ENVIRONMENTAL ASSESSMENT FOR THE LOST CREEK IN SITU URANIUM RECOVERY FACILITY LICENSE AMENDMENT FOR CLASS V UNDERGROUND INJECTION CONTROL

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Office of Nuclear Material Safety and Safeguards
Division of Fuel Cycle Safety, Safeguards, and
Environmental Review

Enclosure

CONTENTS

FIGURES

TABLES

ABBREVIATIONS/ACRONYMS

ac	acres
BLM	Bureau of Land Management
CFR	*Code of Federal Regulations*
EA	Environmental Assessment
EPA	Environmental Protection Agency
ft	feet
gal	gallon
gal/min	gallon per minute
GEIS	Generic Environmental Impact Statement
ha	hectares
ISR	in situ uranium recovery
km	kilometer
L	liter
L/min	liter per minute
LCI	Lost Creek ISR, LLC
m	meter
mi	mile
min	minute
mR	milliRoentgen
mrem	millirem
mSv	millisievert
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
RO	reverse osmosis
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
UIC	underground injection control
USDW	underground source of drinking water
WDEQ	Wyoming Department of Environmental Quality
WQD	Water Quality Division

1 INTRODUCTION

By letter dated March 20, 2008, Lost Creek ISR, LLC (LCI) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new source material license for the proposed Lost Creek In Situ Uranium Recovery (ISR) Facility (LCI, 2008). In June 2011, the NRC published a Supplemental Environmental Impact Statement (SEIS) for the Lost Creek ISR Project in Sweetwater County, Wyoming (NRC, 2011), which was Supplement 3 to NRC's Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities [GEIS] (NRC, 2009). The SEIS provided an analysis of the environmental impacts from the construction, operation, aquifer restoration, and decommissioning of LCI's proposed ISR facility at the Lost Creek Project site. On August 17, 2011, the NRC issued Source Materials License SUA-1598 to LCI for the construction and operation of the Lost Creek ISR facility, as amended (NRC, 2016b). Upon completion of facility construction, LCI began ISR operations in August 2013.

LCI submitted a request to the NRC, by letter dated March 3, 2015, to amend materials license SUA-1598 (LCI, 2015a). LCI proposes by this request to inject treated wastewater into Underground Injection Control (UIC) Class V disposal wells at the Lost Creek ISR Facility.

The NRC staff has reviewed LCI's amendment request and prepared this Environmental Assessment (EA) in accordance with the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and the NRC staff guidance document, NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003a). NRC's regulations in 10 CFR Part 51 implement Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA). This EA includes an evaluation of the potential environmental impacts of the action requested in LCI's license amendment application.

Through the Underground Injection Control (UIC) program, the U.S. Environmental Protection Agency regulates the construction, operation, permitting, and closure of injection wells used to place fluids underground for storage or disposal. The program consists of six classes of injection wells, with each well class based on the type and depth of the injection activity, and the potential for that injection activity to result in endangerment of an underground source of drinking water (USDW).

Class I wells are used to inject hazardous and non-hazardous wastes into deep, isolated rock formations.

Class II wells are used exclusively to inject fluids associated with oil and natural gas production.

Class III wells are used to inject fluids to dissolve and extract minerals.

Class IV wells are shallow wells used to inject hazardous or radioactive wastes into or above a geologic formation that contains a USDW.

Class V wells are used to inject non-hazardous fluids underground. Most Class V wells are used to dispose of wastes into or above USDWs.

Class VI wells are wells used for injection of carbon dioxide into underground subsurface rock formations for long-term storage, or geologic sequestration.

http://www.epa.gov/uic (accessed on January 20, 2016)

In addition to an environmental review, the NRC staff is also conducting a detailed safety analysis of LCI's amendment request to determine if the application meets the requirements of

10 CFR Part 40, “Domestic Licensing of Source Material.” The safety analysis will be documented in a separate Safety Evaluation Report (SER), in accordance with the NRC staff guidance document, NUREG-1569, “Standard Review Plan for In-Situ Leach Uranium Extraction License Applications” (NRC, 2003b). The NRC decision whether to grant the license amendment, as proposed, will be based on both the EA and the SER.

1.1 Site Location and Description

The Lost Creek ISR Project, located in the northeastern section of Sweetwater County, Wyoming, encompasses approximately 1,722 hectares (ha) [4,254 acres (ac)] of land. The project area is set in the Great Divide Basin within Township 25N, Range 92W, including parts or the entirety of Sections 16 through 20, 30, and 31 and Township 25N, Range 93W, including parts or the entirety of Sections 13, 24, and 25. Topography at the site is relatively flat, sloping at 20 meters (m) per kilometer (km) [100 feet (ft) per mile (mi)] southeast.

The project site is located approximately 61 km [38 mi] northwest of Rawlins, 113 km [70 mi] southeast of Lander, and 144 km [90 mi] southwest of Casper. The nearest residences to the site are in the town of Bairoil, about 24 km [15 mi] northeast of the project site. The Kennecott Sweetwater Uranium Mine and Mill, located about four miles to the southwest, is the nearest commercial facility.

1.2 Current Facility Use

LCI recovers uranium at the site using the ISR process, which involves two primary operations: mobilization and recovery. First, LCI mixes a solution known as lixiviant, from native ground water, oxygen, and bicarbonate, and injects the lixiviant through wells drilled into the subsurface uranium orebody. The lixiviant mobilizes uranium found in the orebody to create a uranium-laden solution that is pumped from the production wells and through pipelines to the central processing plant. In the processing plant, uranium is recovered from the solution through ion exchange systems, and then concentrated, filtered, and dried in preparation for offsite shipment. The dried product is a solid form of mixed uranium oxides and hydroxides known as yellowcake. Yellowcake is packaged and then transported to a uranium conversion facility, where it is converted into uranium hexafluoride (UF_6) gas, in preparation for enrichment, and ultimately deconversion and fabrication into fuel for nuclear power reactors.

LCI reinjects the lixiviant into the orebody again to continue the mobilization and recovery process. During the ISR process, LCI creates a net inward flow of ground water by extracting more water than is reinjected into the host orebody aquifer. The excess water that is extracted, referred to as production bleed, ranges from about 0.5 to 1.5 percent of the inward ground water flow rate at the Lost Creek ISR facility. LCI is licensed for a maximum daily ground water flow rate of approximately 22,712 liters per minute (L/min) [6,000 gallons per minute (gal/min)] or a maximum instantaneous ground water flow rate of approximately 23,848 L/min [6,300 gal/min] (NRC, 2016a).

The fluids generated as production bleed, as well as the plant wastewater and wastewater generated from ground water restoration, are considered byproduct material[1] under 10 CFR 40.4 and must be managed and disposed of in compliance with applicable federal and state regulations.

