uranium is recovered, should they occur.

The Applicant proposes three well-construction methods that would each comply with WDEQ/LQD requirements (see Figures 2.8, 2.9, and 2.10) (Strata, 2011b).



1 Source: Strata, 2011a.

Figure 2.7

Primary Components of a Ross Project Wellfield Module

Step	Description of Activity
1	A pilot hole 5 to 6.5 inches in diameter is drilled through the projected mineralization zone. Geophysical logs consisting of gamma, resistivity, spontaneous potential, and deviation are then completed. From the geophysical logs, the grade of each mineralized intercept is calculated.
2	If, after geophysical logging, it is determined that the mineralization is not of sufficient quality or that the ore continuity is inadequate to warrant completion, the hole is sealed from the bottom to the top with neat cement slurry. An Abandonment Record is then completed for each sealed hole.
3	Assuming the decision is reached to complete the well, the hole is reamed to a diameter of 8 to 10 inches (a minimum of 3 inches larger than the casing OD) to a depth approximately 15 feet below the bottom of the mineralization. Alternatively, in areas where the geologist is more confident in intercepting mineralization, the initial hole may be drilled at the final diameter of 8 to 10 inches in one pass followed by the geophysical logging. Fiberglass or PVC casing (minimum rating of SDR 17) with an outside diameter (OD) of 5 to 6.5 inches is placed in the reamed hole to a depth approximately 10 feet below the mineralization. PVC centralizers are placed on the casing string at a maximum spacing of one per 40 feet.
4	A calculated amount of neat cement slurry mixed to the required specifications (approximate unit weight of 15 lbs/gallon) is placed inside the casing through a cementing or pump-down head. A calculated volume of displacement water is then pumped into the casing forcing the cement slurry out the bottom of the casing and up the annulus between the casing and the reamed hole until cement reaches the surface. After displacement, the valve on the cementing head is closed which holds the cement in place while hardening occurs.
5	After a minimum of four days, the well is underreamed through the mineralized zones to a diameter of 10 to 14 inches. The well annulus will be topped off with cement to the surface prior to reentry by the drilling rig. The underreaming is completed by a specialized tool utilizing retractable blades. The blades are closed for the trip down the well and are opened by pressure from the rig mud pump. The blades are held open by the weight of the drill string. After underreaming the designated zone through the casing and cement, the blades are again retracted for the trip out of the well. The well may be caliper logged as necessary to verify the correct interval has been opened. If deemed necessary, to support sand zones that are not competent, PVC screen is telescoped into the casing using a J-collar hooked to the drill pipe. The uppermost screen openings will be placed below the top of the underreamed interval and below the bottom of the annular seal. A PVC riser pipe is extended from the top of the screen approximately 10 feet. One or more k-packer(s) will provide a seal between the riser pipe and the casing. Filter sand may be placed between the screen and the underreamed hole.
6	The well is developed to remove contaminants and fines from the drilling and completion process and maximize the flow rate. A Well Installation Record is completed which contains all the details on drilling, geophysical logging, completion materials, casing depth, completion interval, and the cement mix.
7	After drying, the drill cuttings contained in the pits are covered with subsoil and the stockpiled topsoil. The ground surface is then recontoured and reseeded.
8	The well is integrity tested as discussed in Section 3.1.2.3 below.

Source: Strata, 2012a.

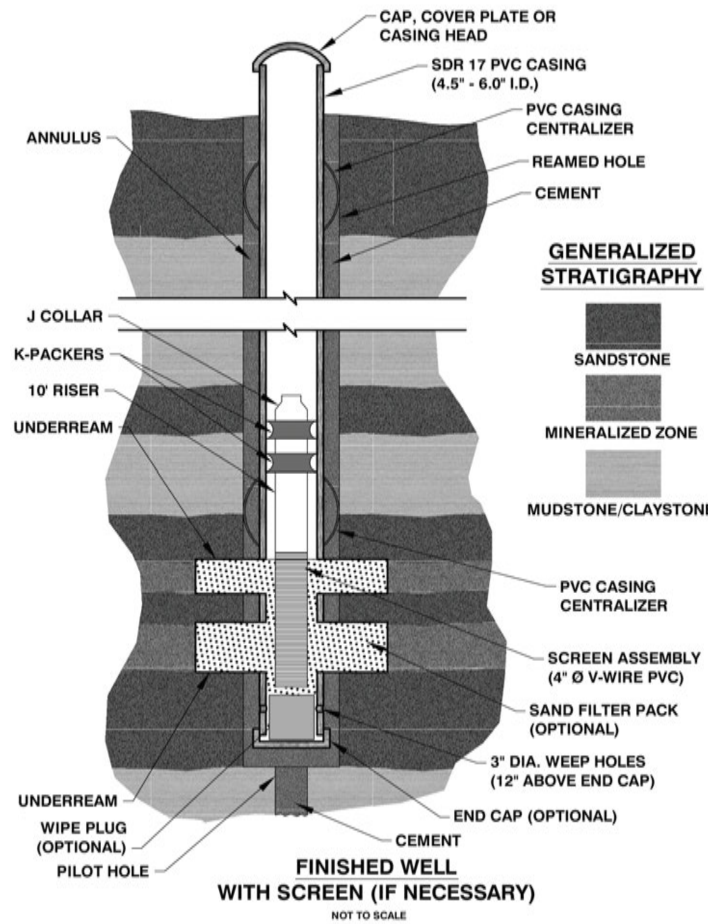


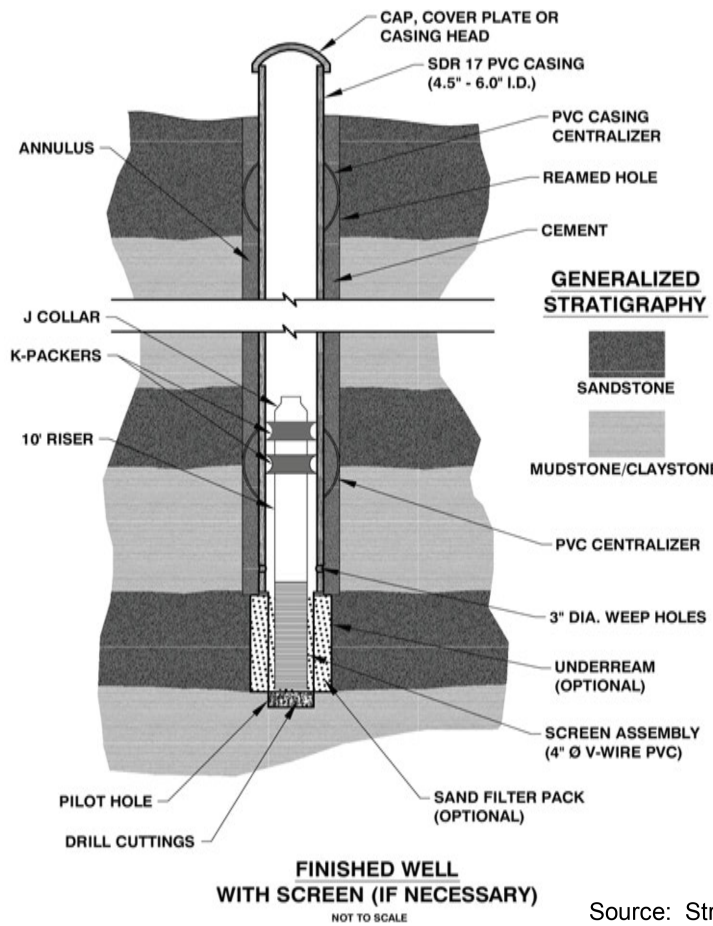
Figure 2.8

Proposed Well-Installation Method 1 for Ross Project Injection and Recovery Wells

1

Step	Description of Activity
1	A pilot hole 5 to 6.5 inches in diameter is drilled to the top of the projected completion interval. Geophysical logs consisting of a minimum of gamma, resistivity, and self potential are then completed.
2	The hole is reamed to a diameter of 8 to 10 inches (a minimum of 3 inches larger than the casing OD). An option for this method is to drill to the final hole diameter of 8 to 10 inches in one pass followed by the geophysical logging.
3	Fiberglass or PVC casing (minimum rating of SDR 17) with an OD of 5 to 6.5 inches is placed in the reamed hole. PVC centralizers are placed on the casing string at a maximum spacing of one per 40 feet.
4	A calculated amount of neat cement slurry mixed to the required specifications (approximate unit weight of 15 lbs/gallon) is placed inside the casing through a cementing head. A calculated volume of displacement water is then pumped into the casing forcing the cement slurry out the bottom of the casing and up the annulus between the casing and the reamed hole until cement reaches the surface. After displacement, the valve on the cementing head is closed which holds the cement in place while hardening occurs.
5	After a cement-hardening period of at least two days, the designated completion interval is drilled below the casing with a bit that is smaller than the casing inside diameter (ID). The well annulus will be topped off with cement to the surface prior to reentry by the drilling rig. Geophysical logs consisting of gamma, resistivity, spontaneous potential, and deviation are then completed in the newly drilled hole. If the sand zone is competent, the completed interval may be left open and unsupported. If PVC screen is necessary, the completion interval may be underreamed to a larger diameter prior to the installation of the screen. The uppermost screen openings will be placed below the bottom of the casing and the annular seal. A PVC riser pipe is extended from the top of the screen approximately 10 feet. A seal between the riser pipe and the casing is provided by one or more k-packer(s). Filter sand may be placed between the screen and the underreamed hole.
6	The well is developed to remove contaminants and fines from the drilling and completion process and maximize the flow rate. A Well Installation Record is completed which contains all the details on drilling, geophysical logging, completion materials, casing depth, completion interval, and the cement mix.
7	After drying, the drill cuttings contained in the pits are covered with subsoil and the stockpiled topsoil. The ground surface is then recontoured and reseeded.
8	The well is integrity tested as discussed in Section 3.1.2.3 below.

Source: Strata, 2012a.



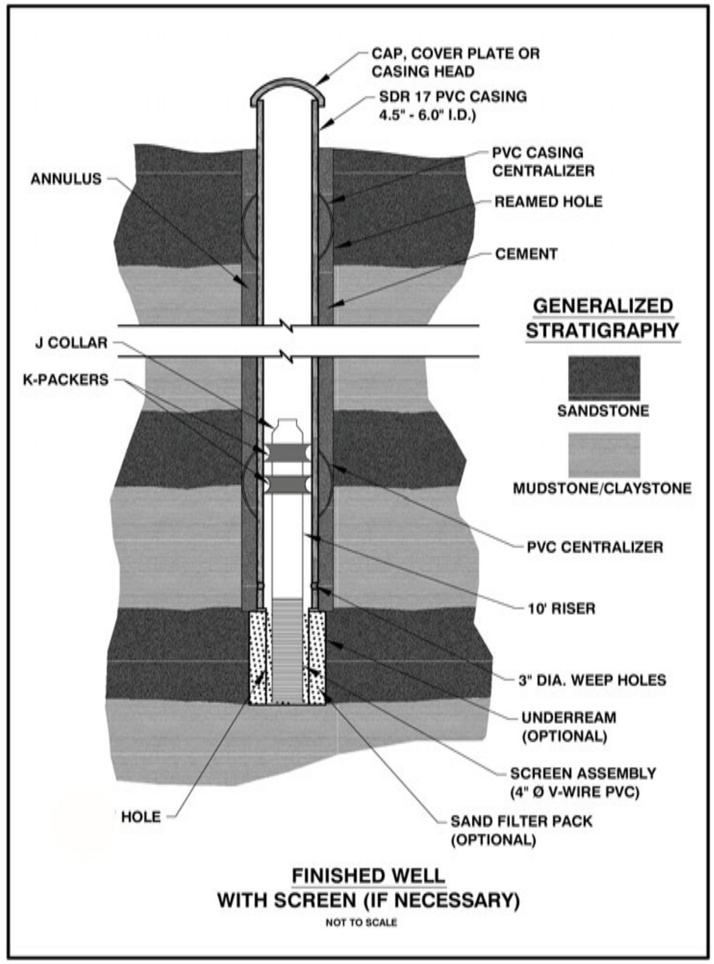
Source: Strata, 2011b

Figure 2.9

Proposed Well-Installation Method 2 for Ross Project Monitoring Wells

Step	Description of Activity
1	A pilot hole 5 to 6.5 inches in diameter is drilled to the top of the projected completion interval. Geophysical logs consisting of a minimum of gamma, resistivity, and self potential are then completed.
2	The hole is reamed to a diameter of 8 to 10 inches (a minimum of 3 inches larger than the casing OD). An option for this method is to drill to the final hole diameter of 8 to 10 inches in one pass followed by the geophysical logging.
3	Fiberglass or PVC casing (minimum rating of SDR 17) with an OD of 5 to 6.5 inches is placed in the reamed hole. PVC centralizers are placed on the casing string at a maximum spacing of one per 40 feet.
4	A calculated amount of neat cement slurry mixed to the required specifications (approximate unit weight of 15 lbs/gallon) is placed inside the casing through a cementing head. A calculated volume of displacement water is then pumped into the casing forcing the cement slurry out the bottom of the casing and up the annulus between the casing and the reamed hole until cement reaches the surface. After displacement, the valve on the cementing head is closed which holds the cement in place while hardening occurs.
5	After a cement-hardening period of at least two days, the designated completion interval is drilled below the casing with a bit that is smaller than the casing inside diameter (ID). The well annulus will be topped off with cement to the surface prior to reentry by the drilling rig. Geophysical logs consisting of gamma, resistivity, spontaneous potential, and deviation are then completed in the newly drilled hole. If the sand zone is competent, the completed interval may be left open and unsupported. If PVC screen is necessary, the completion interval may be underreamed to a larger diameter prior to the installation of the screen. The uppermost screen openings will be placed below the bottom of the casing and the annular seal. A PVC riser pipe is extended from the top of the screen approximately 10 feet. A seal between the riser pipe and the casing is provided by one or more k-packer(s). Filter sand may be placed between the screen and the underreamed hole.
6	The well is developed to remove contaminants and fines from the drilling and completion process and maximize the flow rate. A Well Installation Record is completed which contains all the details on drilling, geophysical logging, completion materials, casing depth, completion interval, and the cement mix.
7	After drying, the drill cuttings contained in the pits are covered with subsoil and the stockpiled topsoil. The ground surface is then recontoured and reseeded.
8	The well is integrity tested as discussed in Section 3.1.2.3 below.

Source: Strata, 2012a.



Source: Strata, 2011b

Figure 2.10

Proposed Well-Installation Method 3 for Ross Project Monitoring Wells

These methods all conform to the typical well-completion standards described in the GEIS (NRC, 2009). Wells would be constructed of polyvinyl chloride (PVC) or fiberglass with a sufficient pressure rating to withstand the maximum anticipated injection pressure, the maximum external collapsing pressure, and the maximum pressure of cementing; they would be constructed in accordance with WDEQ rules (WDEQ/LQD, 2005). The casings would be joined using an O-ring and spline modified to fit the ore zone, and well spacing would range from 15 – 46 m [50 – 150 ft]. The Applicant proposes that wells configured in a line-drive pattern would likely require increased aquifer restoration efforts; therefore, the Applicant would make limited use of line-drive patterns. Where it is not possible to avoid the use of line-drive patterns, the Applicant would perform additional computer modeling to determine the most efficient well spacing so as to facilitate aquifer restoration.

The Underground Injection Control (UIC) program administered by WDEQ/LQD regulates the design, construction, testing, and operation of all injection and recovery wells (WDEQ/LQD, 2005). WDEQ has primary regulatory authority for such actions as delegated by the U.S. Environmental Protection Agency (EPA). Wells for uranium extraction are classified under the UIC program as Class III wells; the Proposed Action would therefore require a UIC permit from WDEQ to use Class III injection wells. Before ISR operations could begin at any wellfield, the Applicant would be required by a license condition to provide the NRC with documents clearly delineating the approved aquifer exemption areas. (Portions of the aquifers designated for uranium recovery must be exempted as an underground source of drinking water [USDW] by EPA and reclassified by WDEQ/Water Quality Division (WQD) in accordance with the *Safe Drinking Water Act* [SDWA].)

Consistent with the typical design described in the GEIS (NRC, 2009), the Applicant proposes that each wellhead would be covered by an insulated fiberglass box in order to provide freeze protection and spill containment (Strata, 2011b). The protective box would include a solid base with access tunnels for well casing, electrical, and water-flow lines as well as a leak-detection system. Each recovery well would contain a submersible pump properly sized to carry solutions from the well to the module building. Injection wells would be equipped with air-release valves to permit relief of any excess pressure that could occur in the wells.

In the event that recovery, injection, and/or monitoring wells must be located within a floodplain, engineered controls and instrumentation would act to prevent leakage to the environment or contamination to the wells from a flood event (Strata, 2011b). The well seals would prevent inflow of flood waters down the well casing, while the fiberglass structure and bottom containment feature would limit exposure of the well to the environment. Erosion-control measures, such as rip-rap, grading, contouring, and water bars, would be utilized where appropriate in order to reduce sediment mobilization and runoff velocities.

Following installation, the well would be “developed” by pumping, air lifting, jetting, and/or swabbing to clean it and improve its hydraulic efficiency. The goal of these activities would be to remove drilling fluids and any small, fine particles from the well-completion zone, to provide good hydraulic communication, and to maintain the natural geochemical conditions. The Applicant expects that the water produced during well development would meet Wyoming’s temporary Wyoming Pollution Discharge Elimination System (WYPDES) discharge standards, which would allow this water to be discharged directly to the ground surface (WDEQ/WQD, 2007).

> **What is mechanical integrity testing (MIT)?**
>
> After each well is completed, and before the well is brought into service, all injection and recovery wells are tested for mechanical integrity. A "packer" is set above the well screen, and the well casing is filled with water. At the surface, the well is pressurized with either air or water to 125 percent of the maximum operating pressure, which is calculated based upon the strength of the casing material and depth. The well pressure is monitored to ensure significant pressure drops do not occur through drillhole leaks. A pressure drop of no more than 10 percent in a period of 10 to 20 minutes indicates that the casing and grout are sound (i.e., do not leak) and that the well is fit for service. Well integrity tests are also performed if a well has been damaged by nearby surface or subsurface activities or has been serviced with equipment or procedures that could damage the well casing, such as insertion of a drill bit or cutting tool. Additionally, each well is retested periodically (once each 5 years or less) to ensure its continued integrity. If a well casing fails an MIT, the well is taken out of service, repaired, and retested. If an acceptable test cannot be obtained after repairs, the well is plugged and properly abandoned.

Prior to operation, the integrity of each well would be verified by a pressure-based mechanical-integrity testing (MIT) that conforms to the procedure described in the GEIS and required by WDEQ (NRC, 2009; Strata, 2011b; WDEQ/LQD, 2005). After initial testing by the Applicant, the well would be retested at five-year intervals. In addition, the MIT would be repeated if the well is entered by a drilling bit or an under-reaming tool, or if well damage is suspected for any reason. The well-integrity test results would be documented and filed onsite and provided to WDEQ/LQD on a quarterly basis.

The Applicant proposes that MIT be conducted by placing inflatable packers or a comparable device near the top of the casing and above the screened interval (Strata, 2011b). The packers are inflated, and the interval between the packers is pressurized with water to the designated test pressure (maximum allowable injection pressure plus a safety factor of 25 percent). This pressure must be maintained within 10 percent for 10 minutes in order for the well to pass the MIT. A well-integrity record would be completed for each tested well. If a well demonstrates an unacceptable pressure drop during the MIT, the packers would be reset, the equipment checked for leaks, and the test repeated. If in subsequent tests the well passes the integrity requirements, the well would be deemed acceptable for use as an injection, recovery, or monitoring well. If a well continues to fail the MIT, it would be plugged and properly abandoned (i.e., sealed with cement slurry). Any well excluded due to MIT failure, or any that have arrived at the end of their useful life, would be properly abandoned. A well-abandonment record would be completed and retained onsite until the termination the Applicant's license, as would be required in NRC's license.

The Applicant's proposed design for pipes and module buildings is consistent with the industry standard described in the GEIS (NRC, 2009). Module buildings (referred to as pump and header houses in the GEIS) would be located throughout the wellfield and would be approximately 4.6 m x 12.2 m [15 ft x 40 ft] in size (see Figure 2.7) (Strata, 2011b). Piping from the module building to the CPP is referred to as feeder lines and trunk lines. Flow to injection wells and from recovery wells would be conveyed through 2.5 – 5 cm [1 – 2 in] HDPE pipelines (flow lines) that are connected through a manifold in the module building. Pipes inside the module buildings would be HDPE, PVC, or stainless steel rated for an operating pressure greater than the proposed maximum injection pressure. Feeder-line and trunk-line junctions would be contained in valve manholes located along the trunk lines. Each module building would have the capability of being isolated from the trunk lines by manually operated butterfly valves contained in the valve manholes. Piping would be buried below the frost line.

Each well flow line would have a meter to record the total flow passing through each flow line, pressure transmitter, and manual valve to control the flow rate. A small sample-collection valve for each well would be included on the recovery flow lines. The recovery-well flow lines would enter a manifold on one side of the module building, and the injection well lines would enter a manifold on the other side. A manifold building would house: 1) electrical equipment required to control the recovery pumps; 2) a pressure-limiting valve, a pressure transmitter, and equipment to add the oxidant to lixiviant on the injection manifold; and 3) flow meters that would indicate rate and totalizer readings on the trunk lines (Strata, 2011b). Each module building would have a manhole to access flow lines and feeder lines (see Figure 2.7). The manholes would also contain leak-detection systems.

The Applicant would test for leaks with fresh water on the pipelines prior to their burial, in order to ensure the pipelines' mechanical integrity (Strata, 2011b). The tests would be conducted in accordance with the manufacturer's recommendations or industry standards prior to final burial. In the event of leakage from pipelines or fittings, the defective component would be replaced. Prior to backfilling the trench dug to install a pipeline, the Applicant would perform a final inspection of all pipes and valves, the quality of the pipe embedment material, and the suitability of the backfill. Pipeline installation and trench backfilling would follow standard procedures that would be designed to ensure the quality of the installation and backfilling (Strata, 2011b). These procedures include the Applicant:

- Laying of pipe at required grades and lines
- Minimizing accumulation of water during laying or backfilling
- Limiting lateral displacement with use of embedment material
- Preventing contamination of the trench with foreign, unsuitable material
- Covering pipe with at least 0.6 – 2 m [2 – 6 ft] of material
- Using insulated tracer wire and warning tape
- Using properly sized and placed bedding material
- Using proper backfill material, which would not impose undue shock or unbalance to the pipe (i.e., frozen soils, mud, or snow)
- Using trench plugs at the appropriate spacing, particularly at or near areas of elevated ground water

> **What are pre-licensing baseline water-quality concentrations?**
>
> Prior to the submittal by an Applicant of its license application to the NRC, an Applicant performs site-characterization environmental-monitoring efforts for at least a year at the site at which it wishes to conduct uranium recovery prior to major Project construction. 10 CFR Part 40, Appendix A, Criterion 7 requires this monitoring (10 CFR Part 40). In addition, other regulations, such as those promulgated by the U.S. Environmental Protection Agency (e.g., 40 CFR Part 192, 40 CFR Part 141, and 40 CFR Part 143) and/or pertinent authorized State regulations, such as Wyoming Department of Environmental Quality's Hydrology Guidelines for Permitting Mines, Appendix 1, *Pre-mining Water Quality Sampling in the Guideline No. 8* may also inform an Applicant's environmental-monitoring strategies (WDEQ/LQD, 2005). Finally, NRC's guidance, Regulatory Guide 4.14, also makes recommendations regarding environmental monitoring efforts.
>
> As part of site-characterization efforts, ground-water monitoring wells are installed and ground-water samples are obtained. These samples are analyzed for certain water-quality constituents, or parameters, that are important to the characterization of existing conditions at a particular site. These concentrations are known as the "pre-licensing baseline" values of the respective water-quality constituents.
>
> These values are also sometimes known as "background" values. However, in the case of the Ross Project, because an earlier uranium-recovery operation was conducted within the Ross Project area, this operation could potentially have impacted "background values." Thus, the values measured by Strata prior to its submitting its license application are called "pre-licensing baseline" values in this SEIS.

As NRC license conditions would require, the Applicant would install a monitoring-well ring around the perimeter of each wellfield that would be used to detect horizontal and vertical excursions of uranium-recovery solutions during ISR operations (see SEIS Section 2.1.1.2) (Strata, 2011b). Prior to commencing ISR operations, these wells would allow sampling and analysis of ground water and, in this SEIS, this type of monitoring is called "post-licensing, pre-operational." The resulting post-licensing, pre-operational data would be used to determine concentration-based levels that would permit identification of any excursions from the respective wellfields; these would be called the Ross Project's upper control limits (UCLs). These post-licensing, pre-operational baseline values would be established for each separate wellfield (and they would be codified in the Applicant's NRC license). During uranium-recovery wellfield operation, the Applicant would then sample ground water from the wells and compare the analytical values to the NRC-specified baseline constituent concentrations to determine whether an excursion of any solution (such as lixiviant) into the surrounding aquifers has occurred. The Applicant would use Methods 2 or 3 (shown in Figures 2.9 and 2.10) to install these ground-water monitoring wells.

The Applicant's site-characterization efforts, which were conducted prior to its license-application submittal to the NRC, established "pre-licensing baseline" values of certain ground-water constituents; these values represent the baseline constituent concentrations currently present in the ground water under the Ross Project area (Strata, 2011a; Strata, 2011b). (See the text box above.) Later, prior to actual uranium-recovery wellfield operation, but after the initial NRC license is issued for wellfield construction, the ground water in each wellfield would be analyzed for the post-licensing, pre-operational baseline concentrations of constituents specified by the NRC (NRC, 2003a).

Within each wellfield, the well spacing that the Applicant proposes is in accordance with the minimum requirement described in the GEIS as necessary to detect excursions (NRC, 2009). Typical well spacing for a five-spot or seven-spot pattern is between 12 and 50 m [40 and 150 ft] apart. Wells completed in the aquifer underlying the ore body and wells completed in the

aquifer overlying the ore body would be installed at an interval of one well per 0.8 ha [2 ac] of wellfield to detect vertical migration (Strata, 2011b). The Applicant also proposes a spacing of the perimeter monitoring wells of 122 m [400 ft] apart and at a distance of approximate 122 [400 ft] from the edge of the wellfield, to detect potential horizontal excursions. Simulations by the Applicant demonstrate that the proposed spacing successfully detects hydraulic anomalies in the form of water-level increases well before lixiviant has moved beyond the active uranium-recovery areas.

To reduce the possibility of lixiviant excursions, all previously drilled exploration and/or delineation drillholes that can be located on the Ross Project area and that are within a monitoring-well ring would be re-entered to each drillhole's total depth and sealed with cement slurry, per standard well-abandonment protocols (Strata, 2011b). These historic exploration and/or delineation drillholes would be located through the use of a hand-held metal detector that would locate the brass cap associated with each drillhole with its identification number. After a drillhole is located, a small drilling rig would be set up over the hole to ream them out to their total depth. The drillholes would then be cemented from the bottom to the ground surface. Details of each drillhole's abandonment would be documented in a record (examples in Strata, 2011b, Addendum 2.7-F), which would be filed at Strata's Oshoto field office in the appropriate drillhole file and provided with the respective wellfield data package, as appropriate.

What are underground injection control permits?

The EPA has delegated authority to the State of Wyoming, to administer its own Underground Injection Control (UIC) Permits. Classes I and III are most applicable to ISR operations.

- **Aquifer Exemption:** UIC criteria for the exemption of an aquifer that might otherwise be defined as an underground source of drinking water are found at 40 CFR Part 146.4. These criteria include whether the aquifer is currently a source of drinking water and whether the water quality is such that it would be economically or technologically impractical to use the water to supply a public water system.
- **Industrial and Municipal Waste Disposal Wells (UIC Class I):** Wells in this Class are used for the deep disposal of industrial, commercial, or municipal waste below the deepest usable aquifer. This type of well uses injection and requires applied pressure. This Class includes all wells that dispose of waste on a commercial basis. For ISR operations, this type of UIC Permit is necessary to use deep-well injection for waste disposal.
- **Mining Wells (UIC Class III):** This type of UIC Permit governs injection wells used to recover minerals. They include experimental technology wells; underground coal gasification wells; and wells for the in situ recovery of materials such as copper, uranium, and trona. For ISR operations, this type of UIC Permit covers wells that inject lixiviant into the uranium-bearing aquifer.

Deep-Injection Wells

The Applicant plans to dispose of liquid effluent generated during uranium-recovery operations via Class I UIC disposal wells. The Applicant has received a ten-year permit (UIC Permit No.10-263), dated April 4, 2011, for up to five Class I deep-disposal wells from WDEQ (WDEQ/WQD, 2011b). This Permit authorizes the injection of liquids into the Flathead and Deadwood Formations within specified intervals at depths of about 2,488 – 2,669 m [8,163 – 8,755 ft] below the ground surface; these formations are at least 500 ft below the lowermost potential USDW (the Madison Formation).

Under the terms of the UIC Class I Permit, the Applicant is allowed to inject into the Class I deep-disposal wells the following: operation bleed streams, yellowcake wash water,

sand-filter and ion-exchange wash water onsite laboratory waste water, RO brine, aquifer-restoration ground water, facility wash-down water, wash waters used in cleaning or servicing waste-disposal-system equipment, and storm water—all generated during uranium-recovery activities—as well as fluids produced during the drilling, completion, testing, or stimulation of wells or test drillholes related to uranium-recovery operations, or during the work-over or abandonment of any such well, and drilling-equipment wash water. Under the terms of the UIC Permit, the Applicant is also prohibited from injecting certain materials into these wells. For example, hazardous wastes as defined by EPA or WDEQ cannot be injected into these wells (WDEQ/WQD, 2011b). Well construction, operation, MIT inspection, and well abandonment plugging and requirements are defined in this Permit as well. The Applicant would need to obtain written acceptance of financial-assurance methods from WDEQ prior to construction of each of the proposed wells.

The Applicant proposes that each well location would consist of a 76 m x 76 m [250 ft x 250 ft] pad with a storage tank (Strata, 2011b; Strata, 2012b). Surface equipment for the deep-disposal wells would include storage tanks, pumps, filtration systems, instrumentation and control systems, and equipment for injection of process chemicals (Strata, 2011b). Pads would either be asphalt pavement or gravel and would be retained through the life of the disposal well in order to conduct maintenance. Access roads to well sites with widths up to 4.3 m [14 ft] would be constructed on existing roads where possible. The supply pipelines to the wells would be 15 – 25 cm [6 – 10 in] HDPE plastic.

Pressures and flow rates for the pipes and disposal wells would be constantly monitored at the CPP. Instrumentation details for the deep-disposal wells are provided in Addendum 4.2-A of the TR (Strata, 2011b). System instrumentation would provide the necessary measures to ensure safe operation of the disposal system. At a minimum, instrumentation would include a flow totalizer, flow meter, pressure regulator, pressure indicator, pressure switch, annular tank level indicator, and injection pressure chart recorder. Water quality, fluid quantity, and injection rates would be reported to the WDEQ/LQD UIC program as required by the UIC Permit.

Injection rates up to the maximum are controlled by surface-injection pressures that are limited to the fracture pressure. Exceeding the limiting surface pressure set forth in the permit or creating or propagating fractures within the receiving zone would be a permit violation. The permit requires the installation of a kill switch on the injection tubing to preclude violation of the pressure limits.

2.1.1.2 Ross Project Operation

As shown by the proposed schedule in Figure 2.6, uranium recovery during the proposed Ross Project would follow a “phased” approach, where one group of well modules could be in operation, while preceding well modules are being engaged in aquifer restoration (Strata, 2011b). During the operation phase, three major phases would occur involving the wellfields: an operation-only phase, a concurrent operation- and aquifer-restoration phase, and an aquifer-restoration-only phase.

<u>Uranium Mobilization</u>

The Applicant proposes the use of an alkaline lixiviant to dissolve the uranium as described in Section 2.4 of the GEIS (NRC, 2009; Strata, 2011b). Gaseous oxygen (O_2) or hydrogen

peroxide (H_2O_2) is used as the oxidant and sodium bicarbonate ($NaHCO_3$) or carbon dioxide (CO_2) is added to aid in keeping uranium in its dissolved state. Native ground water would be fortified with sodium bicarbonate at the CPP and then pumped to the module buildings where the oxidant and, potentially, CO_2 would be added at the injection manifolds located inside the module buildings (see Figure 2.7).

What are the basic steps of uranium mobilization?

- **Ground-Water Injection**

  Uranium mobilization is accomplished by the injection of a non-uranium-bearing ("barren") solution, or "lixiviant," through "injection" wells into the uranium-bearing ore zone. The lixiviant moves through pores in the ore-zone aquifer, dissolving uranium and other metals.
- **Ground-Water Extraction**

  Recovery, or "production," wells extract the now "pregnant" lixiviant, which contains uranium and other dissolved metals, and the solution is then pumped to a central processing plant (CPP) for further uranium recovery and purification.

The Applicant proposes the carbonate/bicarbonate lixiviant because of its compatibility with minerals within the ore zone. In addition, carbonate/bicarbonate lixiviants are generally considered more amenable to aquifer restoration than other acidic lixiviants (NRC, 2009). Preliminary leach testing performed by the Applicant in 2010 demonstrated that this type of lixiviant successfully mobilized uranium into solution. Comparison of the Applicant's expected concentration ranges of chemical constituents in the pregnant lixiviant with the typical lixiviant chemistry presented in Table 2.4-1 of the GEIS shows consistency between the Ross Project and the GEIS, except for higher concentrations of uranium and vanadium that could be present in the pregnant lixiviant at the Ross Project (Strata, 2011b; NRC, 2009).

As described in Section 2.4.3 of the GEIS, the recovery wells extract slightly more water than is injected into the ore-containing aquifer, which creates a "cone of depression" within the respective wellfield and, thus, maintains an inward flow of ground water. This inflow prevents migration of lixiviant toward the perimeter monitoring wells. The excess water, referred to as "production bleed," is a radioactive byproduct material that must be properly managed and disposed (NRC, 2009). For the Ross Project, the Applicant proposes a production-bleed range from 0.5 percent to 2 percent, and averaging 1.25 percent of the injection volume (Strata, 2011b). At the maximum flow rate, approximately 360 L/min [94 gal/min] of production bleed would be generated.

The Applicant proposes to use actual wellfield data and reservoir-engineering software to predict a sufficient bleed rate to minimize water consumption while the potential for hydraulic anomalies outside of the uranium-recovery area is minimized (Strata, 2011b). The wellfield flows would be balanced to produce appropriate bleed based upon the module-injection and recovery feeder-line meters. The individual well-flow targets would be determined on a per-pattern basis to ensure that local wellfields are balanced on at least a weekly basis.

The Applicant proposes a maximum injection pressure of 970 kPa [140 lb^2/in] measured at the injection manifold. This pressure is less than the formation-fracture pressure, which is approximately 2,240 kPa [325 lb^2/in] at the Ross Project and less than the pressure rating for operation of the pipes and other equipment (Strata, 2011b). Although injection pressures are initially expected to be relatively low, pressure requirements within a specific wellfield generally tend to increase with time. The Applicant suggests that, in order to maintain flow rates and

wellfield balance, some wells would require flexibility in their allowable injection pressure. To specifically avoid the injection-restriction problems that plagued the Nubeth operation, the Applicant has proposed several improvements to well design, well development, and filtration (Strata, 2011a; Strata, 2011b).

Flows and pressures for the injection and recovery pipeline network would be monitored continuously at the module building, valve manhole, and CPP; the pressures would also be displayed in the CPP's control room (Strata, 2011b). Changes in flow or pressure that are outside of normal operating ranges would result in the activation of visual and audible alarms in the CPP, and eventually automatic sequential shutdown of pumps and control valves, if the condition is not corrected promptly.

In addition, the leak-detection sensors that would be located in the module-building sumps and the valve manholes would trigger audible and visual alarms at that location and in the CPP if fluid is detected (Strata, 2011b). The Applicant could also utilize dual leak detection in these areas, which would consist of two sensors at high and low levels within a module building. If fluid is detected by the low-level sensor, an audible and visual alarm would be triggered at that location and in the CPP. If fluid is detected by the high-level sensor, automatic pump shutdown would occur to prevent the fluid from overflowing the containment system and contaminating the surrounding environment.

Pipe and fitting leaks at the wellheads would be detected by sensors located in the wellhead sumps. In addition, a system would be instituted in the facility's operating plan for personnel to inspect the interior of each well module on a weekly basis. Minor leaks or other problems would be detected in this manner and then promptly repaired to reduce the likelihood of major releases.

As noted in SEIS Section 2.1.1, NRC regulations at 10 CFR Part 40, Appendix A, as well as the individual NRC license that would be issued to the Applicant, would require licensees to have an operational monitoring-well system to detect excursions. NRC guidance defines an excursion as occurring when two or more excursion indicators or parameters are present in a monitoring well or if one excursion parameter exceeds the respective UCLs by 20 percent (NRC, 2009). GEIS Section 2.4.1.4 described how ISR operations can potentially affect the ground-water quality near a site, when, during an excursion, lixiviant escapes the production zone, where uranium recovery is underway, and is not recovered by the intended recovery wells (NRC, 2009). This would result in either a vertical or horizontal excursion. Excursions can be caused by an improper water balance between injection and recovery wells, undetected high-permeability strata or geological faults, improperly plugged and abandoned exploration drillholes, discontinuity within the confining layers, poor well integrity, or unintended fracturing in the well zone or surrounding units (NRC, 2009). The monitoring of water levels that would be performed would serve to avert a potential excursion. Water-quality indicators in the ground water from monitoring wells that would be established after wellfield installation (i.e., post-licensing, pre-operational baseline concentrations defined as excursion indicators) would also be used to detect whether an excursion has occurred.

> **What are excursion indicators and upper control limits?**
>
> Prior to the commencement of injection of lixiviant into a wellfield and actual uranium recovery, an Applicant must propose excursion indicators (which are water-quality parameter concentrations, such as chloride, that are measured to describe the quality of the ground water) as well as upper control limits (UCLs) per 10 CFR Part 40, Appendix A, and as per the license the NRC would issue (10 CFR Part 40). These indicator chemical constituents, or "excursion indicators," would be based upon post-licensing, pre-operational baseline ground-water-quality parameters (i.e., chemical constituents occurring in the ground water) and lixiviant chemistry.
>
> Only after a wellfield and its monitoring-well ring are installed would several ground-water samples would be obtained and analyzed by the Applicant. The results of these analyses provide post-licensing, but pre-operational, baseline values for the respective ground-water-quality parameters that would be used to indicate contemporary ground-water quality. If, during ISR operations, two indicator constituents' are exceeded, or if one is exceeded by 20 percent, (with respect to the corresponding UCLs), then an excursion of lixiviant would be defined as occurring.
>
> UCLs are set on a wellfield-by-wellfield basis and are stated in constituent concentrations for selected excursion indicators so as to provide early warning if uranium-bearing solutions (lixiviant) are moving away from a particular wellfield. The UCLs are subject to the NRC's staff review and approval and their establishment would be required in the NRC license. As described by the NRC (2003a), the best excursion indicators are easily measurable parameters that are found in higher concentrations during uranium recovery than in the natural ground water.
>
> At most in situ uranium-recovery operations, for example, chloride is often selected because it does not interact strongly with the minerals in the ore zone; it is easily measured; and chloride concentrations are significantly increased during ISR operations. Conductivity, which is correlated to total dissolved solids (TDS), is also considered a good excursion indicator because of the high concentrations of dissolved constituents in the lixiviant as compared to the surrounding aquifers (Staub et al., 1986, and Deutsch et al., 1985, as cited in NRC, 2009b). Total alkalinity (carbonate plus bicarbonate plus hydroxide) is used as an indicator in wellfields where sodium bicarbonate or carbon dioxide is used in the lixiviant.
>
> At least three excursion indicators are selected to be monitored in each wellfield, and the UCLs are determined using statistical analyses of the post-licensing, pre-operational baseline water quality in the respective wellfield. The NRC staff has identified several statistical methods that can be used to establish UCLs. For example, in areas with good water quality (TDS less than 500 mg/L), the UCL could be set at a value of 5 standard deviations above the mean of the measured concentrations. Conversely, if the chemistry or a particular excursion indicator is very consistent, a specific concentration could be specified as the UCL. If post-licensing, pre-operational baseline data indicate that the ground water is homogeneous across the wellfield, the same UCLs could be used for all monitoring wells. Alternatively, if the water chemistry in the wellfield is highly variable, unique UCLs could be set for individual wells.
>
> An excursion is defined to occur when two or more excursion indicators in a monitoring well exceed their UCLs (NRC, 2003a). Alternate excursion detection procedures (e.g., one excursion indicator exceeded in a monitoring well by a specified percentage) could also be used, if approved by the NRC.

The NRC would require in its license that the Applicant conduct sampling of its monitoring wells twice each month and to analyze those samples for the excursion indicators (i.e., select baseline water-quality constituent concentrations) specified in its license, so it can be determined whether an excursion has occurred. The Applicant has proposed such an operational ground-water monitoring program (Strata, 2011b). Water levels would be routinely measured during the sampling of the perimeter, overlying, and underlying monitoring wells in order to provide an early warning for impending wellfield problems. An increasing water level in a perimeter monitoring well has been shown to be an indication of a local flow imbalance within the wellfield, which could result in an excursion (Strata, 2011b). An increasing water level in an overlying or underlying monitoring well could be caused by the migration of fluid from the ore zone or by an injection well-casing failure. As stated above, samples would also be collected from the appropriate monitoring wells once every two weeks and would be analyzed for the license-established excursion

parameters. In addition, the Applicant expects that dedicated pressure transducers and/or in situ water-quality instruments could be used in the perimeter monitoring wells to provide the earliest detection of potential excursions or hydraulic anomalies. The Applicant anticipates that this monitoring effort would allow corrective action to be immediately taken to balance locally the injection and recovery flows or to shut down individual injection well(s) or the entire wellfield, as necessary (Strata, 2011b).

Per conditions that the NRC would include in the Ross Project's license, the Applicant would be required to notify the NRC within 24 hours if an excursion were confirmed in the Project's ground-water monitoring wells. If a vertical excursion occurs, then the Applicant's injection of lixiviant would cease and, for any excursion, corrective action would be initiated (the GEIS documented that vertical excursions tend to be more difficult to recover than horizontal excursions) (NRC, 2009). The NRC would require in the Applicant's license that verification and progress ground-water samples are collected by the Applicant weekly until the excursion indicators are at or below their respective UCLs (i.e., the excursion is "recovered") as indicated by three consecutive weekly samples.

The Applicant would also be required to provide a report to NRC within 60 days, including a confirmation of an excursion, a description of the excursion, a discussion of the corrective actions taken, and the results of those corrective actions. If an excursion cannot be recovered within 60 days of confirmation (measured by a concentration of more than 20 percent of any excursion indicator), the Applicant would be required either to terminate lixiviant injection within the wellfield until aquifer cleanup is complete (for horizontal excursions) or to increase the surety for the ISR project by an amount sufficient to cover the full third-party cost of correcting and remediating the excursion. As the GEIS described in Section 2.11.4, licensees typically retrieve horizontal excursions back into the production zone by repairing and reconditioning wells and adjusting pumping rates in the wellfield.

Uranium and Vanadium Processing

Uranium and vanadium in pregnant lixiviant would be extracted from solution by IX resin, stripped from the loaded IX resin ("eluted"), precipitated into a slurry, thickened, de-watered, dried, and packaged as yellowcake (Strata, 2011b). Prior to introduction to the IX columns, pregnant lixiviant could be passed through a de-sanding filtration system (Strata, 2011b). Carbon dioxide could also be added to the pregnant lixiviant to optimize the IX resin-loading capacity. The filtered, pregnant lixiviant would then be passed through two-stage, pressurized, down-flow IX columns, where the uranium and the vanadium dissolved in the lixiviant would be selectively adsorbed onto the IX resin beads. In exchange of uranium and vanadium, the resin releases chloride, bicarbonate, or sulfate ions into the lixiviant. The barren lixiviant exiting the second IX column would be monitored and would normally contain less than 2 mg/kg ("parts per million" or "ppm") of uranium. When the resin beads in the IX column become saturated with uranium and vanadium, the columns would be taken offline for resin elution.

Prior to elution ("elution" is the process whereby the resin beads are "washed" with water to remove uranium and vanadium), the loaded uranium-bearing resin would be transferred to vibrating screens to wash away sand, silt, broken resin, scale, and other process contaminants. The solid material recovered during this step would be collected, stored, and disposed of as a byproduct waste. The elution process would then consist of four stages. The first three sequential stages are where a single batch of resin is contacted with a volume of eluant (water

containing approximately 10 percent sodium chloride and 2 percent sodium carbonate) three times the volume of the batch of loaded resin. The fourth stage is a final rinse where the batch of resin is contacted with four bed volumes, or pore volumes, of fresh water (i.e., four bed volumes is equal to four times the amount of pore space [i.e., empty space] in the resin) (Strata, 2011b). In addition to processing resin from the Ross Project wellfields, the elution circuit would have the capacity to process loaded resin from other uranium-recovery operations owned either by the Applicant or another company as well as from water-treatment facilities that use IX resin to filter or condition water (Strata, 2011b).

The precipitation circuit produces a slurry of uranium solids from the eluant. The Applicant proposes a design consisting of multiple precipitation tanks plumbed in series, with mechanical agitation. The sequential addition of chemicals to bring about precipitation would be as follows: 1) sulfuric acid, 2) sodium hydroxide (caustic soda), 3) hydrogen peroxide, and 4) sodium hydroxide. The slurry containing the uranium precipitate would then be pumped to a yellowcake thickener, which separates the solids particles from the liquid. The “underflow” from this thickener (i.e., the still-wet separated solids) would then undergo a second stage of dissolution and precipitation to remove any impurities entrained in the first precipitate (the underflow). The “overflow” (i.e., the liquid with few solid particles remaining after precipitation) from both thickener stages would then go to the vanadium-recovery circuit.

After precipitation, the yellowcake slurry would be washed in a filter press to remove excess chloride and other soluble contaminants. After multiple washings, the filter cake would be transferred to a radiologically controlled area for drying and packaging (Strata, 2011b). Drying would be accomplished in completely enclosed low-temperature vacuum dryers. The GEIS describes the type of dryer proposed by the Applicant as the standard for newer ISR facilities (NRC, 2009). The off-gases generated during the drying cycle would be filtered and scrubbed to remove entrained particulates. The GEIS noted that the drying, filtration, and scrubber process proposed by the Applicant is designed to capture virtually all escaping particles (NRC, 2009).

The dryers would be batch type, and drying would typically take 16 hours per batch. Batch dryers create the potential for the escape of yellowcake during loading and unloading of the dryer. The Applicant proposes to reduce this potential by the design of the equipment. A water-sealed vacuum pump would provide ventilation during loading of the yellowcake slurry into the dryer and transferring the dried product into 208-L [55-gal] drums by facility personnel (Strata, 2011b). Transfer equipment would be located directly below the dryer and would include a discharge chute, rotary airlock valve, ventilated drum hood, and a drum conveyor. A drum would be placed beneath the dryer discharge chute; the ventilation hood would be secured over the drum opening to prevent escape of yellowcake into the surrounding environment. After a drum is in place and securely covered, the rotary airlock valve would be activated to start the loading process. A viewport in the hood would allow personnel to determine when the drum is full. The loaded drum would be weighed and labeled, and then moved to the side to cool and off-gas before it is sealed and stored for offsite shipment.

The uranium-depleted solutions from the uranium thickeners would be pumped to a vanadium precipitation tank (Strata, 2011b). Steam, facility air, ammonia, and ammonium sulfate would be added to cause precipitation of crystals containing vanadium. The precipitate slurry would be pumped to a horizontal belt filter, where the solution is removed from the crystals. The filter

cake would be washed and transferred to a batch vacuum rotary dryer similar to the dryer that would be used to dry uranium yellowcake. Off-gas from the precipitation tanks and dryer would be filtered to remove particulates and directed to a wet scrubber to capture ammonia for reuse. The dried product would then be packaged for offsite shipment. The Applicant estimates that 0.1 – 2 kg [0.2 – 4.4 lb] of V_2O_5 would be produced for every 1 kg [2.2 lb] of U_3O_8.

The waste water would be treated by reverse osmosis (RO) (Strata, 2011b). The water quality of permeate that is anticipated by the Applicant is provided in Table 2.2. Most of the permeate from the RO system would be recycled back to the wellfield as lixiviant. The lined surface impoundments within the facility would be used to store and manage excess permeate and brine. Permeate and brine would be managed as radioactive byproduct materials. Brine would be disposed in the deep-injection wells.

Table 2.2
Permeate Water Quality

Parameter	Unit	Typical Value	Minimum Value	Maximum Value
EC	µS/cm	300	180	400
TDS	mg/L	200	100	250
pH	s.u.	8	6	6.5
Alkalinity as $CaCO_3$	mg/L	100	50	200
Sulfate	mg/L	15	10	20
Bicarbonate	mg/L	150	50	200
Chloride	mg/L	15	5	25
Calcium	mg/L	0	0	1
Sodium	mg/L	50	20	100
Manganese	mg/L	0	0	0.1
Selenium	mg/L	0	0	0.1
Arsenic	mg/L	0	0	0.1
Uranium	mg/L	0	0	0.1
Radium	pCi/L	30	5	100

Source: Table 4.2-2 in Strata, 2011b.

2.1.1.3 Ross Project Aquifer Restoration

After uranium recovery has ended, each wellfield that is to undergo aquifer restoration would contain ground-water constituents that would have been mobilized by the lixiviant. The purpose of aquifer restoration is to restore the respective aquifer to its baseline conditions, as defined by post-licensing, pre-operational constituent concentrations (see Section 2.1.1.2), so as to ensure public health and safety. The Applicant would be required to provide a financial-surety instrument that would cover planned and delayed aquifer-restoration costs in compliance with 10 CFR Part 40, Appendix A, Criterion 9 to cover the ISR facility's decontamination and decommissioning. NRC would review the adequacy of this financial-surety annually (see SEIS Section 2.1.1.7) (10 CFR Part 40).

Under the Federal UIC program, the exempted production aquifer would no longer be used as a USDW under the SDWA (40 CFR Part 145). In accordance with the requirements for a Class I-V well under 40 CFR Part 146.4, the exempted aquifer 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 (40 CFR Part 146). Hence, ground water in exempted aquifers cannot be considered as a source of drinking water after restoration.

The aquifer-restoration activities proposed for the Ross Project are the same as those methods described in Section 2.5 of the GEIS: 1) ground-water transfer, 2) ground-water sweep, 3) RO with permeate injection, 4) ground-water recirculation, and 5) stabilization monitoring (Strata, 2011a; NRC, 2009). The Applicant proposes that concurrent ISR operations and aquifer restoration would occur when several of the first well modules have been depleted and are ready for restoration activities (Strata, 2011b). As aquifer restoration occurs in depleted well modules, ISR operations would be ongoing in subsequent well modules.

The Applicant has proposed a ground-water restoration schedule that is benchmarked to production schedules and waste-water disposal capacity, but it estimates that aquifer restoration for each wellfield would take approximately eight months (Strata, 2011b). The Applicant's proposed restoration methodology would include ground-water sweep, permeate injection, and ground-water recirculation.

