Lost Creek KM Amendment
Environmental Report
February 2015

NRC License SUA-1598

General Table of Contents

TABLE OF CONTENTS

1.0 INTRODUCTION

Lost Creek ISR, LLC (LC ISR, LLC) is submitting this Environmental Report (ER) to the United States (US) Nuclear Regulatory Commission (NRC) in support of an amendment to source and byproduct material license SUA-1598 to expand the Lost Creek Project (Project) in accordance with the Atomic Energy Act of 1954, as amended, 10 Code of Federal Regulations (CFR) Parts 20, 40, 51, and 70, and other applicable laws, regulations and NRC guidelines. Amendment of this license would authorize LC ISR, LLC to:

1. Expand in situ recovery (ISR) uranium mining into the KM geologic horizon within the Lost Creek license area. ISR from the HJ Horizon was approved in the original licensing action.
2. Expand the area of ISR recovery in the HJ Horizon within the confines of the previously approved license area.

Per the National Environmental Protection Act (NEPA) of 1969, federal agencies are obligated to evaluate the effects of major federal actions on the health and safety of the public and assess impacts to the environment. NRC and the Bureau of Land Management (BLM) are the federal agencies with jurisdiction over the Project and the Lost Creek Permit Area (Permit Area), respectively. NRC has jurisdiction under 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions. NRC is required to perform an environmental evaluation of the proposed licensing actions. As the land manager, the BLM has jurisdiction over leases related to the use of the Permit Area.

This ER is organized in accordance with the guidance contained in NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards (NMSS) Programs, dated August 2003. **Section 1** provides an introduction of the Amendment request, discusses why LC ISR, LLC is requesting an amendment, and presents a Project description. **Section 2** discusses the proposed action versus alternatives, including the no-action alternative and alternatives considered but eliminated. **Section 3** describes the existing environmental conditions in the Permit Area; and **Section 4** discusses how those conditions could be impacted, if at all, by the proposed action, and the mitigation and monitoring measures that will be implemented during the Project. **Section 5** presents the Cost-Benefit Analysis. **Section 6** provides the summary of the environmental consequences from the Project. **Sections 7** and **8** contain a list of references and preparers, respectively.

1.1 Purpose and Need for the Proposed Action

The expansion of the Lost Creek Project will contribute to the advancement of the energy security goal of maintaining a reliable, economical, and domestic source of uranium. Exploratory drilling and testing have provided the delineation of the uranium ore trend and a reliable estimate on the uranium reserve, ore grade and percent recovery.

The Project will support energy-independent and environment-friendly policies. The uranium production will assist to supply a viable domestic uranium recovery industry by applying new technologies that minimize environmental disturbance and potential adverse effects to public health and safety. This Project will also help to offset the deficit in annual domestic uranium production and help to meet increasing energy demands. Between 1989 and 2003, annual domestic uranium production decreased by 75 percent. The United States produces about two percent of world uranium production, while consuming over 25 percent of that production. As of 2006, the world produced just over 50 percent of the annual consumption of U_3O_8. The gap between demand and supply has been filled by stockpiles and uranium from non-traditional sources (e.g., dilution of weapon-grade uranium). There are concerns about the long-term availability of uranium from non-traditional sources. Regulatory approval to recover uranium from the KM Horizon and expansion of the area of HJ mining will enable LCI to address significant resources.

Mining and other industrial activities have potential impacts. However, ISR operations will minimize surface and underground disturbance and reduce potential adverse impacts to workers and the general public.

Nuclear energy production is an important strategy for curbing global climate change over the long-run. Unlike coal-fired power plants, nuclear power plants produce virtually no greenhouse gas emissions.

1.2 Proposed Action

LC ISR, LLC is applying for an amendment to the current source and byproduct material license for the Project in order to facilitate the production of U_3O_8 from the KM geologic horizon at Lost Creek and also expand the area of mining in the HJ Horizon; all within the confines of the original license area. Two new KM Horizon mine units, Mine Units 3 and 12, would be installed and the area of mining within the HJ (4 HJ mine units including Mine Unit 1 which is in operation) would be expanded as shown in Plate OP-2b of the LC East Amendment Technical Report.

1.2.1 Overview

The Lost Creek license area is located in the northeastern corner of Sweetwater County, south-central Wyoming. The license area is in an unpopulated region about 15 miles southwest of Bairoil, Wyoming, about 38 miles northwest of Rawlins, and 91 miles southwest of Casper. Additional details regarding the license area can be found in the original Environmental and Technical Reports.