LCI received a 10-year permit from the Wyoming Department of Environmental Quality (WDEQ) for the installation of five UIC Class I deep disposal wells for injection of the liquid byproduct material into the Fort Union Formation (WDEQ, 2010). Details regarding disposal via UIC Class I deep disposal wells can be found in Section 2.1.1.1 of the NRC's SEIS for the Lost Creek ISR Project (NRC, 2011).

Currently, LCI has installed and is using three of the five permitted UIC Class I wells to dispose of production bleed and plant wastewater. No wellfields are in the restoration phase; thus no restoration fluids are being generated.

2 PROPOSED ACTION AND REASONABLE ALTERNATIVES

2.1 Proposed Action

LCI's proposed action is to amend NRC License SUA-1598 to include the injection of treated wastewater into UIC Class V disposal wells at the Lost Creek ISR Facility (LCI, 2015a). The wells that LCI proposes to use for this function have already been installed. Five wells were installed at the Lost Creek site for monitoring and characterization, which LCI now proposes to use as UIC Class V disposal wells. LCI would operate the UIC Class V wells in addition to the UIC Class I deep disposal wells for the disposal of wastewater from its site operations.

The proposed action includes water treatment at the processing plant to reduce levels of contaminants of concern (see parameters in Table 5-1) prior to injection as shown in Figure 2-1. The proposed treatment methodology consists of the following phases: (1) ion exchange, (2) filtration, (3) reverse osmosis (RO), (4) sodium hydroxide addition, and (5) radium removal (LCI, 2015a). Infrastructure and equipment for the first three phases have already been approved by the NRC and installed for use at the facility under the existing license. LCI is not proposing the use of any additional RO equipment beyond that already described in the original license application. The ion exchange system uses anionic exchange resin to remove uranium from the process water or restoration fluids. Filtration removes particles that may get entrained on the resin and/or fluids passing the resin and uses bag filters to remove particles greater than 5 microns in size.

The next phase, RO treatment, separates the wastewater into two streams: (1) a relatively clean fluid (commonly referred to as permeate), in which approximately 98 percent of the total

[1] *Byproduct material* are the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition (10 CFR 40.4).

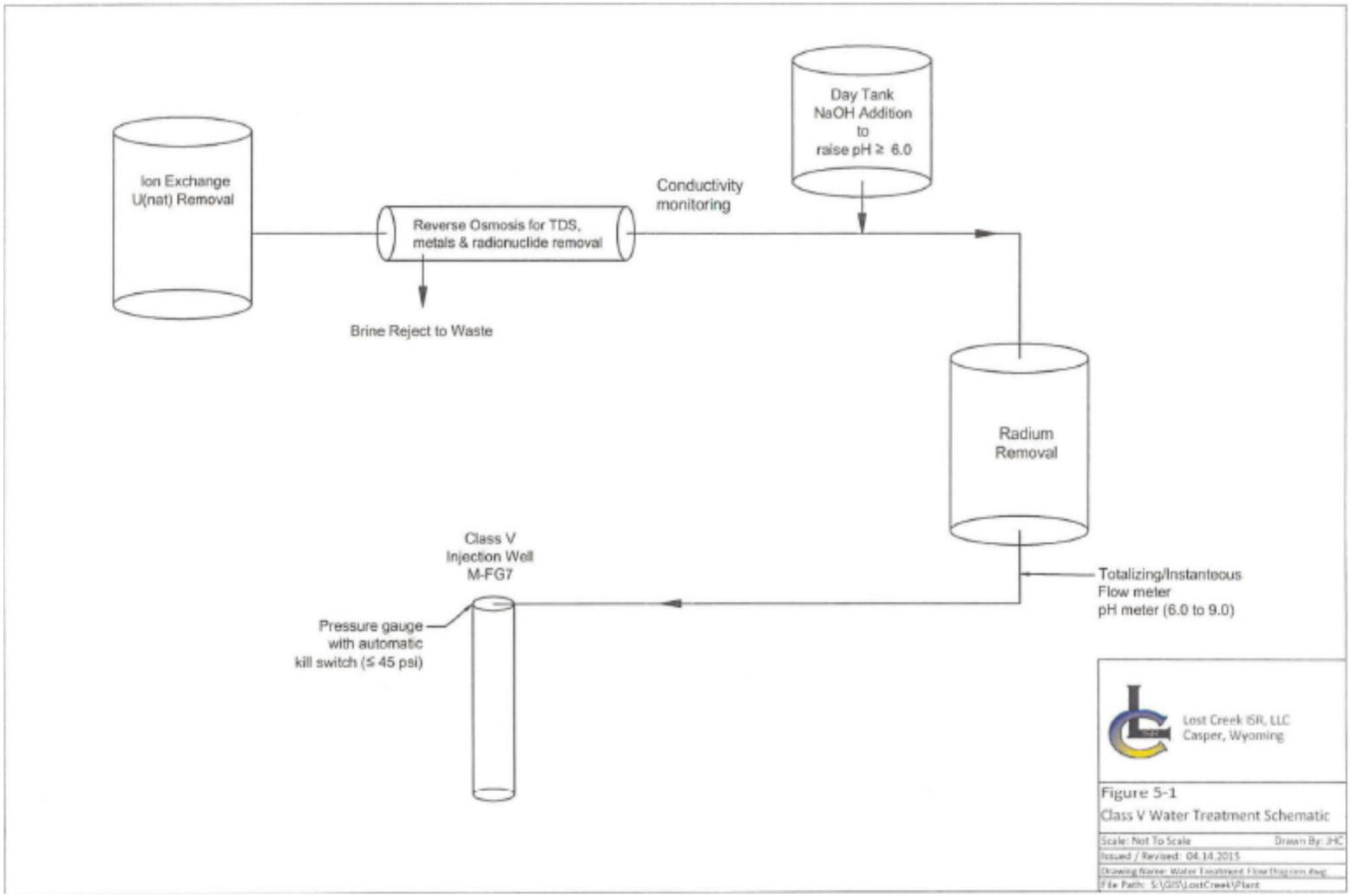

Figure 2-1 Class V Water Treatment Schematic
Source: LCI, 2015a

dissolved solids, radionuclides, and trace metals in the source fluid are removed; and (2) a concentrated fluid, commonly referred to as a brine, in which the salts from the source fluid are concentrated. The brine stream is separated from the permeate stream, and disposed of in the UIC Class I deep disposal wells. Impacts from the brine stream, including the potentially higher contaminant concentrations what would result from the proposed action, were previously assessed by the NRC in its SEIS for the Lost Creek site.

To further treat the permeate, sodium hydroxide would be added to increase the permeate pH to an acceptable range of 6.0 to 9.0.[2] Then LCI would use a Dowex Radium Selective Complexer resin to remove residual radium from the permeate. Finally, LCI would then pump the treated permeate directly to the UIC Class V disposal well(s) for disposal.