During ground-water sweep, water is pumped from injection and recovery wells to the facility without reinjection, as the GEIS described in Section 2.5.2. In response to this pumping, water from outside the wellfield flows into the ore zone, flushing contaminants from areas that have been affected by the horizontally spreading lixiviant in the respective aquifer during uranium recovery (NRC, 2009). Ground water produced during the sweep phase would contain uranium and other contaminants mobilized during uranium recovery as well as residual lixiviant. The initial concentrations of these constituents would be similar to those during uranium recovery, but the concentrations would decline gradually with time. The water removed from the aquifer during the sweep first would be passed through the IX system to recover the uranium and then be disposed of as excess permeate. The pumping rates used would depend on the hydrologic conditions at the Ross Project, and the duration of the aquifer sweep and the volume of water removed would depend on the volume of the aquifer affected by the ISR process.

Aquifer volume typically is described in terms of "pore volumes," a term used by the ISR industry to represent the volume of water that fills the void space in a given volume of rock or sediment. The Applicant's aquifer-restoration plan calls for removing up to 0.5 pore volumes of water during ground-water sweep (Strata, 2011b). Additional pumping would occur in select areas that would be identified during facility operation. The pumping rate is estimated at 284 L/min [75 gal/min] from well modules in the ground-water sweep stage. The Applicant proposes to use ground-water sweep selectively (for example, around the perimeter of the wellfield) rather than throughout the entire well module to minimize the consumptive use of ground water (Strata, 2011a).

The Applicant proposes to use ground-water treatment and permeate injection would be used after the ground-water sweep process, as described in Section 2.5.3 of the GEIS (Strata, 2011b). This phase would return total dissolved solids (TDS) (a water-quality parameter), trace-metal concentrations, and aquifer pH to the pre-operational baseline values that would have

been determined during the Applicant's post-licensing, pre-operational sampling and analysis program; these concentrations would be required by the NRC license (NRC, 2009). Ground water recovered from a depleted portion of the ore zone would be treated with sulfuric acid or other chemicals to prevent scaling on the RO circuit (Addendum 6.1-A in Strata, 2011b). Low concentrations of uranium in the ground water would be removed by passing the water through the IX circuit, as during operations. Following the IX circuit, other chemical constituents are removed by passing the ground water through the two-phase RO system consisting of pressurized, semi-permeable membranes. The RO process yields two fluids: permeate (approximately 85 percent), which would be re-injected into the aquifer, and brine (approximately 15 percent), which would be managed as liquid waste.

The pumping and injection rates during this process would be similar to those during the sweep phase, but depending upon site hydrology, many pore volumes (often more than 10) could be circulated to achieve aquifer restoration goals (NRC, 2009). For the Ross Project, the Applicant estimates that aquifer restoration would average 3,880 L/min [1,025 gal/min] from well modules in the RO and permeate-injection process of aquifer restoration (Strata, 2011b). During aquifer restoration (except during ground-water sweep), all permeate would be used as lixiviant or injected into the aquifer for restoration.

The ground-water recirculation process would begin after completion of the permeate-injection process. In this phase, ground water from the production zone would be pumped from recovery wells and re-circulated into injection wells in the same well module. This process homogenizes the ground water within the aquifer to minimize the risk of "hot-spots," areas of the aquifer with unusually high concentrations of dissolved metal concentrations. The Applicant proposes that the only water treatments that would occur during recirculation are filtration and removal of uranium and vanadium (Strata, 2011a).

The purpose of stabilization during aquifer restoration is to establish a chemical environment that would reduce the solubility of dissolved constituents such as uranium, arsenic, and selenium, as described in GEIS Section 2.5.4. An important component of aquifer stabilization during the aquifer-restoration phase is to convert metals to their insoluble forms (NRC, 2009). If the oxidized (i.e., the more soluble) state is allowed to persist after uranium recovery is complete, metals and other constituents such as arsenic, selenium, molybdenum, uranium, and vanadium could continue to leach and remain at elevated levels. To stabilize these constituents' concentrations, the pre-operational oxidation state in the ore zone must be reestablished as much as is possible. This stabilization often requires adding an oxygen scavenger or a reducing agent, such as hydrogen sulfide (H_2S) or a biodegradable organic compound such as ethanol, into the production zone during the later stages of recirculation (NRC, 2009).

The need for aquifer stabilization would be determined on a case-by-case basis and would depend upon how effectively the sweep and recirculation processes restore the affected aquifer to the license-required standards. Following aquifer restoration, the Applicant would monitor the ground water by quarterly sampling to demonstrate that the approved standard for each constituent has been met and that any adjacent nonexempt aquifers are unaffected. The Applicant would reinitiate the entire aquifer restoration phase if stabilization monitoring determines it is necessary. Both WDEQ and the NRC must review and approve all monitoring results before aquifer restoration would be considered to be complete.

All injection, recovery, and monitoring wells and drillholes would be plugged and abandoned in place according to applicable regulations after ground-water restoration is approved by the NRC and WDEQ (WDEQ/LQD, 2005). To comply with these regulations, the Applicant proposes standard operating procedures (SOPs) of well abandonment that includes plugging all wells with cement containing 2 percent bentonite clay (Strata, 2011b).

2.1.1.4 Ross Project Decommissioning

Prior to the Ross Project's facility decontamination, dismantling, and decommissioning; the wellfields' aquifer restoration; and the Project site's reclamation and restoration; appropriate cleanup criteria for surfaces would need to be established in concert with NRC requirements, and a Ross Project-specific decommissioning plan (DP) would need to be accepted by the NRC (NRC, 2003b). The Applicant has committed to satisfying these NRC requirements for decontamination and decommissioning (Strata, 2011b).

To begin the Ross Project's decommissioning phase, the Applicant would conduct a series of radiation surveys to identify those areas at the Ross Project that would need decontamination to meet applicable cleanup criteria or those that cannot economically meet the criteria (Strata, 2011b). These surveys would include building, structural, and equipment surfaces as well as potentially contaminated environmental media such as soil and water (NRC, 1999; NRC, 2003a). The onsite excavated pits, or "mud pits," used for the disposal of drilling fluids and muds (or "cuttings") during the installation of wells, would be included in the survey to ensure no long-term radiological impacts (Strata, 2011a). In addition, records of radiation surveys and the entire cycle of decontamination, dismantling, decommissioning, and disposal activities would be maintained in accordance with the Applicant's license.

Based upon the results of the radiation surveys, decontamination and dismantling of buildings, structures, and equipment would be conducted in accordance with the DP. Contaminated surfaces, including processing and water-treatment equipment such as tanks, filters, IX columns, pipes, and pumps, would be decontaminated (Strata, 2011b). High-pressure washing would be used to remove loose contamination from the surfaces. If required, secondary decontamination would consist of washing with dilute acid or equivalent compatible solution (Strata, 2011b). All successfully decontaminated buildings and equipment could be released for unrestricted use (NRC, 2003b).

The buildings, structures, and equipment that are not or no longer contaminated would be moved to a new location within the Ross Project for further use or storage, removed to another facility for either reuse or salvage, or taken to a properly permitted, permanent solid-waste disposal facility. Concrete flooring, foundations, and foundation materials, if uncontaminated, would be broken up and disposed of at an appropriately permitted solid-waste facility. All radioactively contaminated buildings and structural materials that cannot be successfully decontaminated would be dismantled and then disposed of at a properly licensed radioactive waste disposal facility (i.e., a facility licensed by the NRC or an Agreement State). Contaminated soils would also be disposed of at the same or similar licensed facility. A final-status radiation survey would then be performed to ensure that any residual contamination on the surfaces is below the cleanup criteria. All disturbed lands would be reclaimed (NRC, 1999). Section 2.6 of the GEIS describes the general process for decontamination, dismantling, and decommissioning of an ISR facility and the restoration and reclamation of the land itself (NRC, 2009).

During decommissioning of the facility, all UIC Class III injection and recovery wells, monitoring wells, and the UIC Class I injection wells would be abandoned according to the DP. The total number of wells would number between 750 and 1,000 based upon the Applicant's estimate of 40 recovery wells per each of 15 – 20 wellfield modules plus monitoring wells (Strata, 2012a). Decontamination, decommissioning, and restoration of a wellfield would begin approximately five years after its construction (refer to Figure 2.6) (Strata, 2011a). However, at the Ross Project, complete decontamination, dismantling, and decommissioning of the ISR facility itself, and restoration and reclamation of the Ross Project area, could occur years after the wellfields begin to be decommissioned and the aquifer begins to be restored, in order to accommodate the Applicant's continuing recovery of uranium and production of yellowcake from its future satellite projects and/or from other uranium-recovery or waste-water-treatment operations (Strata, 2011a).

During the decommissioning phase, the Applicant proposes that all primary, secondary, and tertiary roads and other temporary access routes to and within the Ross Project would be removed and the land reclaimed, unless a request by the respective landowners or lessees to not do so is received by the Applicant. In this case, then, the landowners or lessees would assume responsibility for the long-term maintenance and ultimate reclamation of the roads and routes, after the NRC license has been withdrawn (Strata, 2011b).

All contaminated soil or gravel that is determined to be a byproduct radioactive waste would be disposed at a radioactive waste disposal facility licensed by the NRC or an Agreement State, as necessary, while petroleum-contaminated soil would be disposed at a WDEQ-permitted facility. Removal of roads would be accomplished by the Applicant removing excess road surfacing material, and then ripping the road and the underlying shallow subsoil to loosen the base. Culverts would be removed and preconstruction drainages would be re-established. The vicinity would be graded to a contour consistent with the surrounding landscape. Finally, topsoil would be applied in a uniform manner and the area seeded to achieve WDEQ/LQD reclamation standards.

The Class I deep-disposal wells would be plugged and abandoned in accordance with the requirements of the Applicant's UIC Class I Permit (Strata, 2011b). All wastes and the equipment associated with the surface impoundments, such as accumulated sludge, impoundment liners, and leak-detection pipes and lines, would be surveyed for radioactive contamination and then disposed of appropriately or released for unrestricted use (Strata, 2011b). The soil beneath the surface impoundments would be analyzed for radioactive contamination, and any areas that exceed the cleanup criteria for unrestricted release would be excavated and disposed of at a licensed radioactive waste disposal facility.

The natural flow of shallow ground water beneath the facility and in the immediate vicinity outside of the CBW would also be re-established during decommissioning (Strata, 2011b). Flow through the CBW would be accomplished by the Applicant's creating a series of breaches, also known as finger drains, along the up-gradient and down-gradient reaches of the CBW. Each finger drain would consist of a 0.5 m [1.5 ft] wide by 7.6 m [25 ft] long trench that is cut through the CBW at a right angle and to a depth that is 0.6 m [2 ft] below the lowest historical ground-water level. Gravel would be placed in the trench from the bottom to a point 0.6 m [2 ft] above the highest recorded ground-water level such that a highly permeable flow path is created through the CBW. The

remaining trench would be backfilled with native topsoil and seeded. Selected monitoring wells that would have been used by the Applicant to characterize the shallow aquifer in the area, before its installation of the CBW, would be retained. Water levels would be monitored following CBW reclamation to verify that the natural flow of shallow ground water through the CBW and beneath the facility has been restored.

> **What types of wastes would be generated at the proposed Ross Project?**
>
> **Liquid Wastes**
>
> ***Liquid Byproduct Waste*** is all liquid-phase wastes generated by the proposed Ross Project, except for sanitary waste water and well development and testing waste water. This waste is contaminated with byproduct material.
>
> ***Liquid Hazardous Waste*** is regulated under the Resource Conservation and Recovery Act or is a State-defined hazardous waste that is a non-byproduct waste. This waste includes universal hazardous wastes and used oil.
>
> ***Sanitary Waste Water*** is ordinary sanitary septic-system waste water; this waste water is non-hazardous, non-byproduct waste water.
>
> ***Well Development and Testing Waste Water*** is waste water generated during well development and during pumping tests; this waste water is non-hazardous, non-byproduct waste water. Such waste water does not require treatment before disposal.
>
> **Solid Wastes**
>
> ***Solid Byproduct Waste*** is all solid-phase wastes generated by the Ross Project that exceed NRC limits at 10 CFR Part 20 for unrestricted release. This waste is contaminated with byproduct material.
>
> ***Hazardous Waste*** is regulated under the Resource Conservation and Recovery Act or is a State-defined hazardous waste that is non-byproduct waste. This waste includes universal hazardous wastes.
>
> ***Nonhazardous Solid Waste*** is domestic, office, and municipal waste (i.e., trash), construction and demolition debris, septic solids, and materials such as equipment and soils that have been determined to meet NRC criteria in 10 CFR Part 20 for unrestricted (i.e., unregulated) release.

The Applicant proposes to re-contour, as necessary, the disturbed areas within the Ross Project area to blend in with the natural terrain and to be consistent with the preconstruction topography (Strata, 2011b). Revegetation would be accomplished in accordance with the WDEQ/LQD Permit to Mine requirements and would be required by the NRC license. Topsoil that was salvaged prior to construction activities and stored in a stockpile would be used for reclamation to the extent possible (Strata, 2011b); the topsoil would be spread over the area to be reclaimed and would be seeded with a native seed mix. During ISR facility operation the topsoil stockpiles and as much as is practical of the disturbed wellfield, would be seeded to establish vegetative cover to minimize wind and water erosion. At the completion of decommissioning, the Applicant commits to reclaiming the entire area to equal or better conditions than existed prior to ISR (Strata, 2011b, Addendum 6.1-A). Reclaimed land would be capable of supporting livestock grazing, dry-land farming, and wildlife habitat. The respective landowners and WDEQ would be consulted as the Applicant selects the seed mix. Seeding would be conducted by drill or broadcast methods depending upon the type of seed being used. Mulch could also be used to cover the seed (Strata, 2011b).

2.1.1.5 ISR Effluents and Waste Management

Section 2.7 of the GEIS describes the airborne effluents as well as the liquid and solid wastes that are typically generated at ISR facilities and corresponding waste-management practices

(NRC, 2009). The effluents and wastes expected from the proposed ISR project and the waste-management practices the Applicant proposes are consistent with the industry standards reported in the GEIS. The types of liquid and solid wastes, the quantities of these wastes anticipated by the Applicant, and the Applicant's proposed management systems are provided in Strata (2012a). (See also Table 4.9 in SEIS Section 4.14.) Impacts from liquid and solid waste management are described in SEIS Section 4.14.

Airborne Emissions

There would be both radioactive and non-radioactive airborne particulates and gases emitted during all phases of the Proposed Action (Strata, 2011b). As discussed below, the design features proposed by the Applicant to control all airborne effluents are consistent with the industry standards presented in the GEIS (NRC, 2009).

Non-Radioactive Emissions

Emissions from internal combustion engines would be the primary source of non-radioactive gaseous effluents (i.e., emissions). Releases would be anticipated from drilling rigs, drilling support equipment (e.g., backhoes, water trucks, pipe trucks, and cement units), utility trucks employed for wellfield service, light vehicles used for personal transport through the wellfields, in addition to vehicles used by ISR facility personnel to and from the Ross Project area (Strata, 2011b). The emissions from these types of vehicles would include carbon monoxide (CO), CO_2, sulfur dioxide (SO_2), nitrogen species (NO_x), and total hydrocarbon (THC) as well as particles less than 10 μm in diameter (PM_{10}) (Strata, 2011a). These emissions are consistent with those from a generic ISR project described in the GEIS (NRC, 2009).

Smaller sources of airborne non-radioactive gaseous and particulate emissions during operation would also include fugitive dust from cementing operations; welding fumes; particulates from grinding steel during construction and during operation; salt and soda ash during process-chemical delivery; and fumes from chemicals used in the laboratory, in addition to the carbon dioxide, oxygen, and water vapor that would be vented from the Ross Project. Vanadium precipitation, drying, and packaging would also present a potential for non-radioactive particulate emissions.

Fugitive dust would also be generated during all phases of the Proposed Action due to the mechanical disturbance of soil by heavy equipment, from transport vehicles traveling on access roads, and from wind blowing over disturbed areas and stockpiles. The Applicant has proposed to mitigate fugitive-dust emissions with its use of speed limits, strategic placement of water-loading facilities near access roads, suppression of dust with chemicals such as magnesium chloride, selection of road-surface materials that would minimize dust, and prompt revegetation of disturbed areas (Strata, 2011a).

Radioactive Emissions

Radon gas would be the primary radioactive gaseous effluent from the Ross Project. Radon is a radioactive, colorless, and odorless gas that occurs naturally as the decay product of radium, which is found where there is uranium as radium itself is a radioactive decay product of uranium. Radon would be found in the lixiviant solution that is extracted from the wellfields and piped to the CPP for processing. Radon gas could potentially be released in the CPP as a

result of uranium-recovery fluid spills, filter changes, IX resin-transfer operations, and maintenance activities. Routine monitoring of radon progeny (i.e., the products of radon's own radioactive decay) within the CPP would identify exposure levels and would allow timely corrective actions to be initiated, if necessary (Strata, 2011b). The sources of radon described by the Applicant and the design features proposed by the Applicant to limit radon concentrations (e.g., the use of proper ventilation systems and radon detectors) are consistent with the industry standard described in the GEIS (NRC, 2009).

All exhaust points in the CPP would be ducted through a common system to a wet scrubber and discharged to the atmosphere (Strata, 2011b). The Applicant has committed that these discharges would meet all local, State, and Federal requirements related to air quality as well as occupational health and safety (Strata, 2012b). A performance-monitoring station would be located at the CPP's exhaust fan's point of discharge at the roof. The ambient air within the facility would be gravity ventilated up through a ridge vent. The CPP and other buildings would also be passively ventilated by the opening and closing of doors during periods of time when radon could be released.

Radon gas could also be released outside of the CPP from wellheads, other auxiliary buildings such as well modules, and the surface impoundments (Strata, 2011b). At the wellheads and the surface impoundments, radon would be released directly to the atmosphere, where it would rapidly disperse and decrease in concentration. Wellhead enclosures, such as the module buildings, would be vented to reduce radon buildup that could otherwise expose wellfield personnel to radon during inspection and maintenance activities. The Applicant proposes that, if vents are not installed on wellhead enclosures, SOPs would be developed for accessing wellheads to ensure radon exposures are below the regulatory limits of the EPA and the NRC. Such buildings would have ventilation systems consisting of a roof- or wall-mounted fan as well as a separate radon ventilation system with an intake located in the building's sump and an exhaust point on the building's roof.

Potential radioactive particulate emissions would consist primarily of airborne yellowcake in the uranium drying and packaging process (Strata, 2011b). This potential would be mitigated by design features to prevent releases into the atmosphere as described earlier in this section of this SEIS.

Liquid Effluents

The GEIS, Section 2.7.2, describes the liquid effluents generated during all phases of uranium recovery: construction, operation, aquifer restoration, and decommissioning. During most of these phases, liquid wastes could contain elevated concentrations of radioactive and chemical constituents. The composition and quantities of liquid waste from Ross Project processes related to uranium recovery are similar to those ranges provided in Table 2.7-3 of the GEIS (NRC, 2009); however, representative water quality parameter(s) for permeate are not included in the GEIS for comparison. The methods that the Applicant proposes for treatment of liquid wastes, such as RO as well as its disposal and management practices, are similarly noted as industry standards in the GEIS (NRC, 2009).

The Proposed Action would generate liquid effluents classified as byproduct wastes as well as other liquid effluents that are not (Strata, 2011b; Strata, 2012a). Liquid wastes would be categorized as follows:

- Brine and permeate from the RO treatment of lixiviant bleed and ground water from aquifer restoration. Most of the permeate would be reused as lixiviant in the wellfields and as process make-up water.
- Other liquids such as spent eluate, collected fluids from drains in the processing areas at the CPP, contaminated reagents, IX resin wash water, filter back wash, facility wash-down water, decontamination water (e.g., employee showers), and fluids generated from work-over and enhancement operations on injection and recovery wells.
- Non-byproduct liquid wastes would include drilling fluids and ground water collected during construction and development of injection, recovery, and monitoring wells as well as during environmental sampling and aquifer testing; storm-water runoff; toxic and hazardous wastes such as petroleum products and spent chemicals; and domestic sewage.

The Applicant proposes the use of surface impoundments for the collection and management of byproduct waste liquids (Strata, 2011a). Production of liquid byproduct wastes would vary over the three phases of operations and ground-water restoration: 1) operation only; 2) concurrent operations and aquifer restoration; and 3) aquifer restoration (Strata, 2011b).

GEIS Section 2.7.2 described four disposal options for use at ISR facilities: evaporation, land application, deep-well injection, and surface-water discharge (NRC, 2009). Of these disposal options, the Applicant proposes to rely on deep-well injection, with supplemental disposal by evaporation of brine and disposal of excess permeate from the surface impoundments (Strata, 2011b; Strata, 2012a). Land application is not currently proposed as a method for permeate disposal by the Applicant (Strata, 2012b). The surface impoundments would primarily provide transient storage of liquids with little evaporation actually occurring during the liquids' residence time.

Excess permeate could be produced during two relatively brief periods of operations (Strata, 2011b): the first two and one-half years of uranium production without reinjection of permeate into the aquifer for wellfield restoration and the two months when ground-water sweep is occurring in the first wellfield modules to undergo aquifer restoration. The Applicant proposes that excess permeate during the periods of uranium-recovery would be disposed of by deep-well injection (WWC Engineering, 2013). As noted earlier, the Applicant would utilize Class I deep-well injection for disposal of brine and other liquid wastes (Strata, 2011b). WDEQ has approved a UIC Class I Permit for up to five wells to be installed in the Deadwood and Flathead Formations (Permit No. 10-263) (WDEQ/WQD, 2011b). The Applicant expects the capacity of each of the five Class I wells to range between 132.5 – 302.8 L/min [35 – 80 gal/min]. The Applicant proposes a storage tank that, along with the lined impoundments, would provide surge capacity for management of the brine (Strata, 2012b).

Net annual evaporation of brine in the surface impoundments would be approximately 5.3 L/min-ac [1.4 gal/min-ac] which would reduce the volume of brine injected in the disposal wells (Strata, 2011b). The Applicant estimates typical flow rates of brine mixed with other byproduct liquid waste to the deep-disposal wells of 235 L/min [62 gal/min] during the operation-only phase; 859 L/min [227 gal/min] during the phase where the ISR facility is operating concurrently with aquifer restoration; and 719 L/min [190 gal/min] during the aquifer-restoration-only phase (Strata, 2011a). Brine produced during decontamination and decommissioning would be less

than 38 L/min [10 gal/min] (Strata, 2011a). The Applicant's estimated flow rate of brine, permeate, and other liquid wastes for disposal would be less than noted in the GEIS (Table 2.7-3) (NRC, 2009).

The following non-byproduct (non-radioactive) liquid wastes would be generated at the Ross Project:

- Storm water from the paved areas of the proposed Ross Project facility
- Domestic sewage from the proposed facility
- Drilling fluids from construction of the proposed wellfields

Storm-water management would be controlled under a WYPDES Permit from WDEQ. As part of this permit, best management practices (BMPs) would be developed to restrict contaminants from the surface water and storm drains. Runoff from the facility would be diverted by the storm-drain system to a sediment surface impoundment near the CPP (Strata, 2011b).

The Applicant estimates that the volume of domestic sewage would range between 1,100 L/d [300 gal/d] and 4,500 L/d [2,600 gal/d] depending upon the number of workers during each project phase (Strata, 2012a). Domestic waste water would be collected in a gravity-sewer collection system serving the administration building, CPP, maintenance building, and any other buildings or structures with restrooms. This system would be designed according to WDEQ/WQD standards and would include one or more septic tanks for primary treatment. Septic-tank effluent would be disposed in a drainfield or in an enhanced treatment system (Strata, 2011b).

Drilling fluids of ground water and drilling muds would be produced only during the construction phase from the drilling and development of injection, recovery, and monitoring wells. The Applicant estimates that a volume of 22,000 L [6,000 gal] of water and 12 m^3 [15 yd^3] of drilling muds would be produced per well. The fluid would be stored onsite in mud pits constructed adjacent to the respective drilling pad(s) and evaporated. The Applicant expects the production of ground water during operation and decommissioning from wells completed outside of the aquifer exempted for uranium recovery (Strata, 2011a). This ground water would be discharged under a temporary WYPDES Permit. The Applicant was authorized to discharge these fluids under a temporary WYPDES Permit (No. WYG720229) issued during installation and sampling of monitoring wells (WDEQ/WQD, 2011a). This Permit was renewed in December 2012.

<u>Solid Effluents</u>

The GEIS describes the solid-phase wastes that would be generated during all phases of uranium-recovery operations. These solid wastes would be hazardous, radioactive, or typical solid waste. The projections of solid-waste generation and management methods proposed by the Applicant for the Proposed Action are within the industry standards described in Section 2.7 of the GEIS (Strata, 2011b; Strata, 2012b; NRC, 2009). The Applicant provides a list of anticipated waste disposal facilities with adequate capacity that could be used for waste generated at the Ross Project (Strata, 2012a).

The Applicant estimates the production of 19 L/mo [5 gal/mo] of used oil and less than 9 kg/mo [20 lb/mo] of used oil filters and oily rags. These wastes would be stored in a designated used-oil storage area and would be shipped to a commercial recycling facility for disposal, such as Tri-State Recycling Services, Newcastle, Wyoming (Strata, 2012a). Petroleum-contaminated soil, estimated as less than 1 m^3/wk [1 yd^3/wk], would be transported by a waste-disposal contractor to a permitted land farm in northeast Wyoming such as the Campbell County Landfill (Strata, 2012a).

Less than 100 kg/mo [220 lb/mo] of waste designated as hazardous by the EPA and WDEQ, such as used batteries, expired laboratory reagents, burnt-out fluorescent light bulbs, spent solvents, certain cleaners, and used degreasers, would also be generated (Strata, 2012a). The hazardous waste would be stored at the Ross Project in secure, specially designed containers inside the maintenance shop. The Applicant expects the Ross Project to be classified as a conditionally exempt small quantity generator (known as a CESQG) of hazardous waste (Strata, 2011b). Hazardous waste would be transported by a hazardous waste contractor to an appropriately permitted commercial recycling facility outside Wyoming (Strata, 2012a). The Applicant proposes onsite disposal contaminated laboratory reagents in the lined retention impoundments and deep-well injection (Strata, 2012a).

Radioactive byproduct solid waste that would be generated at the Ross Project include filtrate and spent filter media from production and restoration circuits; general sludge, scale, etc. from maintenance operations; affected soil collected from any spill or leak areas; spent/damaged ion exchange resin; well solids from injection/recovery well work-over operations; contaminated PPE; wellfield decommissioning waste such as pipelines, pumps, and impacted soil; affected concrete floors, sumps and berms in the CPP; equipment and piping in the CPP; pond sludge, pond liners, and leak detection systems; and disposal well piping and equipment (Strata, 2012a). Byproduct solid wastes would be generated during all Proposed Action phases, except construction. During facility operation and aquifer restoration, the Applicant estimates the production of 80 m^3/yr [100 yd^3/yr] of solid byproduct waste. The largest volumes of byproduct waste, including contaminated soil requiring licensed disposal, would be generated during facility decommissioning, which is estimated to be 4,000 m^3 [5,000 yd^3] (Strata, 2012a). The Applicant has identified four facilities with sufficient capability located in Wyoming, Utah, and Texas that are permitted to accept byproduct waste from ISR facilities (Strata, 2012a).

During all phases of the Proposed Action, when any byproduct wastes are generated, they would be stored inside a locked and posted room within the CPP (i.e., this area would be a restricted area). The wastes would be placed inside 208-L [55-gal], lined drums, sealed and placed inside a 15-m^3 [20-yd^3] roll-off container. The sealed roll-off containers containing the waste would be transported by a licensed transporter to a licensed radioactive waste facility for disposal. The Applicant anticipates about five annual shipments of byproduct wastes during the facility-operation and aquifer-restoration phases. During decommissioning, which is expected to last 12 to 18 months, up to 200 shipments per year would be expected (Strata, 2011b).

Non byproduct solid wastes generated at the Ross Project include ordinary trash, petroleum-contaminated soil, construction debris, and decontaminated material and equipment. The Applicant estimates that 12 m^3/wk [15 yd^3/wk] of ordinary municipal solid waste such as office trash along with 4 m^3/wk [5 yd^3/wk] of recyclable wastes (plastic, glass, paper, aluminum, and cardboard) would be generated throughout the life of the Ross Project (Strata, 2012b). Small amounts (less than 0.8 m^3/wk [5 yd^3/wk]) of petroleum-contaminated soil would also be

generated. The generation of solid waste consisting of construction debris and decontaminated materials and equipment would be less than 4 m^3/wk [5 yd^3/wk] during facility construction and operation, and aquifer restoration. During the decommissioning phase, the Applicant estimates up to 1,500 m^3 [2,000 yd^3] of such solid waste (Strata, 2012a).

During facility operation and aquifer restoration, non-hazardous solid wastes would be collected daily from work areas and disposed in trash receptacles located within the facility, but near a primary access road for convenient access for a waste-disposal contractor. Non-hazardous solid waste would be disposed offsite in the Moorcroft landfill or the Campbell County landfill in Gillette, Wyoming (Strata, 2011a). Solid waste of construction and demolition debris would be disposed in the municipal or country landfills in the three towns nearest the Ross Project: Moorcroft, Sundance, and Gillette.

2.1.1.6 Transportation

Primary transportation activities would involve truck shipping and personnel commuting. A variety of truck shipments are planned to support proposed activities during all phases of the Proposed Action. Light-duty trucks and automobiles would transport construction contractors and the operations workforce. Baseline transportation conditions and impact of the Ross Project are discussed in SEIS Sections 3.3 and 4.3, respectively.

Transportation routes within 80 km [50 mi] of the Proposed Action include interstate highways, other U.S. highways, Wyoming highways, county roads, and local roads (Strata, 2011a). The major transportation corridors that could be used to access the Ross Project area include Interstate-90, approximately 32 km [20 mi] south; U.S. Highway 14, approximately 16 km [10 mi] southeast; State Highway 59, approximately 32 km [20 mi] west; and U.S. Highway 212, approximately 64 km [40 mi] northeast. Regional and local transportation routes are shown on Figure 2.1.

The primary access to the Ross Project area is from D Road [CR 68] from the New Haven Road (CR 164). The primary access road to the ISR facility would be constructed to flow from New Haven Road (CR 164). The design of the road includes a 9 m [30 ft] top width with 5 horizontal to 1 vertical side slopes. According to American Association of State Highway and Transportation Officials (AASHTO), a 5:1 slope is traversable and recoverable; therefore, no guardrails would be used on the access road (AASHTO, 2002; Strata, 2011b).

2.1.1.7 Financial Surety

Prior to commencement of operations, the Applicant would be required to provide assurance that sufficient funds will be available to cover decontamination, dismantling, and decommissioning as well as to cover aquifer restoration of the Ross Project, including all costs of site reclamation and decommissioning waste disposal (10 CFR Part 40, Appendix A, Criterion [9]). A decommissioning funding plan (DFP) would be required from the Applicant as an NRC license condition; the DFP would contain a decommissioning cost estimate, the amount of which the Applicant would be required to maintain in a financial-surety arrangement. The initial decommissioning cost estimate would be based upon the first year of operation, which includes the construction of the CPP, and would be fully described in the DFP. NRC license conditions and the WDEQ/LQD Permit to Mine would also require, on a forward-looking basis, annual revisions to the decommissioning cost estimate and the related financial surety. When NRC,

WDEQ, and the Applicant have agreed to the initial cost estimate and DFP, the Applicant would submit a surety instrument acceptable to both NRC and WDEQ. Details of NRC's requirement for financial surety would be part of the Safety Evaluation Report (SER) for the Ross Project and the surety would be required by the Applicant's NRC license. The Applicant would be required to maintain these surety arrangements until the NRC determined that the Applicant had complied with its reclamation plan. For additional information on decommissioning funding plans and financial-surety requirements, see 10 CFR Part 40, Appendix A; NUREG–1757, *Consolidated NMSS Decommissioning Guidance*; and the GEIS in Section 2.10 (NRC, 2003b; NRC, 2009).

2.1.2 Alternative 2: No Action

Under the No-Action Alternative, the NRC would not issue a license for the proposed ISR project and BLM would not approve the Applicant's Plan of Operations (POO). The No-Action Alternative would result in the Applicant's not constructing, operating, restoring the aquifer of, or decommissioning the proposed ISR project. However, even if the proposed Ross Project is not licensed, the Applicant has already accomplished certain preconstruction activities that do not require an NRC license or BLM POO at the Ross Project area. At no time would radioactive materials be present at the Ross Project during any preconstruction activities. These previously completed preconstruction activities are evaluated as part of Alternative 2: No Action.

Preconstruction activities that have already been accomplished include the Applicant's locating and properly abandoning the former Nubeth's exploration drillholes. As of October 2010, the Applicant has located 759 of the 1682 holes thought to exist from Nubeth exploration activities and has plugged 55 of them (Strata, 2011b). In addition, Strata has drilled and then properly abandoned 512 holes used to delineate the ore zone. The Applicant has also drilled and completed 51 wells for ground-water monitoring and testing (Strata, 2011a) as well as installed 3 surface-water monitoring stations and a meteorology station. Data collection activities from the ground-water wells, surface-water stations, and the meteorological station are continuing. In August 2011, an additional 74 drillholes and 4 ground-water monitoring wells were installed to support a geotechnical investigation of the area proposed for the Ross Project (Strata, 2012b). These drillholes have also been properly plugged and abandoned, and the four ground-water monitoring wells are being used for ongoing ground-water monitoring. Finally, a ranch house that was present on the property has been remodeled to serve as the Applicant's Field Office at the Ross Project area.

In the No-Action Alternative, no uranium would be allowed to be recovered from the subsurface ore zone, and no injection, production, or monitoring wells would be installed. No lixiviant would be introduced to the subsurface, and no recovered uranium would be extracted and no facilities would be constructed to process extracted uranium or store chemicals. The No-Action Alternative is included to provide a benchmark for the NRC to compare and evaluate the potential impacts of the other alternatives, including the Proposed Action.

2.1.3 Alternative 3: North Ross Project

Under Alternative 3, the NRC would issue the Applicant a license for the construction, operation, aquifer restoration, and decommissioning of the proposed ISR project, except that the entire ISR facility itself, which includes all buildings, other auxiliary structures, and the surface impoundments would be located north of where it is to be situated during the Proposed Action, but the locations of

the wellfields would not change. This alternate location for the ISR facility, referred as the "north site" by the Applicant (and referred to herein as the "North Ross Project"), was considered, but eliminated, by the Applicant in its license application (Strata, 2011a). The north site is located about 240 m [800 ft] north of the Oshoto Reservoir in S½SW¼ Section 7, T53N, R67W (see Figure 2.11). It is about 900 m [3,000 ft] northwest of where the facility would be located in the Proposed Action (referred to by the Applicant as the "south site"). An unnamed surface water drainage feature generally divides the north site. To avoid the floodplain of the drainage an actual design of the facility at this site would likely place the CPP and other buildings on one side of the drainage and the surface impoundments on the other side.

The Applicant documents its decision to select the south site over the north site with the following comparisons (Strata, 2011a):

- The south site is situated on relatively flat topography, which would minimize the amount of earthwork and surface disturbance required to prepare the site for construction of the CPP, auxiliary buildings, surface impoundments, and parking areas.
- The south site's surface is entirely privately owned and onsite instrumentation is currently adequate for all required pre-operational baseline environmental studies (see 10 CFR Part 40, Appendix A).
- The south site has little uranium mineralization beneath it, and what there is would be accessible without major modification of the wellfield- and monitoring-well layout.
- The preliminary geotechnical studies at the south site indicate that subsoil materials are relatively impermeable and have adequate strength for the proposed buildings and structures.
- The preliminary estimates of the radionuclide release rates from the entire project, including the south site, indicates that the average annual radiation dose to the nearest receptor would be less than 5 percent of the NRC's 1 mSv/yr [100 mrem/yr] annual limit.
- The owner of the south site is also the owner of the Oshoto Reservoir, so a surface-use agreement, lease, or purchase of this area would afford Strata control over the Reservoir as well.

The North Ross Project is included as an Alternative in this SEIS because of the expected differences in the depth to ground water between the north and south sites. Based upon the water levels measured in a nearby well cluster, Well No. 12-18, and the surface topography, shallow ground water of the north site is likely to be greater than 15 m [50 ft] below the ground surface (Strata, 2011a). In contrast, shallow ground water beneath the south site ranges from 2 – 4 m [8 – 12 ft] below the ground surface and necessitates the construction of the CBW (Strata, 2011b).

Certain factors related to the north site as a location for the proposed Ross Project facility are considered in this SEIS's impact analyses. These factors include:

- The north site's deeper ground-water levels, which could eliminate the need for a CBW and dewatering in order to protect ground water.

- The north site's more pronounced topography, which could require more earthwork and surface disturbance for construction of the facility and surface impoundments.
- The north site's greater distance to the Little Missouri River, which could mitigate potential impacts on surface-water resources.
- The north site's natural screen provided by the ridges to the west, north, and east, which could decrease impacts on visual and scenic resources.
- The north site's increased uranium mineralization beneath it, which could potentially require a reconfiguration of the facility to allow uranium recovery.

2.2 Alternatives Eliminated from Detailed Analysis

This section describes alternatives to the Proposed Action that were considered for this SEIS, but were not carried forward for detailed analysis. Section 2.2.1 describes the recovery of uranium by conventional mining and milling; Section 2.2.2 discusses the use of a lixiviant with different chemistry; and Section 2.2.3 compares alternative methods of waste management.

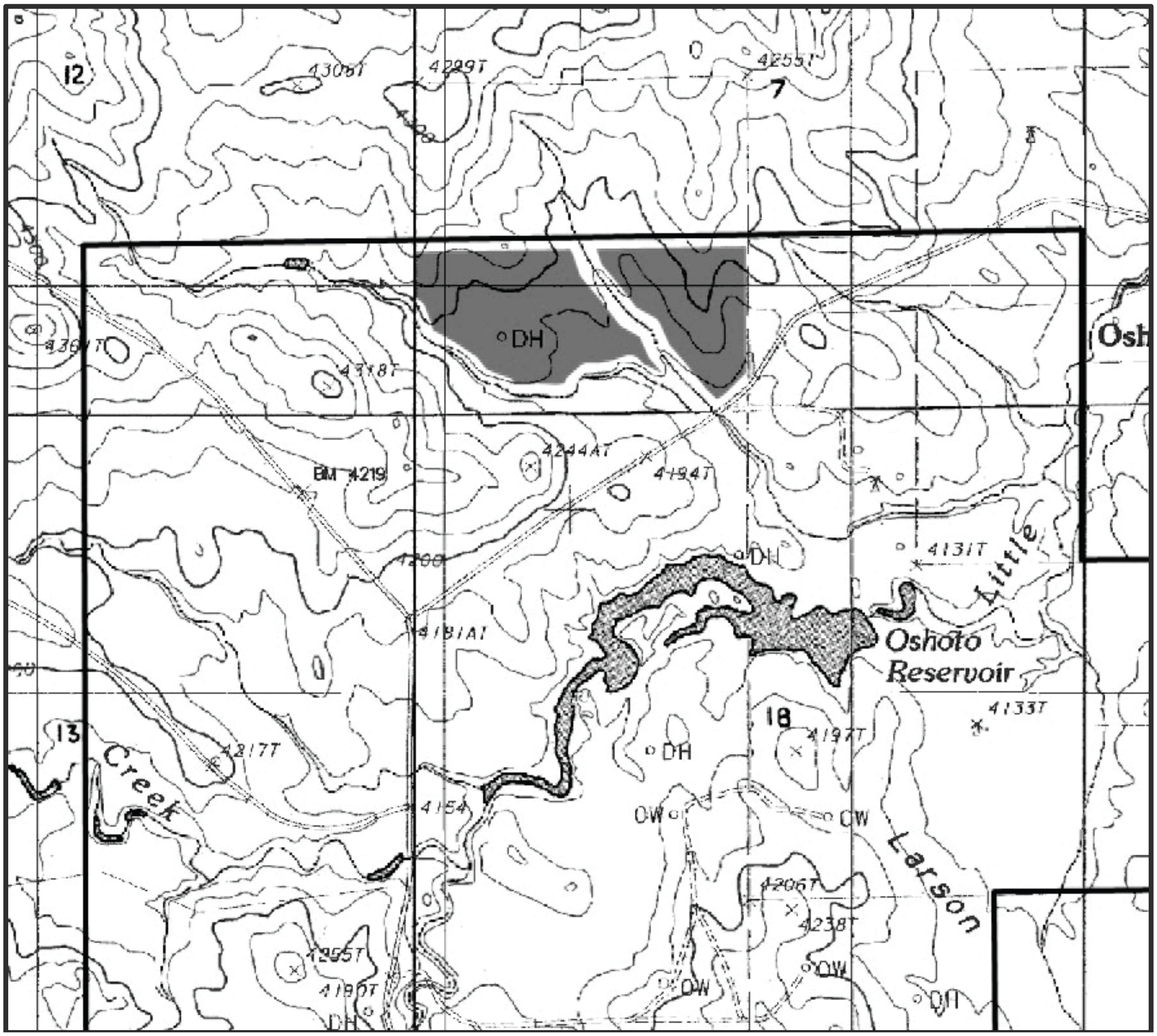
2.2.1 Conventional Mining and Milling

The GEIS includes an evaluation of conventional mining and milling as an alternative to ISR (NRC, 2009). Although the characteristics of the uranium deposits of the proposed Ross Project are amenable to ISR extraction, evaluating the Proposed Action against the conventional mining and milling allows comparison of impacts of the two uranium-recovery methods. Conventional mining practices (open-pit and underground) to recover uranium ore in addition to conventional milling were considered and eliminated as an alternative to ISR operations at the proposed Ross Project, as they were in the GEIS (NRC, 2009; Strata, 2011a).

Conventional mining refers to the physical removal of uranium ore by either underground mining methods or from an open pit. Uranium is extracted and converted to yellowcake in a processing facility; this process is referred to as uranium "milling." Open-pit mining is suitable for shallow ore deposits, generally deposits less than 170 m [550 ft] below ground surface (bgs), such as those found at the Ross Project area.

Underground mining could be used for deeper deposits; however, the cost of underground mining and milling requires a higher grade of ore to be economically feasible compared to open pit-mining and ISR (EPA, 2008). Uranium-ore grade in the Lance District is low-grade (Strata, 2011a; Peninsula, 2011). The ore zone at the Ross Project is approximately 30 – 60 m [90 – 180 ft] thick (Strata, 2011b). The base of the ore is generally at depths of 150 – 200 m [500 – 700 ft], which is nearly the maximum depth for surface mining to practically recover uranium from an open pit.

In addition to the depths involved with open-pit mining, water consumption of open-pit mining likely would be greater than at an ISR facility because of the required dewatering down to the depth of the pit's floor. At the Ross Project, dewatering of several aquifers above the ore zone and the ore zone itself would be required for open-pit mining and large amounts of water would be produced (Strata, 2011a).



Source: Strata, 2012a

Figure 2.11

Alternative 3: North Ross Project
(CPP on Right and Surface Impoundments on Left)

Far greater areas of land disturbance would occur from an open-pit mine compared with the Ross Project and the required restoration of the open pit would be far more extensive. Even though overburden could be backfilled into the pit, the pit would permanently impact the surface's appearance and its land use.

Conventional uranium milling requires construction of a facility that would be larger than the proposed facility at the Ross Project. As described in Appendix C of the GEIS (NRC, 2009), ore processing at a conventional uranium mill involves a series of steps (handling and preparation, concentration, and product recovery). Uranium ore is crushed, ground, and classified to produce uniform-sized particles (EPA, 2008). After grinding, the ore is added to a series of tanks for leaching by a lixiviant similar to that proposed by the Applicant for the Ross Project. The precipitation of uranium from the pregnant lixiviant, drying the product, and packaging the yellowcake follow the same processes as proposed for the Ross Project. Emissions containing radiological constituents generated by handling, grinding, and classifying the ores creates the potential for greater impacts to the health and safety of workers.

Wastes generated by milling include the spent ore, which are referred to as "tailings." The volume of tailings is roughly 95 percent of the volume of the ore brought to the mill. Wastes from conventional uranium milling, such as well waste water, spent resins, and filtrate, would be the same as the wastes generated by Applicant's proposed processing of pregnant lixiviant from ISR wellfields.

Wet tailings are disposed in surface impoundments constructed with liners and covers to prevent escape to the environment. Although the chemical character of tailings depends upon the uranium ore and lixiviant, tailings generally contain soluble metals, radium, and high levels of dissolved solids. Reclamation of a tailings pile generally involves evaporation of any liquid in the tailings, settlement of the tailings over time, and protection of the pile with a thick radon barrier and earthen material or rocks for erosion control. An 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).

As an alternative to conventional milling, uranium from low-grade ore that is recovered by open-pit mining can be recovered by heap leaching. Heap leaching occurs at or very near the mine site itself. The low-grade ore is crushed to a fine size and mounded above grade on a prepared pad. A sprinkler or drip system distributes lixiviant over the mound. The lixiviant trickles through the ore and mobilizes uranium into solution. The solution is collected at the base of the mound and processed to produce yellowcake. The processing to yellowcake of the pregnant lixiviant would be the same as for the Ross Project.

Given the uranium ore grade and depth to the ore, open-pit mining and conventional milling would be possible at the Ross Project; however, the costs, environmental impacts, and potential health and safety impacts to workers are more substantial than impacts from the ISR process (see SEIS Section 4).

As noted in the GEIS on uranium milling (NRC, 1980b), besides cost considerations, the environmental impacts of open-pit mining, and tailings impoundment would be greater than from an ISR project. Greater impacts such as those listed below would affect land use and soils as well as ecological, water, and air resources. Some of these impacts are:

- A larger area of surface disturbance for an open-pit mine and uranium mill, which could increase environmental impacts.
- A permanent tailings pile, which would require long-term care and maintenance to prevent impacts to air and water.
- A permanent mine pit if an open-pit mining were to be used, into which groundwater would flow creating a lake of poor water quality.
- A greater consumptive water use, which would result from the ground water's intruding into the mine and its needing to be pumped (i.e., dewatered) with the excess water then discharged to the environment.
- A greater surface discharge of water, which would result from the pumping and treatment of excess water from the mine pit.

The mine workers' excavating the uranium ore during the mining operation, through the uranium milling process itself, and the disposal of the tailings also increase the potential impacts to workers' health and safety.

Based upon these greater impacts, the alternatives of conventional uranium mining and milling have been eliminated from further analysis in this SEIS.

2.2.2 Alternate Lixiviant Chemistry

The lixiviant proposed for the Ross Project is consistent with the assumption in the GEIS that the ISR process would employ alkaline lixiviants (NRC, 2009). Alkaline solutions are typically used to dissolve uranium in the ore zone when the lime content of the host rock in the ore zone is above 12 percent, which is the case for the Ross Project site (Strata, 2011b). Other lixiviants can be made with sulfuric acid or ammonia, and these have been shown to dissolve uranium (NRC, 2009). However, the lixiviant that is selected for a specific ISR project must be able to dissolve uranium from the host rock while it maintains the permeability of the aquifer. In addition, the lixiviant and its reaction products must be amenable to ground-water restoration.

How do you select a proper lixiviant?

The geology and ground-water chemistry determine the proper ISR techniques and chemical reagents used for uranium recovery. For example, if the ore-bearing aquifer is rich in calcium (e.g., limestone or gypsum), alkaline (carbonate), lixiviant might be used (Hunkin, 1977, as cited in NRC, 2009). Otherwise, an acid (sulfate) lixiviant might be preferable. The lixiviant chemistry chosen for ISR operations could affect the type of potential contamination and the vulnerability of aquifers during and after ISR operations.

Typical ISR operations in the U.S. use an alkaline sodium bicarbonate system to remove the uranium from ore-bearing aquifers. In addition, aquifers where an alkaline-based lixiviant was used were considered to be easier to restore than those where acid lixiviants were used (Tweeton and Peterson, 1981, and Mudd, 1998, as cited in NRC, 2009).

Acidic lixiviant has been used most broadly in conventional milling. These acid-based fluids have generally achieved high yield and efficient, rapid uranium recovery, but they also dissolved other metals associated with the uranium in the host rock, and this dissolution can contribute to adverse environmental impacts. In Wyoming, acid lixiviants have been

used for small-scale research and development operations, but they have not been used in commercial operations (NRC, 2009). Tests with acid lixiviants have identified two major problems: 1) gypsum (a calcium mineral) precipitates on well screens and within the aquifer during uranium recovery, plugging wells and reducing the aquifer's permeability, which is critical for economic operation; and 2) the precipitated gypsum gradually dissolves after aquifer restoration, increasing the salinity and sulfate levels in the ground water. Because of the potential impacts of soluble metals and increased salinity in the aquifer as well as the potential for plugging of the aquifer by their use, acid-based lixiviants have been eliminated from further analysis in this SEIS.

Ammonia-based lixiviants have been used at some ISR operations in Wyoming. However, operational experience has shown that ammonia tends to adsorb onto clay minerals in the ore zone and then slowly dissolves from the clay during aquifer restoration, therefore requiring that a much larger volume of ground water be removed and processed during the aquifer restoration phase (NRC, 2009). Traces of the ammonia from the lixiviant have remained in affected aquifers even after extensive aquifer restoration. Because of the greater consumption of ground water to meet aquifer-restoration requirements, the use of an ammonia-based lixiviant has been eliminated from further analysis in this SEIS.

2.2.3 Alternate Waste Management Methodologies

Liquid-effluent disposal practices that the NRC has previously approved for use at specific ISR sites include waste evaporation from surface impoundments, application of waste on land, injection of waste into deep wells, and discharge of waste to surface water (NRC, 2009).

The Proposed Action would employ injection into a UIC-permitted Class I well as the primary method of disposal of the brine and other process waste waters excluding permeate from the RO process. The Proposed Action would include surface impoundments located near the CPP to store and manage the brine and to allow reuse of permeate as lixiviant or process water. Of the approximately 6.5 ha [16 ac] of impoundment surface area in the Proposed Action, 2.5 ha [6.3 ac] would be available for evaporation (Strata, 2011b). The Applicant predicts that the evaporation of brine during the time it is stored in the surface impoundments would reduce the volume for deep disposal by 20 percent during the operation-only phase and about 5 percent during the concurrent operation- and aquifer-restoration phases. Excess permeate while stored in the surface impoundments would evaporate at an average annual rate of 1.5 gpm per surface acre (Strata, 2012b).

Reliance on evaporation to dispose of all the brine and other liquid byproduct wastes generated at the CPP, and thus eliminating the need for deep-well injection, would require a larger surface area of the impoundments. The maximum production of brine and other process waste occurs during the concurrent facility operation and aquifer-restoration phases. During this time, 859 L/min [227 gal/min] of byproduct liquid would be generated (Strata, 2011a). The remaining surface-impoundment volume in the Proposed Action would be used for permeate management and reserve capacity in the event of upset conditions.