The Permit Area is characterized by low-relief, sagebrush-dominated plains, dissected by small, ephemeral drainages. Due to little variation in topography, severe winter conditions, and less than ten inches of annual precipitation, the ecological diversity in the Permit Area is limited.

The discovery of uranium deposits in the Permit Area and consequential exploratory drilling and studies have occurred over the course of four decades.

1.2.2 Project Description

LC ISR, LLC is proposing the construction, operation, and reclamation of facilities for ISR operations within the Lost Creek Area. ISR involves the use of a recovery solution, otherwise known as a lixiviant, to extract the mineral from the geologic formation in which it occurs without physically removing the ore-bearing strata.

1.2.2.1 Design and Construction of Mine Units and Facilities

The methods of construction, mining, and reclamation outlined in the original ER will not change for this amendment.

1.2.2.2 ISR Operations

The ISR methods previously described in the original ER will not change. However, the mining horizons will include the HJ and KM.

1.2.2.3 Instrumentation and Control

The description of instrumentation and control in the original ER will continue to apply.

1.2.2.4 Restoration, Decommissioning, and Reclamation

Please see Section 1.2.2.4 of the original ER.

1.2.3 Schedule

Prior to Project start up, amendments to the WDEQ Permit to Mine, NRC Source Material License, and other federal, state and local permits and approvals must be approved.

The projected mining schedule assumes a production rate of approximately 1,000,000 pounds of U_3O_8 per year. The actual development schedule and production rates will be adjusted in response to actual mine unit conditions (e.g., flows, recovery rates, etc.) and the market demand for uranium. **Figure** OP-4a of the LC East Technical Report Amendment provides a current estimated schedule of operational activities at Lost Creek. Additional ore reserve and resources areas are known to exist within the Permit Area, but are not currently drilled adequately to evaluate for ISR planning. These reserve areas have the potential to extend the ultimate Project life beyond this initial period.

1.3 Applicable Regulatory Requirements, Permits, and Required Consultations

Prior to commencing ISR operations from the KM Horizon and expanding mining in the HJ Horizon, LC ISR, LLC must obtain an amendment to the License to Mine and a Permit to Mine from WDEQ-LQD. This amendment will include an aquifer exemption for the utilization of UIC Class III wells. The NRC Source and Byproduct Material License must also be amended.

There have been no changes to the list of agencies with regulatory authority or oversight laws since the original ER.

Class I and III Archeological surveys were previously performed in the areas to be affected under this amendment and submitted to the Rawlins BLM Field Office and the NRC.

Individual and Block permits will be sought from the Wyoming State Engineer's Office on an as needed basis. The Wyoming State Engineer recently determined that permits are not required for monitor wells.

TABLE OF CONTENTS

2.0 ALTERNATIVES

2.1 No-Action Alternative

Under this alternative, no expansion would be conducted. There would be no uranium produced from the KM Horizon or HJ expansion area and no favorable or unfavorable impacts from this alternative.

2.2 Alternatives Considered but Eliminated

Underground and open pit mining represent the two currently available alternatives to ISR of the uranium resources in the Permit Area.

2.2.1 Open Pit Mining

Open pit mining requires the removal of all material covering the orebody (overburden) and then the ore itself. The ore would then be transported to a conventional mill for further processing and extraction through grinding, leaching, purifying, concentrating, and drying.

From an economic point of view, open pit mining of the relatively low grade and moderate depth of the Lost Creek orebodies would require a much larger investment than ISR, especially in the early phase, when a significant investment would be required for acquisition of heavy equipment to perform the earthwork to expose the orebody. The overall size of the operation facilities would be larger because of greater manpower and material handling requirements.

Waste rock piles from excavation of the overburden and the mine pit would make permanent changes to the topography, with a disturbed area approximately three times the area of the orebody mined, in order to maintain slope stability. Potential personnel injury rates and potential radiological exposures at the mining site would also be higher with open pit mining than what would be experienced with ISR.

A mill tailings pond would be required to contain the millions of tons of waste produced from the uranium mill. This tonnage would represent a large volume of radioactive tailings slurry covering a large area of ground surface. Conventional mill operation would involve higher risks of spillage and radiological exposure to both personnel and the environment than those associated with the proposed ISR operations.