LCI obtained a UIC Class V Subclass 5C3 Permit from the WDEQ WQD for this proposed action in February 2016 (WDEQ, 2016). In the state of Wyoming, the WQD regulates the quality of water injected into UIC Class V wells. The waste stream in this type of well cannot be a hazardous waste. Wastes accepted for disposal under LCI's UIC Class V permit must be neutralized to a pH greater than 6.5 and less than 9.0. Permitted wastes for UIC Class V injection include the following (WDEQ, 2016):

- Treated wastewater from ISR mining solutions
- Water derived from plant processes
- Chemistry lab wastewater
- Water generated from ground water restoration
- Water from UIC Class I and Class III wells during drilling, completion, and maintenance

As discussed in Section 2.1.1.2.4 of the SEIS for the Lost Creek ISR Project, LCI must treat the wastewater to meet NRC release standards in 10 CFR Part 20, Subparts D and K, and Appendix B, as appropriate for the method of disposal (NRC, 2011). LCI must also ensure that all toxic substances meet the WDEQ class-of-use standards or any federal primary drinking water standards; whichever is more stringent (WDEQ, 2016).

LCI installed five UIC Class V wells (M-FG6, M-FG7, M-FG8, M-FG9, and M-FG10) near the existing Lost Creek ISR central processing plant as shown on Figure 2-2. These wells, located approximately 450 m [1,500 ft] from the nearest wellfield (i.e., Mine Unit 1), are low to the ground and housed in naturally colored well boxes to blend with the environment. Well M-FG7 will serve as the primary injection well for treated wastewater. Wells M-FG6, M-FG8, M-FG9, and M-FG10 are monitoring wells for M-FG7. LCI has designated M-FG6 as the proposed backup injection well.

The land disturbance associated with LCI's installation of the UIC Class V wells is approximately 0.1 ac (LCI, 2015a). The injection wells are located on federal lands managed by the Bureau of Land Management (BLM), Rawlins Field Office. LCI selected horizons at shallow depths within the Battle Spring Formation beneath the site as the receiving zones for the UIC Class V disposal wells. The proposed injection interval ranges in depth from approximately 58-138 m [190-455 ft] below the ground surface. The proposed maximum injection rate is 760 L/min [200

[2] LCI is required to increase the permeate pH greater than 6.5 in accordance with the UIC Class V Subclass 5C3 Permit issued by the WDEQ-WQD (WDEQ, 2016).

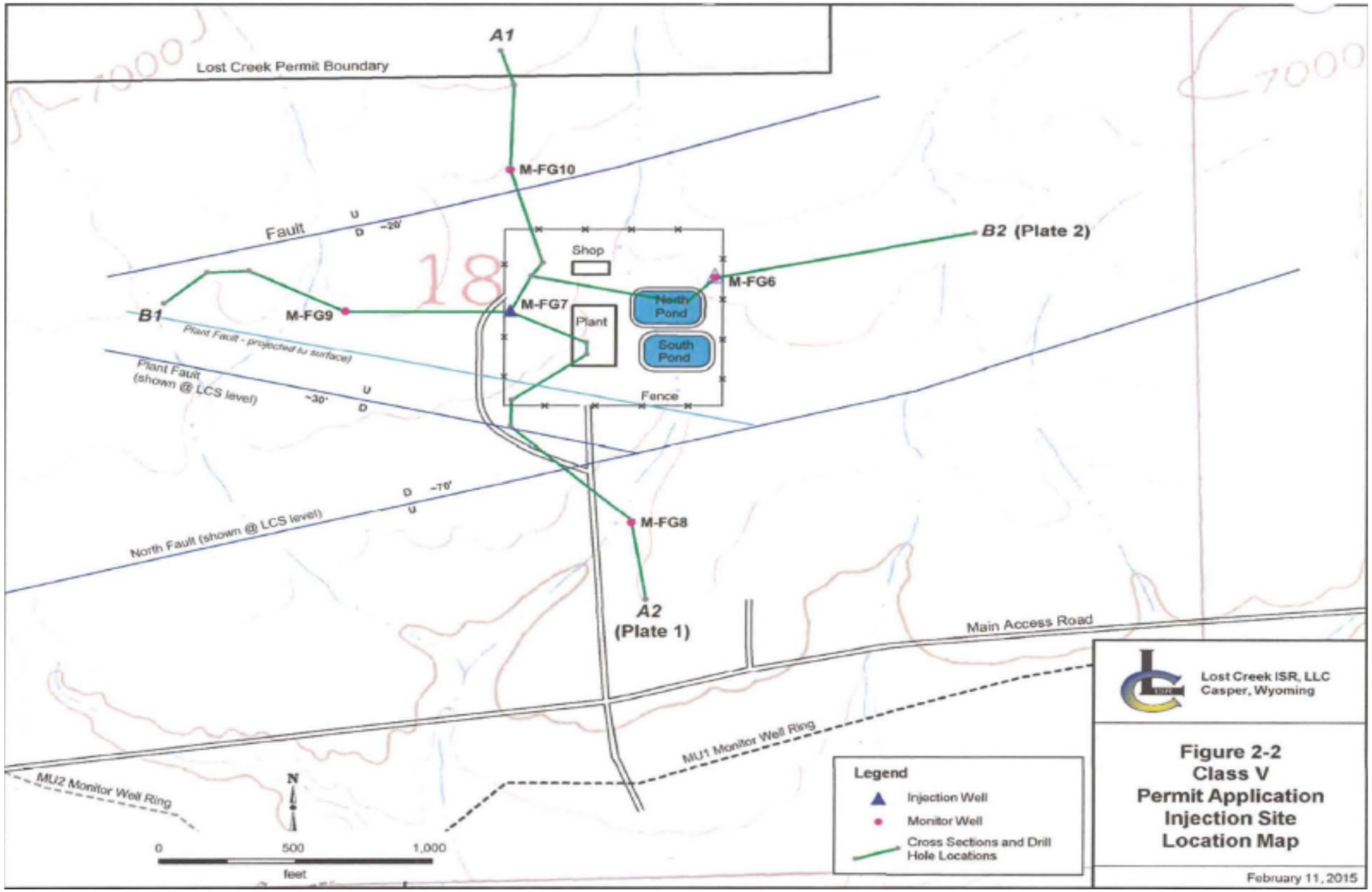

Figure 2-2 Class V Injection Site Location Map
Source: LCI, 2015a

gpm] and the requested maximum permissible injection pressure is 3.15 x 10^5 Pa [45.7 psi]. Based on a continuous injection rate of 265 L/min [60 gpm] for five years and 760 L/min [200 gpm] during the remainder of an assumed operational period of 14 years, LCI estimates the total injected volume to be 4.2 x 10^9 L [1.48 x 10^8 cubic feet] (1.1 billion gallons) (LCI, 2015b).