The Applicant has estimated that the 2.5 ha [6.3 ac] available for evaporation in the Proposed Action would provide 33.3 L/min [8.8 gal/min] of average annual evaporation. Linear extrapolation suggests that 65 ha [160 ac] is the minimum surface area required for evaporation of all brine and other byproduct waste generated at the CPP. Considering the requirement to

maintain reserve capacity to manage upset conditions and the natural fluctuations, the necessary surface impoundments would exceed 80 ha [200 ac]. Impoundments of sufficient size to eliminate the need for deep-well injection would nearly double the disturbed area. In the Proposed Action, approximately 113 ha [280 ac] would be disturbed during the entire Ross Project. The disturbed area required for only evaporation would be present throughout the entire construction, operation, aquifer restoration and decommissioning phases. It is likely that the CBW would need to be constructed around these large surface impoundments. Because the CPP and the surface impoundments would be expected to remain operational after the life of the proposed wellfields of the Ross Project, the surface impoundments would likely be in place for more than 10 years.

These large-scale surface impoundments could potentially impact land use and soils as well as ecological, water, air, and visual resources. These impacts and related occupational health impacts could require mitigation. In contrast, the GEIS concluded that the permit process required for a Class I injection well provides confidence that the impacts from deep-well disposal would be SMALL. For these reasons, the alternative of the elimination of waste disposal in Class I deep-injection wells in favor of surface impoundments over more than 12 times the area of impoundments in the Proposed Action has not been carried forward for impact analysis in this SEIS.

2.3 Comparison of Predicted Environmental Impacts

The GEIS categorized the significance of potential environmental impacts as described in the adjacent text box (NRC, 2009). The large table, presented in the "Executive Summary" as Table ExS.1, summarizes the potential environmental impacts to each resource area for all four of the Ross Project's phases: construction, operation, aquifer restoration, and decommissioning. The levels of significance—SMALL, MODERATE, and LARGE—are noted for each resource area.

> **How is the significance of identified impacts classified?**
>
> - ***Small Impact*:** 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 Impact*:** The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.
> - ***Large Impact*:** The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

The respective resource areas, as they currently exist at the Ross Project area, which is called the "affected environment," are described in Section 3 of this SEIS. The potential environmental impacts of the Ross Project are evaluated in Section 4 of this SEIS. The measures intended to mitigate any impacts are also discussed in SEIS Section 4 of this SEIS.

2.4 Preliminary Recommendation

After weighing the impacts of the Proposed Action and comparing the Alternatives, the NRC staff, in accordance with 10 CFR Part 51.71(f), sets forth its 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 materials license for the Proposed Action be issued as

requested. The NRC staff concludes that the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 4 will eliminate or substantially lessen the potential adverse environmental impacts associated with the Proposed Action.

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

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

  1. Transportation resources during all phases of the proposed action. Increases in traffic during construction and operation would have a MODERATE to LARGE impact. Impacts would be MODERATE with mitigation for construction, operation, aquifer restoration, and decommissioning (See SEIS Sections 4.3.1.1, 4.3.1.2, 4.3.1.3, and 4.3.1.4).

  2. Groundwater resources during operation and aquifer restoration. During operations there would be a MODERATE impact to ore-zone aquifer water quality due to excursions; however with measures in place to detect and resolve the excursions, the impacts would be reduced. During aquifer restoration there would be a MODERATE impact to ore-zone aquifer water quantity due to short-term drawdown (See SEIS Sections 4.5.1.2 and 4.5.1.3).

  3. Noise resources during construction, operations, and decommissioning. During these phases of the Ross Project there would be MODERATE impacts due to increased noise levels, however they would be intermittent and short term (See SEIS Sections 4.8.1.1, 4.8.1.2 and 4.8.1.4).

  4. Historical and cultural resources during construction. Section 106 consultation and efforts to identify and determine the eligibility of historical and cultural resources that could be adversely affected by the proposed Ross Project are currently ongoing. Therefore, to be conservative in this draft SEIS, the NRC staff considers that construction could have a MODERATE to LARGE impact on historic properties, 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 Section 4.9.1.1). However, once identification efforts are complete, mitigation efforts, which could require an MOA, would be developed to reduce impacts. The final SEIS will include the outcome of Section 106 consultation and would discuss mitigation measures, including an MOA, if one is developed.

  5. Visual and scenic resources during construction. There would be MODERATE impacts to residents near the Ross Project for the first year, however over the long term, impacts would be reduced (See SEIS Section 4.10.1.1).

  6. Socioeconomic resources during construction and operations. There would be MODERATE impacts to Crook County during these phases of the Ross Project because taxes from the Project will be paid to the county (See Sections 4.11.1.1 and 4.11.1.2).

- 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, Strata would 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 would be required to provide detailed hydrologic pumping test data packages and operational plans for each wellfield at the Ross Project. Strata would also be required to restore groundwater parameters affected by the ISR operations to levels that are protective of human health and safety.

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

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

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3 DESCRIPTION OF AFFECTED ENVIRONMENT

3.1 Introduction

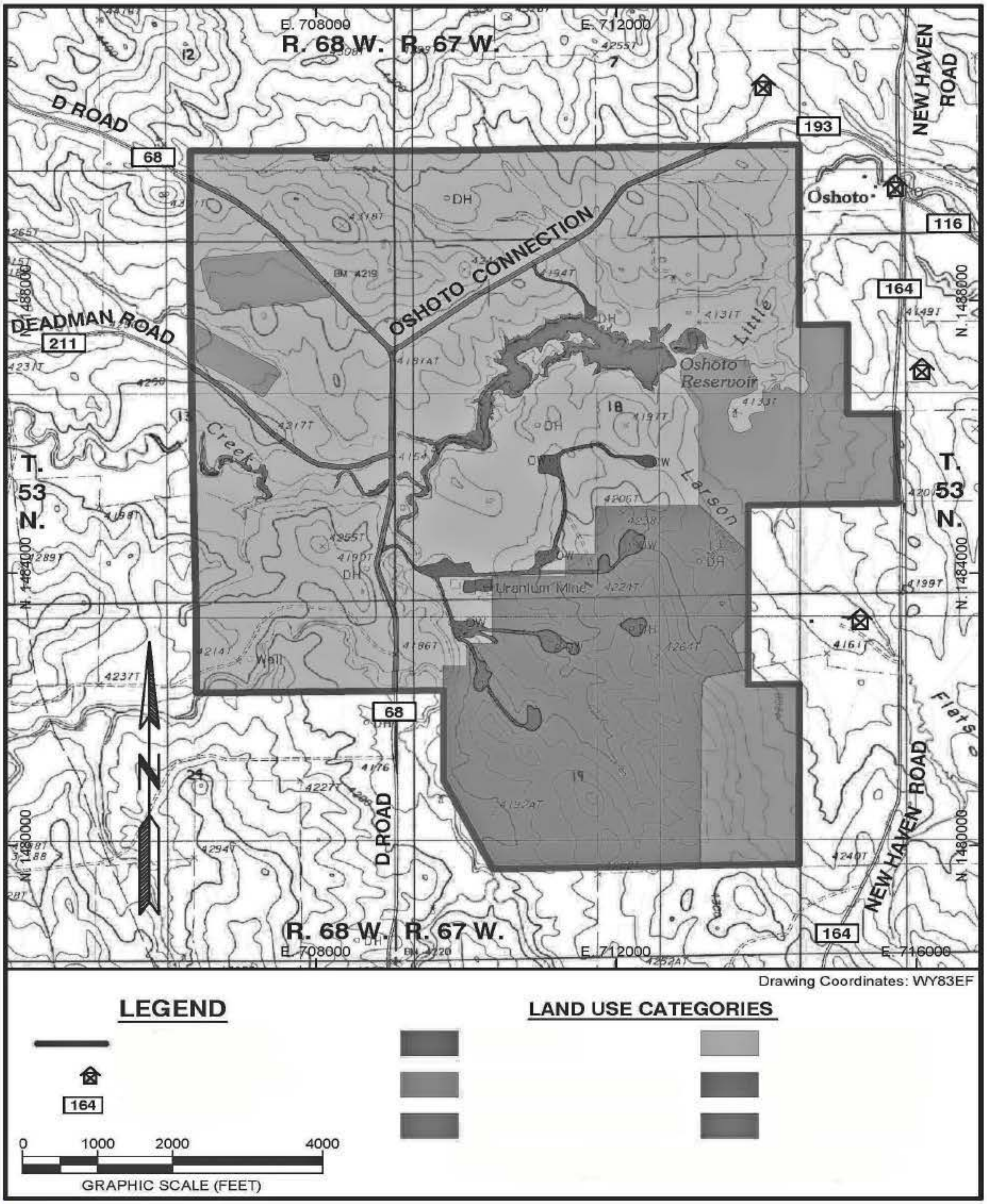
The Ross Project would be located in northeastern Wyoming, in a rural area of western Crook County, approximately 35 km [22 mi] north of the town of Moorcroft, Wyoming (see Figure 2.1 in SEIS Section 2). This section describes the existing conditions at the Ross Project area, the 697-ha [1,721-ac] area that is addressed in this Supplemental Environmental Impact Statement (SEIS), and its vicinity. The resource areas described in this section include land use; transportation; geology and soils; water, both surface water and ground water; ecology; noise; meteorology, climatology, and air quality; historical and cultural resources; visual and scenic resources; socioeconomics; public and occupational health and safety; and waste management. This description of the affected environment is based upon information provided in the Applicant's license application and its Responses to the U.S. Nuclear Regulatory Commission's (NRC's) Requests for Additional Information (RAIs) and supplemented by additional information identified by NRC and others in the public domain (Strata, 2011a; Strata, 2011b; Strata, 2012a; Strata, 2012b). The information in this section forms the basis for the evaluation discussed in Section 4, Environmental Impacts and Mitigation Measures, which discusses the potential impacts of the Proposed Action and of each of the Alternatives in each resource area, as defined in SEIS Section 2.1.

3.1.1 Relationship between the Proposed Project and the GEIS

As shown on Figure 2.3 in SEIS Section 2.1.1, the Ross Project area is located in the northern end and on the western edge of the Nebraska-South Dakota-Wyoming Uranium Milling Region (NSDWUMR), as defined in the GEIS (NRC, 2009b). However, in defining the NSDWUMR, the Generic Environmental Impact Statement (GEIS) focused on potential in situ recovery (ISR) sites located in the Black Hills area of South Dakota, which is east of the Ross Project area. As a result, some of the affected environment discussion in the GEIS for the NSDWUMR does not reflect actual site conditions at the Ross Project area (in particular, the subsurface geology and water resources information). However, the GEIS's discussion of the Wyoming East Uranium Milling Region (WEUMR), located west of the Ross Site, does provide germane information with respect to the Ross Project area's subsurface geology and water resources. These differences are described in the subsequent sections below.

3.2 Land Use

The Ross Project area encompasses approximately 697 ha [1,721 ac], as described in SEIS Section 2.1.1. Nearby towns include Pine Haven, 27 km [17 mi] southeast; Moorcroft, 35 km [22 mi] south; Sundance, 48 km [30 mi] southeast; and Gillette, 53 km [33 mi] southwest. The Ross Project area is adjacent to the unincorporated ranching community of Oshoto. There are 11 residences within 3 km [2 mi] of the Ross Project, but no residences within the Project area. The closest residence is approximately 210 m [690 ft] north-northeast of the Ross Project boundary (see Figure 3.1). Existing land uses include livestock grazing, oil production, crop agriculture, communication and power transmission infrastructure, transportation infrastructure,

1 

Source: Strata, 2012a.

Figure 3.1

Current Land Use of Ross Project Area

limited recreational opportunities, stock and other reservoirs, and wildlife habitat (see Figure 3.2). The actual land ownership of the Ross Project area's surface differs from general land ownership in the region, in that 97.6 percent is owned by private landowners or the State of Wyoming, and 2.3 percent is owned by the Federal Government (as described in Section 3.3.1 of the GEIS, 53.3 percent of Wyoming land is public land). The proposed Ross Project facility would be located on private property, and the wellfields would be located on private, State, and Federal lands.

The State of Wyoming owns all of the mineral rights below State-owned land, and the Federal Government controls all of the mineral rights below U.S. Bureau of Land Management (BLM)-owned land. There are private lands where the Federal Government (through the BLM) controls the mineral rights below the Ross Project area, a situation known as a "split estate." Between land ownership and split estate, the Federal Government through the BLM therefore controls 11.7 percent of the total mineral rights under the Ross Project area (see Table 3.1), as opposed to 2.3 percent of the surface. All of the Federal rights are managed by the BLM.

Table 3.1
Distribution of Surface Ownership and Subsurface Mineral Ownership

Ownership	Surface Ownership		Subsurface Mineral Ownership	
	Ha / Ac	Percent	Ha / Ac	Percent
Private	553.3 / 1367.2	79.4	488.2 / 1206.4	70.1
State	127.1 / 314.1	18.2	127.1 / 314.1	18.2
Federal	16.2 / 40.0	2.3	81.3 / 200.9	11.7
TOTAL	696.6 / 1721.3	--	696.6 / 1721.3	--

Source: Strata, 2011a.

3.2.1 Pasture-, Range-, and Croplands

Approximately 95 percent of the Ross Project area is used for rangeland, cropland, or pastureland. The largest portion, over 80 percent, is rangeland, while 14 percent is used for agriculture. In Crook County, rangeland is primarily used for cattle, with some grazing of sheep. Crops grown in the vicinity include hay, oats, and wheat.

3.2.2 Hunting and Recreation

There are many hunting and recreational opportunities within Crook County. However, there are limited opportunities for hunting and recreation within the Ross Project area because the majority of the land is privately owned. The State-owned land within the Ross Project area is accessible from County Road (CR) 193, but the Federal BLM land is not served by public roads so the public cannot access the BLM land to hunt. Large-game hunting in the area includes antelope (North Black Hills herd), mule deer (Powder River and Black Hills herds), and white-tailed deer (Black Hills herd). Other hunting opportunities in the vicinity include sage-grouse, wild turkeys, and small game such as cottontail rabbits and snowshoe hares as well as red, gray, and fox squirrels. There are hunting seasons specific to each type of game; however,

because of the predominantly private ownership of the land, hunting within the Ross Project area is limited.

Recreational areas in the Ross Project vicinity include Devils Tower National Monument (Devils Tower), Black Hills National Forest, and Keyhole State Park. These areas offer access to hiking, camping, boating, biking, horseback riding, fishing, and hunting. The nearest of these is Devils Tower, approximately 16 km [10 mi] east of the Ross Project.

Although native fish have been observed in the Oshoto Reservoir, there are no fisheries in the Ross Project area because of the ephemeral or intermittent nature of the streams. The Oshoto Reservoir is partially located on State land; however, the Wyoming Game and Fish Department (WGFD) does not stock the Reservoir and it is not managed by any private agencies. However, fishing has been reported downstream of the Little Missouri River, outside of the Ross Project area (Strata, 2011a).

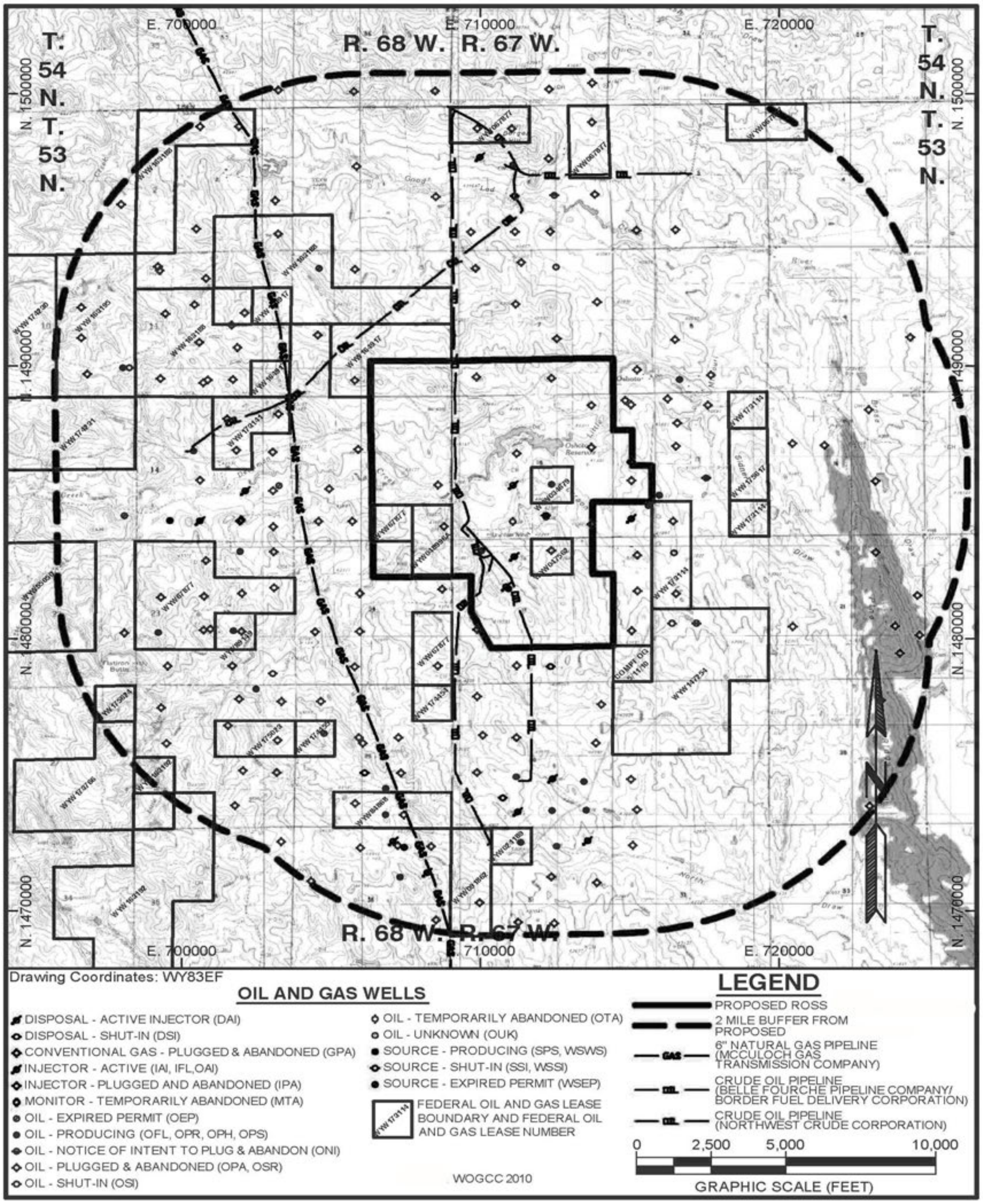
3.2.3 Minerals and Energy

There are three operating oil wells within the Ross Project area, producing from depths between 1,800 – 2,000 m [5,900 – 6,500 ft] below ground surface (bgs) (see Figure 3.2). Oil production is currently the only mineral extraction activity within the Ross Project area, although Crook County has other mineral resources which include coal, gas, bentonite (mine located 8 km [5 mi] to the northeast), sand, gravel, gypsum, and limestone in addition to uranium and vanadium.

There are currently no licensed or operating uranium-recovery facilities within 80 km [50 mi] of the proposed Ross Project, although four potential projects are under preliminary consideration and are in the very early planning stages (Strata, 2011a). These include the Bayswater Uranium Corporation's (Bayswater's) Elkhorn, Wyoming, project approximately 27 km [17 mi] to the northeast of the Ross Project area; Bayswater's Alzada, Montana, project at 58 km [36 mi] to the north-northeast; the UR-Energy/Bayswater's Hauber, Wyoming, project at 21 km [13 mi] to the north-northeast; and Powertech Uranium Corporation's (Powertech) Aladdin project at 64 km [40 mi] to the east-northeast (see Figure 3.3).

3.3 Transportation

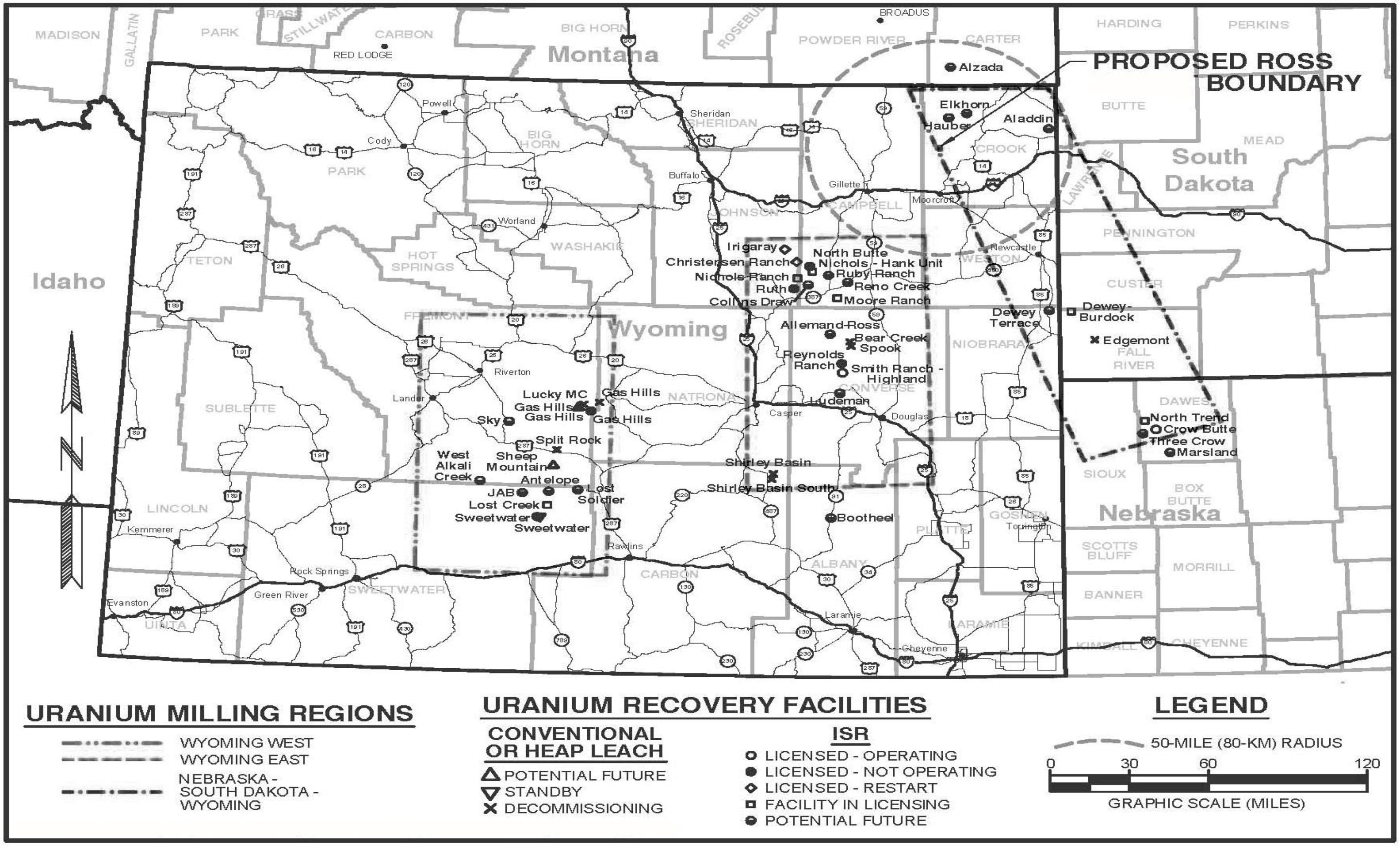
The Proposed Action would rely on existing roads for supply and material transport, workforce commuting, and yellowcake and waste shipments to and from the Ross Project. The existing transportation network is discussed in this section; Figure 3.4 depicts this network. The primary access road to the Ross Project area is from Exit 153 on I-90. From that point the Ross Project is reached by a vehicle's travelling south on US 14/16, west on WY 51, north on Bertha Road, north on CR 68 (also known as D Road), and north on CR 164 (also known as New Haven Road). The distance from the I-90 exit to D Road is 2.6 km [1.6 mi]. D Road is a two-lane asphalt and gravel road approximately 9 – 11 m [30 – 35 ft] wide with posted speed limits of 89 km/hr [55 mi/hr] for cars and 72 km/hr [45 mi/hr] for trucks. The asphalt pavement extends to 4.8 km [3 mi] north of Bertha Road, where it changes to a reclaimed-asphalt pavement, which has been rotomilled and blended with crushed base and subgrade. This surface continues for 11.7 km [7.3 mi] after which D Road has only a gravel surface. New Haven Road is a two-lane, crushed-shale road approximately 7.6 – 9.1 m [25 – 30 ft] wide, with a posted speed limit of 72 km/hr [45 mi/hr]. CR 193, also known as the Oshoto Connection, is a two-lane, crushed-shale



Source: WOGCC, 2010, as shown in Strata, 2012a.

Figure 3.2

Oil and Gas Wells within Two Miles of Ross Project Area

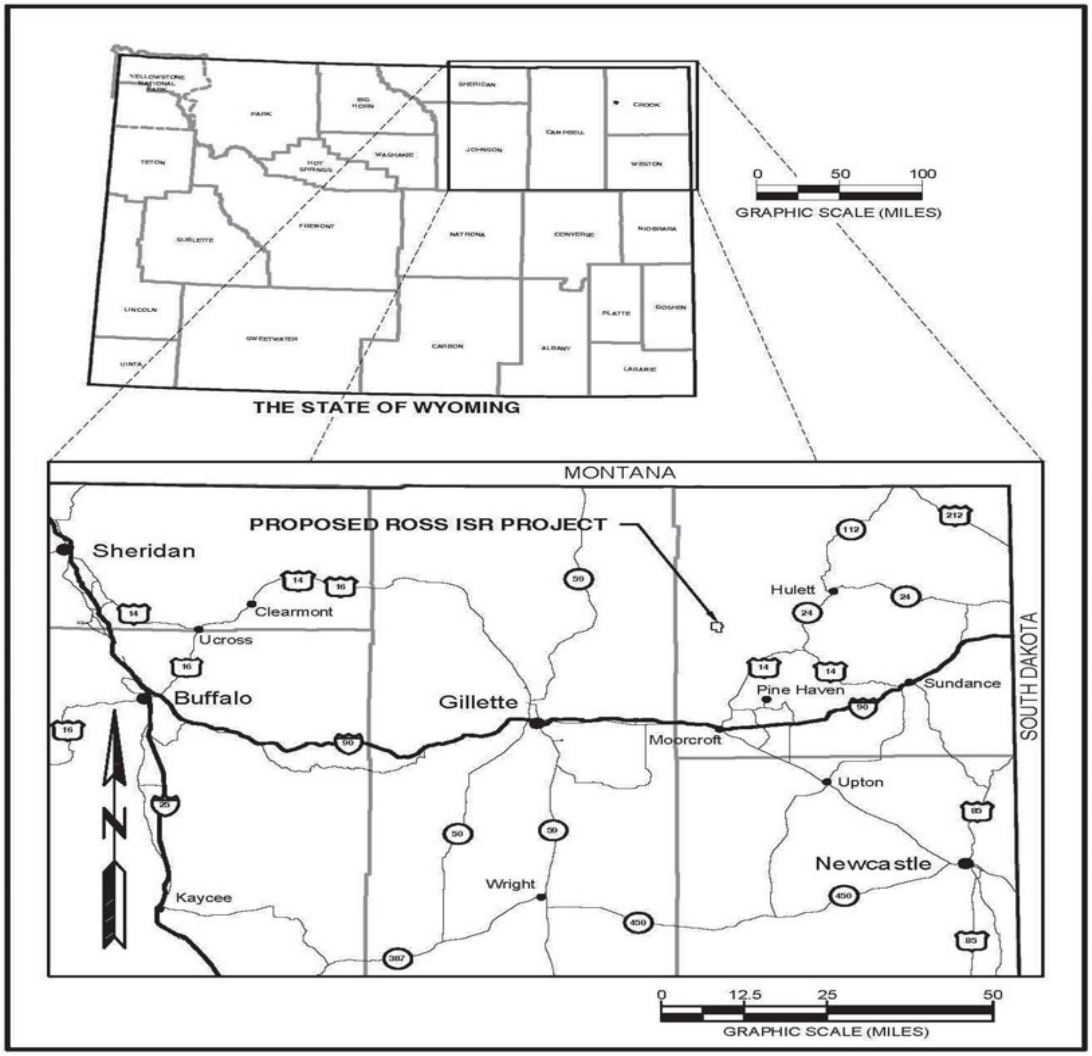


Sources: Bayswater, 2010a; NRC, 2009b; NRC, 2010a; NRC, 2010b; Powertech, 2010; and UR-Energy, 2010 as shown in Strata, 2012a.

Figure 3.3

Existing and Planned Uranium-Recovery Facilities

1



Source: Strata, 2012a.

Figure 3.4

Existing Transportation Network in Northeast Wyoming

road that connects New Haven Road to D Road along the northern portion of the Ross Project area. Other county roads in the local vicinity that can be used to access the Ross Project area include CR 26 (Cow Creek Road), CR 91 (Spring Creek Road), and CR 211 (Deadman Road). Figure 2.1 shows the relative locations of these roads. Crook County conducts year-round routine maintenance of all CRs, including snow and debris removal, blading and grading, and miscellaneous repair.

The Applicant has completed traffic studies on the county roads near the Ross Project area (Strata, 2011a), as has the State of Wyoming for its highways (see Table 3.2). Much of the existing truck traffic on the CRs adjacent to the Ross Project is due to local oil- and gas-recovery activities as well as to a bentonite mine approximately 8 km [5 mi] northeast of the Project.

Table 3.2
Traffic Volumes on Roads and Highways in Vicinity of Ross Project Area (2010)

Road/Highway	Vehicles per Day	
	All Vehicles	Trucks
I-90 at Moorcroft	4,744	906
New Haven Road South of Ross Project Area	108	10.8
New Haven Road South of Oshoto Connection	138	11
On-Site Measurements		
D Road South of Deadman Road	25	1.5
D Road North of Deadman Road	49	2.3
D Road North of Oshoto Connection	62	6.2
Oshoto Connection between D Road and New Haven Road	87	11.3

Sources: Strata, 2011a, and Wyoming Department of Transportation (WYDOT), 2011.

3.4 Geology and Soils

The Lance District, which includes the Ross Project area (refer to Figure 2.1), is structurally situated between two major tectonic features: the Black Hills uplift to the east and the Powder River Basin to the west (Strata, 2011a). Both of these regional features are described in the GEIS (NRC, 2009b). The Black Hills uplift is generally allocated to the NSDWUMR, and the Powder River Basin to the WEUMR. The Project area's structural geology, stratigraphy, uranium mineralization, and seismology as well as the types and characteristics of the soils present at the Project area are described in this section.

3.4.1 Ross Project Geology

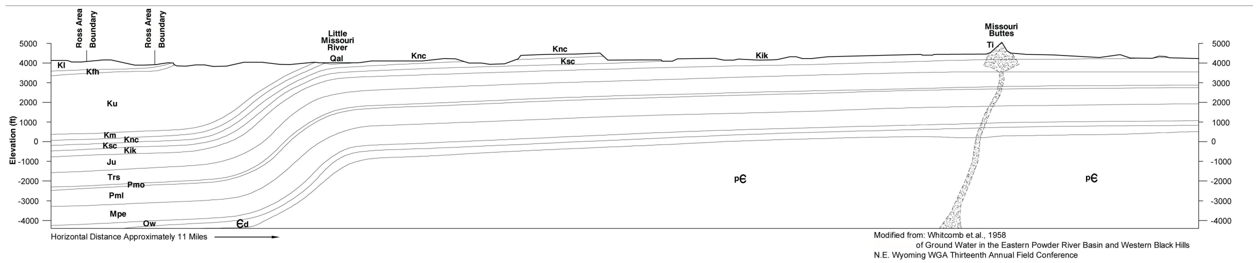
The uranium-bearing units targeted for recovery within the Ross Project area are located in permeable sandstones of the Late Cretaceous Lance and Fox Hills Formations. The uranium roll fronts deposited in the Oshoto area demonstrate patterns similar to those across the Powder River Basin. The Ross Project area's roll fronts were created by precipitation of uranium from ground water as a coating on sand grains primarily due to changes in aquifer conditions and ground-water flow (Buswell, 1982). The roll-front geometry at the Project area can vary as a result of differences of the host sandstones. The deeper Fox Hills roll fronts are generally thicker and more massive due to the near-shore environment into which the sediments were deposited. The lower Lance Formation sandstones were deposited in a fluvial environment (i.e., deposited by rivers or streams), resulting in narrower, often stacked channel systems containing uranium mineralization. Because of the variability of the depositional environment, the roll fronts near or at the Ross Project area are complex, and new exploration activities consistently yield increasing total uranium estimates. At this time, estimates of recoverable uranium within the Ross Project area exceed 2,495 t [5.5 million lb] of uranium and, based on current projections, these estimates are likely to increase as more exploration and characterization results become available.

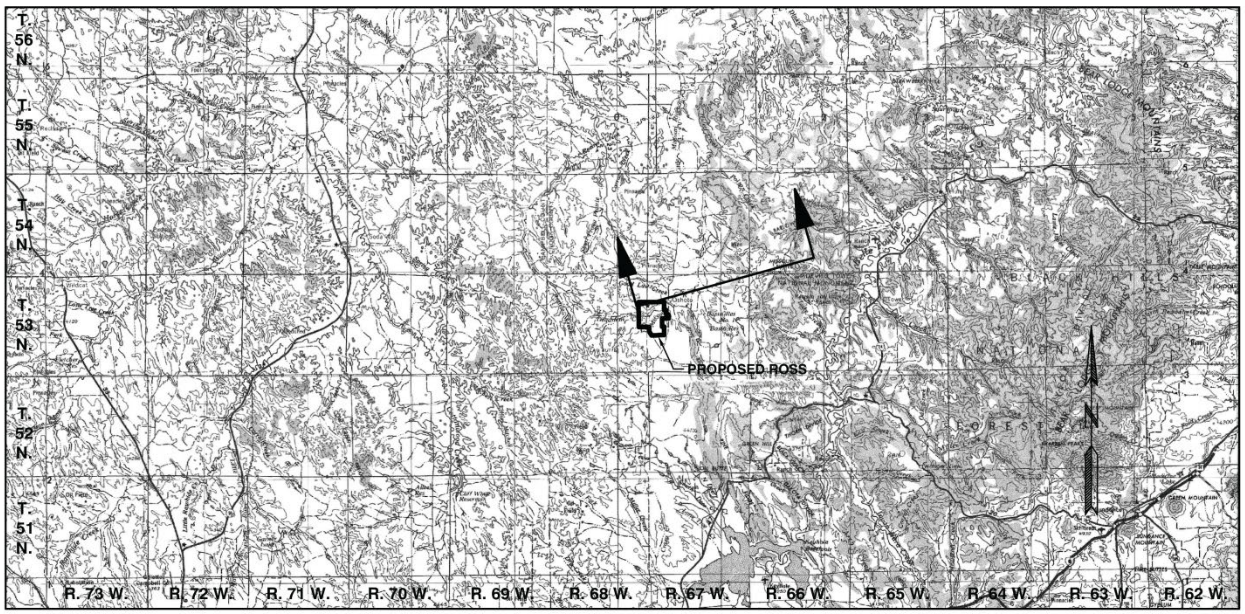
3.4.1.1 Structural Geology

The Black Hills uplift is a broad north-trending dome-like structure approximately 290 km [180 mi] long (north to south) and 121 km [75 mi] wide (west to east) whose core is composed of Precambrian basement rocks (NRC, 2009b). The western flank of the uplift is characterized by a monoclinal (a one-limbed or step-like flexure) break near the Ross Project area (Lisenbee, 1988). The eastern edge of the Ross Project area lies along the hinge of the Black Hills monocline. Because of the Black Hills monocline, the regional stratigraphic dip goes from essentially horizontal within the Powder River Basin, to steeply dipping along the eastern edge of the Ross Project area (see Figure 3.5). As indicated in the bedrock geologic map, Figure 3.6, the entire Ross Project area lies within the outcrop of the Lance Formation. The Cretaceous Formations below the Lance Formation all outcrop within roughly 3 km [2 mi] east of the Ross Project area.

Devils Tower, which is discussed later in the visual and scenic resources section of this section (Section 3.10), is located approximately 16 km [10 mi] east of the Ross Project area. Devils Tower and the Missouri Buttes (15 km [9.5 mi] northeast of the Ross Project) are geologic features formed by the intrusion of igneous material (i.e., magma) through the earth's crust during the Tertiary Period (i.e., subsequent to the deposition of the upper Cretaceous formations hosting the Lance District's uranium deposits) (Robinson, 1964).

With the exception of the Black Hills monocline, there are no significant structural features within the Ross Project area. No faults of major displacement are known to exist within the Ross Project area; however, minor localized slumps, folds, and differential compaction features that formed shortly after deposition are common (Strata, 2011a).





CROSS SECTION LOCATION

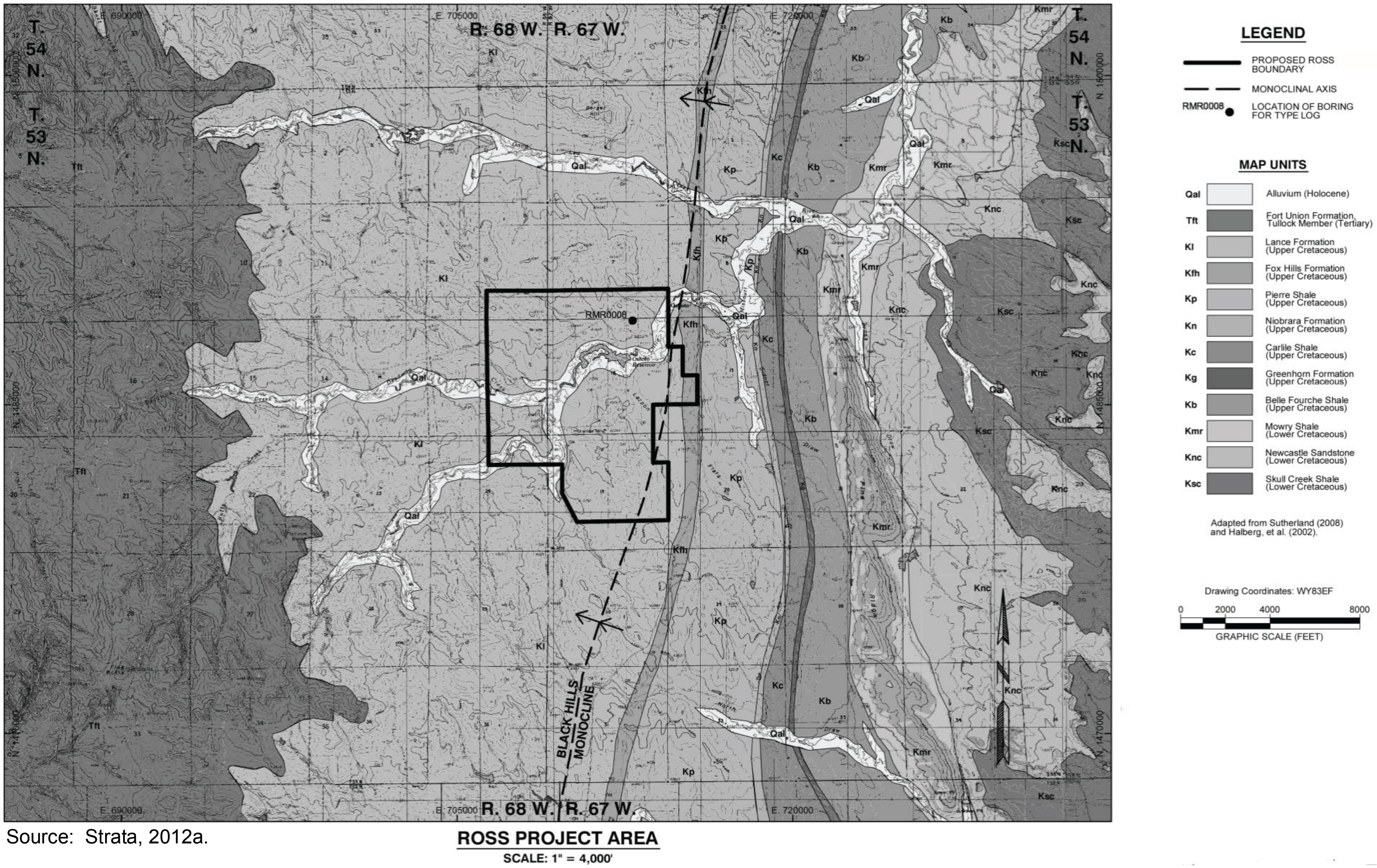
LEGEND

- Qal Quaternary Alluvium
- Ti Tertiary Intrusives
- Kl Lance Formation
- Kfh Fox Hills Formation
- Ku Upper Cretaceous, undivided
- Km Mowry Shale
- Knc Newcastle Sandstone
- Ksc Skull Creek Shale
- Kik Inyan Kara Group
- Ju Jurassic, undivided
- Trs Spearfish Formation
- Pmo Minnekahta Limestone and Opeche Formation
- Pml Minnelusa Sandstone
- Mpe Pahasapa and Englewood Limestones
- Ow Whitewood Limestone
- Ꞓd Deadwood Formation
- pꞒ Precambrian

Source: Strata, 2012a.

Figure 3.5

Generalized Cross Section of Black Hills Monocline in the Oshoto Area



Source: Strata, 2012a.

Figure 3.6

Surface Geology of Ross Project Area

3.4.1.2 Stratigraphy

Stratigraphy describes the layers of rocks and soils below the ground's surface (i.e., the subsurface) that host the ore zone as well as the layers of rock that separate the ore zone from the aquifers above and below it. An analysis of the local stratigraphy is used in assessments of whether the ore zone is adequately confined above and below by rock layers of low permeability that would prevent vertical movement of water from the ore zone.

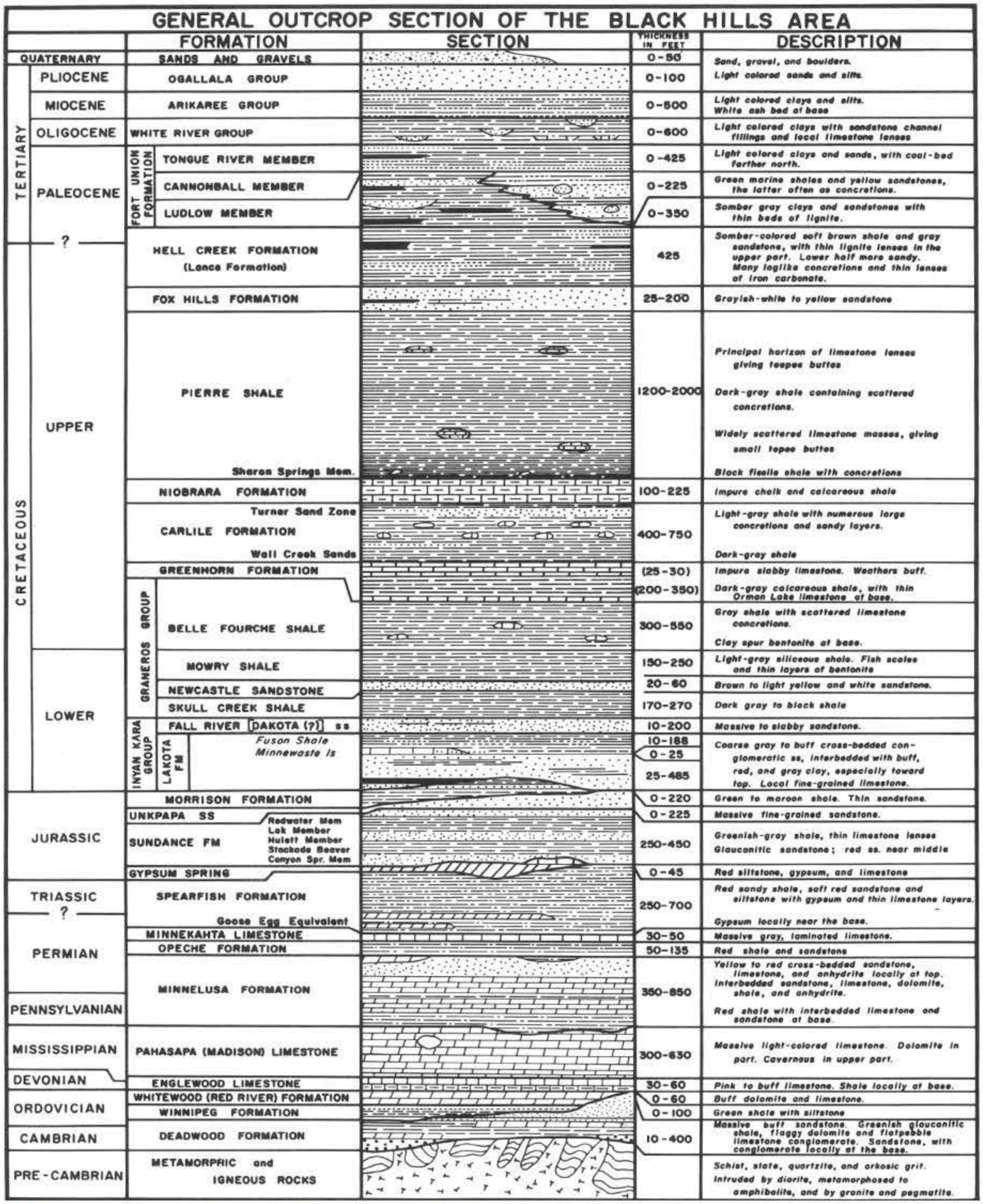
The regional stratigraphy of the Black Hills area is shown in Figure 3.7. The ore zone, which would be the "production zone" (i.e., the deposits from which uranium would be recovered) at the Ross Project, is within the upper Cretaceous stratigraphic units, including the lower Lance (Hell Creek) and upper Fox Hills Formations.

Detailed analysis of the subsurface stratigraphy and mineralogy of the Ross Project area began with the first uranium exploration and development efforts in the Oshoto area during the 1970s by the Nubeth Joint Venture (Nubeth) as described in SEIS Section 2.1.1 (Strata, 2011a). In 2008 and 2009, the Applicant began confirmation and exploration drilling at the Ross Project (Strata, 2011a). As of October 2010, the Applicant possessed information from the 1,682 holes drilled by Nubeth as well as its own 540 recent exploration drillholes, which are all located within a 0.8-km [0.5-mi] radius of the Ross Project area. The logs of these drillholes were used by the Applicant to characterize the site-specific stratigraphy of the Ross Project area (Strata, 2011a; Strata, 2011b).

The Pierre Shale in this area is a massively bedded, relatively uniform, thick marine shale that is considered a regional confining layer (or "unit" or "interval") (NRC, 2009b). This unit outcrops approximately 0.4 km [0.3 mi] east of the Ross Project's eastern boundary (see Figure 3.6). Based upon the width of the outcrop and geophysical logs from oil wells located in the general area, the Applicant has estimated the thickness of the Pierre Shale to be approximately 670 m [2,200 ft] thick under the Ross Project area (Strata, 2011a; Robinson, 1964). Because of its thickness and low permeability, the Pierre Shale is considered the lower ground-water-confining unit within the Ross Project vicinity, separating the older, deeper Formations below the Pierre Shale from the Ross Project's target ore zones which are in the overlying Fox Hills and Lance Formations.

Below the Pierre Shale, the Cambrian-age Deadwood and Flathead Formations are encountered at depths of approximately 2,490 – 2,600 m [8,160 – 8,560 ft] bgs (WDEQ/WQD, 2011). The Applicant proposes that these Formations are the optimum target interval for the Underground Injection Control (UIC) Class I deep-injection wells that would be used for waste-water disposal at the Ross Project. The Applicant has already received its UIC Class I Permit for this type of disposal (Strata, 2011a).

The Fox Hills Formation, which lies between the Pierre Shale and the Lance Formation, outcrops along the proposed eastern boundary of the Ross Project (refer to Figure 3.6). The Fox Hills Formation is a sequence of marginal marine to estuarine sand deposits that were deposited during the eastward regression of the upper Cretaceous interior seaway (Dunlap, 1958; Merewether, 1996). In the vicinity of Oshoto, the Fox Hills Formation is divided into lower and upper units, which are based on differences in color, bedding, trace fossil concentrations, lithology, and texture (Dodge and Spencer, 1977).



Source: South Dakota School of Mines, 1963. **Figure 3.7**

Regional Stratigraphic Column of Area Containing the Lance District

Above the Fox Hills Formation, the Lance Formation has been interpreted as being fluvio-deltaic in origin, consisting of a mixture of non-marine-deposited sandstones and floodplain mudstones with thin beds of coal (Connor, 1992). This depositional environment created a stratigraphic sequence of shale, mudstones, and sandstones that is complicated and vertically heterogeneous (Dodge and Powell, 1975).

The horizontal continuity of the various stratigraphic intervals beneath the Ross Project is clearly depicted on the geologic cross-sections and fence diagrams provided by the Applicant (Strata, 2011a; Strata, 2012b). The upper Fox Hills and lower Lance Formations are stratigraphically continuous and hydraulically isolated from the overlying upper Lance Formation by continuous and impermeable mudstones and claystones as well as from the underlying units by the basal Fox Hills siltstone-claystone interval and the Pierre Shale.

3.4.2 Soils

Soils at the Ross Project are typical for semi-arid grass- and shrublands in the western U.S. (Strata, 2011a). Most of these soils are classified as Aridic Argiustolls, Ustic Haplargids, or Ustic Torrifluvents that were derived from the Lance Formation over time.

General topography of the Ross Project area ranges from nearly level uplands to steep hills, ridges, and breaks. The soils occurring on hills, ridges, and breaks at the Ross Project are generally sandy or coarse texture with clayey or fine-textured soils occurring on nearly level uplands and near drainages. The Ross Project area contains moderate and deep soils on level upland areas and drainages with shallow soils located on hills, ridges, and breaks. Figure 3.8 depicts the types of pre-licensing baseline soils located on the Ross Project area (Strata, 2011a; Strata, 2012b). The area of the Ross Project is about equally divided between sandy loam soils and clay loam soils (Strata, 2011a; Table 2.6-9 in Strata, 2012b). The soil characteristics of both the Proposed Action's south site (Alternative 1) and the north site (Alternative 3) are of particular interest since these would be the largest areas of soils disturbance during the Ross Project (see Table 3.3).

Approximate topsoil salvage depths range from 0.13 – 1.5 m [0.42 – 5 ft] with an average of 0.5 m [1.7 ft]. Factors that affect the suitability of a soil as a vegetation-growth medium are: texture, soil-adsorption ratio (SAR), electrical conductivity (EC), and pH as well as selenium and calcium carbonate concentrations. Based upon a comparison of laboratory analysis results and field observations with the respective Wyoming Department of Environmental Quality (WDEQ)/Land Quality Division (LQD) standards, suitable and marginally suitable material was found in 19 of the 26 samples within the Ross Project area (Strata, 2011a; WDEQ/LQD, 1994); unsuitable material was found in 7 of the 26 samples. The parameters that exceeded topsoil suitability criteria in those seven samples were high clay texture, high SAR, alkaline pH, and high concentration of selenium.