Open pit mining at the Permit Area would also require substantial dewatering of the pit to depress the potentiometric surface of all aquifers. Large quantities of groundwater would be discharged to the surface. Some of this groundwater contains naturally elevated radium-226 (Ra-226), radon and uranium, which would have to be treated before discharge and the residue disposed of as radioactive solid waste.

2.2.2 Underground Mining

Underground mining of the uranium resources at the Permit Area would involve sinking of shafts to the vicinity of the orebodies, horizontally driving crosscuts and drifts to the orebodies at different levels, physically removing the ore and transporting the mined ore to the conventional mill for further processing. Processes for milling and uranium extraction from underground mined ores would be the same as those for ores mined from the open pit.

When one considers the alternative of underground mining, the economic and environmental disadvantage closely parallel those of an open pit mine. These, as stated above, include large amounts of initial investment, permanent changes to the topography (though in a smaller scale than open pit mining because less amounts of waste rock are being generated), generation of a significant amount of mine tailings, increased risks of injury and potential exposure to radioactive materials during mining and milling, and surface discharge of groundwater from mine dewatering with elevated radionuclide concentrations.

One major concern for underground uranium mining is the potential exposure of miners to radon gas if the gas is not continuously vented to the atmosphere. Subsequent land surface subsidence could also occur after the completion of underground mining.

Economic costs and environmental impacts associated with open pit and underground mining clearly show that ISR is the more viable uranium extraction technique to use. The initial investment is lower; the tailings problem is completely eliminated; radiation exposure and environmental impacts are minimized; and the groundwater resource is preserved. In addition, because of the reduced costs, lower grade ores can be recovered through ISR than can be recovered from open pit and underground mines.

2.3 Proposed Action

The Project will use ISR technology to extract uranium from permeable, uranium-bearing sandstones of the HJ and KM Horizons. Once extracted, the uranium will be recovered by means of ion exchange at the previously licensed Lost Creek Plant.

2.4 Reasonable Alternatives

Since the majority of the facility, including plant complex, holding ponds, main access roads and power lines are already installed as part of the Lost Creek licensed action, very few significant reasonable alternatives are available for consideration. The mining techniques employed successfully within the Lost Creek area will continue to be utilized.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The Lost Creek Area is located in the northeastern corner of Sweetwater County, Wyoming near Carbon County, Wyoming. The Permit Area is about 15 miles southwest of the Bairoil, Wyoming, about 38 miles northwest of Rawlins, and about 90 miles southwest of Casper. The Permit Area consists of 297 unpatented federal lode claims totaling 5,751 acres. The general location of the Permit Area is shown in **Figure D1-1a** of the LC East Technical Report.

The regional landscape consists of rolling plains with some draws, rock outcroppings, ridges, bluffs and some isolated mountainous areas. Vegetation is primarily sagebrush and rabbit brush. The area is sparsely populated, and the closest residence is approximately 15 miles from the Permit Area boundary. The weather is dry and windy, with short, hot summers and cold winters. There is no perennial surface water, although there are a few ephemeral drainages that can convey surface water during spring snowmelt and following intense rainstorms.

3.1 Land Use

The land within the Permit Area is entirely publicly owned and managed by the Rawlins BLM Field Office. The primary land use in the study area is rangeland for cattle, but the area is also used for dispersed recreation such as hunting, off-highway vehicle (OHV) use, and antler collecting. The main access road into Lost Creek passes through the amendment area. Regional land uses include grazing, industry, wildlife habitat, hunting, dispersed recreation, OHV use, oil and gas extraction, gas and carbon dioxide (CO_2) pipelines, and transmission lines.

3.1.1 Existing Land Uses

3.1.1.1 Rangeland and Agriculture

See the original ER.

3.1.1.2 Wildlife Hunting and Viewing

No changes to this section from the original ER.

3.1.1.3 Recreation and Special Use Areas

No changes to this section from the original ER.

3.1.1.4 Minerals and Energy

No changes to this section from the original ER.

3.1.1.5 Infrastructure

The Lost Creek Mine is now constructed and in operation as described in the original ER.

3.1.2 Planned Land Uses and Developments

No changes to this section from the original ER.