2.2 Need for the Proposed Action

Under the existing NRC source and byproduct materials license SUA-1598, the Lost Creek ISR facility cannot use UIC Class V wells for wastewater disposal. Liquid effluents generated from operations and aquifer restoration at the Lost Creek ISR facility are currently licensed to be disposed of via UIC Class I deep disposal wells for wastewater disposal. To date, LCI is operating three permitted UIC Class I wells for this purpose.

LCI's proposed action would allow it to also treat wastewater onsite and dispose of the treated liquid effluents using UIC Class V wells. If approved, LCI's use of the UIC Class V wells would allow for decreased ground water consumption and an increased future ground water restoration rate (LCI, 2015a). This is because LCI proposes instead to treat and return to the Battle Spring Formation the ground water currently disposed of in Class I deep disposal wells. Additionally, because of the accompanying option for managing wastewater, the use of Class V wells will significantly shorten the time required for ground water restoration.

2.2.1 Alternative to the Proposed Action

The alternative considered in this EA is the No-Action alternative. Additional discussion of alternative wastewater disposal options can be found in Section 2.1.1.2 of the SEIS for the Lost Creek ISR Project (NRC, 2011). Under the No-Action alternative, NRC would not amend license SUA-1598 as proposed. The NRC staff would not approve LCI's request to utilize UIC Class V wells for disposal of treated wastewater. The No-Action alternative would result in LCI's continued use of UIC Class I deep disposal wells as their only wastewater disposal method.

Impacts from the use of UIC Class I wells were previously assessed by the NRC in its SEIS (NRC, 2011).

3 AFFECTED ENVIRONMENT

This section provides a brief description of the affected environment for those resource areas that could be impacted by the proposed action. A more detailed description of these resource areas can be found in Section 3 of the Lost Creek ISR SEIS (NRC, 2011).

3.1 Land Use

The Lost Creek ISR project is located in the northeastern section of Sweetwater County, Wyoming and encompasses approximately 1,722 ha [4,254 ac] of land. The surface ownership of the Lost Creek ISR project is comprised of public lands. Approximately 85 percent is owned by the U.S. Government and administered by the BLM Rawlins and Landers Field Offices, with the remaining 15 percent owned and administered by the State of Wyoming (NRC, 2011). The subsurface minerals are owned by the U.S. Government and the State of Wyoming.

According to LCI, there have been no changes in land use since the original license application (LCI, 2015a). The primary land use within the project area is for cattle grazing. There is no crop production within two miles of the project site. Other land uses within the surrounding region include grazing, mining, wildlife habitat, hunting, recreation, off-road vehicle use, oil and gas extraction, gas and carbon dioxide pipelines, and transmission lines. The closest residence is in the town of Baroil, located approximately 24 km [15 mi] from the project site (NRC, 2011).

Oil recovery operations are located approximately 25 to 30 km (15.5 to 18.6 mi) to the northeast from the Lost Creek ISR Project, with wells drilled into deep formations such as the Dakota, Nugget, Tensleep, and Madison Formations. Gas recovery operations at their closest are located approximately 10 to 15 km (6.2 to 9.3 mi) to the southwest, with wells drilled into the Lance, Fox Hills, Lewis, and Mesaverde Formations (Wyoming State Geological Survey, 2016).

3.2 Geology, Soils, and Seismicity

A schematic geologic cross section across the site is shown in Figure 3-4 of the Lost Creek ISR SEIS (NRC, 2011). This figure shows the Battle Spring Formation present at the site from the ground surface down to depth, where it is underlain by the Wasatch Formation. These formations have an estimated combined thickness of 1,890 m [6,200 ft] (NRC, 2011). The Battle Spring Formation consists of thick beds of very fine- to coarse-grained sandstones separated by various mudstone and siltstone layers that were deposited as part of a major alluvial system. Beneath the Battle Spring and Wasatch Formations, the Fort Union Formation is present at the site. This formation is approximately 1,417 m [4,650 ft] thick (NRC, 2011).

As shown in Figure 2-2, several faults transect the site. Displacement of layers across the faults is recognizable, with little displacement in the center of the project site and as much as 24 m [80 ft] in the eastern third of the site (NRC, 2011).

Soil types at the site are similar in color, depth of horizon, and geomorphic surface, and differ primarily by texture (NRC, 2011). Wind erosion is more of a concern at the site than water erosion due to silt present in the soils, limited precipitation, and the lack of perennial and intermittent streams (NRC, 2011).

LCI's construction activities have affected the geology and soils at the Lost Creek site. LCI has installed injection, recovery, and monitoring wells to support ISR activities, laid supporting pipelines, installed the UIC Class I deep disposal wells and monitoring wells which LCI now proposes to use as UIC Class V disposal wells, and constructed the processing plant, administrative buildings, header houses in the wellfields, storage ponds, and access roads.

3.3 Water Resources

The Lost Creek ISR project lies northeast of the Great Divide Basin center, an internally closed drainage basin that contains uranium-bearing aquifers and encompasses 9,064 km^2 [3,500 mi^2]. Ground water flow at the project site is toward the southwest. At the Lost Creek site, sandstone unit aquifers can be found within the Battle Spring, Wasatch, and Fort Union Formations.

For its purposes, LCI has divided the Battle Spring Formation into five horizons in descending order as BC, DE, FG, HJ, and KM, with each horizon separated by various thicknesses of shale,

mudstone, and siltstone. Under the proposed action, LCI proposes to inject the treated waste water via UIC Class V wells into the DE and FG horizons at a depth of approximately 58-138 m [190-455 ft] below ground surface (LCI, 2015a). The shallowest occurrence of ground water within the project area is within the DE Horizon, with the depth-to-water table varying from approximately 43 to 61 m [160 to 200 ft] below ground surface. The DE Horizon is separated from the FG Horizon by an unnamed shale layer approximately 0 to 15 m [0 to 50 ft] thick. The confining unit between the DE and FG horizons may not fully inhibit flow between the horizons, with the vertical hydraulic gradient between the horizons indicating the potential for downward flow (NRC, 2011).

Beneath the FG Horizon and separating it from the HJ Horizon is the Lost Creek Shale, which ranges in thickness from 1.5 to 14 m [5 to 45 ft] (NRC, 2011). The HJ Horizon is the primary uranium production zone for the Lost Creek ISR project. At the site, the top of the HJ Horizon is approximately 91 to 137 m [300 to 450 ft] below ground surface, and this horizon is 30 m to 49 m [100 to 160 ft] thick (NRC, 2011).