The hazard for wind and water erosion at the Ross Project varies from negligible to severe, based upon the soil-mapping descriptions. The potential for wind and water erosion is primarily dependent on the surface characteristics of the soils, including texture and organic-matter content. Given the slightly coarser texture of the surface horizons at the majority of the Ross Project, the soils are slightly more susceptible to erosion from wind than water.

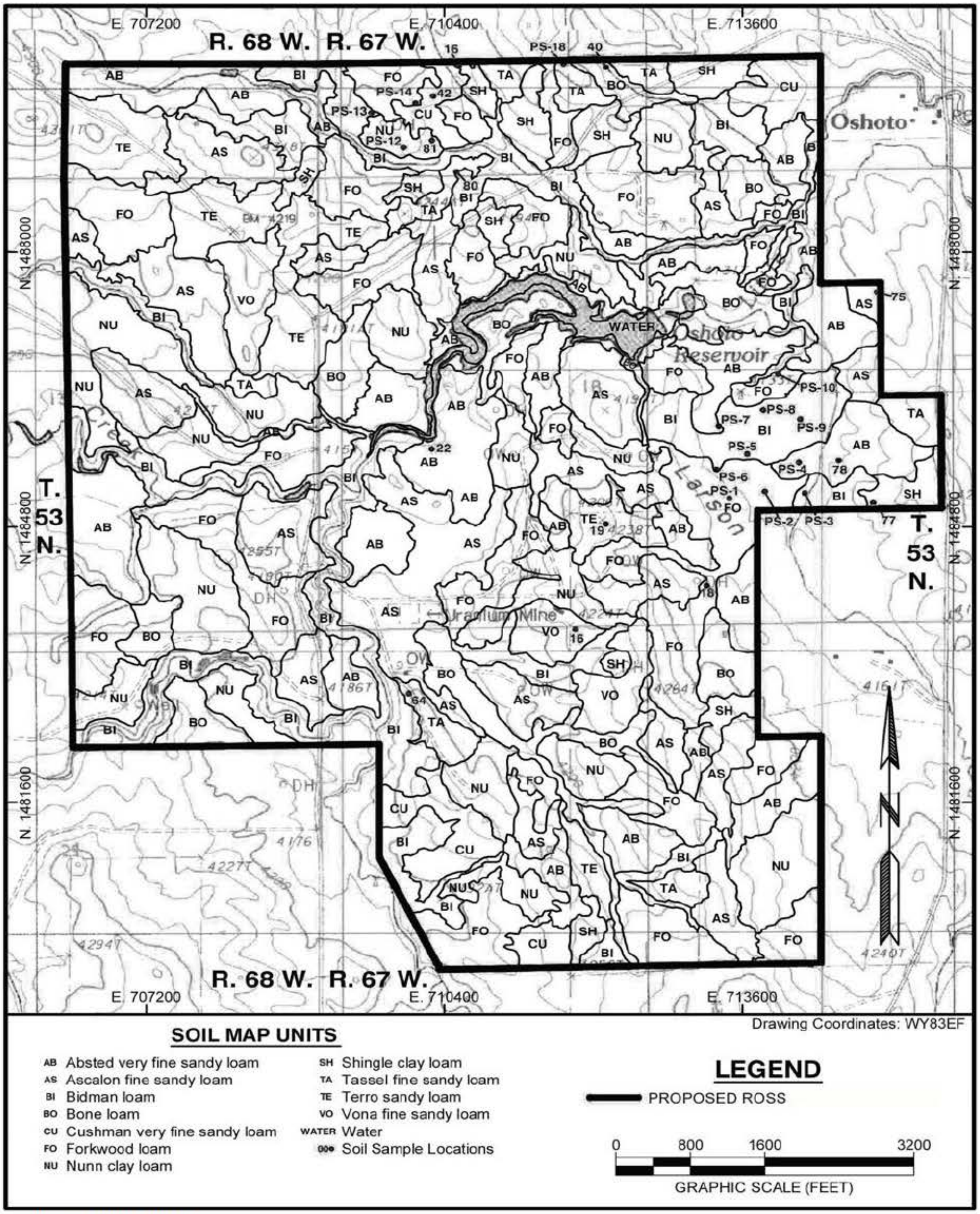
Table 3.3 Soil Coverage and Characteristics for Ross Project Area					
Soil Name	**Soil Map Symbol**	**Alternative 1 (South) Site (ha [ac])**	**Alternative 3 (North) Site (ha [ac])**	**Water Erosion Hazard**	**Wind Erosion Hazard**
Absted very fine sandy loam	AB	3.7 [9.1]	N/A	Moderate	Moderate
Bidman loam	BI	9.3 [23.1]	2.2 [5.4]	Moderate	Moderate
Cushman very fine sandy loam	CU	N/A	2.0 [5.0]	Moderate	Slight
Forkwood loam	FO	7.1 [17.5]	3.4 [8.4]	Moderate	Slight
Nunn clay loam	NU	N/A	2.4 [5.9]	Slight	Slight
Shingle clay loam	SH	N/A	2.3 [5.7]	Moderate	Moderate
Tassel fine sandy loam	TA	N/A	2.7 [6.7]	Slight	Moderate

Source: Strata, 2011a.

Notes:

N/A = The type of soil is not present at the south or north site as indicated.
"Water Erosion Hazard" describes the susceptibility of the soil type to erosion by water, and "Wind Erosion Hazard" describes the susceptibility of the soil type to erosion by wind.

Although laboratory analyses for non-radioactive, chemical constituents in the soils at the Ross Project are not required by WDEQ/LQD to establish pre-operational baseline values, radioactive constituents in some soils were measured in order to establish such a pre-licensing baseline for radioactive species concentrations. These concentrations of specific radioactive elements are presented in Table 3.21 (see Section 3.12.1).



Source: Strata, 2012a.

Figure 3.8

Soil Mapped Units at Ross Project Area

3.4.3 Uranium Mineralization

What are the characteristics of uranium deposits that make them amenable to in situ uranium recovery?

Certain geologic and hydrological features make a uranium deposit in an ore zone suitable for in situ uranium recovery (based on Holen and Hatchell, 1986, as cited in NRC, 2009b):

- **Deposit geometry:** For ISR operations, the wellfield boundaries are defined based upon the geometry of the specific uranium mineralization. The deposit should generally be horizontal and have sufficient size and lateral continuity to enable economic uranium extraction.
- **Permeable host rock:** The host rock of the ore-zone aquifer must be permeable enough to allow the solutions (the lixiviant) to access and interact with the uranium mineralization. Preferred flow pathways, such as fractures in the rock, may short circuit portions of the mineralization and reduce the recovery efficiency. The most common host rocks are sandstones.
- **Confining layers:** Hydrogeologic (formation) geometry must prevent lixiviant from vertically migrating. Typically, low permeability layers such as shales or clays "confine" the uranium-bearing sandstone(s) both above and below. This confinement isolates the uranium-producing zone from overlying and underlying aquifers.
- **Saturated conditions:** For ISR uranium-recovery techniques to work, the uranium mineralization should be located in a hydrologically saturated zone (in an aquifer).

The process of uranium mineralization in the Lance District in general and specifically at the Ross Project is consistent with the characteristics of the uranium deposits that are identified in the GEIS as amenable to in situ uranium recovery. This mineralization includes fluvial sandstones (NRC, 2009b).

The lithological variability within the upper Fox Hills and Lance Formations would allow the geometric definition of ore deposits (i.e., areas of uranium mineralization) with sufficient size and continuity to make economic recovery viable. The saturated sandstone lithology of the ore zone would provide adequate permeability to allow uranium-recovery solutions access and interaction with uranium in the ore zone. In addition, the presence of impermeable intervals above and below the ore zone would prevent vertical migration of lixiviant or other fluids. Thus, the geology of the deposits would provide the characteristics required for an effective uranium-extraction project.

The mineralogy and petrography determined by the Applicant indicated that the ore zone is suitable for ISR (Strata, 2011a). The sandstone in the ore zone consists of 60 percent quartz, 35 percent feldspar, 5 percent montmorillonite clay, approximately 1 percent organic material, and less than 1 percent of pyrite and carbonate minerals (Strata, 2011a). The presence of pyrite confirms the geochemical conditions necessary for formation of the roll front. Petrographic analyses show that the ore zone has sufficient porosity (or reservoir quality) for movement of lixiviant from injection to recovery wells (Strata, 2011a). The ore zone is composed of fine grained, moderately well sorted, argillaceous sandstone with subangular to subrounded grains that are lightly to moderately compacted.

Consistent with the GEIS and typical of roll-front deposits (NRC, 2009b), analysis of the samples from the ore zone at the Ross Project shows that the principal uranium minerals are uraninite, an uranium oxide (UO_2), and coffinite, an uranium silicate ($U[SiO_4][OH])_4$) (Strata, 2011a). Vanadium in the form of vanadinite (a lead chlorovanadate $[Pb_5\{VO_4\}_3Cl]$) and carnotite [a hydrated potassium uranyl vanadate ($K_2[UO_2]_2[VO_4]_2\ 3H_2O$)] is also found in association with the uranium at an average ratio of 0.6 (vanadium) to 1.0 (uranium).

3.4.4 Seismology

There are no active faults with surface expression mapped within or near the Ross Project, according to the U.S. Geological Survey (USGS) (USGS, 2011). The closest capable faults to the Project area are located in central Wyoming, 270 km [170 mi] to the west-southwest. Six east-west trending structural faults through the Ross Project area were mapped by Buswell (1982). These faults are due to heterogeneity of the lithology among the shale and sandstone intervals within the upper Cretaceous Formations. However, these were based upon limited observations and information from one core sample and one aquifer test. The Applicant's examination of multiple geological cross-sections developed from stratigraphic information obtained from exploration drillholes do not appear to support this interpretation of the Ross Project area's faults (see SEIS Section 3.4.1.2) (Strata, 2011a).

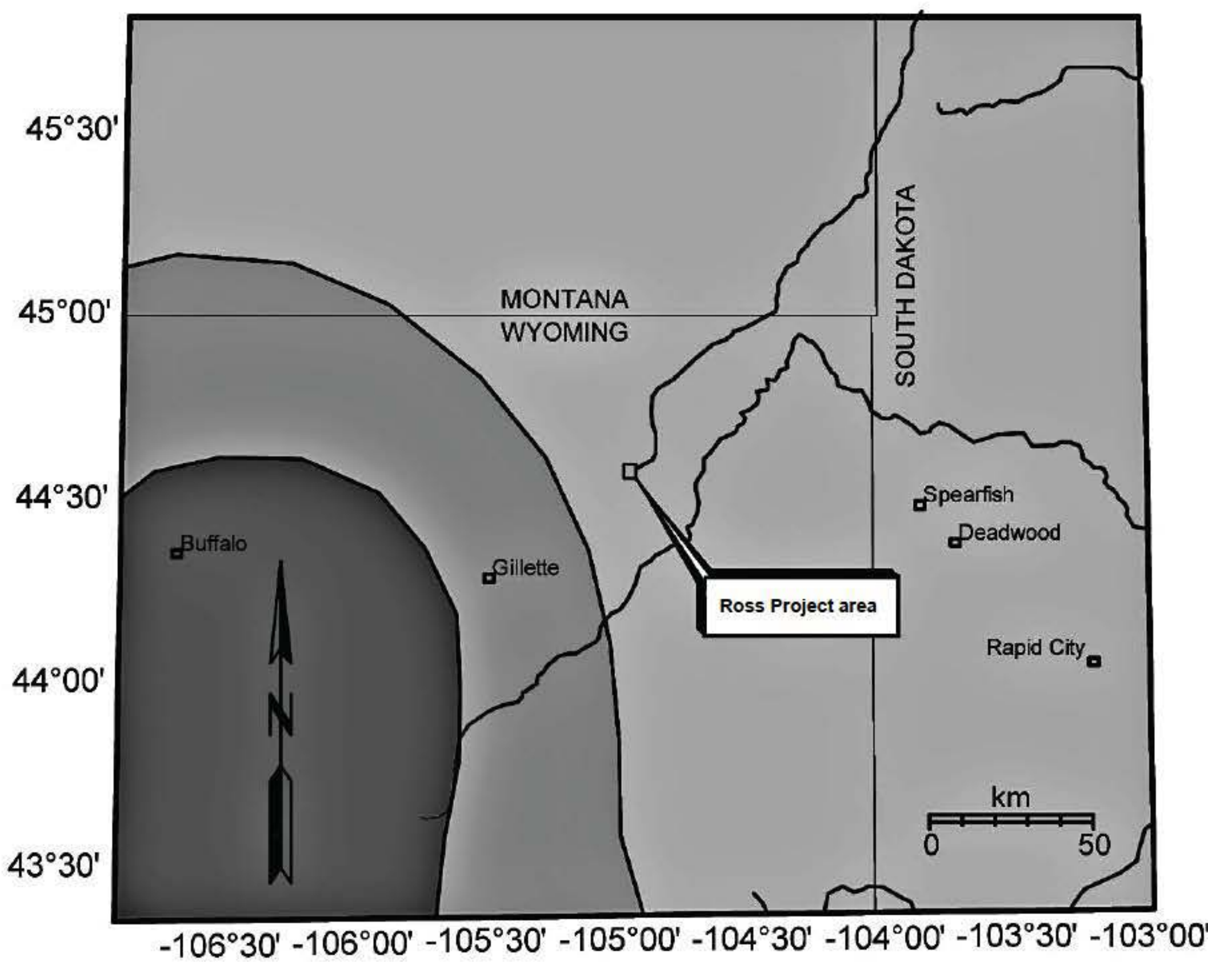
Two earthquakes with magnitudes greater than 2.5 (on the Richter Magnitude Scale) have been recorded in Crook County and nine in Campbell County (Strata, 2011a). Of those with magnitudes greater than 2.5, 3 had magnitudes 3.0 and greater (Case, Toner, and Kirkwood, 2002). The first reported earthquake in Crook County with a magnitude of greater than 3 occurred near Sundance on February 3, 1897, severely shaking the Shober School on Little Houston Creek southwest of Sundance. On November 2004, an earthquake of magnitude of 3.7 was recorded near Moorcroft in Crook County. On February 18, 1972, a magnitude 4.3 earthquake occurred approximately 30 km [18 mi] east of Gillette near the Crook-Campbell County line (Case, Toner, and Kirkwood, 2002). No damage was reported. The occurrence of few, low-magnitude events is consistent with the predicted low probability of seismic-induced or earthquake-caused ground motion in northeastern Wyoming (Algermissen et al., 1982).

Earthquakes generally do not result in ground-surface rupture unless the magnitude of the event is greater than 6.5 (Case and Green, 2000). Because of this, areas of Wyoming that do not have active faults exposed at the surface, such as the Ross Project area, are generally thought not to be capable of having earthquakes with magnitudes over 6.5. As shown on Figure 3.9, the probability of an earthquake with magnitude greater than or equal to 6.5 in the vicinity of the Ross Project is less than 0.001. This figure was prepared using the USGS Probabilistic Seismic Hazard Analysis (PSHA) model (USGS, 2010). Earthquakes with magnitudes less than 6.5 would cause little damage in specially built structures, but they could cause considerable damage to ordinary buildings and even severe damage to poorly built structures. Some walls could collapse, but underground pipes would generally not be broken, and ground cracking would not occur or would be minor (USGS, 2010).

3.5 Water Resources

Water resources in the vicinity of Ross Project include both surface water and ground water. Both the quantity and the quality of both surface and ground waters are described in this section.

Pre-licensing baseline water-quality data have been collected and analyzed by the Applicant in accordance with the following guidelines:



Source: Strata, 2011a.

1

Note: Darkest shaded area indicates probability between 0.003 and 0.002; lighter shaded area indicates probability between 0.002 and 0.001; lightest shaded area indicates probability between 0.001 and 0.000.

Figure 3.9

Probability of Earthquake with Magnitude of Greater Than or Equal to 6.5 in 50 Years

- American Society for Testing and Materials (ASTM) International's Standard D449-85a, *Standard Guide for Sampling Groundwater Monitoring Wells*, as recommended in the NRC's guidance document, NUREG–1569, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* (NRC, 2003). This ASTM Standard was replaced by ASTM Standard D4448-01 in 2007.

- WDEQ's "Hydrology, Coal and Non Coal," Guideline No. 8 (WDEQ/LQD, 2005b).

- NRC's Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*, Revision 1 (NRC, 1980).

These guidance documents by both NRC and WDEQ recommend water samples be filtered before the analysis of any metals each sample might contain. ASTM D449-85a (now ASTM 4448-01) and the NRC's Regulatory Guide 4.14 also specify analysis of radiological parameters in filtered samples (NRC, 1980). The results of the analysis of constituents in filtered samples are then reported as "dissolved" concentrations (versus "unfiltered" samples, which are reported as "total" concentrations). The filtering of water samples before analysis for metals is consistent with WDEQ/WDQ's *Groundwater Sampling for Metals: Summary*, which explains that filtering samples eliminates bias that may arise from variable turbidity in the samples (WDEQ/WQD, 2005a). The NRC's guidance on filtering samples applies to both pre-licensing baseline site-characterization monitoring efforts as well as post-licensing, pre-operational and operational environmental monitoring efforts during ISR operation and aquifer restoration.

The standardized protocol for filtering samples that will be analyzed for metals also allows a sound comparison among other data sets. For example, pre- and post-ISR operation water-quality data available for Nubeth also reported dissolved metal concentrations (i.e., filtered samples were analyzed).

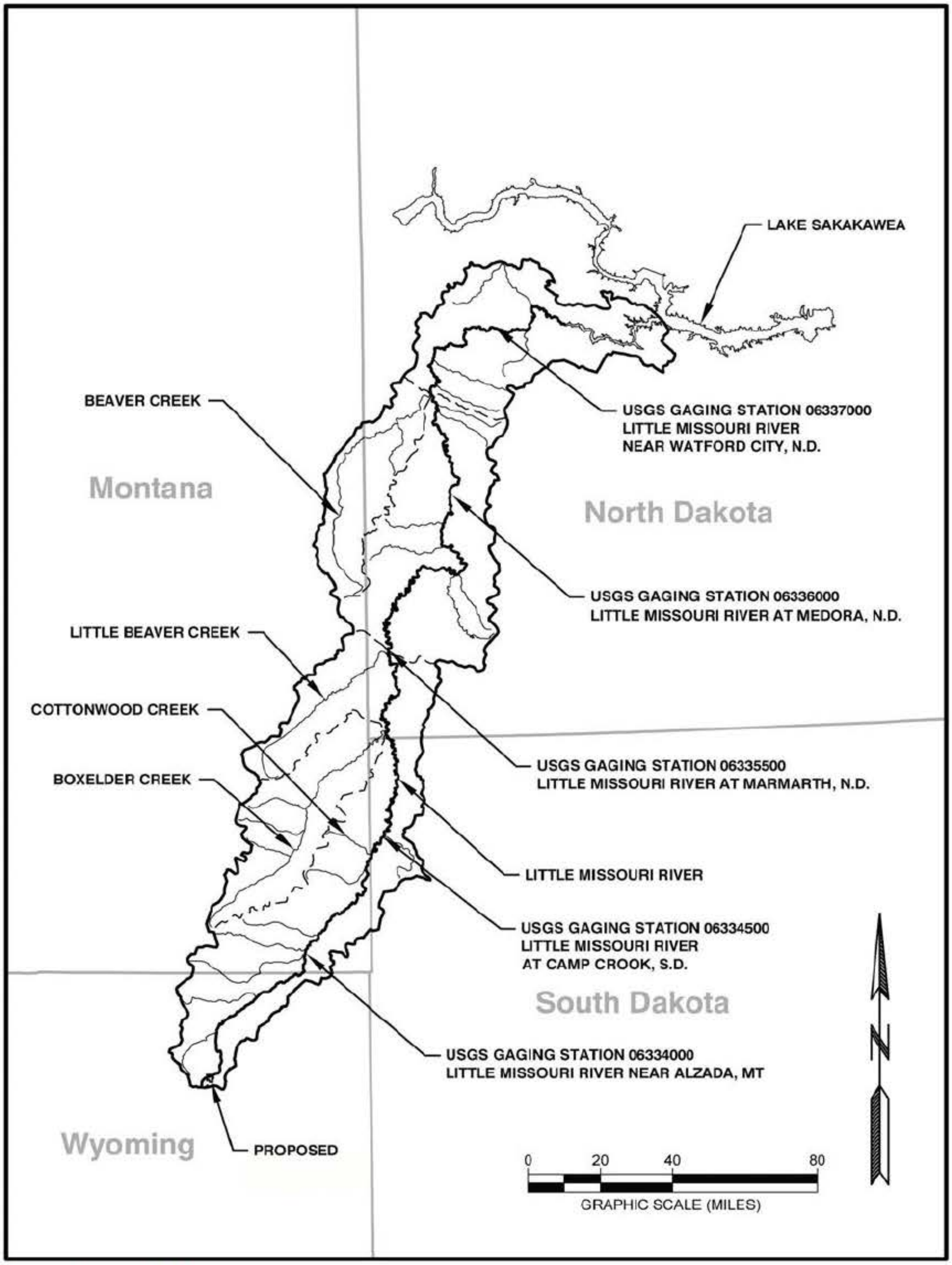
3.5.1 Surface Water

The Ross Project area is located in the upper reaches of the Little Missouri River Basin. The Little Missouri River originates in northeastern Wyoming, flows through southeastern Montana, through northwestern South Dakota, and into North Dakota where it empties into the Missouri River at Lake Sakakawea. The total river length is 652 km (405 mi), and the total drainage area (i.e., the area where all surface waters flow toward the Little Missouri River) is approximately 24,500 km^2 [9,470 mi^2]. Figure 3.10 depicts the Little Missouri River Basin. The drainage area of the Little Missouri River at the downstream boundary of the Ross Project area is approximately 47 km^2 [18.2 mi^2].

A surface-water monitoring system has been employed by the Applicant to characterize surface-water quantity and quality at the Ross Project area. This system includes three monitoring stations and was designed to monitor the major surface-water drainages to the Little Missouri River and to establish pre-licensing baseline, site-characterization surface-water quality.

Surface-Water Features

The surface-water features located within the Ross Project are depicted in Figure 3.11 and consist of several reservoirs and minor stream channels. Oshoto Reservoir, located in the channel of the Little Missouri River, is the main hydrologic feature of the Project area (Water



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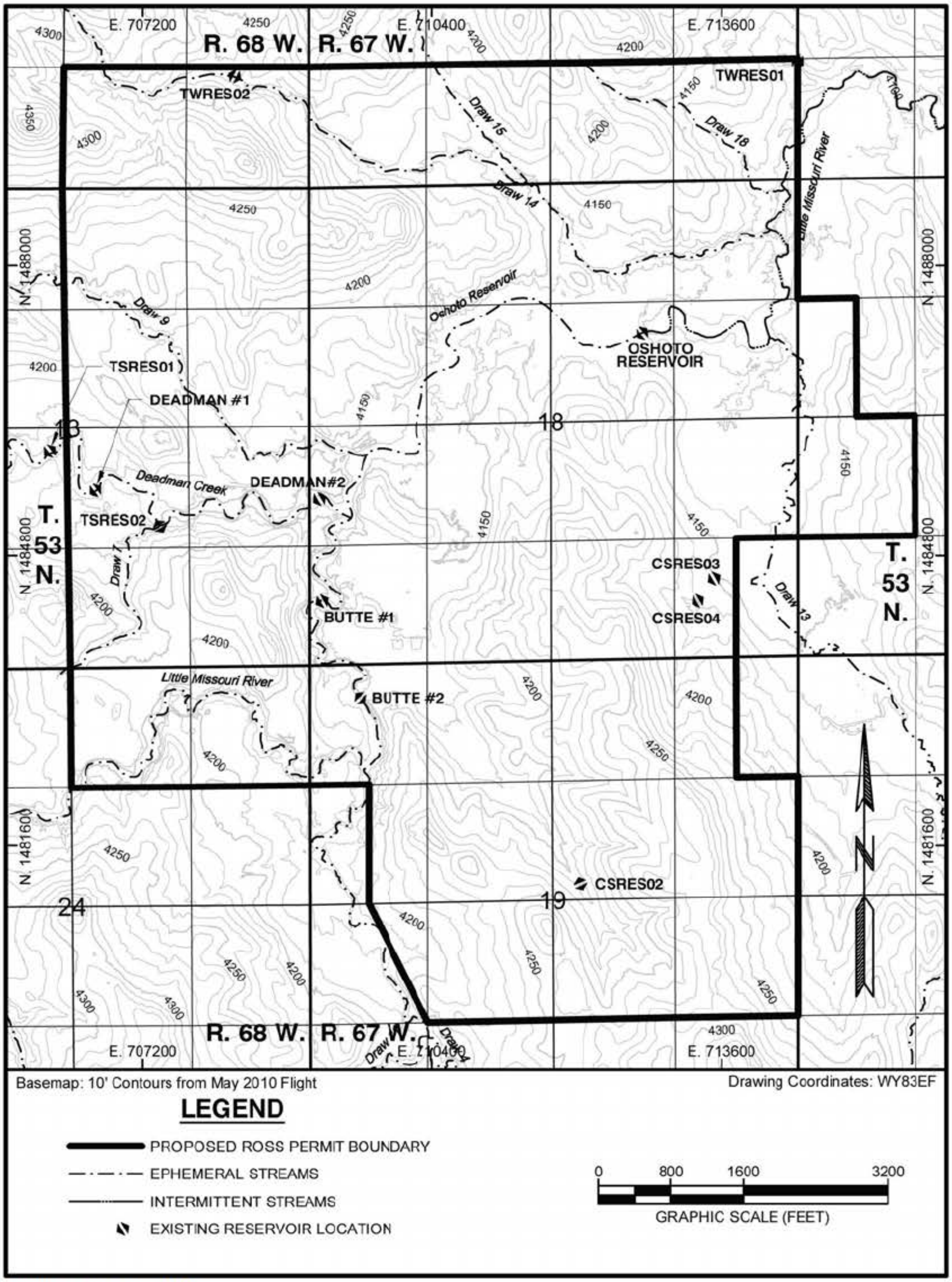
Source: Strata, 2012a.

Figure 3.10

Little Missouri River Basin and Surface-Water Gaging Stations

1



Source: Strata, 2012a.

Figure 3.11

Surface-Water Features of Ross Project Area

Right Permit No. P6046R) (WSEO, 2006). The only potential springs identified within the Ross Project area are associated with nearby wetlands (see Section 3.5.2 of this SEIS) or with the Little Missouri River in the vicinity of the Oshoto Reservoir.

The Applicant has identified 12 existing reservoirs within or just outside the Ross Project area using aerial photography, Wyoming State Engineer's Office (WSEO) permits, and landowner interviews (see Figure 3.11). Other than the Oshoto Reservoir, which has a maximum capacity of 21 ha-m [173 ac-ft] and an area of 11.3 ha [28 ac], all the identified reservoirs have a capacity of less than 1.2 ha-m [10 ac-ft] and a surface area of less than 1 ha [2.5 ac] (Strata, 2011a). The Oshoto Reservoir has the potential to affect stream flow and appears to influence water-table elevations in its proximity (Strata, 2011a).

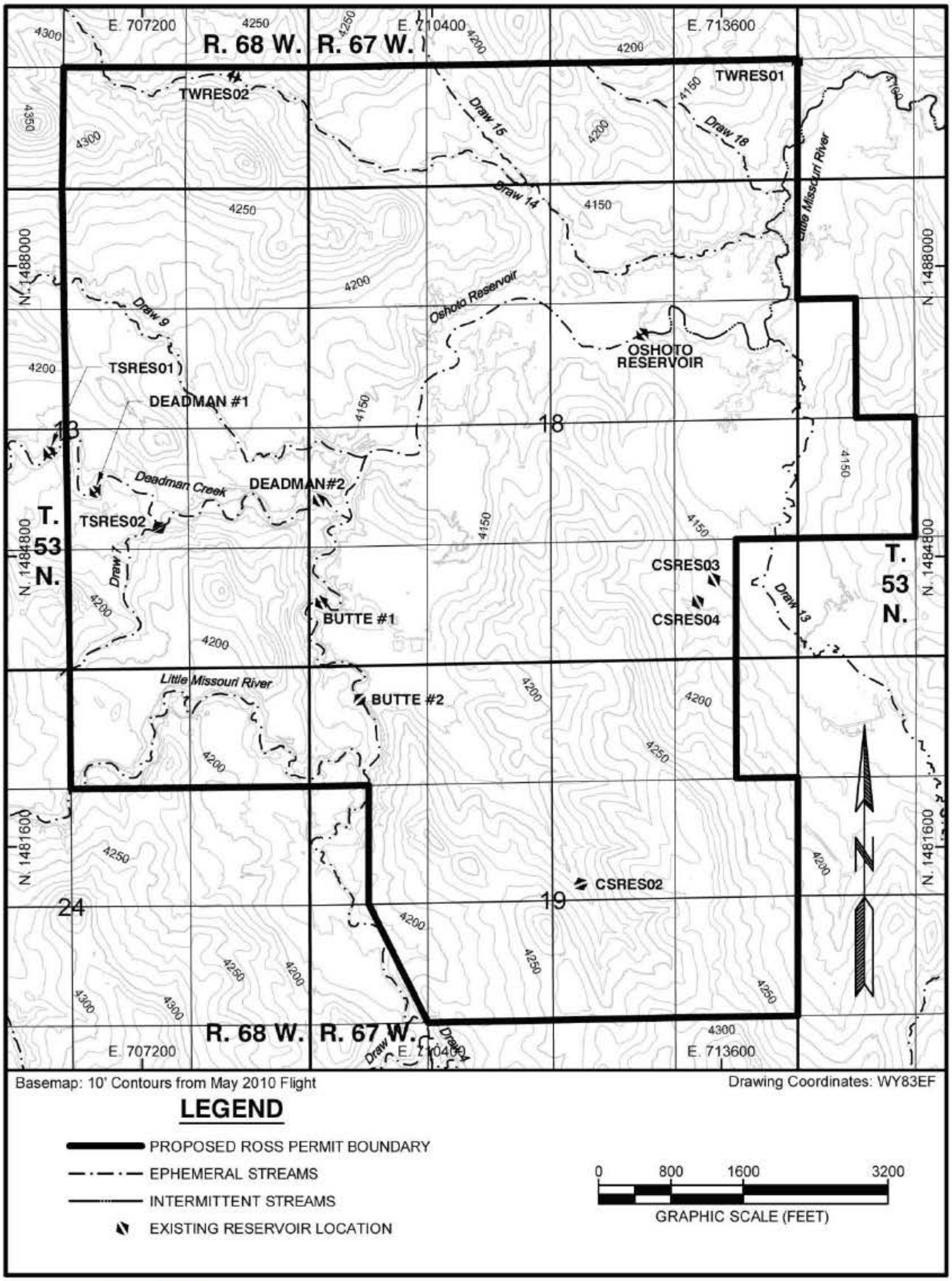
There are three Wyoming Pollution Discharge Elimination System (WYPDES)-permitted outfalls associated with the oil-production operations within the watershed that includes the Ross Project area: two upstream from the Ross Project (Permit Nos. WY0044296 and WY0033065) and one downstream (Permit No. WY0034592) (Strata, 2011a). Discharge rates from the outfalls are relatively low, approximately 0 – 150 m^3/d [0 – 5,300 ft^3/d].

<u>Surface-Water Flow</u>

As shown in Figure 3.10, five USGS gaging stations are located on the Little Missouri River downstream of the Ross Project (USGS, 2012a). The mean annual discharges range from 2 m^3/s [77 ft^3/s] at the most upstream gaging station (near Alzada, Montana) to 15.1 m^3/s [533 ft^3/s] at the most downstream gaging station (near Watford City, North Dakota). The discharges are typically lowest from November through January and highest during the months of March through June (Strata, 2011a). The peak flow for the Alzada, Montana, gaging station occurred in April 1944 when an estimated discharge of 170 m^3/s [6,000 ft^3/s] occurred. The peak flow at the Camp Crook, South Dakota, gaging station took place in March 1978 with a flow of 267 m^3/s [9,420 ft^3/s]. The timing of these events indicates that snow melt and spring runoff typically result in the highest flows for this portion of the Little Missouri River.

The Applicant has established three surface-water monitoring stations and installed continuous stage recorders and pump samplers at each station within the Ross Project area in 2010 (see Figure 3.12) (Strata, 2011a). The stations were located at two sites on the Little Missouri River and one site on Deadman Creek, a tributary to Little Missouri River. The stage recorders are designed to continuously measure discharge and are integrated with the pump samplers that collect water-quality samples during runoff events. The Applicant reports flow data from the three surface-water monitoring stations from June 15, 2010, to October 11, 2011, with a break during the respective winter when the monitoring stations were removed to prevent their freezing (Strata, 2012a).

The results of the surface-water monitoring indicate that, where the streams enter the Ross Project area (SW-2 and SW-3), flow is in response to only snow-melt or precipitation events (i.e., ephemeral) (Strata, 2011a). The Little Missouri River, downstream from the proposed Ross Project boundary (SW-1), has flow for an extended period of the year but not all of the



1 Source: Strata, 2012a.

Figure 3.12

Surface-Water Monitoring Stations at Ross Project Area

year and is, thus, intermittent. The Applicant compared the average daily flow observed at SW-1 to the water-surface elevation in Oshoto Reservoir (Strata, 2011a); the comparison suggests a correlation between the increased flow in the Little Missouri River downstream of Oshoto Reservoir and the amount of head in the Reservoir. This would indicate that some of the flow could be attributed to the stored capacity in Oshoto Reservoir.

What are the types of streams at the Ross Project area?

Perennial Streams: A perennial stream is a stream or part of a stream that flows continually during all of the calendar year as a result of ground-water discharge or surface runoff.

Intermittent Streams: An intermittent stream is a stream or part of a stream where the channel bottom is above the local water table for some part of the year, but which is not a perennial stream.

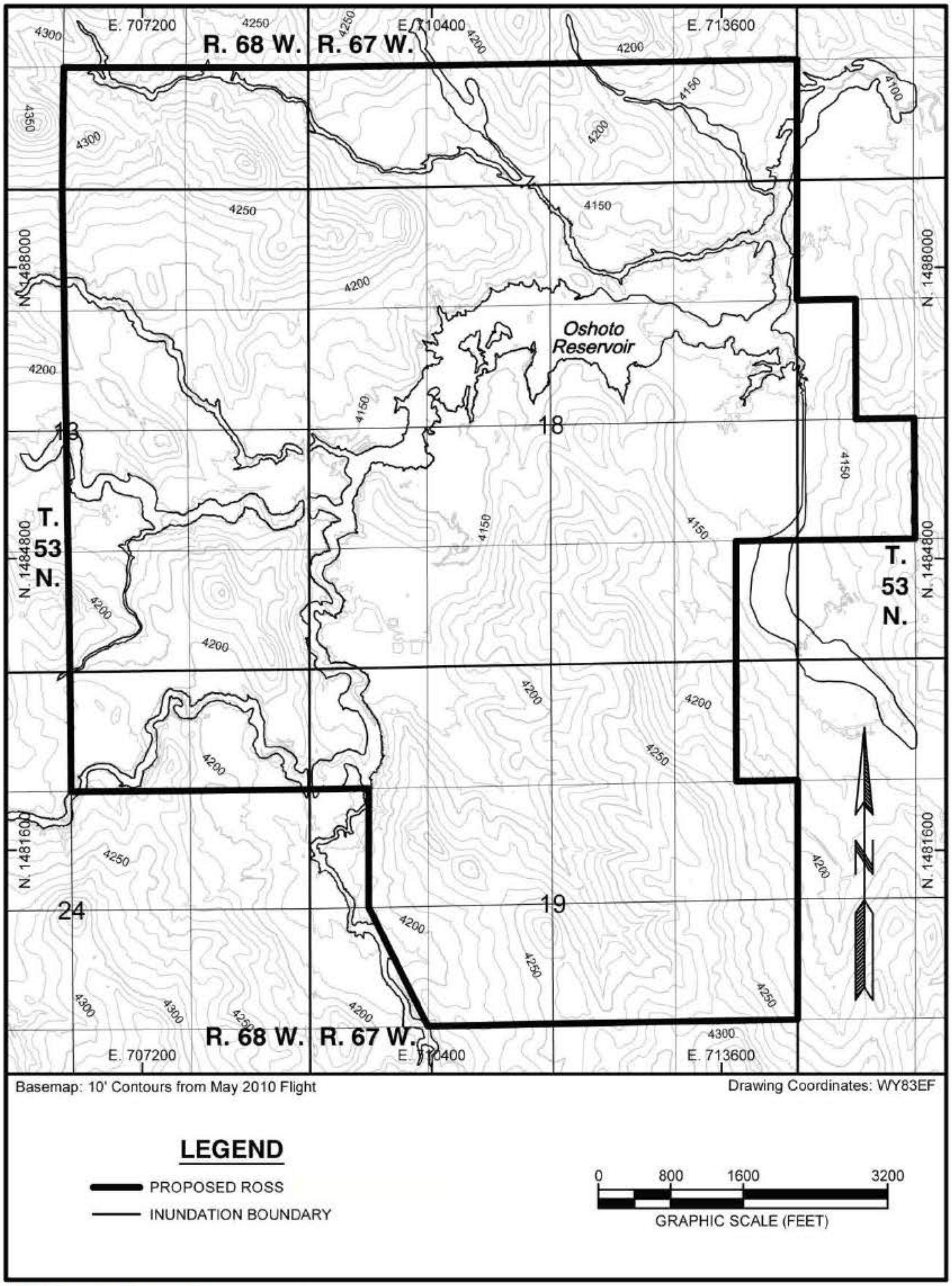
Ephemeral Streams: An ephemeral stream is a stream which flows only in direct response to a single precipitation event in the immediate watershed or in response to a single snow-melt event, and which has a channel bottom that is always above the prevailing water table.

All streams within the Ross Project area, including the Little Missouri River and Deadman Creek, are classified by WDEQ/Water Quality Division (WQD) as 3B streams (WDEQ/WQD, 2001). A Class 3B stream is defined by the WDEQ/WQD as an intermittent or ephemeral stream with a designated use of "aquatic life other than fish." Uses such as drinking water and fisheries are excluded in a Class 3B stream. Approximately 64 km [40 mi] downstream of the Ross Project, the Little Missouri River becomes a class 2ABWW stream at its confluence with Government Canyon Creek; at this point, the River becomes protected as a drinking water source (2AB) and warm-water (WW) fishery.

There are no long-term stream-flow records for flows within or adjacent to the Ross Project; therefore, an U.S. Army Corps of Engineers' (USACE) Hydrologic Engineering Center (HEC)-hydrologic modeling system (HMS) model was developed by the Applicant to estimate the peaks and volumes of floods for various recurrence intervals (Strata, 2011a). The resulting inundation boundaries are shown on Figure 3.13. Measured peak flows during a 2-year, 24-hour storm event in May 2011 were less than predicted by the model, suggesting that the predicted model flows are conservatively high (Strata, 2012a).

Surface-Water Quality

Data from water-quality analyses of samples obtained from the Ross Project surface-water monitoring stations in 2009 and 2010 are provided in the Applicant's *Environmental Report* (ER) and *Technical Report* (TR) (see Figure 3.12) (Strata, 2011a; Strata, 2011b). Due to reasons ranging from the Applicant's not having a landowner's permission to no-flow conditions (i.e., there was no water flowing or the water was frozen), the number of quarters in which the monitoring stations were sampled ranges from one to six (Strata, 2011a). Water-quality analytical data from samples collected in 2011 were submitted to WDEQ/LQD and are provided in the Applicant's Responses to the RAIs issued by the NRC (Strata, 2012a). The data from 2011 are generally consistent with the 2009 and 2010 data, indicating a representative characterization of surface-water quality.



Source: Strata, 2012a.

Figure 3.13

Predicted 100-Year Flood Inundation Boundaries

The surface-water monitoring data characterizing the Little Missouri River and Deadman Creek from the first and second quarter of 2010 are summarized and described below. These data indicate that the overall water quality meets Wyoming's surface-water criteria for a Class 3B stream, which is the designation for the Little Missouri River.

- The water quality in all streams is generally consistent across the entire Ross Project area.
- The field pH measurements ranged from 7.6 – 8.9 standard units (s.u.), indicating alkaline water.
- The field measurements of dissolved oxygen ranged from 6.9 – 10.5 mg/L, indicating an intermediate to high level of oxygen in the water.
- Total salinity of the waters, expressed as total dissolved solids (TDS) concentrations, are low to moderate, ranging from 210 mg/L – 940 mg/L, and the water composition is dominated by sodium and bicarbonate.
- Iron and manganese concentrations in unfiltered samples ranged from 0.32 – 0.95 mg/L and 0.05 – 0.21 mg/L, respectively, suggesting the presence of suspended sediment in the samples.
- Dissolved metals were near or below detection limits, with the exception of iron and uranium. Iron concentrations ranged from less than 0.05 mg/L to 0.92 mg/L, with an outlier of 8.32 mg/L in the sample collected in the third quarter from Station R-5. Concentrations of dissolved uranium ranged from 0.003 – 0.02 mg/L.
- Dissolved radium-226 was less than the detection limit of 0.01 Bq/L [0.2 pCi/L]. Dissolved radium-228 was undetected (i.e., less than 0.04 Bq/L [1 pCi/L]) except for one sample obtained at Station SW2, where it was counted at 0.05 Bq/L [1.3 pCi/L].
- Gross alpha and gross beta ranged from 0.2 – 0.33 Bq/L [4 – 8.8 pCi/L) and 0. 2 – 0.41 Bq/L [6 – 11.2 pCi/L], respectively.

Other water-quality data suggest that the TDS increases downstream in the Little Missouri River and sulfate becomes the dominate anion (Langford, 1964).

The total anion/cation balances were calculated from the analyses of major ions as a quality-control check on the laboratory analyses. The balances, less than 3 percent in 31 of the 36 samples analyzed, and between 3 and 5 percent in five samples, validated the accuracy of the analyses (Strata, 2011a).

The Applicant attempted to collect water-quality samples from 11 reservoirs (see Figure 3.12) from the third quarter of 2009 through the third quarter of 2011 (i.e., quarterly) (Strata, 2011a; Strata, 2011b, Strata. 2012a). Samples were not collected when the reservoirs were dry or frozen or when the Applicant was not able to obtain the landowner's permission. These water-quality data indicate the following:

- Higher TDS corresponds to low-flow conditions in the fourth quarters of both years. TDS in samples of the reservoirs on the channels of the Little Missouri River and Deadman Creek, upstream from Oshoto Reservoir, ranged from 970 – 2,320 mg/L compared to a range of 460 – 730 mg/L in the Oshoto Reservoir and a range of 100 – 170 mg/L in the reservoir on

the Little Missouri River downstream of the Oshoto Reservoir. The TDS in the reservoirs upland from the stream channels range from 110 – 1190 mg/L. Bicarbonate or carbonate (depending upon the pH) was the dominant anion in all of the waters. Sodium was the dominant cation, except in waters on the low end of the TDS range, where calcium was often the dominant cation.

- The waters in all reservoirs were alkaline, with field pH measurements generally ranging from 8 – 10 s.u.
- Field-measured dissolved oxygen ranged from 0.46 – 11.3 mg/L, suggesting seasonal low oxygen conditions.
- Similar to the streams, dissolved metals were generally at or near the laboratory detection limits, except for uranium and iron. Uranium ranged from less than 0.001 – 0.009 mg/L in all of the reservoirs except for those on Deadman Creek, where uranium concentration ranged from 0.019 – 0.087 mg/L. Detectable concentrations of dissolved iron generally corresponded to depleted dissolved oxygen levels. Measureable concentrations of total iron and manganese indicate the presence of sediment in the samples.
- The available data for radionuclides show that most of the analyses were less than the laboratory's lower limit of detection. However, detectable concentrations of lead-210, radium-226 (dissolved and suspended), dissolved radium-228, and suspended thorium-230 were detected. Gross alpha and gross beta ranged from less than 2 – 48.4 pCi/L and 3.9 – 48.5 pCi/L, respectively. The highest values of gross alpha and gross beta were measured in samples from reservoirs on Deadman Creek.

<u>Surface-Water Uses</u>

A search of the WSEO database of permitted surface-water rights within the Ross Project boundaries and the adjacent 3-km [2-mi] radius revealed that 43 surface-water rights existed within and adjacent to the Ross Project in 2010 (WSEO, 2006; Strata, 2011a). The search of the WSEO database indicated that nearly half of the water-right permits have been cancelled, while the remaining permits are complete, fully adjudicated, or un-adjudicated (Strata, 2011a). In addition to the permitted surface-water rights, there are at least 17 additional reservoirs within or adjacent to the Ross Project area, although none of these reservoirs was listed in the WSEO water-rights database, except for the Oshoto Reservoir (Strata, 2011a).

Surface water within the Ross Project area and surrounding 3-km [2-mi] vicinity is primarily used for livestock watering, with lesser amounts used for irrigation and industrial uses (primarily as a temporary water supply for oil- and gas-construction activities) (Strata, 2011a). Including reservoirs not listed in the WSEO database, stock reservoirs account for approximately 90 percent of the total active water rights (Strata, 2011a). Most of the stock reservoirs were constructed before 1970, and the majority are still in use today. Irrigation-water rights only account for a relatively small portion (less than 10 percent) of the surface-water rights. All of the irrigation rights were permitted 50 – 100 years ago for relatively small areas (28 ha [70 ac] or less). The one water right for Nubeth signifies the rise of uranium exploration in the late 1970s. Following this, there were some 15 temporary water-haul permits for oil- and gas-related activities from 1980 – 1991. Finally, the two most recent water rights were appropriated by the Applicant for exploration activities at the Ross Project area (Strata, 2011a).

3.5.2 Wetlands

The Federal definition of wetlands includes “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas” (33 CFR Part 328.3). Wetlands are important resources that provide habitat for aquatic fauna and flora, filter sediments and toxicants, and attenuate floodwaters.

Projects that discharge, dredge, or fill material into “Waters of the United States,” a concept related to surface- and ground-water regulation which includes special aquatic sites and wetlands under the jurisdiction of the USACE, require accurate identification of wetland boundaries for Section 404 of the *Clean Water Act*-permitting process. Through the Section 404 permitting process, the USACE can authorize dredge or fill activities by issuance of a standard individual permit, regional permit, or the Nationwide Permit (NWP).

Site-specific field surveys on behalf of the Applicant were conducted at the Ross Project by WWC Engineering (WWC) staff on June 22 and 28 as well as July 8 and 21, 2010. These surveys were in accordance with the “Interim Regional Supplement to the USACE Wetlands Delineation Manual: Great Plains Region” (USACE, 2008; Strata, 2011a). These wetlands surveys were conducted to identify and to characterize the wetlands located within the Ross Project area. Existing data used in the survey included Natural Resource Conservation Service (NRCS) soil mapping, U.S. Fish and Wildlife Service’s (USFWS’s) National Wetlands Inventory (NWI) mapping, and aerial photography taken May 2010 (NRCS, 2010; USFWS, 2012a; Strata, 2011a).

Thirteen wetland sites were identified on the NWI maps within the Ross Project area and were investigated during the 2010 field surveys. Potential wetlands identified during the initial June survey were later visited during another survey in July to verify that wetland characteristics were present. The wetlands-survey results, photographs, and correspondence with the USACE are provided in the Applicant’s ER (Strata, 2011a). All but two of the NWI areas were included in the baseline field-delineated wetlands (Strata, 2011a). The two sites not included did not have the three required characteristics for a wetland. The three criteria are: 1) hydrophytic vegetation (i.e., plants that grow in hydric soils), 2) hydric soil (i.e., soils that are commonly flooded or saturated), and 3) wetland hydrology (USACE, 2008).

Many of the potential wetland areas delineated during the 2010 field surveys were small depressions (<0.04 ha [0.1 ac]) that were in close proximity to each other but were distinct depressions separated by upland vegetation. A significant number of these small-depression areas appeared to be influenced by ground water, receiving seepage from the Lance Formation, which outcrops in the vicinity. These potential wetlands were classified according to Cowardin et al. (1979) to more accurately describe the types of potential wetlands present within the Ross Project area (Strata, 2011a). Approximately 93 percent of the potential wetlands were man-made (i.e., diked or excavated). A significant majority of these are preliminarily classified as Palustrine, Aquatic Bed, Seasonally Flooded (PABFh) or Diked. Of the areas designated as PABFh, approximately half were areas of open water. In addition, there were approximately 2.1 ha [5.1 ac] (6,750 linear m [22,130 linear ft] x an average 3-m- [10-ft]-wide channel) of “Other Waters of the U.S.” identified within the Ross Project area (Strata, 2011a).

A wetlands delineation report for the Ross Project was submitted to the USACE Omaha District in Cheyenne, Wyoming, during September 2010 (Strata, 2011a). The USACE provided the Applicant a letter on December 9, 2010, that verified the following (USACE, 2010):

- The methods used to identify wetlands and other surface waters were consistent with the USACE's *Wetland Delineation Manual* and its current supplements.
- Exhibit 1 in the wetlands delineation report, entitled *Wetlands and Other Waters of the US. Delineation for the Proposed Ross ISR Project Oshoto, Wyoming* (*Wetland Map*) (dated August 23, 2010), provided an accurate depiction of the boundaries of all wetlands and other waters within the Ross Project area.
- All of the wetlands and channeled waterways identified in the delineation report are connected or adjacent to the Little Missouri River, a navigable water, and are thus likely to be Waters of the U.S. as defined in 33 CFR Part 328.

USACE's final determination of specific wetland areas would not occur until the Applicant applies for coverage for specific construction activities, such as pipeline installation and access-road stream-channel crossings. At that time, the Applicant would be required to provide a site-specific mitigation plan for its disturbance of jurisdictional wetlands (i.e., those wetlands that are under the jurisdiction of the USACE).

3.5.3 Ground Water

Regional Ground-Water Resources

The Applicant presents a description of the regional hydrogeology based upon published literature in its license application (Strata, 2011a; Strata, 2011b). The site-specific hydrogeology of the Lance Formation and the associated stratigraphy underlying the Ross Project area is not described in the GEIS; thus, detailed information is included here. Water-bearing bedrock intervals in the eastern Powder River Basin range in age from Precambrian to Paleocene (see Figure 3.7). Regionally, recharge occurs in the outcrop areas, with ground water moving away from the outcrop into the Basin. Due to the geologic dip of the units, horizons that are accessible near the Black Hills uplift are deeply buried in the Basin's center about 125 km [75 mi] west from the Ross Project area (Hinaman, 2005).

Within the northeast corner of Wyoming there are a number of water-bearing intervals tapped by municipalities and industrial users (Strata, 2011a; Langford, 1964). Below the Fox Hills aquifers, the Minnelusa Formation (210 – 270 m [700 – 900 ft] thick), and the underlying Madison Formation (90 – 270 m [300 – 900 ft] thick) are the most significant aquifers (Whitcomb and Morris, 1964). The Minnelusa and Madison aquifers are recharged at the outcrop in the area of the Black Hills uplift. Ground-water flow in all aquifers is from the recharge areas along the outcrop, westward towards the center of the Powder River Basin. Flow directions are locally modified by pumping wells. The Minnelusa Formation has received aquifer exemptions in portions of Campbell County, which allow it to be used for waste-water disposal (EPA, 1997).