3.2 Transportation

See the original ER for details. Transportation to the site has not changed. The main access roads to the facility are already installed. The secondary access roads to the respective mine units will follow the previously planned routes. See Plate OP-2b of the LC East Technical Report for additional details.

TABLE OF CONTENTS

3.3 Soils

Soils studies were previously completed and documented in the original ER and TR.

TABLE OF CONTENTS

3.4 Geology

3.4.1 Regional Geology

See the original Environmental Report.

3.4.2 Site Geology

Outcrop within the entire Permit Area is represented solely by the upper portions of the Battle Spring Formation, which is the host to uranium mineralization. The Battle Spring Formation in the vicinity of the Lost Creek Property is part of a major alluvial fan system, consisting of a multitude of thin to thick beds of sandstones separated by numerous thin to medium thick layers of mudstone, claystone and siltstone. The sandstone facies represent fluvial channel fill depositional environments. The shaly units represent channel margin and overbank depositional environments. The anastomosing nature of the fluvial channels has resulted in stratigraphy which tends to be erratic and lacking long range continuity. Various stratigraphic intervals, some dominated by sandstone and others by mudstone, have been correlated and named across the Property and Permit Area. These named "Horizons" are described in more depth in the following Section (**Section D5.2.1**).

Lithology of the Battle Spring Formation within the Permit Area consists of approximately 60% to 80% weakly consolidated, medium to coarse, commonly conglomeratic, clean arkosic sands in units from five to 50 feet thick; separated by 20% to 40% interbedded mudstone, claystone, siltstone, and fine sandstone, generally less than 25 feet thick (**Figure D5-1** of the KM Amendment Technical Report). This lithological assemblage remains relatively consistent throughout the entire vertical section of interest within the Battle Spring Formation, such that the lithology of the shallowest units is virtually identical to that of the deepest units of interest. Economic uranium mineralization is generally associated with medium to coarse-grained sand facies.

Uranium deposits within the Lost Creek Property occur as roll front type deposits. The most significant mineral resources in the Lost Creek Property and the Permit Area occur within two major stratigraphic Horizons within the Battle Spring Formation: the HJ and the KM Horizons (**Figure D5-1** of the KM Amendment Technical Report). The HJ Horizon carries the majority of the currently defined mineral resource and is currently permitted and being developed. The KM Horizon, the subject of this application, underlies the HJ Horizon and contains additional economic mineralization, which is the focus of this document.

Depth to the top of any given unit can vary from one end of the mineral trend to the other by up to 220 feet due to the regional dip of one to three degrees, and to displacement by normal faulting. Within the Permit Area the depth to KM Horizon mineralization ranges from 425 to 685 feet, averaging 515 feet.

Mineralization also occurs above the HJ within the DE and FG Horizons. The DE hosts only minor occurrences which are virtually always above the water table. Consequently it is of little economic interest. Mineralization within the FG is secondary to that of the HJ and KM, but is none the less significant, and remains to be investigated for economic viability. Mineral discoveries have also been made in the L, M, and N sands which are collectively referred to as the Deep Horizons and underlie the KM. Economic assessment of these Horizons will require additional exploration activity.

The combined HJ and KM mineral trend within the Permit Area is referred to as the Main Mineral Trend (MMT) and extends in an east-northeast to west-southwest orientation for nearly three miles (**Plate D5-1a and 1b** of the KM Amendment Technical Report). The composite width of the MMT varies from 500 to 2,000 feet. Individual roll fronts within the deposit are typically 25 to 75 feet wide and are very sinuous. Mineralization in both the HJ and KM Horizons are stacked vertically and commonly overlie each other in a complex, erratic, anastomosing pattern in plan-view. Both the HJ and KM mineralization are considered to be the product of the same regional mineralizing event and therefore virtually contemporaneous and similar in most respects. The location of currently identified KM mineralization is illustrated in **Plate D5-1a** of the KM Amendment Technical Report.

The geometry of the uranium mineralization is dominated by the classic roll front "C" shape or crescent configuration at the alteration interface. Thickness of mineralization within each roll front may vary from 5 to 25 feet thick. Typical thickness is from 10 to 15 feet. Mineral intercepts of over 25 feet in total thickness are common where multiple roll fronts occur stacked on top of each other. To date, a total of nine individual roll fronts have been identified in the KM Horizon within a stratigraphic interval of approximately 100 feet. Average grade within the Lost Creek MMT is approximately 0.057% eU3O8. East-west oriented normal faulting is common in the Lost Creek Property. As discussed above, these appear to be the product of relatively late-stage structural adjustments. They appear to be genetically associated with the Chicken Springs Fault system identified on published geological maps approximately five to ten miles to the east. The latest displacement of these faults was post-mineralization and therefore has offset mineralization. They are no longer considered active. The fault planes are close to vertical, being less than 3 degrees from vertical in locations where dip of the fault plane can be determined. Faulting is discussed in greater detail in **Section D5.2.2**.