Ground water data and pump test data for the HJ Horizon across the fault suggest that the fault acts as a barrier to ground water flow, but is not impervious to flow (NRC, 2011).

Distinct from the Environmental Protection Agency (EPA) well classifications described above, WDEQ has its own classification regime with regard to ground water uses. Water quality within the horizons of interest (i.e., the DE, FG, and HJ Horizons) does not meet the WDEQ Class I (domestic use), Class II (agricultural use), or Class III (livestock use) ground water quality standards due to the presence of radionuclides (NRC, 2011). The water quality in the proposed UIC Class V injection horizons where LCI proposes to inject treated wastewaters has been designated as WDEQ Class IVA [industrial use] (WDEQ, 2016).

In its license amendment application, LCI provided a comprehensive summary of water rights within one-mile of the Lost Creek site based on a review of the Water Rights in the State of Wyoming State Engineering Office database. The water rights are largely owned by LCI, but LCI reports 11 water rights are jointly owned by BLM and LCI. LCI has two water supply wells (LC1148W and LC229W) located approximately 73 m [240 ft] and 52 m [169 ft] from the proposed injection well M-FG7 (LCI, 2015a). The water supply wells are used as a source for potable water and fire protection, respectively. The water supply wells are pumped from below the UIC Class V receiving aquifer and at a depth such that the receiving aquifer at the waste supply well aquifer are separated by over 122 m [400 ft] of fine-grained (i.e., relatively impermeable) strata.

LCI is currently conducting ISR activities at the site, recovering uranium from the HJ Horizon. LCI also is conducting excursion monitoring and has identified and addressed two excursions since ISR activities began in 2013 (WDEQ, 2015).

3.4 Public and Occupational Health and Safety

Radiation dose is a measure of the amount of ionizing energy that is deposited in the body. NRC regulations in 10 CFR Part 20 specify that licensed operations be conducted so that the total effective dose equivalent to individual members of the public does not exceed 1 millisievert (mSv) [100 millirem (mrem)] in a year and 0.02 mSv [2 mrem] per hour from any external

radiation sources. The National Council on Radiation Protection and Measurements (NCRP) estimates the annual average dose to a member of the public from all sources (natural and manmade) is 6.2 mSv [620 mrem] (NCRP, 2009).

As stated in the GEIS, the natural background dose rate for the region is 316 mrem/year (NRC, 2009). There are several potential, operating, and decommissioning uranium recovery and conventional mill sites within an 80-km [50-mi] radius of Lost Creek. However, none of these sites represent a source of radiation exposure in and around the project area.

The NRC regulations in 10 CFR Part 20 also specify Radiation Protection Standards which regulate occupational health and safety risks to workers as a result of exposure to radiation. The principle of maintaining doses "as low as reasonably achievable" (ALARA) is implemented through radiation safety measures for protecting workers at ISR facilities, as well as for members of the public.

3.5 Waste Management

Liquid and solid wastes are generated from the operations at the Lost Creek ISR Project. Liquid wastes will be generated during all phases of uranium recovery at the Lost Creek ISR project site and such effluents include sanitary wastewater, well development water, pumping test water, and waste petroleum products and chemicals. The liquid wastes generated during the ISR process are liquid byproduct material. As specified in the Lost Creek ISR SEIS, the liquid byproduct material volumes generated during operations (i.e., uranium recovery from the ore body) is approximately 230 to 340 L/min [60 to 90 gal/min], and the maximum liquid byproduct material that will be produced during aquifer restoration is about 492 L/min [130 gal/min] (NRC, 2011). The liquid byproduct material is disposed of in the UIC Class I deep disposal wells. Sanitary wastes are disposed of in onsite septic systems. The water from well development, sample collection, and pump tests is uncontaminated and is discharged to the surface under the provisions of a Wyoming Pollutant Discharge Elimination System permit (NRC, 2011). The small volume of liquid hazardous wastes (waste petroleum products and waste chemicals) that are generated are collected by a commercial entity for recycling or energy recovery purposes or disposal at a licensed disposal facility.

Similarly, solid byproduct material and nonhazardous solid waste are generated during ISR operations at the Lost Creek ISR project site. Solid byproduct material is material that does not meet the NRC criteria for unrestricted release in 10 CFR part 20. Such material could include spent resin, empty chemical containers and packaging, pipes and fittings, tank sediments, contaminated soils from leaks and spills, and contaminated construction and demolition debris. LCI estimates that approximately 77 m^3 [100 yd^3] of solid byproduct material is generated annually during facility operations (NRC, 2011). Solid byproduct material is disposed of at a licensed disposal site. Nonhazardous solid wastes include septic solid, municipal solid waste (general trash), and other solid wastes.

Approximately 380 to 540 m^3 [500 to 700 yd^3] of nonhazardous solid waste plus 2.3 to 3.8 m^3 [3 to 5 yd^3] of sewage sludge is generated annually during facility operations (NRC, 2011). LCI presently uses the Carbon County Landfill in Rawlins, Wyoming to dispose of nonhazardous solid wastes. Hazardous solid wastes such as batteries are stored onsite in clearly labeled, sealed containers and periodically collected by a commercial entity for recycling or energy

recovery purposes or disposal at a licensed disposal facility. LCI approximates that 4.5 to 9.1 kg [10 to 20 lb] of batteries and other solid hazardous wastes would be generated annually (NRC, 2011).

4 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This section addresses how environmental resources could be affected by the proposed action. A standard of significance has been established by NRC for assessing environmental impacts (NRC, 2003a). With the standards of the Council on Environmental Quality's NEPA regulations in 40 CFR Parts 1500 to 1508 as a basis, where appropriate, each impact is assigned one of the following three significance levels:

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

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

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

The NRC staff has evaluated the potential environmental impacts associated with the proposed action and with the No-Action alternative to the proposed action, and has documented the results of the assessment in this EA. The NRC staff is using the SEIS prepared for the original license application (NRC, 2011) as the basis for this EA and is only focusing on impacts as a result of the proposed action.

4.1 Resource Areas Not Affected by the Proposed Action

The following resource areas are not expected to be impacted by the injection of treated wastewater in Class V wells. As a result, there would be no change to the resource areas shown in Table 4-1 and the NRC staff determined that no further analysis is necessary.

Table 4-1. Environmental Resource Areas Not Affected by the Operation of UIC Class V Wells

Environmental Resource Area	Impact Consideration and Conclusion
Transportation	There would be very minor changes in transportation resulting from the use and disposal of 1.5 m^3 [2 yd^3] of spent radium recovery resins each year. The proposed action would not affect local traffic and transportation. As concluded in the SEIS, overall impacts from transportation are SMALL.
Ecological Resources	The proposed action will not require the removal of vegetation and is not expected to affect listed endangered and threatened species or their critical habitat.