The Minnelusa Formation is also an important hydrocarbon reservoir interval in the areas of the Powder River Basin that are west of the Ross Project (De Bruin, 2007). At the Ross Project area, the Minnelusa Formation is approximately 1,860 m [6,100 ft] bgs (Strata, 2011a). It is

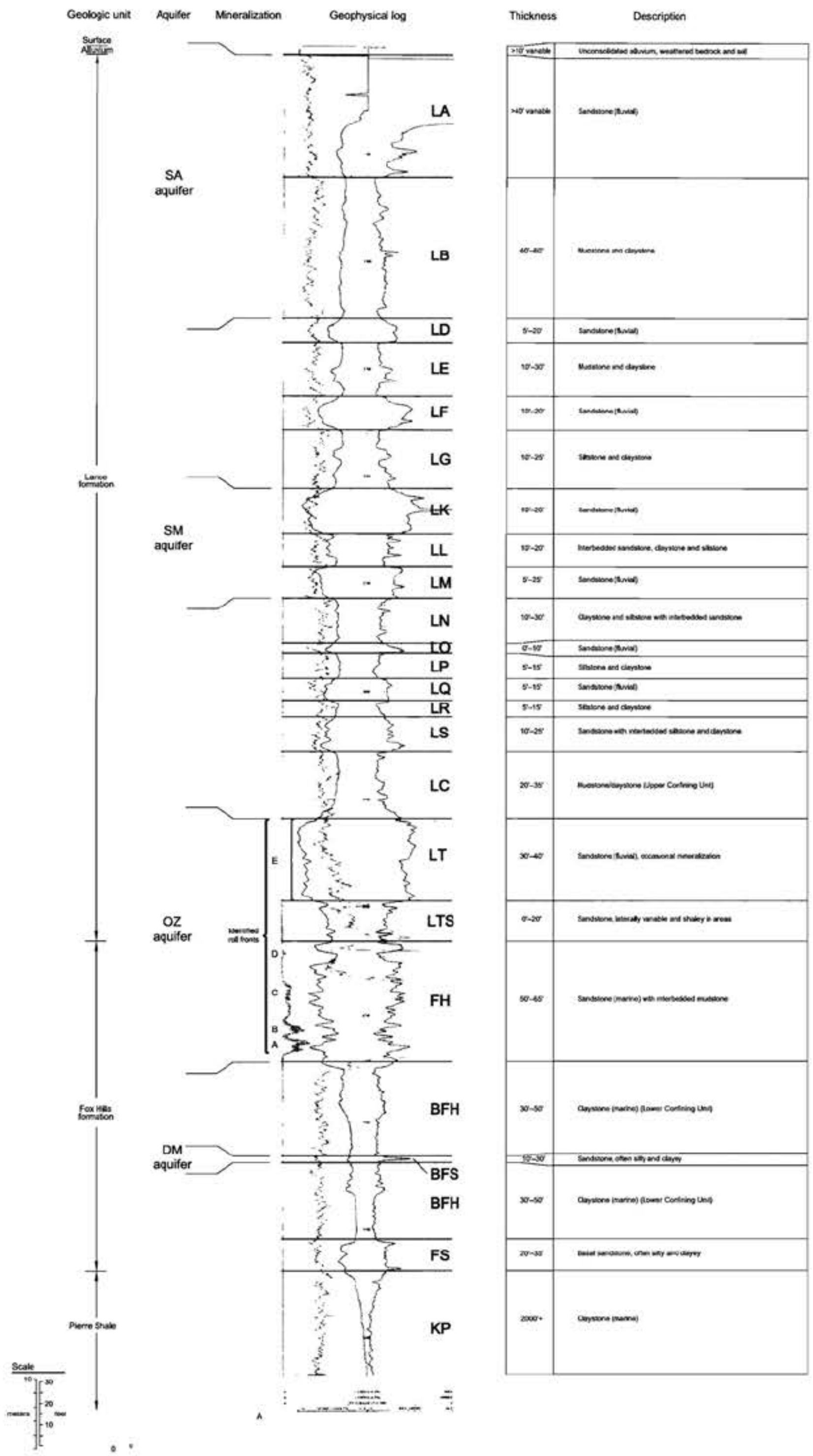
separated from the ore zone by 1,680 m [5,500 ft] of sandstone, claystone and shale, most notably the Pierre Shale which is over 600 m [2,000 ft] thick under the Ross Project area as noted in SEIS Section 3.4 (Whitcomb and Morris, 1964).

Water-supply wells in the Madison Formation have reported yields of up to 3,785 L/min [1,000 gal/min]; the Formation is an important source of drinking water for the communities of Gillette and Moorcroft. The city of Gillette operates a wellfield consisting of ten wells north of the town of Moorcroft, yielding 35,204 L/s [9,300 gal/s] from a depth of approximately 760 m [2,500 ft]. The water is piped approximately 53 km [33 mi] to Gillette and blended with locally-produced ground water from the Fort Union Formation and to a lesser degree from wells completed in the Lance and Fox Hills Formations. Other towns in the vicinity (e.g., Moorcroft, Sundance, Upton, Newcastle, and Hulett) also use the Madison Formation for municipal water supply (Strata, 2011a). In the vicinity of Gillette, the Fox Hills and Lance Formations are typically targeted by industrial users, while smaller municipalities, subdivisions, and improvement districts west of Ross Project area use wells completed within the shallower Fort Union Formation.

Local Ground-Water Resources

The detailed geologic stratigraphy and its relationship to the corresponding hydrology are illustrated in Figure 3.14. The detailed stratigraphic sequence from the land surface to the confining interval below the ore zone is, in descending order: recent, unconsolidated, surficial deposits including residual soils, colluvium, and alluvium; Lance Formation; Fox Hills Formation; and Pierre Shale (see also SEIS Section 3.4). Figure 3.14 illustrates the geophysical log and corresponding lithology obtained from type exploration drillhole No. RMR008, the location of which is shown in Figure 3.14. This particular drillhole was chosen as the “type log” by the Applicant for the Ross Project because of the clarity of the geophysical logs and the associated stratigraphic descriptions from land surface to the top of the Pierre Shale (Strata, 2011a).

Within the Ross Project there are four named aquifers existing between the land surface and the Pierre Shale. The correspondence between stratigraphic and hydrologic units, and the related nomenclature, is summarized in Table 3.4.



Source: Strata, 2012a.

Figure 3.14

Stratigraphic and Hydrogeologic Units at Ross Project Area

Table 3.4
Geologic Units, Stratigraphic Horizons, and Hydrologic Units of Ross Project Area

Geologic Unit	Stratigraphic Horizon	Hydrologic Unit
Lance Formation and/or Recent Alluvium/Colluvium	Qal/LA/LB	SA (Surface Aquifer)
Lance Formation	LD-LG	Lance Units (Aquitard)
	LK-LM	SM (Shallow-Monitoring Aquifer)
	LN-LS	Sandstone within Confining Unit
	LC	Upper Confining Unit
	LT-LTS	OZ (Ore-Zone Aquifer)
Fox Hills Formation	FH	
	BFH	Lower Confining Unit (Aquitard)
	BFS	DM (Deep-Monitoring Aquifer)
	BFH/FS	Sandstone within Confining Unit
Pierre Shale	KP	Regional Confining Unit (Aquitard)

Source: Strata, 2012b.

The surficial aquifer, or the SA interval, is the "water-table" aquifer within the Ross Project area. It consists of the uppermost water-bearing interval within the upper Lance Formation and the alluvium of the Little Missouri River and Deadman Creek. Ground-water levels range from near-surface in the river valleys to over 15 m [50 ft] bgs in topographically higher areas.

The sandstones of the lower Lance Formation (LT intervals) make up the upper portion of the ore zone (i.e., ore-zone [OZ] aquifer) (see Figure 3.14). The LT sands range in thickness from 9 – 12 m [30 – 40 ft] and show hydraulic continuity beneath the Ross Project area. Above the LT sands is a shale layer varying in thickness from 6 – 24 m [20 ft – 80 ft], locally called the LC interval aquitard. The Applicant designates the LC aquitard as the "upper confining unit." The LC aquitard serves as a confining unit that separates the uranium-mineralized sandstones of the FH and LT horizons and the OZ aquifer, from the water-bearing unit above (see Figure 3.14).

The water-bearing sands above the upper confining unit is referred to as the shallow-monitoring (SM) unit, or SM aquifer, and is composed of the LM- through LK-horizon sandstones. Above the SM aquifer is a sequence of thin sands, shales, and silts. Many of the thin sandstones

contain water; however, these sandstones are generally discontinuous and, while they may be used locally for stock and domestic wells, they are not regionally extensive.

The Lance Formation is recharged at the outcrop and at the subcrop beneath the alluvium in the valley of the Little Missouri River and its tributaries. Natural ground-water flow would be expected to be westward from the outcrop toward the Basin.

At the Ross Project area, the thickness of the Fox Hills Formation is approximately 46 m [150 ft], with local variations of up to15 m [50 ft] or more. The Fox Hills Formation consists of an upper sandstone unit (i.e., FH horizon) and a lower sandstone unit (i.e., FS horizon) which are separated by an intervening shale, claystone, and mudstone interval (i.e., BFH horizon) containing the BFS sandstone unit (see Figure 3.14). Uranium mineralization primarily occurs within the Fox Hills Formation's sands, although in localized areas mineralization occurs within the overlying Lance Formation's (i.e., LT horizon) sandstone.

The FS and BFS sandstones represent the only water-bearing units within the lower Fox Hills Formation (see Table 3.4). Both sand units are believed to be continuous throughout the Ross Project area, although in places they are relatively thin. The BFS horizon is the nearest aquifer below the uranium-bearing sandstone (the FH horizon and also known as the ore zone) in the upper Fox Hills Formation, and in terms of uranium-recovery operations, it is referred to as the deep-monitoring (DM) interval, or the DM aquifer. It is separated from the FH sand (i.e., the ore zone) above and the FS (basal sandstone) below by a shale, claystone, and mudstone (BFH horizon). The Applicant provides potentiometric contours for the DM interval in its ER (see Figure 3.15) (Strata, 2011a).

The Pierre Shale yields very little water; it is considered regionally as a confining unit (NRC, 2009b; Whitehead, 1996). No wells are known to be completed within the Pierre Shale at the Ross Project area.

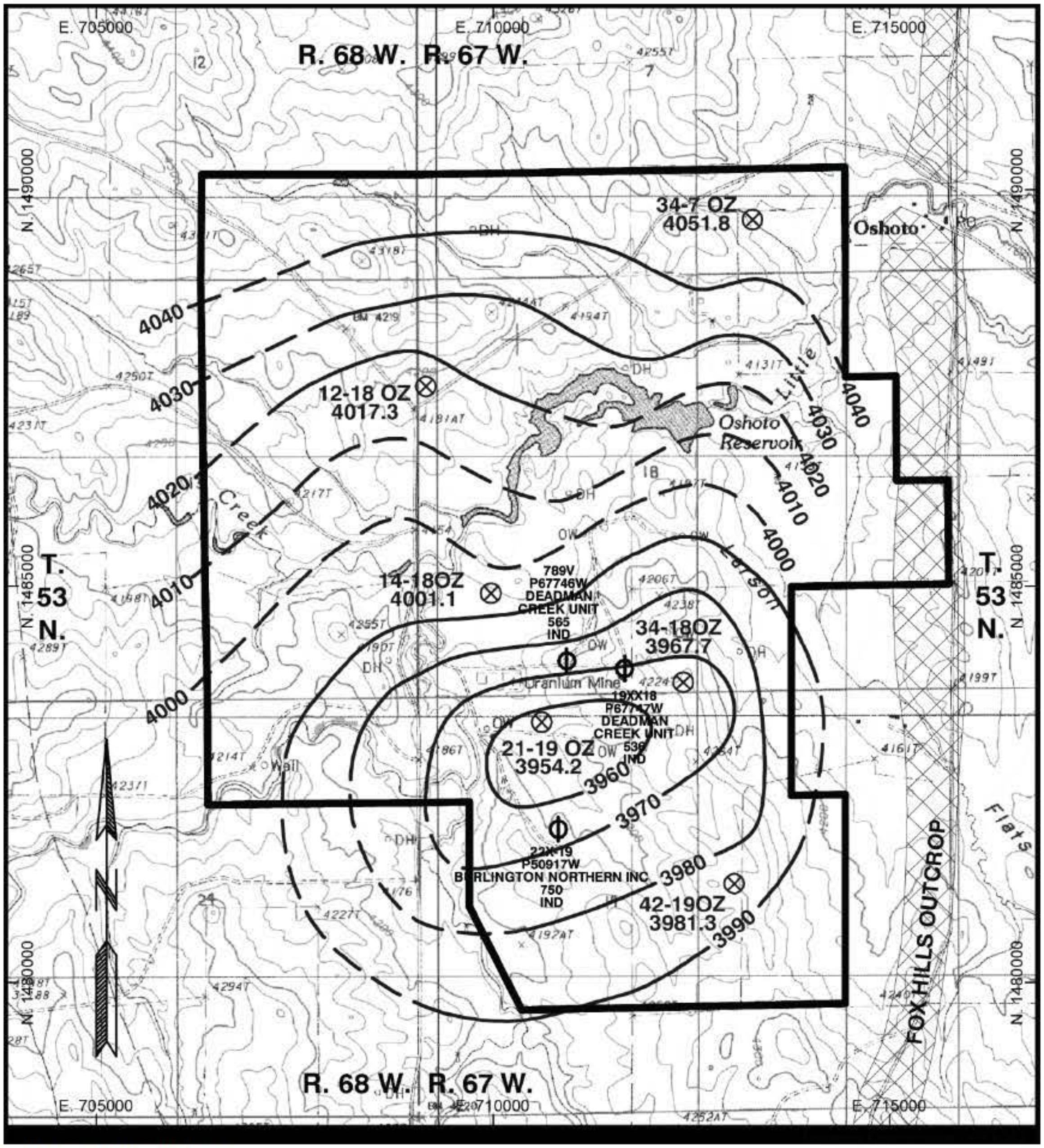
The FH horizon sandstones within the upper Fox Hills Formation contain uranium and are the primary uranium-recovery target interval for the Proposed Action. The Applicant has designated the OZ aquifer as consisting of the FH sandstones with the overlying lower Lance Formation sandstones (LT horizon). The lithologies of the ore zone range from thick-bedded, blocky sandstones to thin, interbedded sandstones, siltstones, and shales. The OZ aquifer is underlain by claystone of the Fox Hill Formation (i.e., BFH interval). Within the Ross Project area, this ore-zone interval ranges from 27 – 55 m [90 – 180 ft] thick (see Figure 3.14). Thin, silty, and clayey sandstone comprises the DM aquifer. The Applicant designates the BFH aquitard above the DM aquifer and below the ore zone as the "lower confining unit."

What terms are used to describe hydrologic characteristics?

Transmissivity: This term is used to define the flow rate of water through a vertical section of an aquifer, considering a unit width and extending the full saturated height of the aquifer under unit hydraulic gradient. Transmissivity is a function of an aquifer's saturated thickness and hydraulic conductivity.

Hydraulic Conductivity: This term represents a measure of the capacity of a porous medium to transmit water. It is used to define the flow rate per unit cross-sectional area of an aquifer under unit hydraulic gradient.

Storativity: This term is used to characterize the capacity of an aquifer to release ground water from storage in response to a decline in water levels.



Source: Strata, 2012a.

Figure 3.15

Potentiometric Contours of Ground Water in Ore-Zone Aquifer

1

Isopachs of this structure show that it ranges in thickness from less than 3 m [10 ft] to more than 30 m [100 ft] (Strata, 2011a). Above the ore zone, the mudstone and claystone of the Lance Formation form the upper confining unit, as noted above, ranging in thickness from less than 6 m [20 ft] to more than 24 m [80 ft] (see Figure 3.14).

The FH sandstones, shales, and silts have been studied extensively through both core analysis and aquifer tests. Seven pumping tests targeting the ore zone were performed by the Applicant at six separate well clusters. Applicable methodology and testing were used and those results are shown in Table 3.5 (and additional details can be found in Strata, 2011a).

Table 3.5
Ore-Zone Aquifer Hydrogeologic Characteristics

	Transmissivity m^2/day [ft^2/day]	Hydraulic Conductivity cm/s [ft/day]	Storativity (Unitless)
Minimum	0.353 [3.80]	4.59E-05 [0.13]	4.00E-06
Maximum	34.2 [368]	2.69E-03 [7.62]	1.50E-04
Median	8.20 [88.3]	1.25E-03 [3.55]	6.10E-05
Geometric Mean	6.10 [65.6]	6.74E-04 [1.91]	4.50E-05
Average	8.15 [87.8]	1.15E-03 [3.26]	6.70E-05

Source: Addendum 2.7-F, Table 3, in Strata, 2011a.

The aquifer properties determined by the 2010 tests are comparable to results reported for previous pumping tests within the Ross Project area (Strata, 2011b).

The Applicant developed a static piezometric surface (i.e., a map showing the static water levels expressed as feet above sea level) for the ore-zone aquifer (see Figure 3.15). The ore zone's potentiometric surface shows a distinct cone of depression near the No. 21-19 well cluster that has resulted from 30 years of ground-water withdrawals by oil-field water-supply wells completed in the OZ aquifer. This pumping has changed the hydraulic gradient and the direction of ground-water flow throughout most of the Ross Project area. The potentiometric surface near the No. 34-7 well cluster, which is farthest from the oil-field water-supply wells that have been pumping for 30 years, has been least affected by such pumping. Based upon the Applicant's estimates, approximately 46 m [150 ft] of drawdown (i.e., the decline in water level) in the ore-zone aquifer has occurred in the vicinity of the No. 21-19 well cluster since pumping began in 1980 for local oil-field water-flood operations (Strata, 2011b). An updated map of the ore zone's piezometric surface prepared by the Applicant using a ground-water model provides additional detail of the drawdown associated with the withdrawals from the Merit Oil Company's (Merit's) three water supply wells (Strata, 2012b).

The Applicant also calculated horizontal gradients and vertical-head differences between the OZ, SM, and DM aquifers (Strata, 2011a). Horizontal gradients in the OZ aquifer are toward the oil-field water-supply wells, and they range from 0.009 – 0.025, with the steeper gradients being in the vicinity of the oil-field water-supply wells. Vertical-head differences between the OZ and the DM aquifers range from 6 m [20 ft] downwards in the northwestern portion of the Ross Project area to 3 m [10 ft] upwards in the area of the oil-field water-supply wells. Vertical gradients are downwards from the SM to the OZ aquifers, with head differences ranging from 15 – 46 m [50 – 150 ft].

The OZ aquifer remains a confined aquifer across the Ross Project area, with potentiometric heads ranging from approximately 46 m [150 ft] to more than 122 m [400 ft] above the top of the ore zone (Strata, 2011a). Recharge to the Fox Hills Formation and, hence, the OZ aquifer, is from precipitation along the outcrop, ground water from the subcrop beneath alluvium in the valley of the Little Missouri River and its tributaries, and from leakage from the overlying Lance Formation. Under current conditions, discharge is to the oil-field water-supply wells.

Continuous measurement of water levels for the period April to October 2010 were recorded by the Applicant in six monitoring wells completed in the OZ aquifer and are presented graphically by the Applicant in its TR (Strata, 2011b). The hydrograph for Well 34-7OZ, which is located farthest from the oil-field water-supply wells, displays the least variation. The variability in the ore-zone-well hydrographs is a function of the well locations relative to the oil-field water-supply wells in Sections 18 and 19. The wells located closest to this area (Wells 21-19OZ, 34-18OZ, 14-18OZ, and 42-19OZ) display water-level fluctuations that are related to pumping of the water-supply wells. Pumping starts and stops that occurred in late June though early July 2010 are apparent on hydrographs from these wells. A rapid water-level rise (over 4.6 m [15 ft] in Well 21-19OZ) in late September 2010 was attributed to a temporary cessation of pumping. This was followed by a rapid decline in the water level, which was interpreted as an indication of resumption of pumping.

Other than the aquifer testing that took place over the period above, other recorded perturbations are related to sampling events and barometric fluctuations. The barometric fluctuations are less than 0.2 m [0.5 ft]. During January through October 2010, the hydrograph for Well 34-7OZ showed a steady increase of approximately 0.6 m [2 ft]. The cause of this increase has not been identified; similar patterns have not been seen in other ore-zone well hydrographs. The hydrograph for Well 12-18OZ varies within a range of approximately 0.76 m [2.5 ft]. Most of the water-level changes are interpreted as responses to barometric pressure changes. However, fluctuations in the late June though early July time period coincide with pumping-related water-level changes observed in the group of four wells discussed above.

The shale, claystone, and mudstone interval, the BFH horizon and lower confining unit, separates the DM aquifer from the FH horizon. This low-permeability unit ranges in thickness from less than 3 m [10 ft] to 24 m [80 ft]. Vertical hydraulic conductivities for this interval are expected to be comparable to that of the Pierre Shale (i.e., 2×10^{-7} cm/s [5×10^{-4} ft/day] or less), based on their similar lithologies.

Pumping tests were performed on six well clusters with pumping from the OZ aquifer and monitoring of the SA, SM, and DM aquifers. No effects from pumping were measured in any of the overlying SA or SM wells. Water levels in two of the six underlying DM wells (Nos. 14-18DM

and 34-18DM) declined slightly during pumping. The lower confining unit is 9 – 15 m [30 ft – 50 ft] thick in the portions of the Ross Project area where these wells are located. The response of the DM-completed wells has been interpreted by the Applicant as being due to vertical leakage across the lower confining unit via drillholes that are in close proximity to the pumping-test well cluster that have not yet been located and plugged. Prior to the Applicant's conducting the aquifer test at Well 12-18, all exploration drillholes in the vicinity of that well cluster were located and plugged, and no response of the DM-aquifer well was observed during that pumping test.

Communication between the OZ and DM aquifers in locations where the lower confining unit has been breached was demonstrated by: 1) the responses observed in the DM zone for two pumping tests, where old exploration drillholes had not been plugged and 2) the similarities in the potentiometric heads in the DM, OZ and SM aquifers in the vicinity of the oil-field water-supply wells, which are completed in both the OZ and DM intervals. To prevent communication between aquifers during uranium-recovery operation, the Applicant proposes to actively locate and plug all exploration drillholes prior to beginning wellfield operations. The Applicant proposes to actively locate and plug all exploration wells prior to beginning wellfield operation.

<u>Ground-Water Quality</u>

The Applicant has compiled regional water-quality data listed in the USGS's NWIS from 16 wells located in Crook and Campbell Counties that were completed in the Lance and Fox Hills aquifers (Strata, 2011a; USGS, 2012b). Data from these wells show a water quality of the Lance and Fox Hills aquifers that is slightly alkaline (i.e., median pH of 8.4) with a median TDS of 1,130 mg/L, with sodium and bicarbonate as the dominant dissolved species.

The water quality of shallow ground water from alluvial deposits on the Lance Formation is dominated by sodium, sulfate, and bicarbonate with moderate levels of TDS of approximately 1,200 – 1,400 mg/L (Langford, 1964). Rankl and Lowry (1990) noted that the water quality in the aquifer sequence through the Lance and Fox Hills Formations depends upon the stratigraphy and varies according to well depth. As well depths increase from 30.5 – 152 m [100 – 500 ft], TDS in the waters decrease sharply due to declining concentrations of calcium, magnesium, and sulfate. Water from wells at depths of 152 m [500 ft] or greater are dominated by bicarbonate and sodium.

The deep-injection-well UIC Class I permit application for the Ross Project contains estimates of water quality in deeper formations, from the Minnelusa through the Cambrian Formations (WDEQ/WQD, 2011). The Minnelusa, Deadwood, and Flathead Formations are expected to have TDS concentrations greater than 10,000 mg/L, while the Madison Formation likely has a TDS concentration around 1,000 mg/L in the vicinity of the Ross Project area.

To comply with the requirements of 10 CFR Part 40, Appendix A, Criterion 7, the Applicant has collected pre-licensing baseline ground-water-quality data from the site characterization of the Ross Project area. These data originate from three sources: 1) the Applicant's own baseline site-characterization monitoring network at the Ross Project and the respective analytical data; 2) existing water-supply-wells sampling and analysis data; and 3) historical data from the former Nubeth operation (Nuclear Dynamics, 1978). The first source of ground-water quality data is the Applicant's own ground-water-monitoring network which it constructed in 2009 and 2012 and which consists of six monitoring-well clusters and four piezometers (Strata, 2011a). Each

well cluster includes four monitoring wells targeting the OZ aquifer and the aquifer units above the ore zone (SA and SM) and below the ore zone (DM) (see Figure 3.14). The Applicant provided construction details of the wells and methods used for ground-water sampling in its ER (Strata, 2011a). The four piezometers in the SA were installed in the portion of the Ross Project area proposed for the central processing plant (CPP) and surface impoundments (Strata, 2011a).

Analytical data from the 2010 quarterly samples are provided in the Applicant's ER and TR (Strata, 2011a; Strata, 2011b). Water-quality data from samples collected in 2011 and submitted to WDEQ/LQD are provided in information received subsequently from the Applicant (Strata, 2012a). The data from 2011 are generally consistent with the 2009 and 2010 data, indicating a representative characterization of ground-water quality. The data are summarized in the following paragraphs.

The average concentrations of the major cations and anions, in addition to the median field measurements of pH and average dissolved-oxygen measurements, are presented on the next page in Table 3.6. Dissolved solids (TDS) in the ground water at the Ross Project area are predominately bicarbonate-sulfate-sodium, which differs from typical ground water described in the GEIS, which is the bicarbonate-sulfate-calcium type. The pH conditions of greater than 8.5 are consistent with bicarbonate water, and dissolved oxygen levels of less than 5 mg/L suggest low-oxygen conditions. These two parameters are typical of uranium-bearing aquifers (NRC, 2009b).

The water quality data indicates distinctive water quality in each aquifer unit, i.e., the SA, SM, OZ, and DM. The distinctive water quality is made possible by the stratigraphic layers between the aquifer units that prevent vertical movement of water between the units. Average values of TDS in Strata's ground-water baseline monitoring network range from 730 mg/L in the SA to 1574 mg/L in the OZ. Ground-water from piezometers in the SA show that the TDS increases sharply with increasing distance from the Little Missouri River (Strata, 2011a).

The effects on Strata's pre-licensing baseline water quality from Nubeth can be evaluated by comparing the Strata's data with baseline data reported by Nuclear Dynamics (1978). The data from Strata (2011a, 2012a) include all four aquifer units. Nuclear Dynamics (1978) reports data from only the ore zone and the aquifer above the ore zone which is likely equivalent to the SM. The comparison shows that the TDS in the SM and OZ have decreased since 1978 (see also SEIS Section 5.7.2).

Table 3.7 summarizes the concentrations of metals, radiological parameters, ammonium, and fluoride measured by Strata in the aquifer units. With a few exceptions, the 1978 mean values are within the range of values reported by Strata (2011a, Strata, 2012a). Strata's pre-licensing baseline concentrations of arsenic, radium-226, and gross beta are slightly lower in the ore zone than was measured in 1978 (Table 3.7). Strata's concentrations of cadmium, lead and nickel are slightly lower in both the ore zone and the aquifer above the ore zone than in 1978.

Table 3.6
Average Concentrations of Major Cations and Anions in Ground Water from the Ore-Zone (OZ) Aquifer and Aquifers Above (SM & SA) and Below (DM) the Ore Zone†

Constituent	Units	Ross Project Monitoring-Well Data (Strata, 2011a; Strata, 2012a)				Nubeth Data (Nuclear Dynamics, 1978)	
		Surficial Aquifer (SA)	Shallow-Monitoring Aquifer (SM)	Ore-Zone Aquifer (OZ)	Deep-Monitoring Aquifer (DM)	Ore Zone	Above Ore Zone
Bicarbonate	mg/L	339	449	583	295	592	653
Calcium	mg/L	21	2	6	3	6.2	6
Carbonate	mg/L	N/A	98	26	103	22	17
Chloride	mg/L	29	4	7	491	10	6
Magnesium	mg/L	13	<1**	2	<1**	2.7	2.7
Potassium	mg/L	12	15	6	19	3.2	3.9
Sodium	mg/L	224	417	545	520	622	592
Sulfate	mg/L	172	318	602	31	715	567
Total Dissolved Solids (TDS)	mg/L	730	1145	1574	1321	1629	1498
Dissolved Oxygen (DO)	mg/L	3.2	3.9	2.8	4.7	N/A***	N/A***
pH	Std. Units	8.6	9.15	8.7	9.4	8.8	8.6

Source: Strata, 2011a; Strata, 2012a; Nuclear Dynamics, 1978.

Notes:

† All values are mean concentrations, except for pH from Strata data, which is the median value, and pH reported in Nubeth, which is a mean value.

† Shading indicates a value greater than WDEQ and U.S. Environmental Protection Agency (EPA) Water Quality Standards.

* 34 percent of the 32 reported concentrations were below the detection limit, which precluded calculation of an average or median value; minimum and maximum values for carbonate concentration in mg/L were less than 5 and 218 mg/L, respectively, for this dataset.

** "<" = "Less than," where the value following the "<" is the detection limit.

***N/A = Not available.

Table 3.7
Summary of Water Quality of Ground Water from the Ore-Zone (OZ) Aquifer and Aquifers Above (SA & SM) and Below (DM) the Ore Zone†
2009, 2010, and 2011 Data from Ross Project Monitoring Wells Nos. 12-18, 14-18, 21-19, 34-7, 34-18, and 42-19
(As reported in Strata, 2011a; Strata, 2012a.)

		Ross Project Monitoring-Well Data								Nubeth Data	
		SA		SM		OZ		DM		Ore Zone	Above Ore Zone
Constituent*	Units	Min	Max	Min	Max	Min	Max	Min	Max	Mean	Mean
Ammonia	mg/L	<0.1**	0.6	<0.1	2.8	<0.1	0.8	<0.1	3.9	0.73	0.53
Arsenic	mg/L	<0.005	<0.005	<0.005	0.023	<0.005	<0.005	<0.005	0.014	0.11	<0.005
Barium	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.01	<0.10
Boron	mg/L	<0.1	0.3	0.2	0.8	0.3	0.6	0.3	1	0.32	0.6
Cadmium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.004
Chromium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/L	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Fluoride	mg/L	0.1	0.8	0.8	2.1	0.2	1.3	0.8	1.6	N/A**	N/A
Iron	mg/L	<0.05	0.66	<0.05	0.21	<0.05	0.69	<0.05	0.4	0.09	0.074
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.037
Mercury	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00004	0.00003
Manganese	mg/L	<0.02	0.36	<0.02	0.88	<0.02	0.06	<0.02	0.37	0.012	0.014
Molybdenum	mg/L	<0.02	0.07	<0.02	0.05	<0.02	<0.02	<0.02	0.06	<0.003	<0.005
Nickel	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.017	0.016
Selenium	mg/L	<0.005	0.008	<0.005	0.017	<0.005	0.009	<0.005	0.03	0.003	<0.005
Silver	mg/L	<0.003	0.006	<0.003	0.011	<0.003	<0.003	<0.003	0.005	<0.003	<0.003
Uranium	mg/L	<0.001	0.007	<0.001	0.004	0.005	0.109	<0.001	0.003	0.073	0.004
Vanadium	mg/L	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.003	<0.003
Zinc	mg/L	<0.01	1.32	<0.01	0.03	<0.01	0.02	<0.01	0.09	0.011	0.016
Radium-226	pCi/L	<0.2	0.5	<0.2	3.7	0.6	12.1	<0.2	0.7	22	0.06
Radium-228	pCi/L	<1	1.8	<1	12.27	<1	1.6	<1	2.2	N/A	N/A
Gross Alpha	pCi/L	<6	13.8	<7	12.2	<5	222	<14	28.3	98	1.4
Gross Beta	pCi/L	<8	17.6	<8	319***	<8	46.8	<20	41	97	3.2

Source: Strata, 2011a; Strata, 2012a; Nuclear Dynamics, 1978.
Notes on next page.

Notes for Table 3.7:

† Analytical results are presented as minimum and maximum values for each constituent; the number of measurements that are less than the detection level precludes calculation of mean concentrations.

† Shading indicates a value greater than WDEQ and EPA Water Quality Standards.

*All constituents reported as dissolved concentrations (i.e., the samples were filtered), except ammonia and fluoride.

** "<" = "Less than," where the value following the "<" value is the detection limit.
"N/A" = Datum not available.

***319 appears to be an anomalous value; the next lowest value is 42.5.

The similarity between the pre-licensing baseline concentrations in the ore zone and aquifer above the ore zone suggests that Nubeth did not alter the baseline water quality. Table 3.8 presents the WDEQ and EPA water-quality standards for constituents that were present in Strata's that were found to exceed the standards in Strata's pre-licensing baseline data (WDEQ/WQD, 2005b; 40 CFR Part 41). Concentrations of constituents that exceed the standards are indicated by shading in Tables 3.6 and Table 3.7.

Table 3.8
Water-Quality Standards Exceeded in Ground Water at the Ross Project (Pre-Licensing Baseline)

Water-Quality Constituent	Units	WDEQ Class I Domestic	WDEQ Class II Agriculture	EPA Primary MCL	EPA Secondary MCL
Ammonia	mg/L	0.5	N/A*	N/A	N/A
Arsenic	mg/L	0.05	0.1	0.01	N/A
Boron	mg/L	0.75	0.75	N/A	N/A
Chloride	mg/L	250	100	N/A	250
Iron	mg/L	0.3	5	N/A	0.3
Manganese	mg/L	0.05	0.2	N/A	0.05
Selenium	mg/L	0.05	0.02	0.05	N/A
Sulfate	mg/L	250	200	N/A	250
Total Dissolved Solids (TDS)	mg/L	500	2000	N/A	500
Uranium	mg/L	N/A	N/A	0.03	N/A
Radium-226 + 228	pCi/L	5	5	5	N/A
Gross Alpha	pCi/L	15	15	15	N/A

Source: WDEQ/WQD, 2005b.

Notes:

* N/A = Not applicable.

Per the WDEQ/LQD Hydrology Guideline No. 8 and NRC Regulatory Guide 4.14, the water-quality data produced by the Applicant and used to compare with the water-quality standards are dissolved concentrations except for ammonium, chloride, fluoride, sulfate, and TDS (WDEQ/LQD, 2005b; NRC, 1980).

Typical of uranium-bearing aquifers described in the GEIS (NRC, 2009b), the average TDS of each aquifer unit associated with Ross Project area exceed EPA's respective Secondary drinking water maximum contaminant levels (MCLs) of 500 mg/L, but they are within all the upper limits set by WDEQ for Class II Agriculture and Livestock Classes of Use (see Tables 3.6 and 3.8) (WDEQ/WQD, 2005b). The two upper aquifers, SA and SM, contain lower TDS than the lower units, and the OZ aquifer contains the highest average TDS.

Comparison of the metals, radiological parameters, ammonium, and fluoride to EPA's MCLs for drinking water and WDEQ standards are provided in Tables 3.7 and 3.8. Ammonia was measured in all four aquifer units at concentrations greater than WDEQ's standard for domestic use, 0.5 mg/L. Iron and manganese are present in all four aquifer units in concentrations greater than WDEQ's standard for domestic use and EPA's secondary MCL for drinking water. Arsenic was measured at concentrations greater than EPA's primary drinking water standard in the SM and DM but less than WDEQ's standard for domestic use. Boron was present at concentrations greater than the WDEQ standard for domestic use in the SM and DM. Uranium and radium-226 were present in the OZ at concentrations greater than the standards (see Table 3.8). Gross alpha exceeded the standards in the OZ and DM aquifer units.

As part of its ground-water sampling and analysis efforts, the Applicant identified 29 currently operable water-supply wells within the Ross Project area and the surrounding 2-km (1.2-mi) area (Strata, 2011a). These wells included two industrial wells, 12 domestic wells, and 15 stock wells. These well locations are shown in the Applicant's ER (Strata, 2011a).

The two industrial wells, completed at depths of 163 m and 229 m [536 ft and 750 ft], were permitted in the early 1980s and provide water for enhanced oil recovery (EOR). Water used in EOR is injected into the oil-bearing rock to displace oil from the rock, thus allowing the oil to be pumped to the surface. Well No. 19X-18 was originally used by Nubeth as a recovery well for its research and development activities, before being converted to a water-supply well for the nearby oil production. The Applicant's review of the well permit reports listed in the WSEO database during 2010 determined general information about each well (WSEO, 2006; Strata, 2011a). Completion depths of permitted stock wells range from 10 – 93 m [40 – 304 ft]. Domestic wells are generally deeper than the stock wells, ranging from 46 – 180 m [150 – 600 ft]. The limited information available on these wells precluded a determination of which aquifer was supplying water to the domestic wells.

The water-supply wells were sampled in consecutive quarters in 2009 and 2010 with the same methods established for the monitoring wells (Strata, 2011a). The results of the water-quality analyses are provided in the Applicant's ER (Strata, 2011a; Strata, 2011b). Comparison between the measured water quality and WDEQ's standards and EPA's drinking- water standards are also provided in the Applicant's ER (WDEQ/WQD, 2005b; 40 CFR Part 141; Strata, 2011a). As described below for each type of well, these analyses showed that the local water supply's contaminants generally exceeded EPA's drinking water standards and often exceeded Wyoming's less stringent quality standards for agricultural use.

Domestic Wells

TDS in samples from the domestic wells consistently exceeded the Wyoming Class I (Domestic) use and the EPA Secondary MCL standards. Sulfate exceeded the Wyoming Class I, the Wyoming Class II and the EPA Secondary MCL standards in 7 of the 13 wells sampled. Gross

alpha in excess of the Wyoming Class I and Class II standards, as well as the EPA Primary MCL of 0.55 Bq/L [15 pCi/L], was measured in samples from 4 of the 13 domestic wells. The Wyoming Class I and the EPA Secondary MCL iron standards were exceeded in two of the wells.

Industrial Wells

Samples from the industrial wells exceeded the Wyoming Class II standard and the EPA Secondary MCL standards for TDS and sulfate. The Wyoming Class II and the EPA MCL standards were exceeded in Well No. 19XX18 for radiological parameters: uranium, radium-226+228, and gross alpha. The gross-alpha standard was also exceeded in samples from Well No. 22X-19.

Stock Wells

The water quality of stock wells is variable. TDS often ranged from 370 to 1,610 mg/L, often exceeding the EPA Secondary MCL standard, but also consistently less than the Wyoming Class II use standard of 2,000 mg/L. Sulfate, ranging from 28 to 679 mg/L, often exceeded the Wyoming Class II and the EPA Secondary MCL standards. Gross alpha exceeded both the Class II standard and the MCL in 7 of the 15 stock wells. Selenium exceeded the Wyoming Class II and the EPA Primary MCL standards in one well.

<u>**Ground-Water Uses**</u>

In order to assess historical and current ground-water use, ground-water rights and unregistered water wells were investigated by the Applicant within the Ross Project area and the surrounding 3.2-km [2-mile] vicinity. Sources of data included WSEO-registered wells, landowner interviews, and field investigations (WSEO, 2006). The search revealed 119 ground-water rights and unregistered wells. The locations and uses of these wells are summarized in the Applicant's ER (Strata, 2011a). Historical ground-water use began with the first domestic and livestock well in 1918. From approximately 1918 – 1977, ground water was used primarily for domestic and livestock consumption, with lesser amounts of water used for irrigation.

In 1977, Nubeth permitted 14 monitoring and industrial-use wells associated with its research and development operation. In addition, between 1980 and 1991, many industrial and miscellaneous wells associated with oil and gas production were permitted in and around the Ross Project area. These include three wells within the Ross Project area itself (Nos. P50917W, P67746W and P67747W) that are currently used as water-supply wells for EOR operations (i.e., water flooding) (Strata, 2011a). In 1981, International Minerals & Chemical Corporation (IM&CC) permitted five pits (Nos. P58895W, P58896W, P58899W, P58902W and P58905W) for dewatering and dust suppression associated with bentonite mining. According to WSEO records, the water rights were cancelled prior to 2001 at the request of IM&CC.

Between 1991 and 2009, the only ground-water rights that have been filed within the Ross Project and surrounding areas are for domestic and livestock use. In 2009, the Applicant obtained ground-water rights for its pre-licensing baseline monitoring wells. The historical ground-water use within the Ross Project area is summarized in Table 3.9.

Table 3.9 Historical Ground-Water Use within Three Kilometers [Two Miles] of Ross Project Area			
Use	**Number of Wells**	**Percent of Total Use**	**Appropriation Dates**
Domestic Only	5	4	1943 – 1995
Domestic and Stock	15	13	1918 – 2003
Domestic, Stock, and Irrigation	1	<1	1972 – 1972
Stock Only	34	29	1933 – 2010
Stock and Irrigation	1	<1	1961 – 1961
Monitoring	39	33	1977 – 2010
Industrial or Miscellaneous	24	20	1977 – 1991
TOTAL	119	100	1918 – 2010

Source: Strata, 2011a.

Within the Ross Project area, ground-water use follows a similar pattern to that observed within the 3.2-km [2-mile] surrounding vicinity, except that historical use has been livestock only (no domestic or irrigation use). More recent uses include monitoring-well use as well as industrial uses associated with Nubeth and with water supply for oil and gas operations. Most of the ground-water rights represented in Table 3.9 have been cancelled or are no longer active. Current ground-water use is limited to four livestock wells, the Applicant's regional pre-licensing baseline monitoring wells, and three industrial wells (i.e., water supply for oil and gas production). The stock wells are completed at total depths ranging from 39 – 81 m [128 – 265 ft], which are considerably above the ore-zone aquifer. The currently operating, industrial water wells are completed at total depths of 163 – 229 m [536 – 750 ft]. Together, these wells withdraw an average of approximately 1.9 L/s [30 gal/s] from the ore-zone aquifer.

3.6 Ecology

The Proposed Action is located within the Powder River Basin of the Northwest Great Plains ecoregion. As described in the GEIS, this area is characterized by rolling prairie and dissected river breaks surrounding the Powder, Cheyenne, and Upper North Platte Rivers (NRC, 2009b). Vegetation within this region is composed of sagebrush and mixed-grass prairie dominated by blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), needle-and-thread grass (*Stipa comata*), rabbitbrush (*Chrysothamnus sp.*), fringed sage (*Artemisia frigida*), and other forbs, shrubs, and grasses (NRC, 2009b).

The Applicant has conducted a number of ecological studies of the proposed Ross Project area to address the guidelines indicated in NUREG–1569, including the identification of important species and their relative abundance, and to meet the applicable Wyoming requirements (NRC, 2003). These studies included vegetation and wildlife surveys conducted on the Ross Project area in late 2009 and 2010 (Strata, 2011a).

3.6.1 Terrestrial Species

3.6.1.1 Vegetation

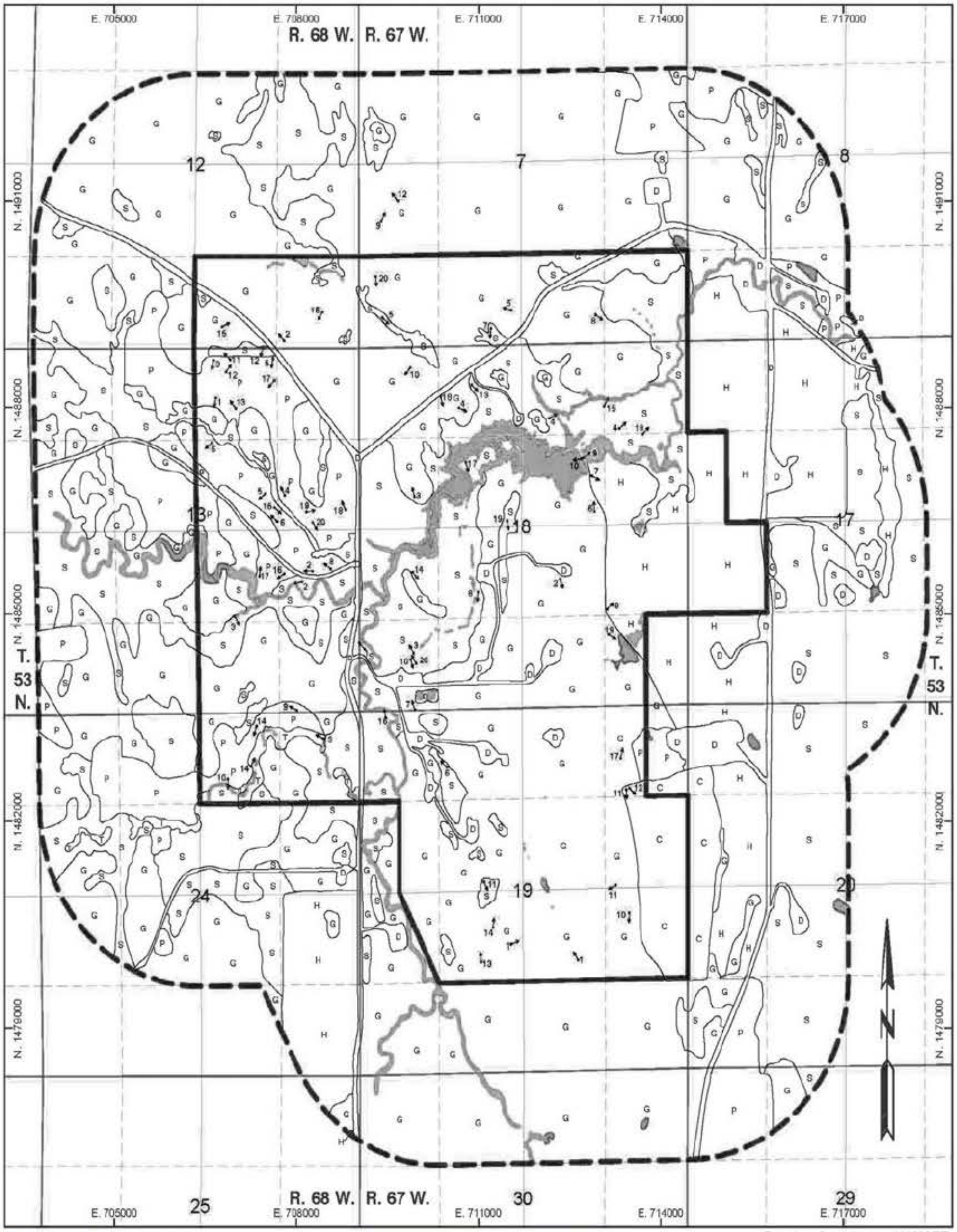
The Applicant conducted pre-licensing baseline vegetation and wetland surveys during 2009 and 2010, in accordance with State and Federal guidelines (Strata, 2011a). The spatial distribution of the vegetation types within the Ross Project area are shown in Figure 3.16. The vegetation mapped at the Ross Project area included upland grassland, sagebrush shrubland, pastureland, hayland, reservoir/stock pond, wetland, disturbed land, cropland, and wooded draw. No threatened or endangered plant species have been documented on the Ross Project area.

Each vegetation community was investigated by the Applicant to establish a baseline in support of the Proposed Action. In terms of diversity, the sagebrush-shrubland vegetation type exhibited the highest total number of individual plant species recorded in 2010, followed by the upland-grassland and pasture-land vegetation types (see Table 3.10).

Table 3.10
Species Diversity by Vegetation Type at Ross Project Area

Species Type	Number of Individual Plant Species Recorded		
	Sagebrush Shrubland	**Upland Grassland**	**Pastureland**
Perennials			
Grass	16	16	9
Grass-like	2	2	0
Forb	28	27	6
Subshrub	4	4	1
Full Shrub	5	1	1
Succulent	1	1	0
Subtotal	**56**	**51**	**17**
Annuals			
Grass	2	2	0
Forb	7	3	1
Subtotal	**9**	**5**	**1**
TOTAL	**65**	**56**	**18**

Source: Strata, 2011a.



Source: Strata, 2012a.

Drawing Coordinates: WY83EF

Figure 3.16

Baseline Vegetation at Ross Project Area

Several species of designated and prohibited noxious weeds listed by the *Wyoming Weed and Pest Control Act* were identified on the Ross Project area. These species included field bindweed (*Convolvulus arvensis*), perennial sow thistle (*Sonchus arvensis*), quackgrass (*Agropyron repens*), Canada thistle (*Cirsium arvense*), houndstongue (*Cynoglossum officinale*), leafy spurge (*Euphorbia esula*), common burdock (*Arctium minus*), Scotch thistle (*Onopordum acanthium*), Russian olive (*Eleagnus angustifolia*), and skeletonleaf bursage (*Ambrosia tomentosa*). These weed species may be locally abundant in small areas, especially around the Oshoto Reservoir and along the Little Missouri River and Deadman Creek, but they were not common throughout the entire area of the Ross Project.

Selenium-indicator species identified on the Ross Project area in 2010 included two-grooved milkvetch (*Astragalus bisulcatus*), woody aster (*Xylorhiza glabriuscula*), and stemmy goldenweed (*Haplopappus multicaulis*); however, these indicator species were not abundant. Little larkspur (*Delphinium bicolor*), locoweed (*Oxytropis sericea* and *Oxytropis lambertii*), and meadow deathcamas (*Zigadenus venenosus*) are poisonous plants that were observed on the Ross Project area in limited numbers (locoweed is only poisonous for cattle). Cheatgrass (*Bromus tectorum*), although not a State-listed noxious weed, was abundant in some areas within the Ross Project area (Strata, 2011a).

3.6.1.2 Wildlife

Habitat Description

Background information on terrestrial vertebrate wildlife species in the vicinity of the Ross Project area was obtained from several sources, including records from the WGFD, BLM, and USFWS as well as from GEIS Section 4.4.5 (NRC, 2009b). Previous site-specific data for the Ross Project area and its surrounding environs were obtained from those same sources and Nubeth's *Environmental Report Supportive Information* (ND Resources, 1977). In addition, the Applicant completed site-specific wildlife surveys from November 2009 through October 2010 to establish one year of baseline site-characterization data (Strata, 2011a). Over 140 different species were noted during these surveys or documented by other sources, e.g. WGFD (see Table 3.11). The surveys also focused on the Applicant obtaining information regarding bald eagles' winter roosts; however, all nesting raptors, threatened and endangered species, the BLM's Sensitive Species (BLMSS), and the USFWS's "Migratory Bird Species of Management Concern in Wyoming" (SMC) (also known as "Migratory Birds of High Federal Interest") were included in the survey procedures. Surveys were also conducted on the Ross Project area for swift fox, breeding birds, and northern leopard frogs. In addition to those species that were targeted, others were noted when observed.