3.4.2.1 Stratigraphy

The upper portion of the Battle Spring Formation is host to the uranium mineralization in the Permit Area. Being the product of an alluvial fan depositional environment, the Battle Spring Formation can be described as a very thick sequence composed of innumerable individual channel sands typically from five to 50 feet thick interfingered with shales typically two to 25 feet thick which represent channel margin and overbank environments. Lateral extent of both of these lithologies can range from 100 feet to miles. Where multiple sand channels are stacked on top of each other, the cumulative sand thickness and width can be considerable. The erratic nature of these narrow channels results in stratigraphy which can be highly variable. The outcome can be very complex, where interfingering or abrupt facies changes may result in drastic changes in shale or sand thickness over short distances. This is well illustrated in the thickness isopach maps of the SBS and K Shales (**Plates D5-3a and D5-3b** of the KM Amendment Technical Report) where discernible patterns of deposition are virtually absent; and also in the Geologic Cross-Sections (**Plates D5-2a to D5-2h** and the Well Completion Reports in **Attachment D5-1** in the KM Amendment Technical Report).

Sedimentary and depositional patterns throughout the entire Battle Spring interval of interest remained quite consistent and uniform. Consequently, from a lithological and stratigraphic perspective there is little difference between deeper units and those near the surface. Distinctive characteristics of given stratigraphic intervals are subtle and generally are not consistent regionally, consequently partitioning into meaningful stratigraphic units remains largely arbitrary. Vertical boundaries have been defined at shale units showing the greatest regional continuity, or lacking that, at pre-established thickness intervals.

In the Permit Area, the top 1,200 feet of the Battle Spring Formation represents the interval of interest. Within this interval the stratigraphy has been sub-divided into several thick stratigraphic "Horizons" (e.g. HJ or KM). Horizons are dominated by sands and separated from each other by "Named Shales" of regional extent. Each horizon, however, is in actuality the composite of numerous "sands" which are in turn separated by numerous "Unnamed Shales" within the horizon. Unnamed shales may be quite extensive, or may be only of local extent. Note also that the term "shale" is used herein rather loosely, as it commonly may include considerable amounts of siltstone or fine grained sand as well as mudstone and claystone.

Horizons of primary interest are further subdivided into "Sub-Horizons" (e.g., LFG, UHJ, UKM). Criteria for establishing sub-horizons are based largely on a combination of continuity of sand packages and continuity of associated mineral horizons. Vertical boundaries between sub-horizons are established somewhat arbitrarily and may or may not coincide with the presence of an intervening shale.

The resulting system of stratigraphic nomenclature is illustrated in the Stratigraphic Column within **Figure D5-1** of the KM Amendment Technical Report. This nomenclature is internal to Ur-Energy and is not recognized officially by the geological community. The foundation for this system has been carried over, with some modification, from that established by Conoco Minerals during its early exploration activities in the region and subsequently adopted by Texasgulf during its tenure with the property. Nomenclature terms from surface downward to the KM Horizon were inherited from previous operators; below that the terms were derived by Ur-Energy.

Note that in the last few years Ur-Energy has abandoned the use of the term "Sand" in favor of the term "Horizon" to describe the major stratigraphic units. It is believed that the term "Sand" can be misleading in recognition of the fact that any substantial stratigraphic interval consists not only of sand facies but also contains a considerable number of interbedded shales which yields hydrogeological characteristics significantly different than an interval consisting only of sand.

Also note that the boundaries between horizons (i.e. Named Shales) have been established on a relatively arbitrary basis and don't necessarily reflect patterns or breaks in sedimentary or depositional characteristics. As a result, the system of nomenclature as illustrated on **Figure D5-1** of the KM Amendment Technical Report should be viewed essentially and simply as a cataloguing tool for stratigraphic organization.