Air Quality	The proposed action is not expected to cause additional impacts to air quality beyond the small impacts described in the Lost Creek SEIS.
Noise	Noise levels at the project site are not expected to increase due to the proposed action. Treatment equipment and injection wells are housed within structures and would be at distance from potential receptors.
Historic and Cultural Resources	The proposed action is not expected to adversely affect cultural or historical resources.
Visual and Scenic Resources	The proposed action will not adversely affect the aesthetics or visual resources. The license amendment would not cause additional scenic or visual impacts beyond the small impacts described in the Lost Creek SEIS.
Socioeconomics	The proposed action will not result in any socioeconomic effects beyond the small impacts described in the Lost Creek SEIS. There will be no change in the operations workforce; therefore, there will be no impact on demographic conditions.
Environmental Justice	The proposed action will not result in disproportionately high or adverse impacts to minority and low-income populations. The Lost Creek SEIS found no environmental justice impacts because no minority population group blocks reside near the Lost Creek project.

4.2 Resource Areas Potentially Affected by the Proposed Action

The following sections discuss the resource areas that could be potentially affected by the utilization of UIC Class V wells for disposal of treated wastewater at the Lost Creek ISR Facility.

4.2.1 Land Use Impacts

The proposed action has resulted in approximately 0.1 ac of additional land disturbance. Five UIC Class V wells have been drilled and installed within the Lost Creek ISR project boundary. However, the existing facility footprint will not change due to the addition of the five wells and there are be no additional changes to land use.

As described in Section 2.1, LCI is proposing to use specialized ionic exchange resin to remove radium from the wastewater. The resin will be contained in two fiberglass vessels approximately 1.24 m [4 ft] in diameter and 1.8 m [6 ft] tall. The vessels will be installed within the existing processing plant, and thus will not affect land use.

Land disturbance from monitoring well installation (the wells that LCI now proposes to use as injection wells) will be reclaimed and revegetated with the BLM-approved seed mix, including topsoil replacement (LCI, 2015a). The impacts resulting from the proposed action are SMALL and not significant.

4.2.2 Geology, Soils, and Seismicity Impacts

The NRC previously analyzed the potential for the site faults to be reactivated by LCI's ISR operations (NRC, 2011). The NRC determined that small pressure changes [344.7 to 1,034.2 kilopascals [kPa] (50 to 150 pounds per square inch)] induced by ISR production activities were well below those observed to result in small earthquakes [6894.8 to 34,473.8 kPa (1,000 to 5,000 psi)]. Under the proposed action, LCI's injection of treated wastewaters via the UIC Class V wells would cause pressure changes up to approximately 310.2 kPa [45 psi] (LCI, 2015). Consequently, the NRC does not expect the proposed action to result in induced seismicity or reactivation of the site faults. Therefore, there is no significant impact to geology from the proposed action.

In the Lost Creek ISR SEIS, the NRC also evaluated the potential impacts to soils from pipeline ruptures and found the short-term impacts to be SMALL to LARGE, depending on the chemical composition of the spilled fluid and the volume of soil affected by the spill. The long-term impacts would be reduced to SMALL given the licensee's stated actions at the time of the spill and the action to remove contaminated soils at final site decommissioning (NRC, 2011). Since LCI began ISR operations at the Lost Creek site in 2013, there have been several spills at the site. LCI has notified the NRC and the WDEQ of each reportable spill and taken actions to (1) immediately identify the cause of the spill, (2) recover as much of the spilled liquid as possible, (3) take radiological exposure readings at the site of the spill, (4) have affected soil samples analyzed for specified radionuclides, (5) map the affected area for site decommissioning records, and (6) repair equipment that contributed to the spill. Should there be a spill from the pipeline from the radium resin vessels to the UIC Class V wells, LCI must take similar spill recovery and response actions. The immediate and relatively immediate impacts have the potential to be SMALL to LARGE depending on a series of factors (e.g., size of the spill, location of surface and near surface ground water to be contaminated). LCI would need to take action upon learning of the spill to mitigate and minimize the impacts. Therefore, the NRC determines that impacts to soils from the proposed action would likewise be SMALL over the long-term and not significant.

4.2.3 Water Resources Impacts

LCI's proposed injection of treated wastewaters via UIC Class V wells may impact ground water resources in various ways, to include effects on water quality, ground water use, consumptive use, existing ISR operations, and other energy resource operations.

As described previously, the UIC Class V wells are located approximately 450 m [1500 ft] from the nearest wellfield (Mine Unit 1) at the Lost Creek site. LCI's ISR operations are limited to the lower horizons in the Battle Spring Formation (i.e., the HJ Horizon), while it would inject treated permeate into separate and shallower horizons (i.e., the DE and FG Horizons). As shown in Figure 2-2, LCI has identified four monitoring wells (M-FG6, MFG8, M-FG9, and M-FG10) and would conduct water quality monitoring per the UIC Class V permit (WDEQ, 2016). The FG Horizon is also designated as the overlying aquifer for ISR operations, and LCI conducts monitoring in the horizon as part of those operations under its NRC license. LCI would be able to take corrective actions should injectate be recognized at either monitoring location (near the UIC Class V injection well M-FG7 or in the FG Horizon overlying ISR operations). Therefore,

the NRC finds that the proposed action would not affect the required monitoring of ISR operations.

The use of UIC Class V wells for wastewater disposal is not expected to significantly affect ground water use or the overall water quality of the Battle Spring Formation. As discussed in Section 3.3, the water quality in the UIC Class V injection horizons where LCI proposes to inject treated wastewaters has been designated as WDEQ Class IVA [industrial use] (WDEQ, 2016). Additionally, the wastewater will be treated prior to injection to meet NRC release standards in 10 CFR Part 20, Subparts C, D, and K, and Appendix B. LCI must also ensure that it meets the limits for the treated injectate and at the monitoring wells found in its UIC Class V permit with the WDEQ (WDEQ, 2016).

As discussed in Section 3.3, LCI's two water supply wells are screened below the DE and FG aquifers and separated from those aquifers by over 122 m [400 ft] of relatively impermeable strata. Oil and gas recovery operations are not active in the Lost Creek ISR Project vicinity, and the formations targeted for those operations are thousands of feet below the UIC Class V injection horizons. Therefore, the NRC concludes that impacts to water quality, ground water use, and to other energy resource operations from the proposed action are SMALL and not significant.