Table 3.11
Wildlife Species Observed on or near Ross Project Area

Scientific Name	Common Name
Mammals	
Sylvilagus audubonii	Desert Cottontail
Lepus californicus	Black-tailed Jackrabbit
Lepus townsendii	White-tailed Jackrabbit

Table 3.11 Wildlife Species Observed on or near Ross Project Area (Cont.)	
Scientific Name	**Common Name**
Mammals (*Continued*)	
Tamias minimus	Least Chipmunk
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel
Cynomys ludovicianus	Black-tailed Prairie Dog
Sciurus niger	Eastern Fox Squirrel
Thomomys talpoides	Northern Pocket Gopher
Dipodomys ordii	Ord's Kangaroo Rat
Castor Canadensis	Beaver
Peromyscus maniculatus	Deer Mouse
Neotoma cinerea	Bushy-tailed Woodrat
Microtus 0ochrogaster	Prairie Vole
Ondatra zibethicus	Muskrat
Erethizon dorsatum	Porcupine
Canis latrans	Coyote
Vulpes vulpes	Red Fox
Procyon lotor	Raccoon
Mustela frenata	Long-tailed Weasel
Taxidea taxus	Badger
Mephitis mephitis	Striped Skunk
Felis concolor	Mountain Lion
Felis rufus	Bobcat
Cervus elaphus	American Elk
Odocoileus hemionus	Mule Deer
Odocoileus virginianus	White-tailed Deer
Antilocapra americana	Pronghorn
Birds	
Branta canadensis	Canada Goose
Cygnus buccinator	Trumpeter swan
Cygnus columbianus	Tundra Swan
Anas strepera	Gadwall
Anas americana	American Wigeon
Anas platyrhynchos	Mallard
Anas discors	Blue-winged Teal
Anas crecca	Green-winged Teal
Anas cyanoptera	Cinnamon Teal
Anas clypeata	Northern Shoveler
Anas acuta	Northern Pintail
Aythya valisineria	Canvasback
Aythya americana	Redhead
Aythya collaris	Ring-necked Duck
Aythya affinis	Lesser Scaup

Table 3.11
Wildlife Species Observed on or near Ross Project Area (Cont.)

Scientific Name	Common Name
Birds (*Continued*)	
Bucephala albeola	Bufflehead
Oxyura jamaicensis	Ruddy Duck
Podilymbus podiceps	Pied-billed Grebe
Podiceps auritus	Horned Grebe
Podiceps nigricollis	Eared Grebe
Pelecanus erythrorhynchos	White Pelican
Phalacrocorax auritus	Double-crested Cormorant
Ardea herodias	Great Blue Heron
Cathartes aura	Turkey Vulture
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Circus cyaneus	Northern Harrier
Accipiter striatus	Sharp-shinned Hawk
Accipiter cooperii	Cooper's Hawk
Buteo swainson	Swainson's Hawk
Buteo jamaicensis	Red-tailed Hawk
Buteo regalis	Ferruginous Hawk
Buteo lagopus	Rough-legged Hawk
Aquila chrysaetos	Golden Eagle
Falco sparverius	American Kestrel
Falco mexicanus	Prairie Falcon
Centrocercus urophasianus	Greater Sage-grouse
Tympanuchus phasianellus	Sharp-tailed grouse
Meleagris gallopavo	Wild Turkey
Porzana carolina	Sora Rail
Fulica americana	American Coot
Charadrius vociferous	Killdeer
Recurvirostra americana	American Avocet
Actitis macularia	Spotted Sandpiper
Bartramia longicauda	Upland Sandpiper
Gallinago delicata	Wilson’s Snipe
Phalaropus tricolor	Wilson's Phalarope
Larus californicus	California Gull
Larus argentatus	Herring Gull
Chlidonias niger	Black Tern
Columba livia	Rock Pigeon
Zenaida macroura	Mourning Dove
Bubo virginianus	Great Horned Owl
Asio flammeus	Short-eared Owl
Chordeiles minor	Common Nighthawk
Ceryle alcyon	Belted Kingfisher

Table 3.11 Wildlife Species Observed on or near Ross Project Area (Cont.)	
Scientific Name	**Common Name**
Birds (*Continued*)	
Picoides villosus	Hairy Woodpecker
Colaptes auratus	Northern Flicker
Contopus sordidulus	Western Wood-Pewee
Sayornis saya	Say's Phoebe
Tyrannus verticalis	Western Kingbird
Tyrannus tyrannus	Eastern Kingbird
Eremophila alpestris	Horned Lark
Tachyceneta bicolor	Tree Swallow
Tachycineta thalassina	Violet-green Swallow
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Riparia riparia	Bank Swallow
Hirundo pyrrhonota	Cliff Swallow
Hirundo rustica	Barn Swallow
Cyanocitta cristata	Blue jay
Pica pica	Black-billed Magpie
Corvus brachyrhynchos	American Crow
Corvus corax	Common Raven
Parus atricapillus	Black-capped Chickadee
Sitta canadensis	Red-breasted Nuthatch
Salpinctes obsoletus	Rock Wren
Troglodytes aedon	House Wren
Sialia currucoides	Mountain Bluebird
Turdus migratorius	American Robin
Oreoscoptes montanus	Sage Thrasher
Toxostoma rufum	Brown Thrasher
Sturnus vulgaris	European Starling
Lanius ludovicianus	Loggerhead Shrike
Vermivora celata	Orange-crowned Warbler
Dendroica petechia	Yellow Warbler
Dendroica coronate	Yellow-rumped Warbler
Geothlypis trichas	Common Yellowthroat
Wilsonia pusilla	Wilson's Warbler
Spizella passerine	Chipping Sparrow
Spizella breweri	Brewer's Sparrow
Pooecetes gramineus	Vesper Sparrow
Chondestes grammacus	Lark Sparrow
Calamospiza melanocorys	Lark Bunting
Ammodramus savannarum	Grasshopper Sparrow
Junco hyemalis	Dark-eyed Junco
Calcarius mccownii	McCown's Longspur
Agelaius phoeniceus	Red-winged Blackbird

Table 3.11
Wildlife Species Observed on or near Ross Project Area (Cont.)

Scientific Name	Common Name
Birds (*Continued*)	
Sturnella neglecta	Western Meadowlark
Xanthocephalus xanthocephalus	Yellow-headed Blackbird
Euphagus cyanocephalus	Brewer's Blackbird
Quiscalus quiscula	Common Grackle
Molothrus ater	Brown-headed Cowbird
Icterus bullockii	Bullock's Oriole
Carpodacus mexicanus	House Finch
Carduelis pinus	Pine Siskin
Passer domesticus	House Sparrow
Amphibians	
Ambystoma tigrinum	Tiger Salamander
Pseudaris triseriata maculate	Boreal Chorus Frog
Rana pipiens	Northern Leopard Frog
Reptiles	
Phrynosoma douglassi brevirostre	Eastern Short-horned Lizard
Sceloporus graciosus graciosus	Northern Sagebrush Lizard
Chelydra serpentina serpentina	Common Snapping Turtle
Chrysemys picta belli	Western Painted Turtle
Crotalus viridis viridis	Prairie Rattlesnake
Pituophis melanoleucas sayi	Bullsnake
Thamnophis elegans vagrans	Wandering Garter Snake
Fish	
Ameiurus melas	Black Bullhead
Lepomis cyanellus	Green Sunfish
Lepomis macrochirus	Bluegill
Catastomus commersoni	White Sucker

Source: Strata, 2011a.

Mammals

Pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*) were the only big-game species that were observed on the Ross Project area during the 2009 and 2010 surveys (Strata, 2011a). American elk (*Cervus elaphus*) have been recorded in the area by the WGFD; however, none were observed during the Applicant's surveys. No crucial big-game habitats or migration corridors are recognized by the WGFD at the Ross Project or the surrounding 1.6-km [1-mi] vicinity.

Pronghorn antelope and mule deer are common but not abundant on the Ross Project area. Pronghorn herds were most often observed in sagebrush-shrubland and upland-grassland habitats, and the mule deer frequented the sagebrush-shrubland habitat (Strata, 2011a). Both

species used haylands and cultivated fields in the area. White-tailed deer were not abundant, but they were observed in the riparian habitats and on the cultivated fields within and near the Ross Project area. Pronghorn antelopes' use of the Ross Project and surrounding areas has been classified by the WGFD as year long, and mule deer use within the areas as winter and year long. White-tailed deer and elk use has been classified by the WGFD as out of their normal range. The Ross Project is located within the WGFD North Black Hills pronghorn-herd unit, the Powder River and Black Hills mule deer-herd units, and the Thunder Basin and Black Hills white-tailed deer-herd units. The Ross Project area is not within a specific elk-herd unit, but it is included in the WGFD designated area referred to as "Hunt Area 129" (Strata, 2011a).

A variety of small- and medium-sized mammals could potentially be present on the Ross Project area. These mammals include a variety of predators and furbearers, such as coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), beaver (*Castor canadensis*), and muskrat (*Ondatra zibethicus*). Prey species that were observed included rodents (e.g., mice, rats, voles, gophers, ground squirrels, chipmunks, prairie dogs), jackrabbits (*Lepus spp.*), and cottontails (*Sylvilagus spp.*). These species are cyclically common and widespread throughout the vicinity, and they are important food sources for raptors and other predators. Each of these prey species was either directly observed during Strata's field surveys or was known to exist through the presence of burrow formation or of droppings. Jackrabbit and cottontail sightings were common.

While black-tailed prairie dogs (*Cynomys ludovicianus*) are listed as occurring in the general area of the Ross Project, no black-tailed prairie-dog colonies (important as habitat for black-footed ferrets) were located within the 1.6-km [1-mi] survey area. Other mammal species, such as the striped skunk (*Mephitis mephitis*), porcupine (*Erethizon dorsatum*), and various weasels (*Mustela spp.*) inhabit sagebrush grassland and riparian communities, and these species were recorded within the Ross Project area during the Applicant's wildlife surveys. No bat species were observed during the baseline surveys. There are no records of prior use of the Ross Project by swift fox (*Vulpes velox*), and none were observed during the 2009 or 2010 surveys.

Birds

Suitable habitat for several raptor species occurs at the Ross Project area and within the 1.6-km [1-mi] vicinity surrounding it. Several raptor species were observed during the wildlife surveys; these included the bald eagle, red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), Cooper's hawk (*Accipiter cooperii*), Sharp-shinned hawk (*Accipiter striatus*), rough-legged hawk (*Buteo lagopus*), great horned owl (*Bubo virginianus*), and short-eared owl (*Asio flammeus*). Turkey vultures (*Cathartes aura*) and prairie falcons (*Falco mexicanus*) have also been recorded on the Ross Project area, but they were not seen during the Applicant's surveys.

In the vicinity of the Ross Project area, nests were observed for the ferruginous, red-tailed, and Swainson's hawks (Strata, 2011a). The only nest observed within the Project area itself was a Swainson's hawk's nest, which was observed to be inactive during the 2010 survey year. A total of seven intact nesting sites were observed within 1.6 km [1 mi] of the Ross Project area.

The wild turkey (*Meleagris gallopavo*), Greater sage-grouse (*Centrocercus urophasianus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and mourning dove (*Zenaida macroura*) were

observed at the Ross Project area by the Applicant. Mourning doves were recorded during the spring and summer months.

The Greater sage-grouse (*Centrocercus urophasianus*) is listed as a Federal candidate species and a Wyoming Species of Concern (WSOC) in Wyoming (75 FR 13090; WGFD, 2005a) (see SEIS Section 3.6.1.4, below). Potential sage-grouse habitat is present at the Ross Project area (upland grassland, sagebrush shrubland, pastureland, hayland, and reservoir/stock pond). Two leks, which is where male sage grouse congregate for competitive mating displays, have been recorded within several miles of the Ross Project. Leks assemble before and during the breeding season on a daily basis; the same group of males meet at traditional locations each season. However, the Ross Project area is not located in a region currently designated as a sage-grouse core area.

Breeding-bird surveys were conducted within the Ross Project area in four habitat types: upland grassland, sagebrush shrubland, pastureland/hayland, and wetland/reservoir. Twenty-seven species were recorded during the 2010 breeding-bird surveys. The Wetland/Reservoir habitat produced the greatest species diversity, with 19 species observed. The upland grassland habitat had the fewest species, with six species observed.

Natural aquatic habitats on the Ross Project occur at the Oshoto Reservoir and along the Little Missouri River. During the Applicant's wildlife surveys, 17 waterfowl and 8 shorebird species were observed. In these categories, the horned grebe (*Podilymbus podiceps*) and upland sandpiper (*Bartramia longicauda*) are the only USFWS's SMC observed within or near the Ross Project area.

3.6.1.3 Reptiles, Amphibians, and Aquatic Species

During the Applicant's baseline wildlife surveys in 2009 and 2010, the eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) and northern sagebrush lizard (*Sceloporus graciosus graciosus*) were often observed. Other reptiles observed in the area included the bullsnake (*Pituophis cantenifer*), wandering garter snake (*Thamnophis elegans vagrans*), and the prairie rattlesnake (*Crotalus viridis viridis*).

Water is a limiting factor for wildlife on the Ross Project area, where only one stream flows occasionally; the Oshoto Reservoir is the major water feature within the Ross Project area. All other natural drainages are categorized as intermittent or ephemeral (see SEIS Section 3.5.1). The lack of deep-water habitat and perennial water sources decreases the potential for many aquatic species to exist. Three aquatic or semi-aquatic amphibian species and two aquatic reptiles were recorded during the Applicant's baseline surveys: the tiger salamander (*Ambystoma tigrinum*), boreal chorus frog (*Pseudacris triseriata*), northern leopard frog (*Rana pipiens)*, common snapping turtle (*Chelydra serpentine*), and western painted turtle (*Chrysemys picta*). All five species were heard and/or seen in the Oshoto Reservoir, Little Missouri River, or near stock reservoirs. All five species are common to the Ross Project and the vicinity as a whole. No egg masses were identified during the egg-mass surveys completed in early June 2010. The reason for their absence could have been that recent high winds could have broken up the egg masses and dispersed the individual eggs. During walking surveys along shorelines and riparian areas in August 2010, the leopard frog appeared to be quite common—over 500 individual adults were counted—while the chorus frog was uncommon.

The Applicant also conducted fish sampling from the Oshoto Reservoir in September 2010, under a WGFD Chapter 33 collection permit, as part of its establishing pre-licensing baseline radiological conditions for the Ross Project. The dominant fish population in the Oshoto Reservoir included black bullheads (*Ameiurus melas*) and green sunfish (*Lepomis cyanellus*); white suckers (*Catastomus* commeroni) and bluegill (*Lepomis macrochirus*) were also present. The sample fish from this population were stunted in size for their ages; high reproductive rates and limited predation leads to over-population and stunted growth. The Oshoto Reservoir and the other water bodies within the Ross Project area are not considered viable sport fisheries (see SEIS Section 3.2.2).

3.6.1.4 Protected Species

The Ute ladies'-tresses orchid (*Spiranthes diluvialis*) is Federally-listed as threatened. The species is a perennial, terrestrial orchid that occurs in Colorado, Idaho, Montana, Nebraska, Utah, Washington, and Wyoming. Within Wyoming, this orchid inhabits moist meadows with moderately dense but short vegetative cover. As noted in Fertig (2000), this species is found at elevations of 1,280 – 2,130 m [4,200 – 7,000 ft], though no known populations occur in Wyoming above 1,680 m [5,500 ft]. This species was not located during the Applicant's vegetation surveys, and it is not known to occur on or in the vicinity of the Ross Project area.

The blowout penstemon (*Penstemon haydenii*) is Federally listed as endangered, although it is not included on the list for Crook County. However, it is on the list for neighboring Campbell County, and the Applicant therefore evaluated the potential for the blowout penstemon to occur in the Ross Project area. This species is found exclusively in sparsely vegetated, early successional sand dunes or blowout areas at elevations of 1,786 – 2,268 m [5,860 – 7,440 ft] (Fertig, 2008). The Ross Project does not have sand-dune habitat, and it is outside of the elevation range in which this species is typically found. This species was not identified during Strata's vegetation surveys; appropriate habitat was not identified; and it is not known to occur on or in the vicinity of the Ross Project.

The black-footed ferret (*Mustela nigripes*) is a Federally listed endangered species, which inhabits prairie-dog colonies. A black-footed ferret survey was not required by USFWS requirements, because black-footed ferrets live exclusively in prairie-dog colonies, which are not present on or within 1.6 km [1 mi] of the Ross Project area (Strata, 2011a).

The bald eagle (*Haliaeetus leucocephalus*) was delisted from Federal threatened status in 2007, but it is still protected under the *Bald and Golden Eagle Protection Act* and the *Migratory Bird Treaty Act*. Potential habitat for bald eagle nesting and roosting activities is quite limited within the Ross Project because of the lack of trees. Bald eagles were observed from the Ross Project area during wildlife surveys that took place November and December of 2009 and January through September of 2010 (Strata, 2011a). No nests were observed, however, and the bald eagle is considered to be a winter migrant to the area.

The Greater sage-grouse (*Centrocercus urophasianus*) is Federally listed as a Candidate species, as a State of Wyoming's Species of Concern (WSOC), and as a BLMSS. On March 5, 2010, the USFWS published a finding in the FR stating that listing of the species was warranted but precluded by higher priority listing actions (75 FR 13909). The Governor of Wyoming issued Executive Order (EO) 2010-4 in August 2010 which sets out 12 provisions for oil- and gas-resource operations within core and noncore population areas to protect the species at the

State level (State of Wyoming, 2011). The WGFD published *Recommendations for Development of Oil and Gas Resources Within Important Wildlife Habitats* and the Wyoming Field Office of the BLM issued an instructional memorandum on March 5, 2010, which supplements the BLM's 2004 *National Sage-Grouse Habitat Conservation Strategy*, to be consistent with the Governor's Executive Order (EO) (WGFD, 2010; BLM, 2004; BLM, 2010a). The WGFD guidance was again updated in April 2010.

The Greater sage-grouse inhabits open sagebrush plains in the western U.S. and is found at elevations of 1,200 – 2,700 m [3,937 – 8,858 ft], corresponding with the occurrence of sagebrush habitat (69 FR 933). The Greater sage-grouse is a mottled brown, black, and white ground-dwelling bird that can be up to 0.6 m [2 ft] tall and 76 cm [30 in] in length (69 FR 933). Breeding habitat, referred to as leks (see SEIS Section 3.6.1.2), and stands of sagebrush surrounding leks are used by sage-grouse in early spring and are particularly important habitat because the birds often return to the same leks and nesting areas each year. Leks are generally more sparsely vegetated areas such as ridgelines or disturbed areas adjacent to stands of sagebrush habitat.

Two sage-grouse leks are known to occur within 3 km [2 mi] of the Ross Project area. The Oshoto Lek (Sections 28 and 29, T53N, 67W) and the Cap'n Bob Lek (Section 32, T53 N, R67W) have been identified; no other sage-grouse leks were identified during the wildlife surveys. Details of sage-grouse mating activities for these leks are summarized in Table 3.12. A ground survey of the Oshoto and Cap'n Bob leks were conducted by the Applicant on two days in April 2010. On the Cap'n Bob lek, a total of two males and one female were observed on one day, and two males were observed on the second day; no sage-grouse were observed at the Oshoto Lek during the survey. No broods or brood-rearing areas were identified during the Applicant's 2010 survey. In addition, no sage-grouse wintering areas were identified on the Ross Project area (Strata, 2011a).

Threats to this species' survival include habitat loss, agricultural practices, livestock grazing, hunting, and land disturbances from energy and mineral development as well as the oil and gas industry (Sage-Grouse Working Group, 2006). Although the two leks described earlier were recorded near the Ross Project, the Project area is not located within a designated sage-grouse core area. Additionally, although sharp-tailed grouse were observed on the Ross Project area during only the 2009 winter survey, they are considered year-long residents of the Project area.

Table 3.12 Summary of Sage-Grouse Activity in Oshoto and Cap'n Bob Leks		
Year of Survey Activity	**Oshoto**	**Cap'n Bob**
1985	6 males	No information
1988	0	"
1988	0	"
1991	0	"
1994	0	"
1997	0	"
2000	0	"
2001	5 males	"
2004	2 males	"
2007	0	10 males
2007	0	10 males
2010	0	2 males 1 female
2010	0	2 males

Source: Strata, 2011a.

The mountain plover (*Charadrius montanus*) is Federally proposed as threatened and is a Wyoming Species of Greatest Conservation Need. The species is a small bird approximately 17.8 cm [7 in] in height with light brown and white coloring. The mountain plover is a native of the short-grass prairie and is found in open, dry shrubland, or agricultural fields with short vegetation and bare ground. Prairie dogs and other burrowing animals provide highly suitable habitat for the mountain plover.

Mountain plover breeding habitat includes the western Great Plains and Rocky Mountain states extending from the Canadian border to northern Mexico (75 FR 37353). The prime breeding and nesting period for the mountain plover is from April 10 through July 10 (BLM, 2007a). In Wyoming, the greatest concentration of mountain plovers is found in the south central part of the state, but they can be found in every county (Andres 2009; UW, 2010). This bird is often found in areas with heavy grazing and landscapes with excessive surface disturbance. USFWS originally proposed this species as threatened on February 16, 1999 (64 FR 7587); the proposal was withdrawn on September 9, 2003, but it was reinstated on June 29, 2010 (68 FR 53083; 75 FR 37353). This species was not observed during either the 2009 or 2010 wildlife surveys (Strata, 2011a).

Table 3.13 lists species that occur in Crook County and that are Federally listed under the *Endangered Species Act* (ESA), State-listed under the *Final Comprehensive Wildlife Conservation Strategy for Wyoming*, or are listed as a BLMSS.

Table 3.13
Species of Concern in Crook County and at Ross Project Area

Common Name *Scientific Name*	USFWS Species of Management Concern (Level)[1]	BLM Sensitive Species	Wyoming Species of Concern Status[2]	Observed on the Ross Project Area
Mammals				
Hayden's Shrew *Sorex haydeni*			NSS4*	
Vagrant Shrew *Sorex vagrans*			NSS3*	
Long-eared Myotis *Myotis evotis*		Yes	NSS2*	
Northern Myotis *Myotis septentrionalis*			NSS2*	
Little Brown Myotis *Myotis lucifugus*			NSS3*	
Long-legged Myotis *Myotis volans*			NSS2*	
Fringed myotis *Myotis thysanodes*		Yes	NSS2*	
Hoary Bat *Lasiurus cinereus*			NSS4*	
Silver-haired Bat *Lasionycteris noctivagans*			NSS4*	
Big Brown Bat *Eptesicus fuscus*			NSS3*	
Black-tailed Prairie Dog *Cynomys ludovicianus*			NSS3*	Yes
Plains Pocket Gopher *Geomys bursarius*			NSS4*	
Olive-backed Pocket Mouse *Perognathus fasciatus*			NSS3*	
Silky Pocket Mouse *Perognathus flavus*			NSS3*	
Western Harvest Mouse *Reithrodontomys megalotis*			NSS3*	
Prairie Vole *Microtus ochrogaster*			NSS3*	Yes
Sagebrush Vole *Lemmiscus curtatus*			NSS4*	
Swift Fox *Vulpes velox*		Yes	NSS4*	

Table 3.13 Species of Concern in Crook County and on the Ross Project Area (*Continued*)				
Common Name *Scientific Name*	**USFWS Species of Management Concern (Level)[1]**	**BLM Sensitive Species**	**Wyoming Species of Concern Status[2]**	**Observed on the Ross Project Area**
***Mammals* (*Continued*)**				
Black-footed Ferret *Mustela nigripes*			NSS1*	
Birds				
Waterfowl and Shorebirds				
Trumpeter swan *Cygnus buccinator*		Yes	NSS2	Yes
Northern Pintail *Anas acuta*			NSS3	Yes
Canvasback *Aythya valisineria*			NSS3	Yes
Redhead *Aythya americana*			NSS3	Yes
Lesser Scaup *Aythya affinis*			NSS3	Yes
Horned Grebe *Podiceps auritus*	Yes (NL)			Yes
Western Grebe *Aechmophorus occidentalis*			NSS4	
American Bittern *Botauosus lentiginosus*	Yes (I)		NSS3	
Great Blue Heron *Ardea herodias*			NSS4	Yes
Black-crowned Night-Heron *Nycticorax nycticorax*			NSS3	
White-faced Ibis *Plegadis chihi*		Yes	NSS3	
Sandhill Crane *Grus canadensis*			NSS3	
Mountain Plover *Charadrius montanus*	Yes (I)	Yes	NSS4*	
Upland Sandpiper *Bartramia longicauda*	Yes (I)		NSS4	Yes
Marbled Godwit *Limosa fedoa*	Yes (NL)			
Long-billed Curlew *Numenius americanus*	Yes (I)	Yes	NSS3*	

Table 3.13
Species of Concern in Crook County and on the Ross Project Area
(*Continued*)

Common Name *Scientific Name*	**USFWS Species of Management Concern (Level)[1]**	**BLM Sensitive Species**	**Wyoming Species of Concern Status[2]**	**Observed on the Ross Project Area**
Raptors				
Bald Eagle *Haliaeetus leucocephalus*	Yes (I)		NSS2	Yes
Northern Goshawk *Accipiter gentilis*		Yes	NSS4*	
Swainson's Hawk *Buteo swainsoni*			NSS4	Yes
Ferruginous Hawk *Buteo regalis*	Yes (I)	Yes	NSS3*	Yes
Golden Eagle *Aquila chrysaetos*	Yes (III)			Yes
Merlin *Falco columbarius*			NSS3*	
Peregrine Falcon *Falco peregrinus*	Yes (I)		NSS3*	
Prairie Falcon *Falco mexicanus*	Yes (III)			Yes
Burrowing Owl *Athene cunicularia*	Yes (I)	Yes	NSS4	
Short-eared Owl *Asio flammeus*	Yes (I)		NSS4	Yes
Upland Game				
Greater Sage-grouse *Centrocercus urophasianus*		Yes	NSS2	Yes
Other				
White Pelican *Pelecanus erythrorhynchos*			NSS3	Yes
Franklin's Gull *Larus pipixcan*			NSS3	
Forster's Tern *Sterna forsteri*			NSS3	
Black Tern *Chlidonias niger*			NSS3	Yes
Black-billed Cuckoo *Coccyzus erythropthalmus*	Yes (II)			
Yellow-billed Cuckoo *Coccyzus americanus*	Yes (II)	Yes	NSS2*	

Table 3.13 Species of Concern in Crook County and on the Ross Project Area (*Continued*)				
Common Name *Scientific Name*	**USFWS Species of Management Concern (Level)[1]**	**BLM Sensitive Species**	**Wyoming Species of Concern Status[2]**	**Observed on the Ross Project Area**
Other (*Continued*)				
Lewis's Woodpecker *Melanerpes lewis*	Yes (II)		NSS3*	
Willow Flycatcher *Empidonax traillii*	Yes (II)		NSS3	
Pinyon Jay *Gymnorhinus cyanocephalus*	Yes (IV)			
Pygmy Nuthatch *Sitta pygmaea*			NSS4*	
Sage Thrasher *Oreoscoptes montanus*	Yes (II)	Yes	NSS4*	Yes
Loggerhead Shrike *Lanius ludovicianus*	Yes (II)	Yes		Yes
Dickcissel *Spiza americana*	Yes (II)		NSS4	
Brewer's Sparrow *Spizella breweri*	Yes (I)	Yes	NSS4	Yes
Sage Sparrow *Amphispoza belli*	Yes (I)	Yes	NSS4	
Lark Bunting *Calamospiza melanocorys*	Yes (II)		NSS4	Yes
Baird's Sparrow *Ammodramus bairdii*	Yes (I)	Yes		
Grasshopper Sparrow *Ammodramus savannarum*	Yes (II)		NSS4	Yes
McCown's Longspur *Calcarius mccownii*	Yes (I)		NSS4	Yes
Chestnut-collared Longspur *Calcarius ornatus*			NSS4	
Bobolink *Dolichonyz oryzivorus*			NSS4	
Cassin's Finch *Carpodacus cassinii*	Yes (IV)			
Amphibians				
Tiger Salamander *Ambystoma tigrinum*			NSS4*	Yes
Plains Spadefoot *Scaphiopus bombifrons*			NSS4*	

Table 3.13
Species of Concern in Crook County and on the Ross Project Area
(*Continued*)

Common Name *Scientific Name*	**USFWS Species of Management Concern (Level)[1]**	**BLM Sensitive Species**	**Wyoming Species of Concern Status[2]**	**Observed on the Ross Project Area**
***Amphibians* (*Continued*)**				
Great Plains Toad *Bufo cognatus*			NSS4*	
Boreal Chorus Frog *Pseudaris triseriata maculate*			NSS4*	Yes
Bullfrog *Rana catesbeiana*			NSS4*	
Northern Leopard Frog *Rana pipiens*		Yes	NSS4*	Yes
Reptiles				
Northern Sagebrush Lizard *Sceloporus graciosus graciosus*			NSS4*	Yes
Western Painted Turtle *Chrysemys picta belli*			NSS4*	Yes
Prairie Rattlesnake *Crotalus viridis viridis*			NSS3*	Yes
Plains Hognose Snake *Heterondon nasicus nasicus*			NSS4*	
Bullsnake *Pituophis melanoleucas sayi*			NSS4*	
Wandering Garter Snake *Thamnophis elegans vagrans*			NSS4*	
Eastern Yellowbelly Racer *Coluber constrictor flaviventris*			NSS4*	

Source: Strata, 2011a.
Notes: See next page.

Notes for Table 3.13::

[1] *USFWS Level:*

- Level I (Conservation Action): Species clearly needs conservation action.
- Level II (Monitoring): The action and focus for the species is monitoring (M). Declining population trends and habitat loss are not significant at this point.
- Level III (Local Interest): Species that Wyoming Partners In Flight may recommend for conservation action that are not otherwise high priority but are of local interest (LI).
- Level IV (Not Considered Priority): Additional species of concern, but not considered a priority species.

[2] *WGFD Status:*

- NSS1: 1996 Nongame Bird and Mammal Plan Species of Special Concern with a Native Species Status of 1.
- NSS2: 1996 Nongame Bird and Mammal Plan Species of Special Concern with a Native Species Status of 2.
- NSS3: 1996 Nongame Bird and Mammal Plan Species of Special Concern with a Native Species Status of 3.
- NSS4: 1996 Nongame Bird and Mammal Plan Species of Special Concern with a Native Species Status *of 4.*

**Species listed wholly or in part due to absence of data.*

The Wyoming Field Office of the USFWS also uses the SMC list for conducting reviews related to non-coal, surface-disturbance projects. Thirty-two birds on the WSOC list were identified on this list for the Ross Project area (see Table 3.13). Surveys for avian WSOC, including sage-grouse, bald eagle, and mountain plovers, were conducted in 2009 and 2010 for the Ross Project area. Table 3.14 lists the avian WSOCs that were observed on the Ross Project area during the Applicant's 2009 and 2010 baseline surveys (Strata, 2011a), including their primary nesting habitats and historical occurrence in the general Ross Project vicinity.

In addition to the species previously discussed above, 20 bird species on the U.S. Fish and Wildlife Service's (USFWS's) SMC list could potentially be present within the Ross Project area. Of these 20 bird species, 7 have been observed within or near the Ross Project (see Table 3.13). Ten non-raptor or non-game bird species on the BLMSS list could potentially occur within the Ross Project. Of the ten bird species, four have been observed on or near the Ross Project area (see Table 3.14). Thirty-two non-raptor or non-game bird species on the WSOC list could potentially be present within the Ross Project area. Of the 32 bird species, 15 have been actually observed on or near the Project area (see Tables 3.13 and 3.14).

Table 3.14 Avian Species of Concern Observed at Ross Project Area		
Common Name ***Scientific Name***	**Primary Nesting Habitat(s)[1]**	**Status[2]**
Level 1 Species of Concern/Conservation Needed		
Bald Eagle *Haliaeetus leucocephalus*	Montane Riparian, Plains/Basin Riparian	Uncommon year-long resident
Ferruginous Hawk *Buteo regalis*	Shrub Steppe and Short-Grass Prairie	Summer uncommon resident
Upland Sandpiper *Bartramia longicauda*	Short-Grass Prairie	Summer uncommon resident
Short-eared Owl *Asio flammeus*	Short-grass Prairie and Meadows	Common year-long resident
Brewer's Sparrow *Spizella breweri*	Shrub Steppe and Mountain-Foothills Shrub	Common summer resident
McCown's Longspur *Calcarius mccownii*	Shrub steppe and short-grass prairie	Common summer resident
Level 2 Species of Concern/Continued Monitoring Recommended		
Sage Thrasher *Oreoscoptes montanus*	Shrub Steppe	Common summer resident
Loggerhead Shrike *Lanius ludovicianus*	Shrub Steppe	Common summer resident
Lark Bunting *Calamospiza melanocorys*	Shrub Steppe and Short-Grass Prairie	Abundant summer resident
Grasshopper Sparrow *Ammodramus savannarum*	Shrub Steppe and Short-Grass Prairie	Common summer resident
Level 3 Species of Concern/Species of Local Interest		
Golden Eagle *Aquila chrysaetos*	Specialized (Cliffs)	Common year-long resident
Prairie Falcon *Falco mexicanus*	Specialized (Cliffs)	Common year-long resident

Sources: USFWS, 2011, and USGS, 2011.

3.7 Meteorology, Climatology, and Air Quality

3.7.1 Meteorology

The region of the Ross Project area is characterized by hot summers and cold winters, and rapid temperature fluctuations are common. The Rocky Mountains (the "Rockies") have a great influence on the climate. As air crosses the Rockies from the west, much moisture is lost on the

windward sides of the Mountains, and the air becomes warmer as it descends on the eastern slopes (NRC, 2009b). The Ross Project area is located in this semi-arid area (Strata, 2011a).

The closest National Weather Service (NWS) station with a long recording period is Gillette Airport, which is located 56 km [35 mi] southwest of the Ross Project (Strata, 2011a). As the GEIS noted, there is a NWS station in Crook County, at Colony, Wyoming (72 km [45 mi] northeast of the Ross Project) (NRC, 2009b). This station, however, ceased operation in 2008. In addition, the Applicant has installed a site-specific meteorology station in 2010, where meteorology data has been collected every month since the station went online (Strata, 2011a).

Temperature

As described in the GEIS, the northwest Great Plains region has summer nights that are normally cool, even though daytime temperatures can be very warm. Winters can be quite cold; however, warm spells during winter months are common. The average temperatures for the two NWS stations in the vicinity of the Ross Project area, Colony and Gillette Airport, are shown in Table 3.15, in addition to the information collected by the Applicant in 2010 (NRC, 2009b; NWS, 2011; Strata, 2011a).

Table 3.15
Average, Minimum, and Maximum Temperatures in Ross Project Vicinity

Station	Average Temperature °C [°F]	Average Minimum Temperature °C [°F]	Average Maximum Temperature °C [°F]
Ross Project[1]	8.9 [48]	- 4.3 [24.3]	23.9 [75]
Gillette Airport[2]	8.1 [46.5]	N/A	N/A
Colony[3]	8.3 [47]	- 5.3 [22.5]	22.4 [72.3]

Source: Strata, 2011a; NRC, 2009b; NWS, 2011.

Notes: N/A = Data not available.
1 = Monitoring period 2010
2 = Monitoring period 1902 – 2009
3 = Monitoring period 1971 – 2000

At the Gillette Airport station, the warmest month of the year is July, with an average temperature of 23.6 °C [74.5 °F] (Strata, 2011a). The coldest month is December, with an average temperature of -4.7 °C [23.6 °F]. This trend was also observed at the Ross Project's meteorology station, with an average July temperature of 23.1 °C [73.6 °F] and an average December temperature of -4.7 °C [23 °F] for 2010.

Wind

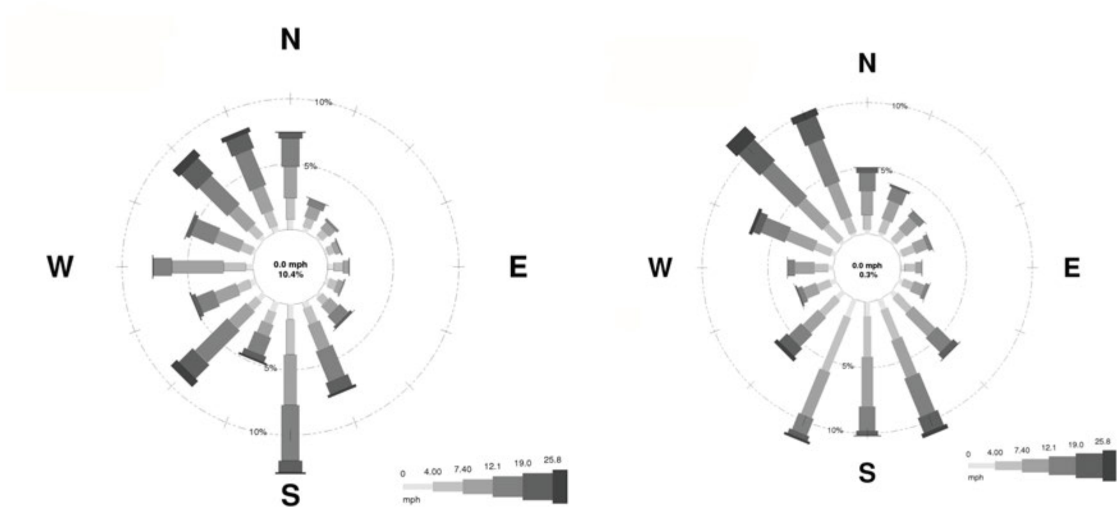
The average wind speed at the Gillette Airport station is 16.9 km/hr [10.5 mi/hr], with an average maximum wind speed from 2000 – 2009 of 77 km/hr [48 mi/hr] (Strata, 2011a). The highest winds were recorded in January through March, with the lowest speeds from July through September. As shown on the wind rose for the Ross Project area, the prevailing wind direction in the fall and winter is north/northwest (as shown in Figure 3.17), whereas in the spring and

summer, the winds are generally from the southeast. The highest wind speeds tend to occur from the north-northwest.

During the 12 months of monitoring at the Applicant's meteorology station in 2010, the average annual wind speed was 18.5 km/hr [11.5 mi/hr], ranging from a minimum wind speed of 0 km/hr [0 mi/hr] to a maximum wind speed of 73.4 km/hr [45.6 mi/hr]. More southerly winds were recorded at the Ross Project than at the Gillette Airport station (as shown in Figure 3.18); however, as at Gillette Airport, the highest wind speeds are from the northwest.

Precipitation

The Ross Project area and the surrounding area receive relatively little rainfall, with average annual precipitation ranging from 25 – 38 cm [10 – 15 in]. The region receives an average annual snowfall of 127 – 152 cm [50 – 60 in]. At the Gillette Airport station, between 2005 – 2009, the average annual precipitation was measured at 30.5 cm [12 in] (Strata, 2011a). Approximately one-half of the precipitation is associated with spring snows and thunderstorms. May is the wettest month, with more than 5 cm [2 in] of precipitation, while January is the driest month, with average precipitation of approximately 1.3 cm [0.5 in] or less (Strata, 2011a).



Source: Strata, 2012a.

Figures 3.17 and 3.18

Gillette Airport Wind Rose (Left)
Ross Project Area Wind Rose (Right)

At the Applicant's onsite meteorology station, the total precipitation measured in 2010 was 24.8 cm [9.8 in], compared to 32.5 cm [12.8 in] for the same period at the Gillette Airport station (Strata, 2011a). The difference in precipitation during 2010 was primarily due to the fact that Gillette Airport received 6.4 cm [2.5 in] more in the month of May than the Ross Project. Otherwise, the monthly precipitation data are very similar.

Evaporation

As with the majority of the western U.S., the evaporation rate in northeastern Wyoming exceeds the rate of precipitation. As discussed in the GEIS, evaporation rates in the region range from 102 – 127 cm/yr [40 – 50 in/yr] (NRC, 2009b). An evaporation pan was installed at the Ross Project's meteorology station in June 2010; however, data are available from only June through late October 2010, because the gauge was removed to prevent its freezing. At the Gillette Airport station, evaporation in 2010 varied from slightly more than 10 cm [4 in] in April to almost 25 cm [10 in] in July and August. For the period of time the evaporation pan operated at the Ross Project, similar rates were observed (Strata, 2011a).

Atmospheric Stability Classification and Mixing Height

Atmospheric stability classification and mixing height are environmental variables that influence the ability of the atmosphere to disperse air pollutants. The stability class is a measure of atmospheric turbulence, and mixing height characterizes the vertical extent of contaminants mixing in the atmosphere. The nearest upper-air data available from the NWS are from Rapid City, South Dakota, approximately 170 km [106 mi] southeast of the Ross Project (Strata, 2011a). However, Rapid City is approximately 1,700 m [5,577 ft] lower in elevation than the Ross Project, and it is on the other side of the Black Hills. Therefore, the data are likely not representative of conditions at the Ross Project area.

Stability-class information was collected using the Applicant's meteorological station, which demonstrated that the class distributions were predominantly neutral approximately 62 percent of the time. Other calculated conditions were Stability Class D (17 percent) and Class E (Strata, 2011a). The classification that results in the least vertical mixing (Class F) was approximately 4.7 percent at the Ross Project area, while Classes A through C ranged from 3 percent to 6.7 percent (Strata, 2011a).

Average annual mixing heights were not reported, although Wyoming has provided statewide mixing heights to be used in dispersion modeling (see Table 3.16) (Strata, 2011a).

Table 3.16
Statewide Mixing Heights for Dispersion Modeling

Stability Class	Mixing Height (m [ft])
Class A	3,450 [11,319]
Class B	2,300 [7,546]
Class C	2,300 [7,546]
Class D	2,300 [7,546]
Class E	10,000 [32,808]
Class F	10,000 [32,808]

Source: Strata, 2011a.

Stability classes E and F are given an arbitrarily high number by the WDEQ/Air Quality Division (AQD) to indicate an absence of a distinct boundary in the upper atmosphere.

3.7.2 Climatology

On a larger scale, climate change is a subject of national and international interest. The recent compilation of the current scientific understanding in this area by the U.S. Global Change Research Program (GCRP), a Federal advisory committee, was considered in preparation of this SEIS (GCRP, 2009). Average temperatures in the U.S. have risen more than 1.1 °C [2 °F] over the past 50 years and are projected to rise more in the future. During the period from 1993 – 2008, the average temperature in the Great Plains increased by approximately 0.83 °C [1.5 °F] from 1961 to 1979 baseline temperatures (GCRP, 2009). The projected change in temperature over the period from 2000 – 2020, which encompasses the period that the Ross Project would be licensed, ranges from a decrease of approximately 0.28 °C [0.5 °F] to an increase of approximately 1.1 °C [3.4 °F]. Although the GCRP did not incrementally forecast a change in precipitation by decade, it did project a change in spring precipitation from the baseline period (1961 – 1979) to the next century (2080 – 2099). For the region in Wyoming where the Ross Project is located, the GCRP forecast a 10 – 15 percent increase in spring precipitation (GCRP, 2009).

The EPA has determined that potential changes in climate caused by greenhouse gases (GHG) emissions endanger public health and welfare based on a body of scientific evidence assessed by the GCRP as well as the National Research Council (74 FR 66496). The Administrator of the EPA has issued an endangerment finding based on a technical support document compiled by these scientific organizations. This endangerment finding specifies that, while ambient concentrations of GHG emissions do not cause direct adverse health effects (such as respiratory issues or toxic effects), public health risks and impacts can result indirectly from changes in climate. Based on the EPA's determination, the NRC recognizes that GHGs may have an effect on climate change. In Memorandum and Order CLI-09-21, the Commission provided guidance to NRC staff to consider carbon dioxide and other GHG emissions in its *National Environmental Policy Act* (NEPA) reviews (NRC, 2009a). GHG emissions, as projected for the Ross Project, are considered as an element of the air-quality impacts evaluation in this SEIS; GHG emissions are discussed in SEIS Section 5.

3.7.3 Air Quality

As described in GEIS Section 3.4 (NRC, 2009b), all of the NSDWUMR is classified as an attainment area for all the primary criteria pollutants under the National Ambient Air Quality Standards (NAAQS) (NRC, 2009b). (The EPA sets NAAQS for air pollutants considered harmful to public health and the environment [40 CFR Part 50]. Some states, such as Wyoming, also set their own Ambient Air Quality Standards,

What is an air-quality attainment area?

The attainment status of an area refers to whether or not its air quality "attains" the National Ambient Air Quality Standards (NAAQS) for specific air pollutants. That is, an attainment area is a particular geographic area where the respective concentrations of primary (or "criteria") air pollutants meet the health-based NAAQS for the corresponding primary air pollutants. If the area persistently exceeds the NAAQS for one or more primary air pollutants, it is classified as being in "non-attainment" for the particular air pollutant(s) that exceed(s) the respective NAAQS standard. The Powder River Basin is an attainment area for PM_{10}.

such as the Wyoming Ambient Air Quality Standards [WAAQS].) Primary NAAQS are established to directly protect public health, and secondary NAAQS are established to protect public welfare by safeguarding against environmental and property damage. As discussed in GEIS Section 3.4.6, the NAAQS defines acceptable ambient-air concentrations for six common nonradiological particulate and gaseous air pollutants (i.e., primary or criteria pollutants): nitrogen oxides (as NO_2), ozone (O_3), sulfur oxides (as SO_2), carbon monoxide (CO), lead (Pb), and particulate matter (less than 10 and 2.5 μm in diameter [PM_{10} and $PM_{2.5}$]). In particular, most of the Powder River Basin, where significant coal mining activities are ongoing, and which includes the Ross Project area, is currently designated an attainment area for all pollutants (Strata, 2011a).

As noted above, states may develop standards that are more strict than or that supplement the NAAQS. The WDEQ/AQD has submitted a draft revision of its own WAAQS to the appropriate State boards. These revisions would result in Wyoming's adding one-hour NO_2 and SO_2 standards and revoking the current 24-hour and 1-hour standards for SO_2 of the existing WAAQS to be identical with NAAQS (see Table 3.17). The Wyoming-specific annual (arithmetic mean) PM_{10} standard of 50 μg/m^3, which is required for short-term modeling of surface coal mine emissions, will be retained. Some primary and secondary NAAQS are presented in Table 3.17 (WDEQ/AQD, 2010).

The air quality in the vicinity of the Ross Project area is currently in compliance with the NAAQS for all primary air pollutants, including particulates (i.e., fugitive dusts) and combustion-engine gaseous emissions.

Table 3.17
National and Wyoming Ambient Air Quality Standards

Criteria Pollutant	National Primary Standards	Wyoming Primary Standards	Averaging Time	Secondary Standards
Carbon Monoxide	9 ppm (10,000 µg/m^3)	9 ppm (10,000 µg/m^3)	8 Hours†	N/A*
	35 ppm (40,000 µg/m^3)	35 ppm (40,000 µg/m^3)	1 Hour†	N/A
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	0.05 ppm (100 µg/m^3)	Annual Arithmetic Mean	Same as Primary
	0.100 ppm (187 µg/m^3)	0.100 ppm (187 µg/m^3)	1 Hour	N/A
Particulate Matter (10-µm Diameter) (PM_{10})	150 µg/m^3	150 µg/m^3	24 Hours	Same as Primary
	N/A	50 µg/m^3	Annual Arithmetic Mean	N/A
Particulate Matter (2.5-µm Diameter) ($PM_{2.5}$)	12.0 µg/m^3	12.0 µg/m^3	Annual Arithmetic Mean	Same as Primary
	35 µg/m^3	35 µg/m^3	24 Hours[a]	Same as Primary
Ozone	0.08 ppm (157 µg/m^3)	0.08 ppm (157 µg/m^3)	8 Hours[b]	Same as Primary
Sulfur Oxides	N/A	*23 ppm (Will Revoke) 60 µg/m^3*	Annual Arithmetic Mean	N/A
	N/A	*100 ppm (Will Revoke) 260 µg/m^3*	24 Hours†	N/A
	75 ppm 200 µg/m^3	*75 ppm (Will Add) 200 µg/m^3*	1 Hour	N/A
	N/A	0.5 ppm (1,300 µg/m^3)	3 hours†	0.5 ppm (1,300 µg/m^3)

Source: Modified from EPA's "National Ambient Air Quality Standards (NAAQS)," as of October 2011.

Notes:

† Not to be exceeded more than once per year.

* N/A = Not applicable.

[a] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35.0 µg/m^3 (effective December 18, 2006).

[b] To attain this standard, the 3-year average of the fourth highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

Italics: Standard is in the rulemaking process in Wyoming. The intention is for WAAQS to reflect NAAQS, while retaining the State annual-average PM_{10} standard of 50 µg/m^3.

3.7.3.1 Particulates

"Particulates" refers to particles that are suspended in the air. Some particles are large enough to be seen (e.g., smoke and wind-blown dust), while others are too small to be visible. Agriculture, forestry, transportation, wind, and fire all contribute airborne particulates to the atmosphere. The NAAQS and WAAQS specify the allowable concentration of airborne particulates of 10 microns in diameter or smaller, or "PM_{10}," to 150 µg/m^3 [9.4 x 10^{-9} lb/ft^3] over 24 hours (see Table 3.17). Wyoming has a supplemental annual (arithmetic mean) PM_{10} standard of 50 µg/m^3 [3.1 x 10^{-9} lb/ft^3] that is averaged over the year (WDEQ/AQD, 2010). The NAAQS also limits allowable concentrations of airborne particles that are 2.5 microns in diameter or smaller ($PM_{2.5}$). Based on the pre-operational background data collected by the Applicant, three radionuclide particulates of interest (natural uranium, Ra-226 and Th-230) are found at concentrations at or below the minimum analytical detection limit and one radionuclide particulate (Pb-210) is found at concentrations just above the minimum analytical detection limits. The detected Pb-210 particulate levels are consistent with the background radon flux as Pb-210 is a progeny of the radon-222 decay.

The eastern portion of the Powder River Basin has an extensive network of PM_{10} monitoring stations that are operated by the mining industry because of the density of the coal mines in the region. There are five surface coal mines within approximately 48 km [30 mi] of the Ross Project area. PM_{10} compliance with the NAAQS and WAAQS 24-hour standards at these five mines (and, by inference, at the Ross Project area) has been consistently demonstrated by these stations (Strata, 2011a); However, there have been three small excursions over the 24-hour PM_{10} at the mines that were determined to be due to high wind conditions. There are also monitoring stations operated by the WDEQ/AQD in the cities of Sheridan, Gillette, Arvada, and Wright, where particulates are generally measured as PM_{10}.

The WDEQ/AQD operates a $PM_{2.5}$ particulate sampler at the Buckskin Mine, about 48 km [30 mi] west of the Ross Project area. Ambient air-quality monitoring data from 2005 – 2009 from the Buckskin Mine show that the average $PM_{2.5}$ ranged from 5.1 – 6.2 µg/m^3 [3.2 – 3.9 x 10^{-10} lb/ft^3], about one-third the annual mean $PM_{2.5}$ standard of 15 µg/m^3 [9.4 x 10^{-10} lb/ft^3]. No excursions above the 24-hour standard of 5 µg/m^3 were recorded at the Mine. The data indicate that particulates from highway and non-road-construction vehicles comprise approximately 28 percent of the total PM_{10} and $PM_{2.5}$ particulate emissions.

As discussed in GEIS Section 3.4.6, prevention of significant deterioration (PSD) requirements identify maximum allowable increases in concentrations for particulate matter for areas designated as in attainment. Different increment levels are identified for different classification areas, with Class I areas having the most stringent requirements. The nearest Class I areas to the Ross Project area is the Northern Cheyenne Indian Reservation (in Montana) and Wind Cave National Park (South Dakota); these areas are 130 km [80 mi] and 160 km [100 mi] from the Ross Project area, respectively. The other sensitive areas are the Class II Devils Tower and the Class II Cloud Peak Wilderness Area. These areas are approximately 16 km [10 mi] and 130 km [80 mi], respectively, from the Ross Project area (Strata, 2011a).