Named Shales represent the shaly interval nearest the stratigraphic level established as the break between Horizons. Strictly defined, they represent the shaly interval between the lowest sand assigned to the overlying Horizon and the uppermost sand assigned to the underlying Horizon. The Battle Spring interval of interest contains many more shales (unnamed) than just the Named Shales (see Type Log #2, **Figure D5-2** of the KM Amendment Technical Report and Geological Cross-Sections **Plates D5-2a to D5-2h** of the KM Amendment Technical Report). As such, Named Shales may not be the dominant shale in any given area nor represent the only shale occurring between production sands. Named Shales may not be regionally continuous; or they may represent a series of shales which can be overlapping, en-echelon, or complexly interwoven with vertically adjacent sands. Because of this complexity, thickness values selected for shale isopach mapping **(Plates D5-3a and D5-3b** of the KM Amendment Technical Report) may not represent all shales in such a series, but rather only the one that best correlates to the stratigraphic nomenclature boundary. An example of shale complexity is well illustrated in the central portions of Cross-Section I-I' (**Plate D5-2h** of the KM Amendment Technical Report).

The most notable exceptions to the above statements are the LCS and SBS Shales which locally may display considerable complexity but do exhibit a high degree of regional continuity and confinement.

Provided below is a brief description of each named stratigraphic unit within the Permit Area. The general lithologic character of the units remains relatively consistent throughout the entire Property, however depths below ground surface (bgs) may vary significantly locally due to regional stratigraphic dip and displacement due to normal faulting.

A Horizon –The A Horizon is poorly characterized largely because it is commonly not present, having been removed by erosion; except in the western down-dip portions of the property and where it has been down-thrown by faulting. When present, lithologic data is often missing in drill logs because it is dry and occurs above the fluid level in the drill hole while logging. Fluid in the hole is required to generate the single point resistance and spontaneous potential (SP) curves used for lithological characterization. The lower boundary of the A Horizon is arbitrary and poorly defined. Significant mineralization is rare.

BC Horizon – The BC Horizon is the horizon occurring at the surface within the majority of the Permit Area. Like the A Horizon, it is often completely or partially above the drilling fluid level while logging, consequently detailed characterization of the BC Horizon is sporadic. In general it appears to be similar in character to the adjacent underlying DE Horizon. The upper and lower boundaries are arbitrary and poorly defined. Thickness is approximately 80 to 100 feet. The BC Horizon is dry, except possibly for some local perched water tables. Significant mineralization is rare.

DE Horizon – This Horizon occurs at the surface in the eastern portions of the Project. It commonly consists of a sequence of relatively thick sands with thick intervening shaly units. In portions of the Permit Area, the lower shale boundary is absent such that the sands of the DE Horizon coalesce vertically with sands of the underlying FG Horizon. In the Lost Creek Project, the top of the unit ranges in depth from surface to 200 feet and is approximately 80 feet thick where the entire section is present. The DE Horizon is the shallowest horizon which carries groundwater (i.e., the shallowest aquifer). When present, standing water levels occur at the very basal portions of the DE Horizon. Significant mineralization is uncommon.

EF Shale (formerly the Upper No Name Shale) – The EF Shale represents the boundary between the overlying DE Horizon and the underlying FG Horizon. Hydrogeological confinement by the EF Shale is not complete. It is not everywhere present and commonly does not consist of one regionally continuous shale but rather multiple shales which overlap in en-echelon manner (for example, see the east half of Cross-Section D-E, **Plate D5-2c** of the KM Amendment Technical Report). Thickness varies considerably from two to 45 feet. Depths to the EF Shale vary from 125 feet in the eastern portions of the Project to 300 feet in the western portions.

FG Horizon – In the Permit Area the top of the FG Horizon occurs at depths of approximately 125 feet in the east to 300 feet in the western regions of the Project. The total thickness of the FG Horizon is typically about 160 feet, ranging between 140 to 175 feet. Stratigraphically, the FG Horizon is subdivided into three sub-horizons: the Upper FG (UFG), Middle FG (MFG) and the Lower FG (LFG), all roughly of equal thickness. The breaks between these are not rigidly defined. Generally they are selected based on significant shales (if present) which separate channel-fill sequences. The character of individual FG sand units tends to be thinner, more erratic and shaly than what is characteristic of lower horizons; and as a whole the FG has a lower Sandstone to Shale (SS/Sh) ratio. The FG contains significant mineralization in the Permit Area.