In the Lost Creek ISR SEIS (NRC, 2011), the NRC noted that the estimated liquid byproduct material volumes during ISR operations would be approximately 230 to 340 Lpm [60 to 90 gpm] and the maximum volume during aquifer restoration approximately 492 Lpm [130 gpm], with an average withdrawal rate of 656 Lpm [175 gpm] over the life of the project. LCI stated that, depending on the efficiency of the treatment system, the volume of ground water consumed could be reduced by more than 70 percent (LCI, 2015a). LCI provided a series of water balance diagrams and information to demonstrate the anticipated efficiency of utilizing the UIC Class V wells. Based upon its assessment of this information, the NRC concludes that impacts to ground water consumption from the proposed action are SMALL and not significant.

4.2.4 Public and Occupational Health and Safety Impacts

The public and occupational health and safety impacts from the proposed action consist of potentially increased activity of alpha, beta, and gamma emitters associated with the concentrated radionuclides in the brine from the RO treatment and the radium accumulated on the resins in the Dowex Radium Selective Complexer resin ion exchange tank. As noted above, the health and safety impacts from the brine, including potentially increased contaminant concentration from increased wastewater treatment, were evaluated in the original license application. The original license application evaluated impacts from the generation of brine of up to 490 L/min [130 gal/min]. LCI estimates that the use of UIC Class V wells under the proposed action would reduce the generation of brine to 265 L/min [70 gal/min].

The new equipment for the proposed action includes two vessels containing the radium resin, associated piping, and injection wells. Other than the radium vessels, the new components would not contain radioactive materials in quantities or concentrations above those already contained in existing systems covered by the NRC-approved LCI radiation protection program. The primary radiological concern is gamma emitter concentration in the brine from the RO and Dowex Radium Selective Complexer resins. Alpha and beta emitters will be effectively

absorbed by the water and the resin vessels. However, due to radium in the vessel, gamma emitter levels could be elevated, and some gamma radiation would pass through the sides of the vessels. LCI proposes to initially monitor the gamma rates surrounding the vessels at least weekly during the first charge of the resin, and no less than monthly thereafter (LCI, 2015a). Depending on the radiation levels determined through monitoring, LCI could control access if needed to areas around the resin vessels.

LCI also proposes to store all radium resin wastes outdoors in a shipping container. LCI will monitor the storage area for radiological hazards and ensure that the appropriate Department of Transportation standards are met when the resin waste is shipped to a licensed facility for disposal.

The water treatment system is completely contained and the brine will be disposed of in UIC Class I deep disposal wells, thus the risk of exposure is minimal. In addition, to protect against the radiologic hazard of radium, LCI personnel will wear protective clothing, gloves, and rubber boots when performing maintenance on the radium resin vessels. Radiation levels will be appropriately posted and occupational doses will be maintained at acceptable levels consistent with LCI's radiation protection program. For these reasons, the impact on public and occupational health and safety from the proposed action is SMALL and not significant.

4.2.5 Waste Management Impacts

The Dowex Radium Selective Complexer resins used to recover radium during the treatment process would be a newly generated source of waste at the Lost Creek ISR facility. LCI estimates that approximately 1.5 m^3 [2 yd^3] of spent radium recovery resins will be generated each year (LCI, 2015a). Pursuant to License Condition 9.9 of SUA-1598, LCI is required to dispose of solid byproduct material at a site authorized by the NRC or an NRC Agreement State to receive solid byproduct material (NRC, 2016b). LCI currently has an agreement in place to dispose of such wastes at Ur-Energy Pathfinder Mine's Shirley Basin uranium mill tailings impoundment in Carbon County, Wyoming. Therefore, given the negligible amount of additional solid byproduct material to be disposed and LCI's disposal agreement, the waste management impacts from the proposed action are SMALL and not significant.

5 MONITORING PROGRAM

LCI's monitoring programs verify compliance with radiological and non-radiological standards for the protection of worker health and safety in operational areas and protection of the public and the environment beyond the project boundary.

To ensure that the proposed treatment method, as described in Section 2.1, is effective and that the NRC effluent standards are being met, LCI will monitor the treated injected water, or injectate. The injection pipeline will be continuously monitored by automated systems for pressure, flow rate, and pH. If any one of the parameters exceeds the respective limit, the system will alarm and shut down the RO circuit pump (LCI, 2015a). LCI proposes to document the pH and conductivity of the liquid effluent at a minimum of every three hours and retain the records.

Table 5-1. Effluent Limits

Frequency	Parameter (dissolved)	EPA MCL: 10 CFR 141	NRC Effluent Limit: 10 CFR Part 20 App B	Receiving Aquifer Background (2)	Effluent Limit	Expected Post Treatment Quality	Ground water Classification from WDEQ-WQD R&R Chapter 8 Table 1	Sample Point(s)
Continuous	pH (standard units)	N/A	N/A	8.94	N/A	6.0 to 9.0	II	Post Treatment (1)
	Conductivity (µmhos/cm)	N/A	N/A	443	N/A	150	N/A	Post RO & Post Treatment (1)
Quarterly Grab	Selenium (mg/L)	0.05	N/A	0.01	0.05	0.0015	I	Post Treatment
	Arsenic (mg/L)	0.01	N/A	0.004	0.01	0.0005	I	
	Barium (3) (mg/L)	2	N/A	ND	2	0.0001	I	
	Beryllium (3) (mg/L)	0.004	N/A	ND	0.004	(5)	I	
	Cadmium (3)	0.005	N/A	ND	0.005	0.001	I	
	Chromium (3) (mg/L)	0.1	N/A	ND	0.1	0.0004	I	
	Copper (3) (mg/L)	1.3	N/A	ND	1.3	0.0005	I	
	Fluoride (3) (mg/L)	4	N/A	0.4	4	0.0001	I	
	Lead (3) (mg/L)	0.015	N/A	ND	0.015	0.0001	I	
	Mercury (3) (mg/L)	0.002	N/A	ND	0.002	0.0001	I	
Quarterly Grab & Monthly Composite	U_{nat} (mg/L)	0.03	0.44	0.158	0.158	0.012	N/A	
	Ra-226 (pCi/L)	5	60	3.6	5.5	0.78	Exceeds all Classes	
	Ra-228 (pCi/L)		60	1.9		(5)		
	Gross Alpha (6) (pCi/L)	15	15 (6)	57	57	(5)	Exceeds all Classes	
	Gross Beta (pCi/L)	4 (mrem/yr)	N/A	15.1	15.1	(5)	N/A	
Monthly Composite	Th-230 (pCi/L)	N/A	<1.9 (6)	1.9 (4)	100	(5)	N/A	
	Pb-210 (pCi/L)	N/A	<3.5 (6)	3.5 (4)	10	(5)	N/A	
	Po-210 (pCi/L)	N/A	<5.1 (6)	5.1 (4)	40	(5)	N/A	

Source: LCI, 2015b and NRC, 2016c

(1) Sample collected to verify treatment systems are working as designed.
(2) Receiving aquifer background water quality is based on the maximum value from samples collected from injection well and surrounding monitor wells.
(3) Since these parameters are not expected to be in the feed stock, LCI proposes to halt routine analysis for these parameters if four consecutive monthly grab samples of the feed stock contain less than the EPA maximum contaminant level (MCL) of the respective parameter.
(4) Includes dissolved and particulate fractions.
(5) Value not determined, but RO rejection estimated to be approximately 98 percent of feed concentration.
(6) As required by license condition, the effluent limit for Th-230, Pb-210, and Po-210 shall be less than the values in the receiving aquifer background column, and the limit for the adjusted gross alpha activity is 15 pCi/L.