3.7.3.2 Gaseous Emissions

Existing regional air pollutants are known to include gaseous emissions, such as NO_2 and O_3, which have been extensively monitored near the Ross Project area and in the Powder River

Basin since 1975 (Strata, 2011a). See Table 3.17, which presents both the respective NAAQS and WAAQS gaseous-emission standards. Radon is a gaseous air emission which is described further in SEIS Section 3.12.1 under ***Air***. Based on the pre-operation background sampling, the radon concentrations in air through the Ross Project ranges from 0.5 to 2.0 pCi/L with a resultant exposure between 9.2 to 38.2 mrem. These values are consistent with expected background levels for radon in air overlying mineralized environments (Strata, 2011a).

Air-quality monitoring for gaseous emissions within the Powder River Basin includes measuring ozone (as O_3) and nitrous oxides (as NO_2) at two WDEQ/AQD stations, the closest of which is 29 km [18 mi] from the Ross Project area. A Wyoming Air Resources Monitoring System (WARMS), which is operated by the BLM, monitors sulfur- and nitrogen-oxide concentrations near Buffalo, Sheridan, and Newcastle. Nitrogen oxides (as NO_2) are also monitored by the WDEQ at the Thunder Mountain Basin National Grassland monitoring station, 29 km [18 mi] west of the Ross Project area as well as at private monitoring stations at the Belle Ayr and Antelope coal mines (see SEIS Section 5.2). All of these monitoring stations routinely indicate that the annual mean NO_2 emissions are well below the NAAQS and WAAQS.

Ozone is also monitored in the Powder River Basin which is considered an ozone attainment area. Although no violations of the ozone standard have occurred in the area, the levels reported by these nearby air-quality monitoring stations are sometimes close to the respective ozone standard.

PSD requirements also incorporate gaseous-emission standards (e.g., for NO_2, SO_2, and O_3) for maximum allowable increases in concentrations for areas designated as in attainment. As discussed above, Class I areas have the most stringent requirements; Class I areas nearest to the Ross Project area are listed above in SEIS Section 3.7.3.2.

3.8 Noise

As described in GEIS Section 3.4.6, eastern Wyoming is predominantly rural and undeveloped, except for the heavily mined Powder River Basin. Rural areas tend to be quiet, and natural phenomena, such as wind, rain, insects, and livestock, tend to contribute the most to background noise. The unit of measure used to represent sound-pressure levels is the decibel (dB) (and on the A-weighted scale, dBA or A-weighted decibel). dBA is a measure designed to simulate human hearing by placing less emphasis on lower frequency noises, because the human ear does not perceive sounds at low frequencies in the same manner as sounds at higher frequencies. In the undeveloped rural areas of Wyoming, the existing background ambient noise levels range from 22 decibels (dB) on calm days up to 38 dB, depending upon factors such as wind and traffic (NRC, 2009b).

> **How Is sound measured?**
>
> The human ear responds to a wide range of sound pressures. The range of sounds people normally experience extends from low to high pressures by a factor of 1 million. Sound is commonly measured using decibels (dB). Another common sound measurement is the A-weighted sound level (dBA). The equivalent sound level is expressed as an A-weighted sound level over a specified period of time—usually 1 or 24 hours. The A-weighting measures different sound frequencies and the variation of the human ear's response over the frequency range. Higher frequencies receive less A-weighting than lower ones.

> **What is noise?**
>
> Sound waves are characterized by frequency and measured in hertz (Hz). Noises that are perceptible to human hearing range from 31 to 20,000 Hz. Audible sounds (those that can be heard) range from about 60 dB at a frequency of 31 Hz to less than about 1 dB between 900 and 8,000 Hz. dBAs assume a human receptor to a particular noise-producing activity.

It should be noted that noise levels lessen with increasing distance from the respective source. Noise from a line source, such as a highway, is reduced by approximately 3 dB per doubling of distance. For example, road noise at 15 m [49 ft] from a highway is reduced by 3 dB at 30 m [98 ft] and further reduced by an additional 3 dB at 60 m [197 ft]. For point sources, such as equipment, compressors, and pumps, the reduction factor with distance is greater, at approximately 6 dB per doubling of distance.

The land uses in the Ross Project area (see Section 3.2) include livestock grazing, oil production, crop production, ordinary transportation, recreation, and wildlife habitat. Existing ambient noise levels at the Ross Project area were measured by the Applicant to establish pre-licensing baseline conditions at the residences located on New Haven Road and 11 residences in a 3-km [2-mi] vicinity of the Ross Project. Future site-specific noise levels associated with uranium-recovery activities would be measured against these baseline conditions to identify relative increases in noise levels.

The baseline noise study specifically studied the two nearest residences to the Ross Project. The first nearest residence is 210 m [690 ft] from the Ross Project's boundary and approximately 762 m [2,500 ft] from the location of the CPP in the Proposed Action. The second residence is 255 m [835 ft] from the boundary and 1,707 m [5,600 ft] from the proposed location of the CPP. Because these residences are so close to the Ross Project area, they bound the upper range of noise for all four of the residences next to the Ross Project area, where all of the residences are located within 0.48 km [0.3 mi] of the Ross Project's boundary (Strata, 2011a). The noise levels at these two residences averaged 35.4 dBA and 37.4 dBA, depending upon simultaneous factors such as wind speed, traffic volume, vehicular speed, and the type of load being transported (Strata, 2011a).

Truck traffic, in particular bentonite hauling from the Oshoto bentonite mine 5 km [3 mi] north of the Ross Project area and, less frequently, livestock hauling, are the main contributors to existing traffic noise on D and New Haven Roads. According to the U.S. Department of Transportation (USDOT), typical noise levels at road speeds ranging from 80 – 113 km/hr [50 – 70 mi/hr] are 62 – 68 dBA (passenger automobiles), 74 – 79 dBA (medium trucks), and 80 – 82 dBA (heavy trucks) (USDOT, 1995). Posted speed limits for D Road, which passes adjacent to the Ross Project area, are 88 km/hr [55 mi/hr] for automobiles and 72 km/hr [45 mi/hr] for trucks. Peak noise levels attributed to truck traffic have been measured at 80 – 90 dBA (Strata, 2011a). A passing truck hauling bentonite registered 73.4 dBA at the residence on New Haven Road.

In a separate noise study, the Applicant collected baseline measurements at the Applicant's Field Office for an entire week; the data yielded an average day-night noise level (l_{dn}) of 41.6 dBA overall, with no variance between weekday and weekend measurements (Strata, 2011a). The l_{dn} is the A-weighted equivalent noise level for a 24-hour period that includes a noise level

at nighttime that is 10 dBA lower than the daytime noise level. Nighttime hours are considered to be from 10 p.m. to 7 a.m. (EPA, 1978).

The Wyoming Department of Transportation (WYDOT) has defined Noise Abatement Criteria (NAC) that take into account land use, because different land-use areas are sensitive to noise in different ways (NACs are used for impact determinations only). The WYDOT procedures consider a person to be affected by traffic noise from highways when existing or future sound levels approach or exceed the NAC, or when expected future sound levels exceed existing sound levels by 15 dBA. In addition, the sound characteristics of noise can affect the acceptability of noise levels to receptors and the acceptability of noise levels is increased when the noise is familiar and routine (WYDOT, 2011). There are no NACs for undeveloped land. The exterior of residential structures would be considered affected by highway traffic above 67 dBA $L_{eq(h)}$ (i.e., equivalent continuous noise level).

Ambient noise levels in larger communities would be expected to be similar to other urban areas (i.e., approximately 50 – 78 dBA). However, the nearest cities to the Ross Project are all quite distant from the Ross Project area and are, thus, not expected to be affected by the noise levels at the Ross Project (nor, conversely, affect the noise levels from the Ross Project). For example, Casper, Wyoming, which has a population of 55,000 and is 225 km [140 mi] away from the Ross Project area (USCB, 2010), and smaller communities, such as Hulett and Moorcroft, which are located 22 km [14 miles] and 35 km [22 miles] away from the Ross Project area, respectively, are too distant to contribute to the noise environment at the Ross Project area.

3.9 Historical, Cultural, and Paleontological Resources

Both NEPA and the *National Historic Preservation Act of 1966* (NHPA), as amended, require Federal agencies to consider the effects of their undertakings on historical and cultural properties. The historic preservation review process is outlined at regulations promulgated by the Advisory Council on Historic Preservation in 36 CFR Part 800. Historical properties are resources eligible for listing in the National Register of Historic Places (NRHP) and may include sites, buildings, structures, districts, or objects. Amendments to Section 101 of the NHPA in 1992 explicitly allowed properties of traditional religious and cultural importance to be eligible for inclusion on the NRHP (and the Wyoming Register of Historic Places). Eligible properties generally must be at least 50 years old and possess criteria of eligibility as defined in 36 CFR Part 60.4; these criteria include: 1) association with significant events in the past, 2) association with the lives of persons significant in the past, 3) embodiments of distinctive characteristics of type, period, or construction, or 4) yield or be likely to yield important information. Historical properties must also possess integrity, defined as the ability of a property to convey its significance (NPS, 1997a).

NEPA established the responsibility of the Federal government to employ all practicable means to preserve important historical, cultural, and natural aspects of national heritage. Implementing regulations for Section 106 provide guidance on how NEPA and Section 106 processes can be coordinated (at Section 800.8[a]) and set forth the manner in which the NEPA process and its documentation can be used to comply with Section 106 (Section 800.9[c]). The NHPA regulations also address the Federal government's responsibility to identify historical and cultural properties and assess the effects of a given Federal undertaking on those properties (Sections 800.4 through 800.5).

As a Federal undertaking, the issuance of an NRC source and byproduct material license for the Ross Project has the potential to affect historic properties located on, in, beneath, or near the Ross Project area. The NRC is required, in accordance with the NHPA, to make a reasonable effort to identify historic properties in the area of potential effect (APE) for the Project. The APE is defined by the Ross Project site boundary and its immediate environs, which may be impacted by the Ross Project construction, operation, aquifer restoration, and decommissioning activities. If historic properties are known to be present, the NRC is required to assess the effects of its issuing a license for uranium-recovery operations on identified properties and to resolve any adverse impacts to those properties.

Several additional statutes and EOs apply to Federal land managed by the BLM, most notably the *Native American Graves Protection and Repatriation Act* (NAGPRA) and the *Archaeological Resources Protection Act* (ARPA). NAGPRA is applicable to burials found on BLM-managed lands, and in that context provides for the protection of Native American remains, funerary objects, sacred objects, or objects of cultural patrimony, and their repatriation to affiliated Native American Tribes following a consultation process between Tribes and the land managing federal agency. ARPA regulates the permitting of archaeological investigations on public land, including those managed by BLM. The State of Wyoming also has a statute pertaining to archaeological sites and human remains, entitled *Archaeological Sites* (Wyoming Statute Ann. §36-1-114, et seq.). The Wyoming State Historic Preservation Office (SHPO) administers and is responsible for oversight and compliance review for Section 106 of the NHPA and NAGPRA as well as compliance with other Federal and State historic-preservation statutes and regulations. The Wyoming SHPO and the Wyoming State Office of the BLM have entered into a programmatic agreement that describes the manner in which the two entities would interact and cooperate under the BLM's National Programmatic Agreement.

3.9.1 Cultural Context of Ross Project Area

The following information is provided as an aid to the reader to understand the Ross Project area in terms of potential prehistoric and historic events that would reasonably be expected to have occurred and that would have left behind artifacts (archaeological resources) of interest to present-day archeologists, paleontologists, and present-day Native American Tribes of this area.

The Ross Project area is within a portion of Wyoming inhabited by aboriginal hunting and gathering people for more than 13,000 years. Throughout the prehistoric past, this area was used by highly mobile hunters and gatherers who exploited a wide variety of resources. The immense expanse of grassland in the Plains region was home to vast herds of bison, also known as buffalo. Exploitation of this resource by indigenous groups structured the Northwest Plains culture area. Fur traders, explorers, and military men were the first Euro-Americans to enter the region and encounter the mounted Indians of the region. These bison-dependent people and their way of life were eventually displaced by permanent farming and ranching settlement.

3.9.1.1 Prehistoric Era

Past research activities within the Northwestern Plains culture area have defined a sequence of cultural periods that provide a general context for identification and interpretation of archaeological resources within the proposed Ross Project area. This chronology for the

Northwestern Plains was developed from the work of Frison (1991; 2001) with age ranges provided in years Before Present (B.P.):

- Paleoindian period (13,000 – 7,000 years B.P.)
- Early Archaic period (7,000 – 5,000 years B.P.)
- Middle Archaic period (5,000 – 4,500 to 3,000 years B.P.)
- Late Archaic period (3,000 – 1,850 years B.P.)
- Late Prehistoric period (1,850 – 400 years B.P.)
- Protohistoric period (400 – 250 years B.P.)
- Historic period (250 – 120 years B.P.)

The most-recent two cultural periods, about which more is known, are more thoroughly discussed in a separate section below.

The Paleoindian period includes various complexes (Frison, 1991; Frison, 2001). Each of these complexes is correlated with a distinctive projectile point style derived from generally large, lanceolate and/or stemmed point morphology. The Paleoindian period is traditionally thought to be synonymous with the "big game hunters" who exploited megafauna such as bison and mammoth (Plains Paleoindian groups), although evidence of the use of vegetal resources has been noted at a few Paleoindian sites (foothill-mountain groups).

The Early Archaic period projectile point styles reflect the change from large lanceolate types that characterized the earlier Paleoindian complexes to large side- or corner-notched types. Subsistence patterns reflect exploitation of a broad spectrum of resources, with a much-diminished use of large mammals.

The onset of the Middle Archaic period has been defined on the basis of the appearance of the McKean Complex as the predominant complex on the Northwestern Plains around 4,900 years B.P. (Frison, 1991; Frison, 2001). McKean Complex projectile points are stemmed variants of the lanceolate point. These projectile point types continued until 3,100 years B.P. when they were replaced by a variety of large corner-notched points (e.g., Pelican Lake points) (Martin, 1999, as cited in Strata, 2011a). Sites dating to this period exhibit a new emphasis on plant procurement and processing.

The Late Archaic period is generally defined by the appearance of corner-notched dart points. These projectile points dominate most assemblages until the introduction of the bow and arrow around 1,500 years B.P. (Frison, 1991). This period witnessed a continual expansion of occupations into the interior grassland and basins, as well as the foothills and mountains.

The Late Prehistoric period is marked by a transition in projectile point technology around 1,500 years B.P. The large corner-notched dart points characteristic of the Late Archaic period are replaced by smaller corner- and side-notched points for use with the bow and arrow. Approximately 1,000 years B.P., the entire Northwestern Plains appears to have suffered an abrupt collapse or shift in population (Frison, 1991). This population shift appears to reflect a

narrower subsistence base focused mainly on communal procurement of pronghorn antelope and bison.

3.9.1.2 Protohistoric/Historic Periods

The Protohistoric period witnessed the beginning of European influence on prehistoric cultures of the Northwestern Plains. Additions to the material culture include, most notably, the horse and European trade goods, including glass beads, metal, and firearms. Projectile points of this period include side-notched, tri-notched, and un-notched points, with the addition of metal points. Introduction of the horse on the southern Plains in the 1600s spread northward to other Tribes, and mounted buffalo hunters became the classic Plains culture known in the period of Euro-American contact. New diseases also spread across the continent with the first arrival of Europeans, affecting Native peoples even before the physical appearance of the newcomers.

The Plains Tribes shared a basic commonality of style in their material culture, with regional and Tribal variation. This material culture was strongly characterized by its dependence on bison. Bison played a part in all aspects of physical life by providing food, clothing, shelter, tools, and fuel (dung), as well as embodying a spiritual force (DeMallie, 2001). The need to follow the seasonal movements of bison herds resulted in seasonal variation in residential patterns. Summer encampments of large groups gathered to hunt, using cooperative hunting techniques such as driving a herd over a cliff (buffalo jump sites) or into a corral at the bottom of a slope or a cut bank.

Extended family and village groups moved along with the herds, hauling their belongings and portable dwellings to new encampments. Originally, long, low, multiple-family tents, the classic Plains teepee built on a foundation of supporting poles, developed following the adoption of the horse (DeMallie, 2001). Extended families were organized in nomadic bands or semi-sedentary villages, each independent but sharing the same language and culture, with the size of their aggregations determined by ecological factors. Communal hunting needed for the bison hunts gave way to smaller, scattered social groups that were optimal at other times. The need for horse pasturage also limited the size and duration of residential groups. Smaller Tribes stayed together more of the year, but large Tribes might only congregate for summer hunts. The largest Tribes, such as the Blackfoot and Crow, might rarely gather in a single place and tended toward more lasting divisions that can be viewed as separate Tribes with their own territories and linguistic distinctions (DeMallie, 2001).

Plains groups shared a fundamental belief in the power inherent in all living beings. This power was accessible to individuals in dreams and visions but was particularly useful to medicine men and priests, whose more heightened understanding and experience of power gave them a special role in the ritual life of Plains communities. Sacred power was acquired by individuals through vision seeking during a retreat and accompanied by fasting and prayer while awaiting the appearance of spiritual beings in a special form, sometimes an animal that embodied a teaching and protective spirit (DeMallie, 2001).

During the historic period, the Plains Tribes came under duress from the effects of a rapidly changing world. As soldiers, settlers, bison hunters, and other Tribal nations pushed westward, epidemic diseases ravaged the native populations, and the dislocation of conflict increased, leading to changing demographic patterns and a breakdown of traditional systems of food gathering and inter-group exchange patterns. As missionaries came onto the Plains they

professed belief systems that conflicted with, and sometimes even forbade, native traditional rites related to a life view that often mingled the spirit and physical worlds. The influx of trading post goods, the shift in hunting patterns, and the loss of access to the seasonal migrations of prey produced a distorting effect that challenged native life. Cultural transformation was rapid, and was characterized by a long period of hostilities with the white settlers and disagreements among various Tribal entities regarding the course of action in the face of encroachment. Eventual resolution of conflict came through military means and treaties that established the present-day reservation system.

The only Tribal reservation in Wyoming is the Wind River Indian Reservation, located approximately 273.6 km [170 mi] southwest of the Ross Project. The Crow and Northern Cheyenne Indian Reservations in Montana (approximately 160 and 146 km [100 and 91 mi] northwest, respectively) and the Pine Ridge Indian Reservation in South Dakota (approximately 185 km [115 mi] southeast) are the other Tribal reservation communities nearest the proposed Ross Project site. A review of the literature indicates that Devils Tower, which is called *Mato Tipila* by some Native Americans which means “Bear Lodge” (other names for Devils Tower include: Bear’s Tipi, Home of the Bear, Tree Rock and Great Gray Horn) (NPS, 2012), (located approximately 18 km [10 mi] from the Ross Project) is a sacred area for several Plains Tribes (Hanson and Chirinos, 1991, as cited in Strata, 2011a). According to the U.S. National Park Service (NPS), over 20 Tribes have potential cultural affiliation with Devils Tower. Six Tribes (Arapaho, Crow, Lakota, Cheyenne, Kiowa, and Shoshone) have historical and geographical ties to the Devils Tower area (NPS, 1997b). Many Native American Tribes of the northern Plains refer to Devils Tower in their legends and consider it a sacred site.

3.9.1.3 Historic Era

The historical context of the Ross Project area includes several themes common to all of northeastern Wyoming. The earliest cumulative historic impact was associated with intermittent exploration, fur trapping, gold seeking, and military expedition, circa 1810s – 1870s. This era was followed by large-scale stock raising (1870s – 1900s). The dry-land farming/homesteading movement was the most substantial historic expansion, occurring from the 1910s – 1930s. The Great Depression resulted in the government assistance programs of the mid- to late-1930s, which affected the settlement patterns of this region. Post-war ranching (1945 to present) is the latest historic theme. Crook County, where the Ross Project is situated, was formed in 1875 and named for Brigadier General George Crook, a commander during the Indian Wars.

Although Euro-Americans began to pass through Wyoming in the early 1800s, these visits were limited to government expeditions of discovery and various British and American fur trapping brigades. Beginning in the 1840s, emigrants of the "great western migration" passed along the Oregon-California Trail along the Platte River and through South Pass heading for lands in Oregon, California, and the Salt Lake Valley, but few if any stayed on in the region. As the lands in the west became more populated and the cattle industry made its way into Wyoming in the 1860s, the region began to attract its own settlers.

The Texas Trail, which operated from 1876 – 1897, was used to move cattle as far north as Canada. Most of the early cattle herds passed through Wyoming and were used to establish Montana's ranching industry. As cattlemen recognized the value of Wyoming's grassland, several large cattle ranches were established and flourished until the devastating blizzards in the winter of 1886-1887. The close of the cattle baron era provided an opening for Wyoming's

sheep industry. Several large ranches, including the 4J and G-M, were established in the Gillette area south of the proposed Ross Project; however, the industry experienced steady declines in the 1900s (Massey, 1992; Rosenberg, 1991, as cited in Ferguson, 2010). The dry-land farming movement of the late 19th and early 20th centuries had a profound effect on the settlement of northeastern Wyoming during the years around World War I. The most intensive period of homesteading activity in northeastern Wyoming occurred in the late 1910s and early 1920s. Promotional efforts by the State and the railroads, the prosperous war years for agriculture in 1917 and 1918, and the Stock Raising Act of 1916 with its increased acreage (but lack of mineral rights) all contributed to this boom period. It soon became evident, however, that dry-land farming alone would not provide a living and farmers began to increase their livestock holdings (Ferguson, 2010).

A severe drought in 1919 followed by a severe winter, along with a fall in market prices in 1920, forced out many small holders. During the 1920s the size of homesteads in Wyoming nearly doubled while the number of homesteads decreased, indicating the shift to livestock raising (LeCompte and Anderson 1982, as cited in Strata, 2011a). A period of drought began in 1932, leading to Federal drought relief programs. In April of 1932, the Northeast Wyoming Land Utilization Project began repurchasing the sub-marginal homestead lands and making the additional acres of government land available for lease. Two million acres within five counties, including about 226,624 ha [560,000 ac] of Federally-owned lands, were included in the Thunder Basin Project (LA-WY -1) to alter land use and to relocate settlers onto viable farmland (Resettlement Administration, 1936, as cited in Ferguson, 2010).

During the development program to rehabilitate the range, impounding dams were erected, wells were repaired, springs developed, and homestead fences removed while division fences were constructed for the new community pastures. The government paid former farmers to remove homesteads and their efforts were so successful that almost no trace remains. The remaining subsidized ranches were significantly larger and provided a stabilizing effect on the local economies. The Thunder Basin Grazing Association, the Spring Creek Association, and the Inyan Kara Grazing Association were formed to provide responsible management of the common rangeland.

Uranium was first discovered in Wyoming in 1918 near Lusk. Nuclear Dynamics and Bethlehem Steel Corporation formed the Nubeth Joint Venture (Nubeth) to develop new uranium recovery districts in the western U.S. with specific attention focused on northeastern Wyoming's Powder River Basin (Strata, 2011a). The initial discovery of uranium near Oshoto was made by Albert Stoick during an over-flight of the area. This was followed by macroscopic sampling efforts and then regional exploration work by the Nubeth Joint Venture (Nubeth) (Buswell, 1982, as cited in Strata, 2011a). Nubeth received a Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD) License to Explore (No. 19) in August 1976 and an NRC license in April 1978 (No. SUA-1331). The Nubeth research and development facility was constructed and operated from August 1978 through April 1979. No precipitation of a uranium product took place, however, and all recovered uranium was stored as a uranyl carbonate solution. All final approvals for Nubeth's decommissioning were granted by the NRC and WDEQ by 1986 (Strata, 2011a).

3.9.2 Historical Resources

Buildings and Structures

No buildings or structures eligible for the NRHP or Wyoming State Register were identified within the Ross Project area (Ferguson, 2010). An earthen structure in the Ross Project area, the Oshoto Dam, did not meet the criteria for eligibility for listing in the NRHP (48 CFR Part 2157). The original dam has been rebuilt numerous times because of flood damage, most recently in 2005, and is considered to be essentially a reconstruction rather than the original dam.

Archaeological Sites

A Class III Cultural Resource Inventory (Class III Inventory) was conducted in support of the Ross Project in April 2010 and July 2010 (Ferguson, 2010). The Inventory included a pedestrian survey in transects of 30-m [102-ft] intervals throughout the Ross Project area. Subsurface exposures such as cut banks, anthills, rodent burrows, roads ruts, and cow tracks were examined. Shovel probes were placed at the discretion of the surveyors, primarily in locations where artifacts or features were located or where soil had accumulated. The Inventory focused on landforms where intact sites might be expected, such as intact, stable terraces and their margins as well as areas of exposure (Ferguson, 2010). In November 2011, a geophysical investigation consisting of a magnetometer survey was conducted at several sites within the Ross Project Area and additional shovel tests were conducted in May 2012 and June 2012.

In preparation for the Class III Inventory, a Class 1 Inventory (i.e., a records search) was conducted for the Ross Project area in 2010; this search included the records of the Wyoming Cultural Records Office (WYCRO), the WYCRO online data base, and the BLM's Newcastle Field Office (Ferguson, 2010).

The records search showed that, prior to the 2010 Class III Inventory, no substantial block inventory (i.e., survey) had been conducted in the Project area. Small-scale investigations, including two associated with power lines and buried telephone cables as well as a drilling-pad and access-road survey, have been conducted in the Ross Project area. Only one survey, an inventory for a linear buried telephone cable in Section 13, identified one prehistoric campsite, 48CK1603. Avoidance of this campsite was recommended as a result. The campsite lies on both State of Wyoming and private land, and it was described as "bisected" by D Road (Ferguson, 2010).

During the Applicant's Class III Inventory for the Ross Project, 24 new sites and 21 isolated finds were recorded. Twenty-three of the recorded sites are prehistoric camps, and one is a historic-period homestead. The 24 sites along with the previously identified 48CK1603 are listed in Table 3.18. Paleontological materials, believed to be out of context, were found at two of the sites. These two sites produced projectile points that represent Middle Archaic and Late Archaic periods; other fragments found indicate Late Prehistoric-period occupation. Twenty-one isolates were also recorded during the Inventory. All but two of these are prehistoric artifacts; the two historic isolates are trash scatters. In addition to the sites identified during the Class III Inventory, the potential exists for deeply buried sites to be found within the Ross Project area because of its propitious location near the headwaters of the Little Missouri River.

Fifteen sites identified for the Ross Project have been recommended by the Applicant as eligible for the NRHP (Ferguson, 2010). These are: Nos. 48CK1603, 48CK2073, 48CK2075, 48CK2076, 48CK2078, 48CK2079, 48CK2080, 48CK2081, 48CK2082, 48CK2083, 48CK2085, 48CK2089, 48CK2090, 48CK2091, and 48CK2092. All of these sites are considered eligible under Criterion D of the NRHP, because they are likely to yield information important to our knowledge of prehistory. Collectively or individually, the sites have the potential to yield important information about the occupations at the headwaters of the Little Missouri River and possibly to add to the understanding of the prehistoric cultural relationships between the Little Missouri River region and the Powder River Basin. Two of the sites, Nos. 48CK2083 and 48CK2091, also provide temporal information (Ferguson, 2010).

In general, the Class III Inventory considered that sites located on intact terrace settings, where site preservation was sufficient for research purposes, were recommended as eligible. The remaining nine sites, where landforms lacked soil development and surfaces were eroded or deflated, were not considered likely to retain additional research potential. The NRC staff is in the process of consulting with the Applicant, interested Tribes, and Wyoming SHPO to evaluate the archaeological sites identified during the Applicant's Class III Inventory.

3.9.3 Cultural Resources

Implementing regulations for NHPA, specifically 36 CFR Part 800.4l(a)(1), require the NRC to determine and document the respective APE in consultation with the Wyoming SHPO and the Tribal Historic Preservation Offices (THPOs) (36 CFR Part 800). The definition of an APE is defined in 36 CFR Part 800.16(d) as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist (36 CFR Part 800). The APE is influenced by the scale and nature of an undertaking, and it may be different for different types of effects caused by the undertaking.

The APE for the Ross Project area would include all lands where construction, operation, aquifer restoration, and decommissioning activities are proposed. This would include associated staging areas and new access roads in addition to the actual footprint of ground disturbance. In addition, the APE for the Ross Project would need to take into account additional areas where potential effects to traditional cultural properties (TCPs) are identified.

3.9.3.1 Culturally Significant Locations

No Native American heritage, special interest, or sacred sites have been formally identified or recorded to date that are directly associated with the Ross Project area. The geographic position of the Project area between mountains considered sacred by various Native American cultures (the Big Horn Mountains to the west, the Black Hills and Devils Tower to the east), however, creates the possibility that existing, specific locations could have special religious or sacred significance to Native American groups.

3.9.3.2 Tribal Consultation

According to Executive Order (EO) No. 13175, *Consultation and Coordination with Indian Tribal Governments*, the NRC is encouraged to "promote government-to-government consultation and coordination with Federally-recognized Tribes that have a known or potential interest in existing licensed uranium-recovery facilities or applications for new facilities" (NRC, 2009b). Although

the NRC, as an independent regulatory agency, is explicitly exempt from the Order, NRC 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), the NRC must provide Native American 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." Tribes that have been identified as potentially having concerns about actions in the Powder River Basin include the Assiniboine and Lakota (Montana), Blackfoot, Blood (Canada), Crow, Cheyenne River Lakota, Crow Creek Lakota, Devil's Lake Lakota, Eastern Shoshone, Flandreau Santee Dakota, Kootenai and Salish, Lower Brule Lakota, Northern Arapaho, Northern Cheyenne, Oglala Lakota, Pigeon (Canada), Rosebud Lakota, Sisseton-Wahpeton Dakota, Southern Arapaho, Southern Cheyenne, Standing Rock Lakota, Three Affiliated Tribes, Turtle Mountain Chippewa, and Yankton Dakota (NPS, 2010). On February 9, 2011, the NRC staff formally invited 24 Tribes (see SEIS Section 1.7.3.2) to participate in the Section 106 consultation process for the proposed Ross Project. The 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 1.7.3.2 describes in detail the consultation activities undertaken by NRC with Tribal governments. At this time, the NRC staff is coordinating with interested Tribes to conduct a survey of the Ross Project area to identify sites of religious and cultural significance to Tribes. Correspondence and other documents related to the NRC's Section 106 Tribal consultation efforts are listed in Appendix A.

Table 3.18 Historic and Cultural Properties Identified within the Ross Project Area		
Smithsonian Number	**Preliminary NRHP Eligibility Recommendation[a]**	**Cultural Affiliation/Site Type**
48CK1603	Eligible	Prehistoric campsite
48CK2070	Not eligible	Prehistoric artifact and possible stone ring
48CK2071	Not eligible	Prehistoric campsite
48CK2072	Not eligible	Late prehistoric campsite
48CK2073	Eligible	Prehistoric campsite
48CK2074	Not eligible	Prehistoric campsite
48CK2075	Eligible	Unknown prehistoric camp site
48CK2076	Eligible	Prehistoric stone feature; Historic cans
48CK2077	Not eligible	Prehistoric campsite
48CK2078	Eligible	Unknown prehistoric camp site; historic debris
48CK2079	Eligible	Unknown prehistoric camp site
48CK2080	Eligible	Unknown prehistoric camp site
48CK2081	Eligible	Unknown prehistoric camp site
48CK2082	Eligible	Unknown prehistoric camp site
48CK2083	Eligible	Late Archaic Prehistoric campsite
48CK2084	Not eligible	Prehistoric campsite
48CK2085	Eligible	Unknown prehistoric camp site
48CK2086	Not eligible	Prehistoric campsite
48CK2087	Not eligible	Unknown cairn
48CK2088	Not eligible	Historic homestead (Maros Homestead)
48CK2089	Eligible	Prehistoric campsite

Table 3.18 Historic and Cultural Properties Identified within the Ross Project Area (Continued)		
Smithsonian Number	**Preliminary NRHP Eligibility Recommendation[a]**	**Cultural Affiliation/Site Type**
48CK2090	Eligible	Unknown prehistoric camp
48CK2091	Eligible	Middle Archaic camp
48CK2092	Eligible	Unknown prehistoric camp
48CK2093	Not eligible	Prehistoric lithic scatter

[a] The eligibility recommendations reflected in this table are those provided by the Applicant's consultant as reflected in the Class III survey report. However, the NRC staff's review of the Applicant's eligibility recommendations for the identified sites is ongoing. Therefore, for the purposes of this NEPA document, those sites that the applicant has recommended as not eligible will be treated as eligible.

3.10 Visual and Scenic Resources

What are the objectives for the visual resource classes?

Class I: To preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

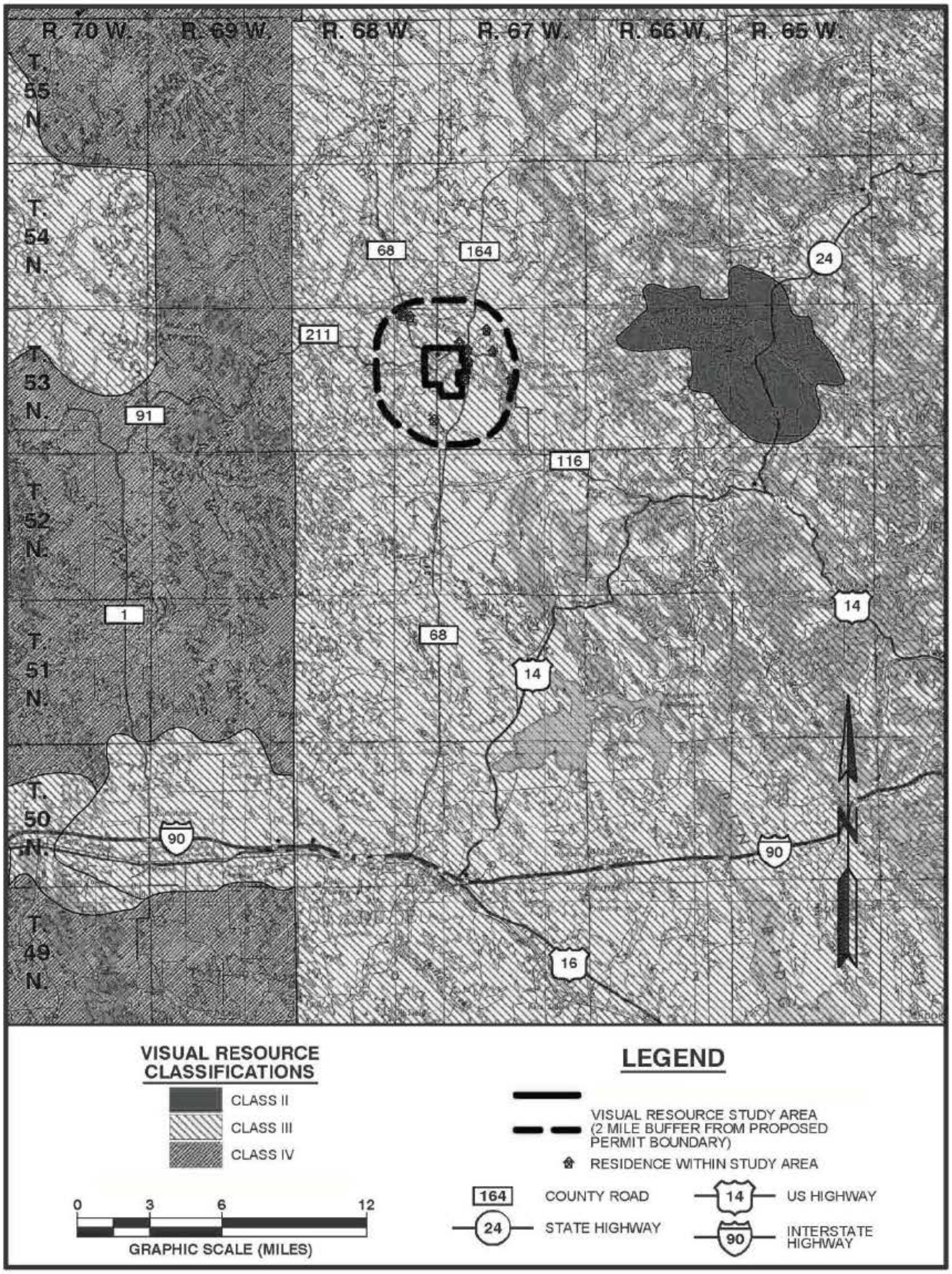
Class II: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Class III: To retain partially the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Class IV: To provide for management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

The Ross Project area is located in a landscape of gently rolling topography and large, open expanses of upland grassland, pasture- and haylands, sagebrush shrubland, and intermittent riparian drainages. Intermittent streams are fed by ephemeral drainages that seasonally drain the adjacent uplands. A mountainous landscape east of the Ross Project can be seen; this landscape includes Devils Tower and the Missouri Buttes.

To quantify visual and scenic resources on the land it administers, the BLM has established an evaluation methodology that defines the visual and scenic quality of land through a Visual Resource Inventory (VRI). The VRI process provides a means for determining visual values. The VRI consists of a scenic-quality evaluation, sensitivity-level analysis, and a delineation of distance zones. Based on these three factors, BLM-administered lands are placed into one of four VRI classes.



Source: BLM, 2000; BLM, 2001.

Figure 3.19

Regional Visual Resources Management Classifications

These classes represent the relative value of the visual resources.

Classes I and II are designated as the most valued, Class III represents a moderate value, and in Class IV, visual resources are of the least value. The VRI classes provide the basis to assess visual values during the resource management planning (RMP) process conducted for all BLM-administered lands (see Figure 3.19) (BLM, 2010b). The VRI classes are considered in addition to other land uses, such as livestock grazing, recreational pursuits, and energy development when the BLM establishes its Visual Resource Management (VRM) classes during the RMP process. All public lands must be placed into one of the four VRM classes. VRM classes may or may not reflect the VRI classes, depending upon other resource considerations (i.e., a VRI Class II area could be managed as a VRM Class III, or vice versa). The text box above describes the VRM classes and the BLM objectives for each visual classification (BLM, 2007c).

The regional visual and scenic resources in the vicinity of the Ross Project area are described below, and the following section describes Ross Project-specific visual and scenic resources.

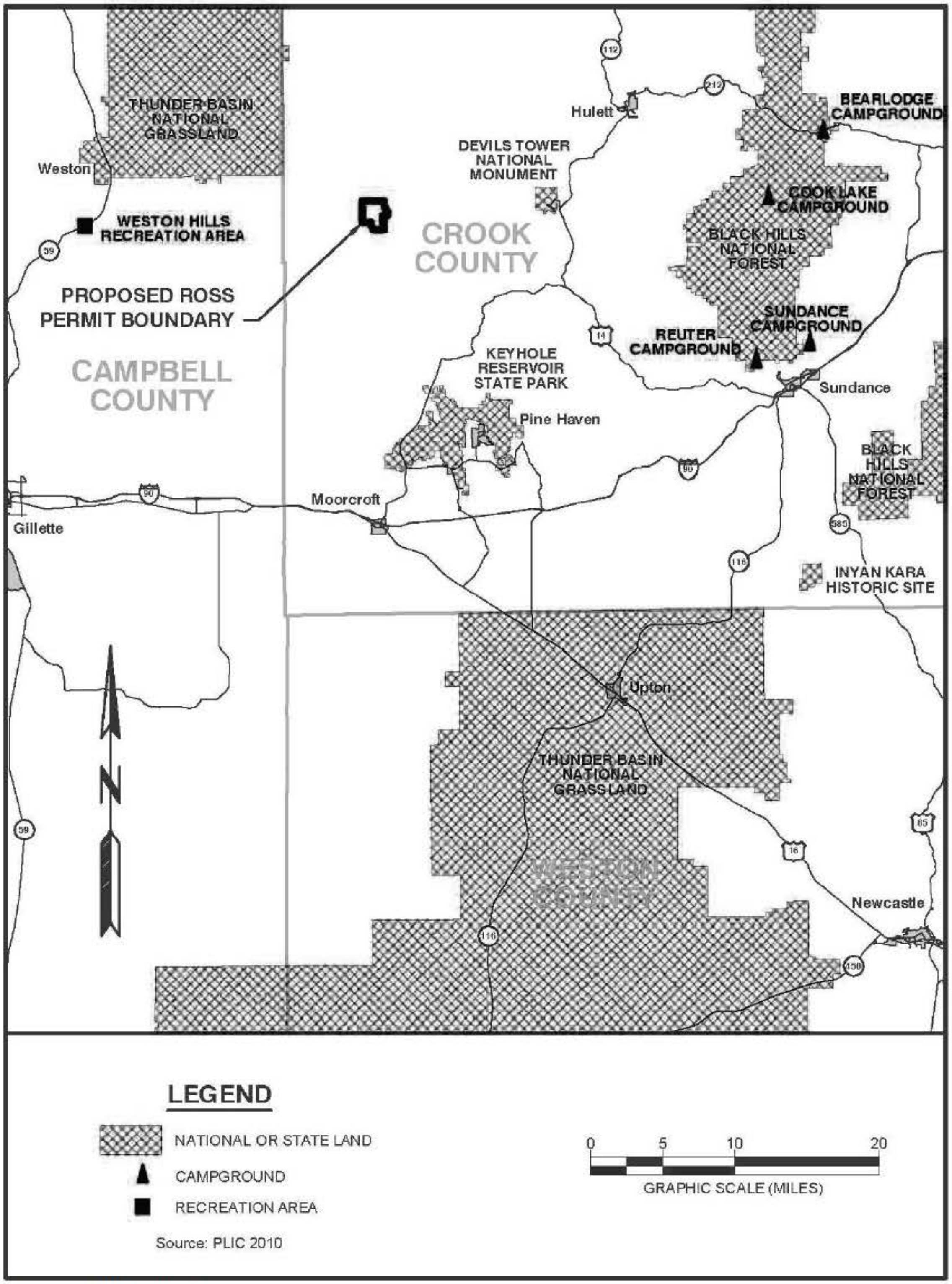
3.10.1 Regional Visual and Scenic Resources

The NSDWUMR is located within the Great Plains physiographic province, adjacent to the southern end of the Black Hills (NRC, 2009b). The northeastern corner of Wyoming, within which the Ross Project is located, is managed by the BLM's Newcastle Field Office. Most of the surrounding area is categorized as VRM Class III, but there are some Class II areas located around Devils Tower and the Black Hills National Forest, along the Wyoming-South Dakota border (see Figure 3.19).

Five areas of visually managed land are located within 32.2 km [20 m] of the Ross Project area, including Devils Tower (16 km [10 mi]) and the Missouri Buttes to the east of the Ross Project. Thunder Basin National Grassland (9.10 km [6 mi]) to the west and south, Keyhole State Park (18 km [11 mi]) to the southeast, and Black Hills National Forest (64 km [40 mi]) to the east (Strata, 2011a). These monuments, parks, and forests in the general vicinity of the Ross Project are indicated in Figure 3.20 (Strata, 2011a).

President Theodore Roosevelt established Devils Tower as a national monument on September 24, 1906. The Monument rises 386 m [1,267 ft] above the Belle Fourche River and is visible for at least 16 km [10 mi], as it is visible from the Ross Project area. Devils Tower and the surrounding countryside of pine forest, woodlands, and grassland attract visitors from around the world. The 545-ha [1,350-ac] park allows climbing, hiking, backpacking, and picnicking. Recreational climbing at Devils Tower has increased significantly in recent years. In 1973, there were approximately 312 climbers; currently, there are approximately 5,000 to 6,000 climbers a year (NPS, 2008). As noted above, the BLM VRM classification for Devils Tower is Class II. Beginning in 1995, climbers have enacted a voluntary closure, or a "no climbing period," for the entire month of June as an act of respect for Native American cultural values (NPS, 2008) (see SEIS Section 3.9.1.2).

The Black Hills National Forest (VRM Class II) encompasses streams, lakes, reservoirs, canyons and gulches, caves, varied topography, and vegetation, all of which provide habitat for an abundance of wildlife (Strata, 2011a). Keyhole State Park (VRM Class III) is home to a variety of wildlife. Keyhole Reservoir is the primary attraction to the Park and provides visitors

1 

Source: PLIC, 2010, as shown in Strata, 2012a.

Figure 3.20

Roads, National Parks, National Monuments, and Forests in Vicinity of Ross Project Area

many recreational opportunities including fishing, camping, and hiking (Strata, 2011a). The Thunder Basin National Grassland (VRM Class IV) also provides many opportunities for recreation, including fishing, hiking, and bicycling. Lush, green pastures at the Grassland provide abundant wildlife habitat. The U.S. Forest Service (USFS) manages the Grassland to conserve the natural resources of grass, water, and wildlife habitats (Strata, 2011a).

3.10.2 Ross Project Visual and Scenic Resources

The Applicant conducted a site-specific scenic-quality inventory and evaluation of the Ross Project area in October 2010, using the BLM VRI methodology (see Figure 24) (BLM, 2010b). The scenic-quality evaluation for the visual-resource study area was evaluated based on the key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. The average scenic-quality index for the Ross Project area was determined by a rating of the scenic quality of four individual aspects (the cardinal compass points) viewed from a high point in the center of the Ross Project. The individual scores were averaged to get a scenic-quality score for the entire Ross Project area. The scenic-quality evaluation presented in Table 3.19 shows that the visual-resource evaluation rating calculated for the Ross Project area is a 10.5 out of a possible 32. More detailed information on the Ross Project scenic-quality inventory and evaluation, including photos, can be found in Appendix B.

Table 3.19
Scenic-Quality
Inventory and Evaluation
(Arithmetic Average of Four Views)

Key Factor	Score
Landform	2.00
Vegetation	3.00
Water	0.50
Color	2.50
Influence of Adjacent Scenery	1.25
Scarcity	2.00
Cultural Modifications	-0.75
TOTAL	**10.50**

The BLM VRM classifications for the lands within and near the Ross Project area are shown on Figure 3.19 (BLM, 2000; BLM, 2001). The land west of the Ross Project is located in Campbell County and is categorized as VRM Class IV, while the land surrounding the Ross Project in Crook County to the east is categorized as VRM Class III. The areas studied for visual

resources include the Ross Project and the 3.2-km [2-mi] surrounding vicinity. Thus, this visual-resources area is located entirely within Crook County, and it is consequently categorized as VRM Class III. The level of change allowed by the BLM to the characteristic landscape in Class III management areas would be moderate (BLM, 2010b).

No developed parks or recreational areas are located within the Ross Project and the 3.2-km [2-mi] area around the Project (Strata, 2011a). Within these areas, there are 11 residences in addition to storage tanks; pump jacks; small maintenance buildings; public and private roads and road signage; utilities and poles (power and other utility lines); agricultural features (fences, livestock, stock tanks, and cultivated fields), and environmental-monitoring installations are prominent in the immediate foreground, and they are often noticeable in foreground views by the casual observer.

Of the 11 residences within the study area, 4 residences have unobstructed views to the Ross Project area where the uranium-recovery facility and wellfields would be constructed, and they are in close proximity to the Ross Project in general. The closest residence is 210 m [690 ft] from the Project boundary. Of the 11 residences, 8 are located to the east of the Project area with views to the east (e.g., Devils Tower) and 3 of the 11 residences are northwest of the Ross Project area. Figure 3.21 indicates the areas where the Ross Project facility (i.e., CPP and surface impoundments) would be visible, and Figure 3.22 indicates the potential areas where light pollution from the Ross Project could impact. Photographs used to document the visual-resource study are included in Appendix B.

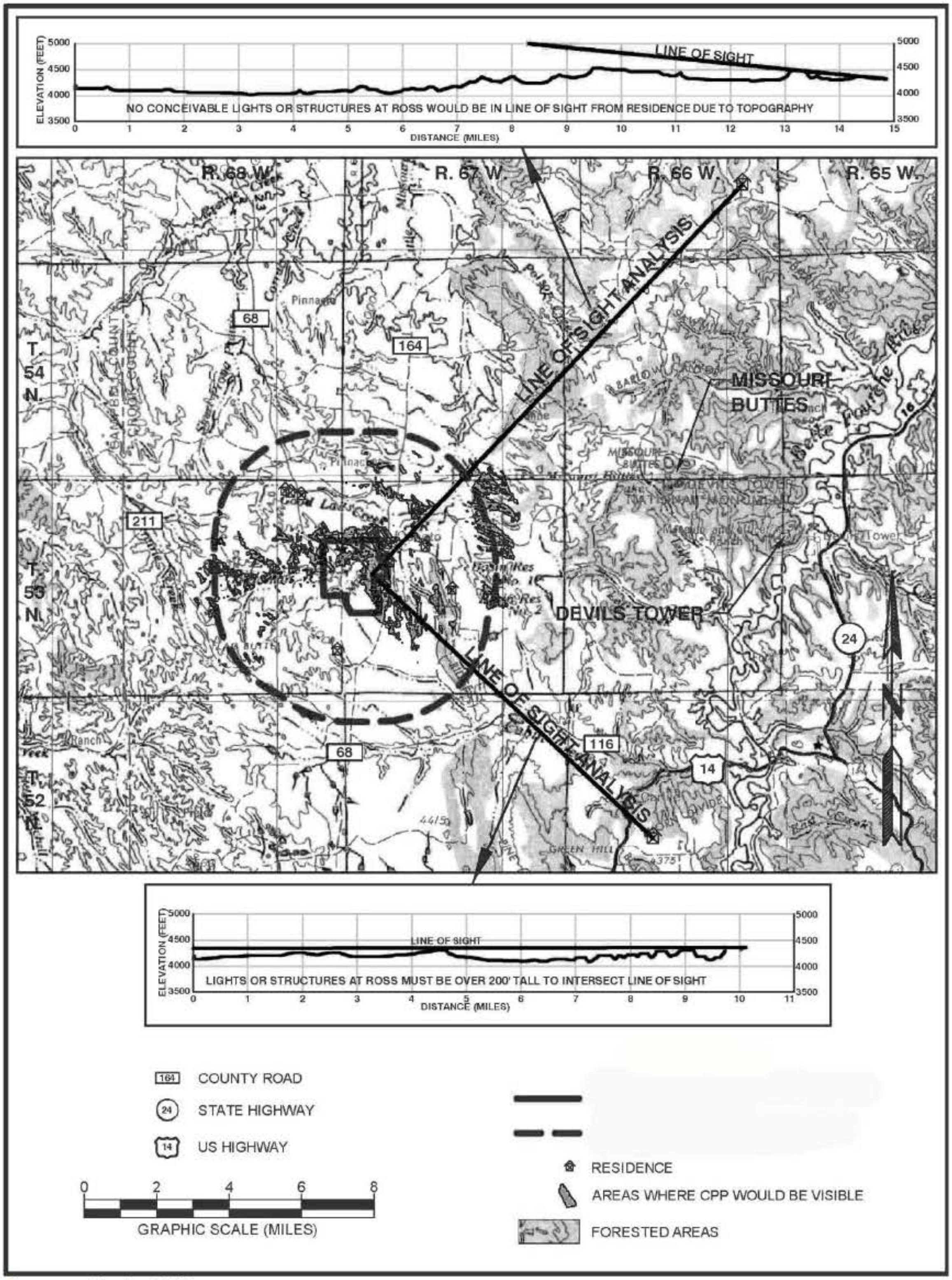
3.11 Socioeconomics

The Ross Project's region of influence (ROI) is defined as the area within which the Ross Project's socioeconomic impacts and benefits are reasonably anticipated to be concentrated. The Ross Project would be located in Crook County, but it is close enough to the Campbell County line that both counties are within this area of potential impacts. The ROI extends approximately 57 miles to the eastern boundary of Crook County, 41 miles to the northern boundary of Crook County, 115 miles to the western boundary of Campbell County, and 121 miles to the southern boundary of Campbell County. The ROI includes all of the towns and unincorporated areas within Crook County, in which the Project's facility and wellfields would be located and, therefore, would benefit from mineral-production tax revenues. It also includes adjacent Campbell County, which hosts the nearest, largest urban area (i.e., Gillette) and is, consequently, a potential source of labor, services, and materials to support the Ross Project.