Lost Creek Shale (LCS) – The Lost Creek Shale separates the FG and HJ Horizons. It is a dominant shaly horizon which has been found to be continuous throughout the Lost Creek Permit area. For this reason it has been used as the datum for stratigraphic correlation. Thickness ranges from 5 to 45 feet, typically being from 10 to 25 feet. Depth ranges from approximately 280 feet in the east portions of the project to 475 feet in the west. Its lithology is dominated by silty mudstone and dense claystone. It commonly includes siltstone, and may locally be sandy or contain thin lenticular sands. Segments of the LCS commonly interfinger with and undergo rapid facies exchanges with lower sands of the FG Horizon and upper sands of the HJ Horizon. This can complicate correlation and often results in dramatic changes in the thickness of the LCS within short horizontal distances.

HJ Horizon – The HJ Horizon is the dominant host for mineralization in the MMT and is the host to current production development. The HJ Horizon has been subdivided into four sub-horizons: Upper HJ (UHJ), Middle HJ1 (MHJ1), Middle HJ2 (MHJ2) and the Lower HJ (LHJ). The boundaries between the sub-horizons are somewhat arbitrary but selection is guided by sand channel and roll front mineral horizon continuity. Boundaries may be accompanied by a shale break. The bulk of the uranium mineralization is present in the two MHJ sub-horizons. The HJ Horizon characteristically includes noticeably thicker sands and a high SS/Sh ratio compared to most of the other horizons. The total thickness of the HJ Horizon ranges from 120 to 160 feet, averaging approximately 130 feet. Depth to the top of the HJ Horizon within the Permit Area ranges from approximately 280 feet in the east to 475 feet in the west.

Sagebrush Shale (SBS) – The Sagebrush Shale forms the boundary between the HJ Horizon and the underlying KM Horizon. As such it represents the aquitard between the HJ production horizon and the proposed KM production horizon. The SBS is laterally extensive and virtually continuous throughout the Permit Area. Within the Permit Area depth to this shale ranges from 425 feet in the eastern portions of the Project to approximately 625 feet in the west. Thickness varies from 2 to 50 feet. Similar to the

LCS, segments of the SBS commonly interfinger with and undergo rapid facies exchanges with lower sands of the HJ Horizon and upper sands of the KM Horizon. This can complicate correlation and often results in dramatic changes in the thickness of the SBS within short horizontal distances, as is evident in the thickness isopach map for the SBS (**Plate D5-3a** of the KM Amendment Technical Report).

KM Horizon – The KM Horizon is the secondary host to the mineralization in the MMT. Proposed production from the KM is the focus of this document. Nomenclature for the KM was modified in recent years. Initially, and at the time of the original Mine Permit, the KM Horizon was assigned three sub-horizons: the Upper KM (UKM), the Middle KM (MKM) and the Lower KM (LKM). As additional drilling results became available over time it became apparent that the KM is better described as having only two sub-horizons, underlain by the K Shale. Consequently the MKM designation was abandoned and replaced by the LKM such that the current nomenclature employs only the UKM and LKM.

In general the character and lithology of the KM is similar to that of the HJ Horizon. Both the UKM and the LKM sub-horizons host mineralization. A shale unit referred to as the No Name Shale (NNS) commonly divides the two sub-horizons of the KM, but it is not present everywhere within the Project. Depth to the top of the KM Horizon ranges from 430 feet in the eastern portions of the Project to 650 feet in the far western portions. Thickness ranges from 80 feet to 110 feet.

K Shale – The K-Shale represents the lower boundary of the proposed KM production horizon. It occurs throughout the Lost Creek area, but may be sporadically absent locally. Where present, continuity and confinement is not seamless as it may locally be represented by multiple overlapping shales. Average thickness is 10 feet, ranging from 2 feet to 40 feet. A thickness isopach map for the K Shale is presented as **Plate D5-3b** of the KM Amendment Technical Report. Depth to the K Shale varies from 525 feet in the eastern margins of the Project to 750 feet in the west.