In addition, daily effluent samples will be combined into a composite for the monthly effluent sample and will be analyzed against the effluent limits listed in Table 5-1. The average quality of the effluent must meet NRC standards in 10 CFR Part 20, Subparts D and K, and Appendix B to ensure that concentrations remain less than those identified in Table 5-1 or any federal primary drinking water standards, whichever is more stringent (see also NRC, 2011). Additionally, LCI will collect a grab sample quarterly and analyze the sample against the EPA's maximum contaminant level requirements in 40 CFR Part 141.

As stated in the application, on a quarterly basis, the water level in each of the monitor wells will be measured, and water samples will be collected and analyzed for alkalinity, chloride, and conductivity. Results from the analyzed samples will help determine if the injectate has migrated to the monitor well.

The effluent monitoring program will be assessed during LCI's annual audit of its radiation protection program. In accordance with requirements of 10 CFR 40.65, LCI will report the quantity of each principal radionuclide released by the effluent discharges, including liquid effluents. Per conditions of the WDEQ UIC Class V permit, LCI is also required to submit to the WQD a quarterly injectate report, quarterly injection well report(s), and semi-annual monitoring well reports (WDEQ, 2016).

6 CONSULTATIONS

The proposed action is the operation of UIC Class V wells for the disposal of treated waste waters. Because no ground disturbance is expected with the operation of these wells, the NRC has concluded that there is no potential to affect threatened or endangered species nor will the proposed action cause effects on historic properties. As a result, consultation under Section 106 of the National Historic Preservation Act or Section 7 of the Endangered Species Act is not necessary.

6.1 Agencies and Persons Consulted

The NRC staff provided the BLM and the WDEQ-WQD the opportunity to review and comment on a draft of this EA. The WDEQ provided its comments by letter dated June 7, 2016 (ML16197A216) and the BLM by e-mails dated May 18, 2016 and May 31, 2016. The NRC staff considered these comments in the final EA.

7 CONCLUSION

The proposed action is to amend License SUA-1598 to utilize UIC Class V wells at the Lost Creek ISR Facility for the disposal of treated wastewater. The NRC has evaluated the potential environmental impacts associated with the proposed action and finds that the proposed action will have no significant impact on the human environment. As a result, the NRC staff concludes that preparation of an Environmental Impact Statement is not warranted. Accordingly, the NRC staff has determined that a Finding of No Significant Impact is appropriate.

8 REFERENCES

10 CFR 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." Washington, DC.

10 CFR 40. *Code of Federal Regulations,* Title 10, Energy, Part 40, "Domestic Licensing of Source Material." Washington, DC.

10 CFR 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Washington, DC.

40 CFR Part 141. *Code of Federal Regulations*, Title 40, *Protection of the Environment*, Part 141, "National Primary Drinking Water Regulations." Washington, DC.

LCI, 2008. "Letter to NRC Regarding Submittal of License Application for the Lost Creek ISR Project, Docket No. 40-9068." ML081060502. March 2008.

LCI, 2015a. "Lost Creek UIC Class V Environmental Report." ML15076A380. Wamsutter, Wyoming. March 2015.

LCI, 2015b. "Lost Creek Response to NRC Requests for Additional Information UIC Class V Amendment." ML15239A726. August 2015.

NCRP, 2009. "Ionizing Radiation Exposure of the Population of the United States." Report Number 160. Bethesda, Maryland: National Council on Radiation Protection and Measurements. 2009.

U.S Nuclear Regulatory Commission (NRC), 2003a. NUREG-1748. "Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards Programs." ML032540811. Washington, DC: NRC, August 2003.

NRC, 2003b. NUREG-1569. "Standard Review Plan for In-Situ Leach Uranium Extraction License Applications." ML032250177. Washington, DC: NRC, June 2003.

NRC, 2009. NUREG-1910. "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML091530075. Washington, DC: NRC, May 2009.

NRC, 2010. "Memorandum of Agreement Among U.S. Nuclear Regulatory Commission, Wyoming State Historic Preservation Officer, Bureau of Land Management Rawlins Field Office, Northern Arapaho Tribe, Eastern Shoshone Tribe, and Lost Creek ISR, LLC Regarding Archeological Data Recovery at 48SW16604, Sweetwater County, Wyoming." ML103330262. Washington, DC: NRC, September 2010.

NRC, 2011. NUREG-1910, Supplement 3. "Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming." ML11125A006. Washington, DC: NRC, June 2011.

NRC, 2016a. "NRC Inspection Report 040-09068/15-002 and Investigation Reports 4-2014-014 & 4-2014-027 and Notice of Violation for the Lost Creek ISR Project." ML16007A102. Arlington, Texas: NRC, January 2016.

NRC, 2016b. Materials License SUA-1598 for Lost Creek ISR Project in Sweetwater County, Wyoming. Amendment 4. ML15279A561. Washington, DC: NRC, March 2016.

NRC, 2016c. Materials License SUA-1598 for Lost Creek ISR Project in Sweetwater County, Wyoming. Amendment 5. ML16123A338. Washington, DC: NRC, August 2016.

Wyoming Department of Environmental Quality (WDEQ), 2010. "State of Wyoming Department of Environmental Quality Underground Injection Control Permit Issued Under Wyoming Water Quality Rules and Regulations, Chapter 13, Class I Injection Well, Lost Creek Disposal Wellfield, Permit Number: 09-586." Cheyenne, Wyoming: WDEQ. May 2010.

WDEQ, 2015. "Lost Creek ISR LLC, Permit 788, September 2015 Inspection." WDEQ – Land Quality Division. ML15279A061. October 1, 2015.

WDEQ, 2016. "State of Wyoming Department of Environmental Quality Underground Injection Control Permit Issued Under Wyoming Water Quality Rules and Regulations, Chapter 16, Class V Injection Well, Lost Creek ISR, LLC, Permit Number: 15-081." Cheyenne, Wyoming: WDEQ. ML16197A225. February 2016.

Wyoming State Geological Survey, 2016. "Oil and Gas Maps and Publications." Interactive Oil and Gas Map of Wyoming. http://www.wsgs.wyo.gov/energy/oil-gas-maps-publications. Accessed July 11, 2016.