3.11.1 Demographics

In Campbell County, Gillette, Wyoming, is the nearest urban area to the Ross Project; it is approximately 53 km [33 mi] to the southwest of the Project. Gillette would likely serve as a regional logistics hub as well as a source of personnel and supplies for the Ross Project (Strata, 2011a). Moorcroft, Wyoming, is approximately 35 km [22 mi] from the Ross Project area and could be a source of personnel as well as a place of residence for Project staff (Strata, 2011a).

Table 3.20 presents the 2000 and 2010 population data for the potentially affected jurisdictions in the ROI. The population in Crook County was 7,083 persons as of 2010, having increased 20.3 percent over 2000 levels (USCB, 2012). The population in Campbell County was 46,133

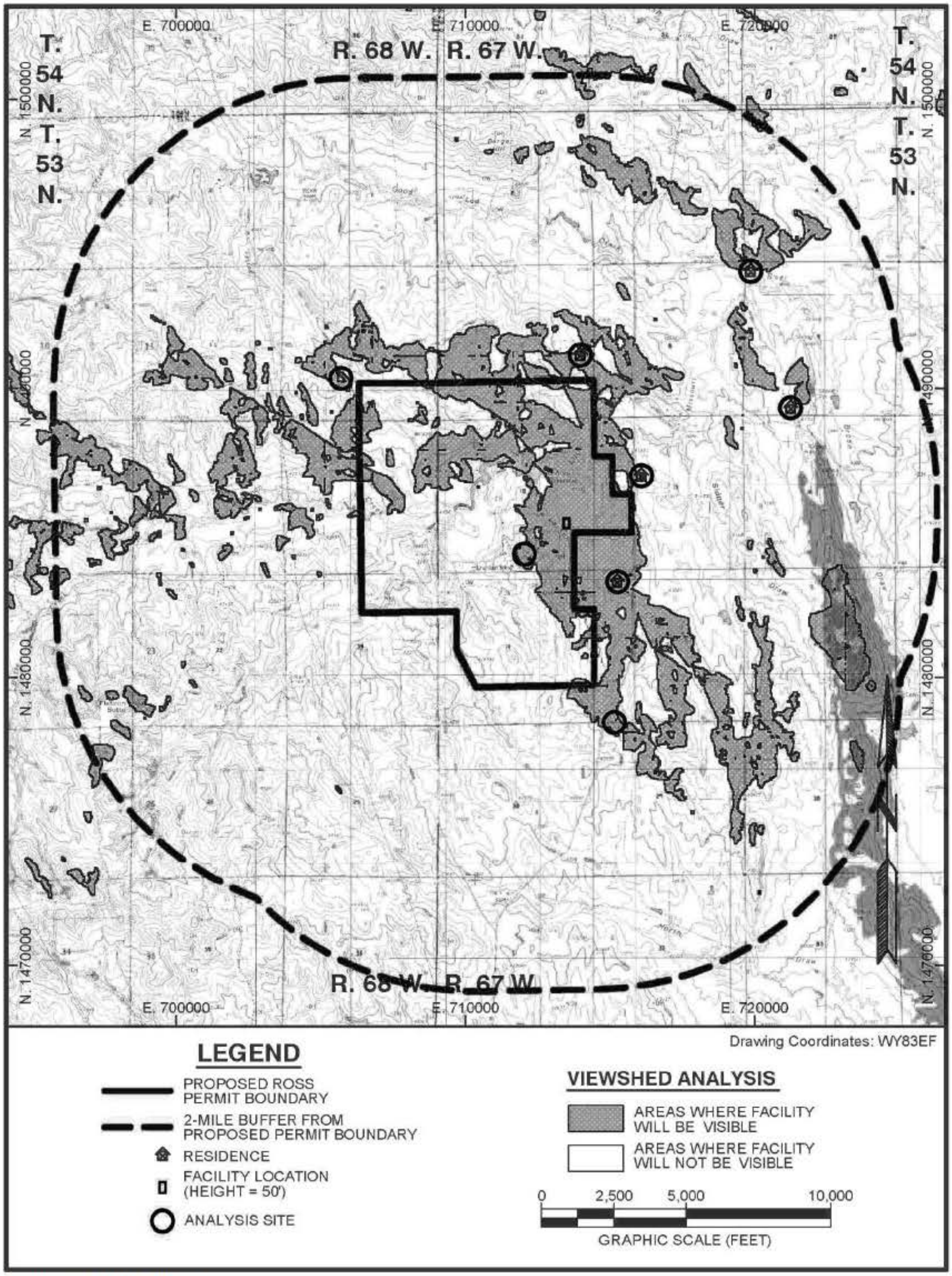


Source: Strata, 2012a.

Figure 3.21

Viewshed Analysis of Ross Project Area

1



Source: Strata, 2012a.

Note: Prior to construction of the Ross Project, baseline monitoring for potential light pollution would be conducted at eight sites.

Figure 3.22

Light-Pollution Study Area

persons as of 2010, having increased 36.9 percent over 2000 levels. In contrast, population of Wyoming as a whole increased only 14.1 percent between 2000 and 2010. Crook County is the third least populous county in Wyoming, whereas Campbell County is the third most populous.

Table 3.20
Populations in Crook County, Campbell County, and Wyoming
2000 and 2010

Jurisdiction	2000	2010	Change	Total Change (percent)	Annual Average Change (percent)
Crook County	5,887	7,083	1,196	20.3%	1.9%
Hulett	408	383	-25	-6.1%	-0.6%
Moorcroft	807	1,009	202	25.0%	2.3%
Pine Haven	222	490	268	120.7%	8.2%
Sundance	1,161	1,182	21	1.8%	0.2%
Campbell County	33,698	46,133	12,435	36.9%	3.2%
Gillette	19,646	29,087	9,441	48.1%	4.0%
Wright	1,347	1,807	460	34.1%	3.0%
TOTAL ROI	39,585	53,216	13,631	34.4%	3.0%
TOTAL WYOMING	493,782	563,626	69,844	14.1%	1.3%

Source: USCB, 2012

Between 2000 and 2010, Gillette grew by 48.1 percent, faster than the county as whole and much faster than the entire State. This is largely attributable to the growth in the energy sector, conventional oil and gas, coal mining, and power plant construction.

The population of Campbell County is younger than the Wyoming average, has more people per household, more households with individuals under 18 years of age, fewer households with individuals over 65 years of age, and slightly more female householders with no husband present and with their own children under 18 years old (USCB, 2012). Conversely, the population of Crook County is older than the Wyoming average with a higher median age, smaller percentage of households with individuals under 18 years of age, and a higher percentage of households with persons 65 years of age or older.

3.11.2 Income

Per capita personal income in Crook County was $45,843 per person in 2009 and was $49,986 per person in Campbell County (USBEA, 2011). By comparison, per capita income in Wyoming

was $49,887 and $40,936 in the U.S. (USBEA, 2011). Based upon the population characteristics discussed above, total personal income in the two-county area was $2.6 billion. Per capita income in Crook and Campbell counties grew at an average annual rate of 3.9 percent over the 2000 to 2009 period (USBEA, 2011). In contrast, per capita income in Wyoming grew at a slightly lower rate of 3.4 percent per year, while the rate of growth in the U.S. over the same period was only 0.8 percent.

Average earnings per job in Crook County were $35,371 in 2009, having increased 2.9 percent annually since 2000. Average earnings per job in Campbell County are almost twice as high as in Crook County and were $64,612 in 2009, having increased 2.9 percent annually since 2000. In contrast, earnings per job State-wide were $46,831 and $52,358 in the U.S. for the same period.

3.11.3 Housing

As of 2010, there were 18,955 housing units in Campbell County (USCB, 2012). Of these, 1,783 were vacant housing units, representing an overall vacancy rate of 9.4 percent (USCB 2012). Of the 1,783 vacant units, 689 of the vacant units were for rent. In contrast, there were only 3,595 housing units in Crook County in 2010. Of these, 674 were vacant housing units, for an overall vacancy rate of 18.7 percent. Of the vacant units, only 54 vacant units were for rent.

Homeownership rates in the two Counties are high by state and national standards. Owner-occupied units accounted for 73.3 percent of all occupied units in Campbell County and 79.3 percent of all occupied units in Crook County (USCB, 2012). Homeownership for the State is 69.2 percent of the population, compared to the entire U.S. where homeownership is 65.1 percent of the population.

3.11.4 Employment Structure

Wyoming State Data

In October 2009, the seasonally-adjusted unemployment rate in Wyoming reached 7.4 percent for the first time since September 1987. Unemployment rates have been on the decline since that time, with the August 2011 rate reported at 5.5 percent (BLS, 2011; WDWS, 2011a).

State-wide employment grew 6.5 percent between the years 2000 and 2010 and stood at 273,313 employed persons in 2010 (WDWS, 2011a). By August 2011, employment was 296,424 persons, up from 277,625 persons in August 2010.

Trade, transportation, and utilities employment represent the largest employment sector in Wyoming, with 24.0 percent of employed persons as of 2010 (WDWS, 2011a), comparable to the U.S. average of 23.0 percent. State-wide employment in the natural resources and mining sector amounted to 13.4 percent of all employment, significantly higher than the U.S. average of 1.7 percent.

Crook and Campbell County Data

Employment in Crook County over the past decade has typically been in the 3,000 to 3,400 range, with peak employment registered at 3,404 persons in 2008 (WDWS, 2011a). Average

annual employment in 2010 was 3,284 persons. The August 2011 monthly level is currently at 3,475 persons, down slightly from the August 2010 level of 3,527 persons. Unemployment rates in Crook County have been typically low by national standards, ranging from 2.7 percent to 4.3 percent over the 2000 to 2007 period, but subsequently rose to 5.8 percent in both 2009 and 2010 (BLS, 2011). The unemployment rate as of August 2011 stood at a slightly reduced level of 5.0 percent, representing 175 unemployed persons at this time.

In contrast to Crook County, employment in Campbell County over the past decade has typically been in the 20,000 to 28,000 range, with peak employment registered at 28,492 persons in 2009 (WDWS, 2011a). Employment dropped slightly in 2010 to 27,531 persons and August 2011 levels are currently at 25,542 persons, up slightly from the comparable period in 2010, but still down from 2010 averages.

Unemployment rates in Campbell County also have been typically low by national standards, ranging from 2.0 percent to 3.7 percent over the 2000 to 2008 period, but subsequently rose to 5.5 percent in 2009 and 6.0 percent in 2010 (BLS, 2011). The unemployment rate as of August 2011 stood at a reduced level of 4.4 percent, representing 11,166 unemployed persons at this time.

3.11.5 Finance

The State of Wyoming does not levy a personal or corporate income tax, nor does Wyoming impose a tax on intangible assets such as bank accounts, stocks, or bonds (Strata, 2011a). In addition, Wyoming does not assess any tax on retirement income earned and received from another state. Revenues to the State of Wyoming come from three sources: taxes on mineral production, earnings on investments, and general-fund revenues. Taxes on mineral production include property taxes on the assessed value of production, severance taxes, royalties on production of State-owned minerals, and the State's share of Federal mineral royalties. General-fund revenues include sales (at 4 percent) and use taxes, charges for sales and services, franchise taxes, and cigarette taxes. The third source of State revenues is earnings from the Wyoming Permanent Mineral Trust Fund and pooled investments.

Cities and counties receive revenues in the form of property taxes as well as local sales and use taxes up to 2 percent, including special assessments such as capital-facilities taxes and revenue sharing from the State. Local governments are responsible for collection of property taxes, which are the primary source of funding for public schools and for municipalities, counties, and other local government units. Although Crook County has a slightly higher average mill levy than Campbell County, the mill levy is applied to a much lower evaluation, thus the property taxes raised in Crook County amounted to only a little more than 4 percent of those raised in Campbell County in FY 2010 (Strata, 2011a).

3.11.6 Education

Kindergarten through 12th grade (K-12) public schools in Wyoming are generally organized at the county or sub-county level by school district. Campbell and Crook counties each have one public school district. Campbell County School District operates 16 elementary schools, 2 junior high schools, 2 high schools, and 1 combined junior/high school (Strata, 2011a). Crook County operates a single K-12 school, 2 elementary schools, 2 secondary (grades 7-12) schools, and 1 high school (grades 8-12).

Campbell County has higher school attendance rates than Wyoming as a whole in all grade levels, except college or graduate school (Strata, 2011a). The student-teacher ratio is 19.6 to 1 (Campbell County School District, 2012). Crook County is below the State average at the nursery and preschool ages as well as at the kindergarten and college/graduate school levels, but well above the State average at the elementary (grades 1 – 8) and high-school levels. The student-teacher ratio is 11 to 1 (Education.com, Inc., 2012).

Wyoming also has seven community-college districts. The Northern Wyoming Community College District consists of the main campus in Sheridan, a satellite campus in Gillette, and outreach centers in Buffalo, Kaycee, and Wright. The Gillette campus is the closest post-secondary school to the Ross Project area (Strata, 2011a).

3.11.7 Health and Social Services

Campbell County Memorial Hospital is the principal health-care provider in northeast Wyoming and offers a full range of health services, including emergency room and outpatient surgery services (Strata, 2011a). It is located approximately 65 miles from the Ross Project area. The Heptner Radiation Oncology Center was completed in 2002, and an expansion of medical oncology services was completed in 2008 to form the Cancer Care Center at Campbell County Memorial Hospital. An approximately 560 m^2 [6,000-ft^2] expansion of the Emergency Department was completed in 2009 and an extensive laboratory was completed in late 2009. The laboratory project included the first full chemistry automation line in Wyoming. A $68-million expansion project on the Hospital began in June 2009, with construction of a 3.5 level, 294-space parking structure adjacent to the main entrance of the Hospital. Construction began on a three-level Hospital addition, capable of supporting three additional levels, in 2010. In addition to the Hospital, Campbell County also has outpatient and walk-in clinics, surgery and rehabilitation centers, and numerous senior-residence facilities.

The Crook County Medical Services District consists of a hospital and clinic located in Sundance, as well as clinics located in Moorcroft and Hulett. The District also provides a long-term-care facility attached to the hospital in Sundance (Strata, 2011a).

Sundance, Moorcroft, and Hulett have an ambulance service to cover each town and surrounding areas. Each service has Emergency Medical Technician (EMT) Intermediates, EMT Basics, and Emergency Medical Responders (EMRs) serving on their teams. Of these, Moorcroft is closest to the Ross Project area.

A community survey of needs and services was published in June 2010 by the Campbell County CARE Board. The primary purpose of this needs assessment was to better understand the needs of people who are living in poverty in Campbell County. This survey showed that both low-income clients and agencies ranked, in order, the following services as the most highly rated needs of the County:

- Emergency services
- Housing
- Health

- Nutrition/food
- Employment and training

3.12 Public and Occupational Health and Safety

The existing pre-licensing baseline radiological conditions at the Ross Project area are discussed below.

3.12.1 Existing Site Conditions

As required by 10 CFR Part 40, Appendix A, Criterion 7, the Applicant has conducted one year of pre-licensing, pre-operational baseline radiological monitoring of the Ross Project area. It began its monitoring activities in August 2009. The resulting monitoring data establish the Ross Project area's baseline characteristics prior to NRC licensing. This site-characterization monitoring was developed and implemented in accordance with the following NRC guidelines:

- NRC Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*, Revision 1 (NRC, 1980).
- NRC Regulatory Guide 3.46, *Standard Format and Content of License Applications, Including Environmental Reports, For In Situ Uranium Solution Mining*, Section 2.9 ("Radiological Background Characteristics") (NRC, 1982a).
- NRC Regulatory Guide 3.8, *Preparation of Environmental Reports for Uranium Mills* (NRC, 1982b).
- NUREG–1569, *Standard Review Plan For In Situ Leach Uranium Extraction License Applications* (NRC, 2003).

These pre-licensing baseline radiological data represent the condition of the Ross Project area prior to development or construction of any Ross Project facility, wellfields, or any other structural improvements. These data would support future assessments of any environmental impacts that could occur as a result of the Ross Project's construction, operation, and decommissioning, including accidental releases. That is, for most resource areas, the site-characterization data collected by the Applicant would be used to compare and contrast any data collected during the operation of the Ross Project as well as post-operational data collected later.

In the case of ground-water resources, however, additional post-licensing, pre-operational data would be collected (i.e., after the NRC license has been issued, but before actual uranium recovery in a wellfield is initiated, as would be required by the NRC license). This post-licensing, pre-operational data set, which would be established for each wellfield prior to uranium recovery in that wellfield, would serve as a benchmark for the Applicant to determine whether an excursion has occurred (i.e., by way of the upper control limits (UCLs) established for that particular wellfield) and whether the ground water in a wellfield has been restored to the respective target values. These further sampling and analysis activities are discussed in SEIS Sections 2.1.1.1 and 3.5.3.

As discussed in SEIS Section 3.5.3, results from ground-water site-characterization samples can be compared to the specific regulatory standards published by the EPA and the WDEQ/WQD. However, most of the analytical results discussed in this section cannot be compared easily to existing standards because the standards are specified in units other than the reported laboratory units. That is, for example, gross alpha results are reported in picoCuries/volume (pCi/L) [Bq/L] or pCi/kg [Bq/kg] (i.e., in liquid or solid matrices, respectively). This unit is a measurement of the radioactivity in a sample (such as ground water or soil). However, the units of radiation-dose standards are specified in radiation dose/unit time (Sievert or millirem [Sv or mrem]/unit time), and pCi/L or pCi/kg concentrations cannot be straightforwardly converted to mrem/unit time, which is a standard for a human's radiation dose, without extensive modeling (including the conversion to a Total Effective Dose Equivalent [TEDE] which is one of the units used in radiation-protection regulations) (see SEIS Section 4.13). The NRC staff has taken the pre-licensing baseline data supplied by the Applicant and reviewed the modeling that the Applicant performed to determine the respective total radiation dose currently present at the Ross Project area, given the radioactivity-concentration values included in Strata's license application (Strata, 2011b; Strata, 2012b). The modeling and the pre-operational monitoring results performed by the Applicant indicate that the existing conditions at the Ross Project area do not exceed any radiation-dose guidelines or standards in the applicable regulations.

How are potential radiation exposures and doses calculated?

Radiation dose estimates are quantified in units of either **Sievert** or **rem** and are often referred to in either milliSievert (mSv) or millirem (mrem) where 1,000 mSv = 1 Sv and 1,000 mrem = 1 rem (Sv = 100 rem). These units are used in radiation protection to quantify the amount of damage to human tissue expected from a dose of ionizing radiation.

Person-Sv (or person-rem) is a metric used to quantify population radiation dose (also referred to as collective dose). It represents the sum of all estimated doses received by each individual in a population and is commonly used in calculations to estimate latent cancer fatalities in a population exposed to radiation.

Radiation dose is a measure of the amount of ionizing energy that is deposited in a human body. Ionizing radiation is a natural component of the environment and ecosystem, and members of the public are exposed to natural radiation continuously. Radiation doses to the general public occur as a result of the radioactive materials found in the Earth's soils, rocks, and minerals (including those in the Ross Project area). For example, radon-222 (Ra-222) is a radioactive gas that escapes into ambient air from the decay of uranium (and its progeny radium-226), which is found in most soils and rocks. Naturally occurring low levels of uranium and radium are also found in drinking water and foods. Cosmic radiation from space is another natural source of radiation. In addition to these natural sources, there are also artificial or human-made sources that contribute to the radiation dose the general public routinely receives. For example, medical diagnostic procedures using radioactive materials and x-rays are the primary human-made source of radiation the general public experiences. For comparison, the National Council for Radiation Protection estimates the average dose to the public from all natural radiation sources (terrestrial and cosmic) is 3.1 millisieverts (mSv) [310 millirem (mrem)] per year. In Wyoming, this figure is approximately 3.15 mSv/year [316 mrem/yr] (NRC, 2009b).

Pre-Licensing Baseline Radiological Conditions

Table 3.21 presents the range (i.e., the minimum and maximum values) of selected pre-licensing baseline data for the some of the radiological parameters required by the NRC's Regulatory Guide 4.14 (Strata, 2011b; NRC, 1980). Individual reported values for the various radiological parameters can be found in the Applicant's TR (Strata, 2011b).

Pre-Licensing Baseline Sample Matrices, Locations, and Results

The Applicant's pre-licensing baseline environmental-monitoring program was conducted under rigorous sampling-and-analysis procedures and quality-control methods (Strata, 2011b). During the Applicant's environmental monitoring efforts, local ground and surface waters were sampled and analyzed as were samples of sediments, vegetation, air, wildlife, and fish. Direct gamma ("γ") radiation was also measured. The pre-licensing baseline monitoring program included the Applicant's obtaining samples of the following matrices at the specified locations and having the samples analyzed for the radiological parameters shown in Table 3.21. The range of the values obtained by laboratory analysis of these samples is presented in Table 3.21 as well.

Surface Water

The surface waters at the Ross Site were sampled by the Applicant at 14 locations. These locations included both the Oshoto Reservoir and two creek samples (one each from Deadman Creek and the Little Missouri River) during June 2010. Ten other water reservoirs in the Lance District were sampled as well. Three locations on the Ross Site are set up to automatically collect samples during any significant runoff events, although none occurred during the monitoring period (Strata, 2011b). In addition, intermittent and ephemeral surface-water channels were sampled when water was present. Figure 3.14 shows these locations.

Ground Water

Ground-water samples were collected during the Applicant's pre-licensing baseline site-characterization efforts at the Ross Project area. The samples were collected at six locations within the Ross Project area using monitoring wells screened from various horizons within the Lance/Fox Hills aquifer, on-site and nearby privately owned water supply wells. The results of all ground-water samples are more fully discussed in SEIS Section 3.5.3. Note that for samples where metals, including uranium, were to be analyzed, these samples were filtered, yielding "dissolved" concentrations in the data reported. This methodology is described in SEIS Section 3.5.3.

As discussed in the Applicant's license application and in SEIS Section 3.5.3, several ground-water samples exceeded radiological criteria specified by the EPA for its MCLs, and some exceeded more than one of the criteria. The three MCLs are:

- Uranium = 30 μg/L
- Radium-226+228 = 5 pCi/L [0.19 Bq/L]
- Gross Alpha = 15 pCi/L [0.56 Bq/L]

Table 3.21
Range of Analytical Results of Pre-Licensing Baseline Samples*
All Sample Matrices

Matrix	Type	Selected Parameters	Range (If Any) of Results** (Minimum to Maximum)	Units	Any Samples Greater than Detection Limit?
Water					
	Surface Water[†,††]				
		Lead-210	<1 – 1.46	pCi/L	Yes
		Polonium-210	<1**	pCi/L	No
		Radium-226	<0.02 – 0.46	pCi/L	Yes
		Radium-228	<1 – 1.52	pCi/L	Yes
		Thorium-230	<0.2	pCi/L	No
		Uranium[a]	<0.001 – 0.089	mg/L	Yes
		Gross Alpha	<2 – 48.7	pCi/L	Yes
	Ground Water[†,††]				
		SA Zone			
		Lead-210	<1	pCi/L	No
		Polonium-210	<1	pCi/L	No
		Radium-226	<0.2 – 0.5	pCi/L	Yes
		Radium-228	<0.1 – 1.8	pCi/L	Yes
		Uranium	<0.001 – 0.007	mg/L	Yes
		Gross Alpha	<6 – 13.8	pCi/L	Yes
		SM Zone			
		Lead-210	<1 – 1.34	pCi/L	Yes
		Polonium-210	<1	pCi/L	No
		Radium-226	<0.2 – 3.7	pCi/L	Yes
		Radium-228	<0.1 – 1.3	pCi/L	Yes
		Uranium	<0.001 – 0.004	mg/L	Yes
		Gross Alpha	<7 – 12.2	pCi/L	Yes
		Ore Zone			
		Lead-210	<1 – 4.89	pCi/L	Yes
		Polonium-210	<1 – 22.9	pCi/L	Yes
		Radium-226	0.6 – 12.1	pCi/L	Yes
		Radium-228	<0.1 – 1.4	pCi/L	Yes
		Uranium	0.005 – 0.109	mg/L	Yes
		Gross Alpha	<5 – 222	pCi/L	Yes

Table 3.21
Range of Analytical Results of Pre-Licensing Baseline Samples*
All Sample Matrices
(*Continued*)

Matrix	Type	Selected Parameters	Range (If Any) of Results** (Minimum to Maximum)	Units	Any Samples Greater than Detection Limit?
		DM Zone			
		Lead-210	<1 – 1.16	pCi/L	Yes
		Polonium-210	<1	pCi/L	No
		Radium-226	<0.2 – 0.7	pCi/L	Yes
		Radium-228	<0.1 – 2.2	pCi/L	Yes
		Uranium	<0.001 – 0.013	mg/L	Yes
		Gross Alpha	<14 – 28.3	pCi/L	Yes
	Piezometers in SA Zone				
		Lead-210	<1	pCi/L	No
		Polonium-210	<1	pCi/L	No
		Radium-226	<0.2 – 0.53	pCi/L	Yes
		Radium-228	<0.01 – 2.5	pCi/L	Yes
		Uranium	<0.01 – 0.264	mg/L	Yes
		Gross Alpha	<8.44 – 218	pCi/L	Yes
Soil					
	Surface and Subsurface Soils				
		Lead-210	<0.2 – 2.0 ± 0.7	pCi/g	Yes
		Radium-226	<0.005 – 14.4 ± 2.0	pCi/g	Yes
		Thorium-230	<0.2 – 1.29 ± 0.59	pCi/g	Yes
		Uranium	<0.01 – 2.80	mg/kg	Yes
		Gross Alpha	<1 – 3.6 ± 1.7	pCi/g	Yes
	Sediments				
		Lead-210	<1 – 471 ± 6.1	pCi/g	Yes
		Radium-226	0.8 ± 0.1 – 1.5 ± 0.1	pCi/g	Yes
		Thorium-230	0.39 ± 0.14 – 371 ± 58	pCi/g	Yes
		Uranium	0.876 – 2.24	mg/kg	Yes
		Gross Alpha	1.1 ± 0.4 - 2.8 ± 0.6	pCi/g	Yes

Table 3.21
Range of Analytical Results of Pre-Licensing Baseline Samples*
All Sample Matrices
(*Continued*)

Matrix	Type	Selected Parameters	Range (If Any) of Results** (Minimum to Maximum)	Units	Any Samples Greater than Detection Limit?
Air					
	Particulates				
		Lead-210	6.25×10^{-8} – 1.14×10^{-5}	pCi/L	Yes
		Radium-226	<Detection Limits[d]	pCi/L	No
		Thorium-230	<Detection Limits – 9.74×10^{-8}	pCi/L	Yes
		Uranium	<1.16×10^{-8} – 9.41×10^{-9}	pCi/L	Yes
	Radon				
		Average Radon[b]	0.3 ± 0.04 – 2.0 ± 0.13	pCi/L	Yes
Vegetation					
	Grazing Vegetation				
		Lead-210	3.9 ± 0.5 – 264 ± 19.1	pCi/L	
		Polonium-210	0.225 ± 0.51 – 23.4 ± 7.2	pCi/L	
		Radium-226	1.12 ± 0.08 – 1,530 ± 0.4	pCi/L	
		Thorium-230	<0.2 – 89.5 ± 16.4	pCi/L	
		Uranium	0.0017 – 8.99	mg/kg	
	Wetland Vegetation				
		Lead-210	9.07 ± 4.1 – 43.1 ± 6.1	pCi/L	
		Polonium-210	1.87 ± 1.7 – 5.88 ± 2.8	pCi/L	
		Radium-226	0.3 ± 0.1 – 11.4 ± 0.5	pCi/L	
		Thorium-230	<0.2 – 3.9 ± 1.5	pCi/L	
		Uranium	0.0005 – 0.0019	mg/kg	
	Hay[c]				
		Lead-210	122 ± 13	pCi/L	
		Polonium-210	7.61 ± 4.1	pCi/L	
		Radium-226	123 ± 1.1	pCi/L	
		Thorium-230	0.83 ± 0.20	pCi/L	
		Uranium	3.10	mg/kg	

Table 3.21 Range of Analytical Results of Pre-Licensing Baseline Samples* All Sample Matrices (*Continued*)					
Matrix	**Type**	**Selected Parameters**	**Range (If Any) of Results** (Minimum to Maximum)**	**Units**	**Any Samples Greater than Detection Limit?**
	Vegetable[c]				
		Lead-210	2.95 ± 4.9	pCi/L	
		Polonium-210	2.55 ± 1.8	pCi/L	
		Radium-226	<0.05	pCi/L	
		Thorium-230	0.40 ± 0.90	pCi/L	
		Uranium	0.0001	mg/kg	
Animal					
	Livestock (Beef)[c]				
		Lead-210	3.12 ± 4.8	pCi/L	
		Polonium-210	<1.0	pCi/L	
		Radium-226	0.288 ± 0.05	pCi/L	
		Thorium-230	<0.2	pCi/L	
		Uranium	<0.001	mg/kg	
	Wildlife (Deer)[c]				
		Lead-210	13.0 ± 7.5	pCi/L	
		Polonium-210	3.68 ± 3.75	pCi/L	
		Radium-226	1.8 ± 1.5	pCi/L	
		Thorium-230	7.6 ± 4.2	pCi/L	
		Uranium	<0.001	mg/kg	
	Fish[c]				
		Lead-210	60.4 ± 93.6	pCi/L	
		Polonium-210	<1.0	pCi/L	
		Radium-226	175 ± 15	pCi/L	
		Thorium-230	0.6 ± 0.6	pCi/L	
		Uranium	0.0160	mg/kg	
Direct Gamma					
	Gamma Survey		5.3 – 25.3 ± 1.54	μR/hr	
	TLD Exposure[d]		17.3 – 30.1	mrem/day	

1 Source: Strata, 2011b.
2 Notes: See next page.

Notes for Table 3.21:

- * As suggested by NUREG-4.14.
- ** "<" = "Less than," where the value following the "<" value is the detection limit.
- † Results also discussed in SEIS Sections 3.5.1 and 3.5.3, Water Quality.
- †† All metals concentrations in water matrices reported as dissolved concentrations (i.e., the samples were filtered).
- [a] All uranium concentrations were obtained by wet-chemistry analysis, not isotope speciation by alpha or gamma spectrometry.
- [b] Averages are radon concentrations taken over three months at each monitoring station.
- [c] One sample only.
- [d] Averages taken from approximately three-month exposures of thermo luminescent dosimeters (TLDs) at each monitoring station. Each value is the "Environmental Dose," where the Environmental Dose is the Reported Dose (i.e., recorded by the TLD) minus the Transit Dose (i.e., dose received by TLD while in transit to laboratory).

Monitoring Wells and Piezometers

Six well clusters were used by the Applicant to sample ground water quarterly in 2010 (Strata, 2011b). An additional four piezometers in the CPP area were also used quarterly beginning in May 2010 (a piezometer is a device that measures the pressure [more precisely, the piezometric head] of ground water at a specific location.) As described in SEIS Section 2.1.1.1, the six well clusters allowed access to four different ground-water systems in the SA, SM, OZ, and DM zones.

Drinking Water Wells

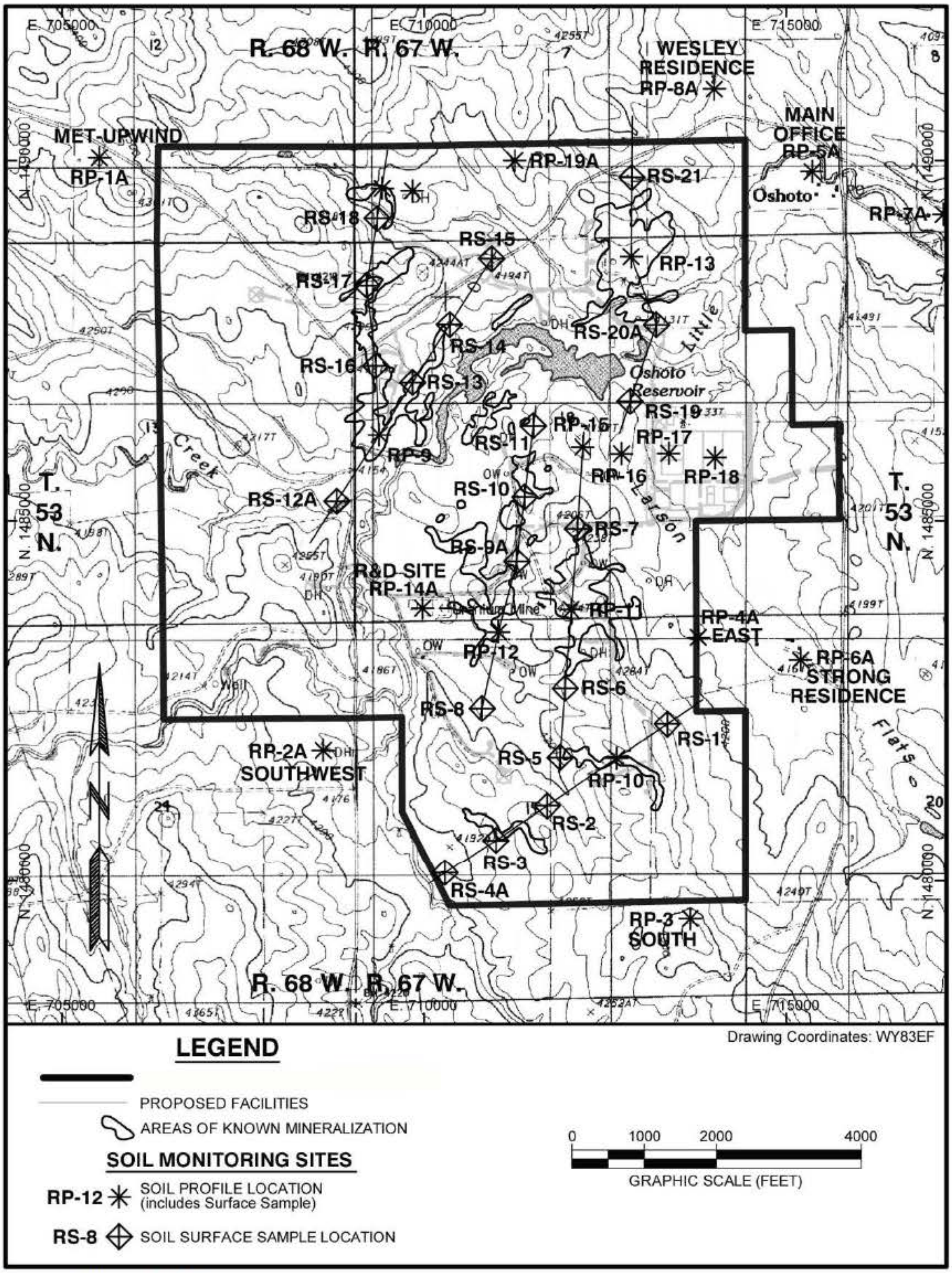
Twenty-nine local drinking water wells were also sampled quarterly, beginning in July 2009. Some of these samples could not always be obtained because some of the wells were either inaccessible during winter or non-functioning (Strata, 2011b).

Sediments

The sediments at Oshoto Reservoir as well as those at the three surface-water monitoring stations were sampled in August 2010 (Strata, 2011b). Two cups of sediment were sampled for each location and analyzed for Uranium, Ra-226, Th-230, Pb-210, and gross alpha.

Soil

Soil samples at the Ross Project area were obtained from 39 locations; each location was sampled at three depths (i.e., 0-30, 30-60, and 60-100 cm [0-11.8, 11.8-23.6, and 23.6-39.4 in]) (Strata, 2011b). Figure 3.23 indicates the locations of soil sampling activities. These include the three nearest residences, Strata's Oshoto Field Office, the potential locations of the surface impoundments and the CPP, and locations over the major ore bodies where production and recovery wells could be located.



Source: Strata, 2011b.

Figure 3.23

Soil Sampling Locations at Ross Project Area

Air

Particulates

Samples of airborne particulates (e.g., dust) were collected by the Applicant at the six air-sampling stations shown in Figure 3.24. Five of these stations commenced operation in January 2010; the sixth began operating in November 2010. The filters at each air-sampling location were collected weekly and then later composited for analysis (i.e., the filters from each sampling station were composited with the filters from only that respective station, the filters having been collected weekly over an entire quarter for a total of approximately 13 filters per composite sample) (Strata, 2011b).

Radon

Seventeen radon-sampling locations were established by the Applicant, and the results at each were collected quarterly beginning in January 2010; two of these stations were established in mid-2010, resulting in fewer samples. The radon (i.e., a potential gaseous emission) samplers are situated at each of the particulate-sampling locations as well as in the proposed CPP and surface-impoundment areas, the four nearest residences, the former research and development site that had been explored by Nubeth, and over two ore bodies that have been identified for potential uranium recovery (Strata, 2011b).

Vegetation

Vegetation at the Ross Project area was sampled by the Applicant in cooperation with the neighboring landowners after a field study to determine the best vegetation-sample locations was conducted in 2010. Eleven vegetation samples were ultimately collected at downwind locations and near the potential locations of the CPP and surface impoundments as well as along the major ore bodies in the mid- to late summer of 2010.

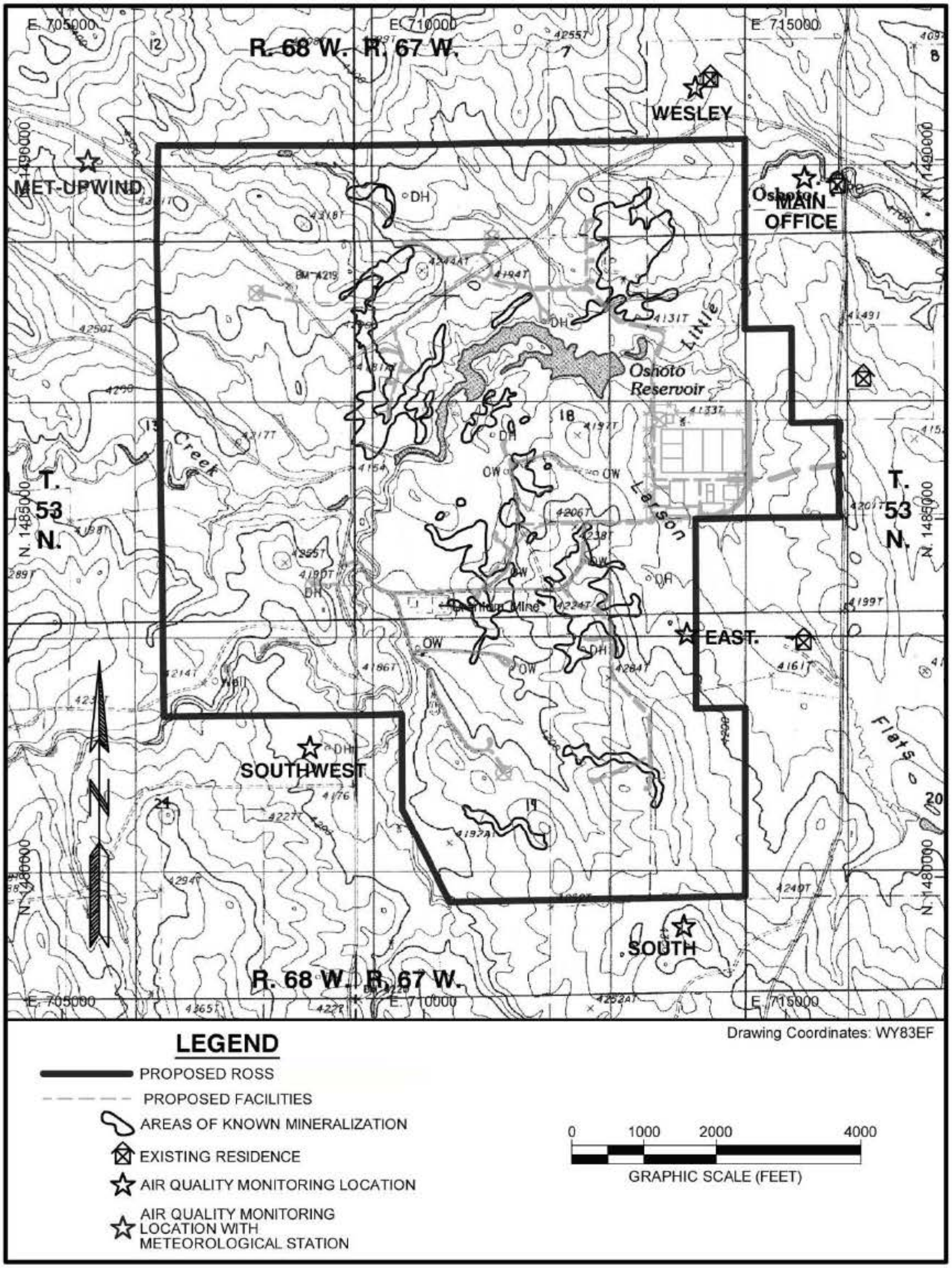
Animals

Livestock

Beef from locally raised cattle were sampled in cooperation with local landowners. Because horses are not raised in the area for human consumption, no horse-meat samples were obtained. A single beef sample was collected in July 2010 (Strata, 2011b).

Wildlife

Based on the wildlife surveys discussed in SEIS Section 3.6, the only wildlife potentially hunted at or near the Ross Project area for human consumption are deer and pronghorn antelope. One deer-meat sample was obtained from a local landowner who had hunted the deer in the Project's vicinity during the 2010 hunting season (Strata, 2011b).



Source: Strata, 2011b.

Figure 3.24

Air-Particulate Sampling Stations at Ross Project Area

Fish

A single composite sample from 99 fish that were caught at the Oshoto Reservoir was collected. Although it is reported by local landowners that fish from the Reservoir are not consumed by humans (Strata, 2011b), this sample was nonetheless submitted for analysis in September 2010.

Direct* (*Gamma*) *Radiation

Gamma Field Survey

A field survey performed by a contractor for the Applicant was conducted during July 19 through 22, 2010. During this survey, a total of 80,833 points were surveyed for gamma radiation (Strata, 2011a). In addition, ten soil samples were obtained for an evaluation of the potential relationship between radiation levels and radium concentrations in the corresponding soils (Strata, 2011b). The survey was performed according to the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (NRC, 2000), which is the generally accepted methodology for gamma field surveys.

Long-Term Gamma Study

A long-term study to measure long-term gamma radiation by thermo-luminescent dosimeters (TLDs) was implemented by the Applicant at the same time the radon monitoring stations were established. Ultimately, a total of 17 TLDs (and 2 controls) would be installed around the Ross Project area to measure quarterly gamma exposures.

3.12.2 Public and Occupational Health and Safety

The exposure of members of the public to hazardous chemical is regulated by the EPA and by the State of Wyoming under a variety of statutes and regulations. The NRC, however, has the statutory responsibility, under the *Atomic Energy Act* (AEA), to protect public and occupational health and safety with respect to radioactive materials and radiation exposures. NRC regulations at 10 CFR Part 20 specify annual radiation dose limits to members of the public of 1 mSv [100 mrem] TEDE and 0.02 mSv [2 mrem] per hour from any external radiation sources (see SEIS Section 3.12.1 for a discussion of the units of radiation dose) (10 CFR Part 20). The existing public and occupational health and safety concerns that exist at the Ross Project area today, where it currently presents minimal chemical and radiation exposures, are discussed below.

3.12.2.1 Public Health and Safety

A factor in any assessment of risks to public health and safety, including both chemical and radiation exposures, is the proximity of potentially impacted populations and the nearest receptors. As described in SEIS Section 3.2, the Ross Project area is located in a sparsely populated area of western Crook County (Strata, 2011a). The nearest community is Moorcroft, Wyoming, 35 km [22 miles] to the south, with an estimated population of approximately 1,000 persons. The unincorporated town of Oshoto which is adjacent to the Ross Project area has only a very small population (approximately 50 persons). There are no residences on the

proposed Ross Project area; however, within 3 km [2 mi], there are 11 residences with approximately 30 residents. The nearest residence to the Ross Project's boundary is approximately 210 m [690 ft] away, and the nearest residence to the CPP is about 762 m [2,500 ft] away (see SEIS Sections 3.2 and 3.8).

In addition, access to the Ross Project by non-local members of the public is very limited because much of it is privately owned land; there are few public roads that enter the area; and there are no actual public attractions or recreational activities within the Ross Project area or its immediate environs. Moreover, as described in SEIS Section 3.12.1, the hazardous substances known to be present at the Ross Project area are crude oil, associated oil-contaminated water and trash, propane and methanol, and, potentially, polychlorinated biphenyls (PCBs) (Strata, 2011a). Thus, there are very limited non-radiological public health and safety concerns at the Ross Project area because there are: 1) few close residential receptors, all of whom are located offsite; 2) few, if any, members of the public who can access the Project area; and 3) very few hazardous materials are present.

With respect to the existing radiological hazards that are present at the Ross Project area, the same limitations exist as described above for nonradiological hazards: few nearby residents, no public access, and few sources of radiation exposure. The pre-licensing, site-characterization results presented in Table 3.21 indicate exposures to only common background radiation as described in SEIS Section 3.12.1. Soil results presented in Table 3.21 indicate the radionuclide concentrations in soils that are naturally occurring, including the decay products (i.e., progeny) of the naturally occurring uranium, thorium, and radon. The surface- and ground-water pathways, as described above (see SEIS Section 3.12.1), yield little if any radiation exposure to those receptors located offsite because the analytical results of surface- and ground-water samples indicate concentrations of radionuclides that are essentially at or below the respective detection limits and/or below regulatory guidelines. Finally, animal samples indicate limited concentrations of naturally occurring radionuclides. Thus, there are very limited public health and safety concerns at the Ross Project area as it is currently characterized.

3.12.2.2 Occupational Health and Safety

Nonradiological

Occupational health and safety (i.e., industrial safety) is regulated by the State of Wyoming under the Occupational Safety and Health Administration Program. However, occupational health and safety hazards within the Ross Project area are limited by the existing land uses, which are primarily grazing, agriculture, and oil production (see SEIS Section 3.2). Known occupational health and safety concerns include common physical health and safety hazards as well as, potentially, exposures to hazardous substances. Occupational exposures could include normal, industrial, airborne hazardous substances associated with servicing equipment (e.g., vehicles); fugitive dust generated by agricultural activities and by access road use during well-drilling activities; and various chemicals used in agriculture or during oil extraction.

A common type of occupational hazard includes injuries and illnesses. According to the Wyoming Department of Workforce Services (WDWS), the most common lost-day injuries among mineral-extraction workers, including oil-production workers (currently the only type of consistent occupational worker present at the Ross Project area), were from strains and sprains

that often resulted from slips, trips, falls, or lifting. The Bureau of Labor Statistics (BLS) compiles annual reports of incidence rates of nonfatal occupational injuries and illnesses by industry and case types. The most recent reports include data from 2009 and 2010. For the category “uranium-radium-vanadium ore mining,” annual average employment is given as 1,000 and 900 in 2009 and 2010, respectively. For both years, no total recordable cases either during work or not during work were reported (BLS, 2009; BLS, 2010).

Radiological

The occupational standard promulgated by the NRC is 50 mSv [5 rem] for TEDE over the entire human body (other limits pertain to exposures other than whole body). In addition, all radiation exposures are to be limited to “as low as reasonably achievable” (ALARA). However, only a few pre-construction activities are currently taking place at the Ross Project area—activities such as drillhole plugging and abandonment, monitoring well installation, and environmental monitoring sample collection by the Applicant’s personnel. As the pre-licensing baseline data demonstrate (Strata, 2011a), little radioactivity is available to come into contact with these personnel at the Ross Project area today. As a result, there is currently only a small occupational exposure to radiation (i.e., there are few personnel to be exposed and few sources of radioactivity that yield measureable doses).

3.13 Waste Management

Few wastes are currently generated at the Ross Project area, either liquid or solid. Those that are generated are described below.

3.13.1 Liquid Waste

Sources of liquid waste generated at the Ross Project area currently include uranium-exploration drilling, monitoring wells drilling and development, and oil-production facilities (Strata, 2011a).

Drilling the many exploration drillholes on the Ross Project generates drilling fluids and muds (i.e., cuttings). These wastes are classified as technologically enhanced, naturally occurring radioactive materials (TENORM); they are defined by EPA as “[n]aturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing” (EPA, 2008). Drilling wastes (i.e., fluid, muds, cuttings) are collected and disposed of by the Applicant in onsite excavated pits, or mud pits, that are dug for this specific purpose pursuant to the various EPA regulations governing TENORM, such as those in 40 CFR Part 192. They are allowed to evaporate and dry, and then the dried pits are reclaimed according to WDEQ/LQD requirements, usually within one construction season.

Drilling fluids and muds similar to those created during uranium-exploration drilling are also generated during the Applicant’s drilling of its preconstruction monitoring wells and drillholes that it is using to support its license application to the NRC (Strata, 2011a). These fluids are contained and evaporated in mud pits the same as those above, which are constructed adjacent to the drilling pads (Strata, 2011b). An average of 23, 000 liters [6,000 gallons] of ground water

along with 12 m^3 [15 yd^3] of drilling muds, are produced during the development and sampling of monitoring wells (Strata, 2011b).

Ground water has also been produced during well tests conducted to characterize aquifer properties (Strata, 2011a). This TENORM water is discharged under a temporary WYPDES Permit No. WYG720229 (WDEQ/WQD, 2011).

Crude oil and water used in its production could be present at the three oil-producing wells on the Ross Project area. These wastes are categorized by EPA as “special wastes” and are exempt from the Federal hazardous waste regulations under Subtitle C of the *Resource Conservation and Recovery Action* (RCRA).

3.13.2 Solid Waste

Few solid wastes are currently generated at the Ross Project area; no AEA-regulated wastes are currently generated. The solid wastes currently generated include predominantly miscellaneous trash from the existing agricultural and oil-production activities that currently take place at the Project area. Agricultural wastes are either disposed of at private landfills or at the local state-permitted landfill in Moorcroft; no private landfills have been identified at the Ross Project area (Strata, 2011a).

Oil-production solid wastes, such as rags contaminated by oil, propane, or methanol, are “special wastes” according to EPA regulations (i.e., they are generated in the production of crude oil) and are exempted from the EPA’s hazardous waste regulations under Subtitle C of RCRA (Strata, 2011a). There is one existing stockpile of discarded oil-production tubing that has been identified on the Ross Project area.

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