L, M, and N Horizons – These horizons are collectively referred to as the "Deep Horizons" and occur within a 300 to 350 feet interval below the K Shale. Currently they are the targets of exploration activities. Available drill data for these horizons is much sparser than for the shallower horizons. Individually, each horizon is approximately 100 feet thick. They consist of lithologies identical to that of shallower horizons. In general, like the remainder of the Battle Spring Formation, they are composed of multiple, stacked, coarse sands separated by numerous shale intervals. Stratigraphically, shales within these horizons are often relatively thick and more continuous than seen in the shallower horizons, contributing to an overall lower SS/Sh ratio. At the same time, individual sands tend to be thicker and show more regional continuity. This character becomes more dominant with depth.

L Horizon: Depth to the L Horizon varies from 525 feet in the east to approximately 750 feet in the west. Thickness of the L Horizon is locally diminished significantly due to substantial thickening of the underlying LM Shale.

M Horizon: Locally the M Horizon exhibits a much more shaly character with more shale interbeds, thinner sands and a much lower SS/Sh ratio than the vertically adjacent horizons. Depth to the top of the M Horizon ranges from 610 feet in the east to 825 feet in the western portions of the Project.

N Horizon: The character of the N Horizon is similar to that of the L and M, commonly exhibiting thick shales with well-developed sands. Depth to the top of the N Horizon ranges from 725 feet in the east to approximately 940 feet in the west.

LM, MN, and NP Shales – These shales represent the lower boundaries of the L, M and N Horizons respectively. Designation of these shales as horizon boundaries were arbitrarily established on roughly 100 foot intervals below the K Shale. As such they do not present unique characteristics compared to any other shales within this stratigraphic interval. Thickness of the shales varies considerably, reaching up to 50 feet with an average of approximately 13 feet. Although these shales have regional extent, continuity is unconfirmed. In many areas drill data spacing is insufficient to confirm correlation. Breaks in these shales have locally been identified.

3.4.2.2 Structure

The dominant geologic structural features in the Permit Area are a series of normal faults. The locations of these faults are illustrated in the General Location Map (**Plate D5-1a and 1b** in the KM Amendment Technical Report); in the Geological Cross-Sections (**Plates D5-2a to D5-2h** in the KM Amendment Technical Report) and in the Isopach Maps; (**Plates D5-3a to D5-3b** in the KM Amendment Technical Report). Bedding within the Battle Spring Formation in the Permit Area is nearly flat-lying, dipping gently to the northwest at roughly three degrees. This regional pattern of strike and dip is modified locally due to horst and graben features resulting from normal faulting in the Lost Creek area.

The MMT within the Permit Area is bisected by a normal fault system, which is collectively referred to as the Lost Creek Fault. This consists essentially of two faults, lying roughly parallel and en-echelon, trending from east-northeast to west-southwest (**Plate D5-1a** of the KM Amendment Technical report).

The 'main' Lost Creek Fault trends east to west and dissects the eastern two-thirds of the Permit Area. Downward displacement occurs on the south block. Throw is approximately 70 to 80 feet in the eastern portion of the Permit Area, decreasing to the west, and eventually losing identity in the western one-third of the Permit Area. Easterly, displacement on the 'main' fault disappears near the eastern boundary of Section 17. In addition, a minor 'splay' fault has been identified close to the 'main' fault in the west-central portion of the Main Mineral Trend. Maximum throw on this fault is roughly 20 feet in the opposite direction than the 'main' fault, creating a localized graben structure between.

A second or 'subsidiary' fault to the 'main' fault is positioned sub-parallel and approximately 800 to 1,000 feet south. Throw is opposite that of the 'main' fault with a maximum down to the north displacement of approximately 50 feet. The 'subsidiary' fault also has a minor splay fault associated with it which splits off to the north between the 'subsidiary' and 'main' faults. Drilling conducted in recent years shows that the primary branch of the 'subsidiary' fault continues easterly out of the Permit Area. Portions of it were previously referred to as the South fault. Westerly, the 'subsidiary' fault appears to diminish before reaching the western Permit boundary.

Drilling has identified additional faults elsewhere within the Permit Area. The 'north' Fault is located roughly 3,800 feet north of the MMT and has displacement ranging from approximately 20 feet to 80 feet. Also a significant fault has been discovered in Section 25 in the southernmost portions of the Permit Area. Displacement on this fault is approximately 120 to 160 feet. Both of these faults are distant from the MMT and are well outside of anticipated production areas. Several other minor faults have also been identified (see **Plate D5-1a** of the Technical Report). Most of these are of limited extent and exhibit throws no more than 10 to 20 feet.

Finally, drilling has revealed three faults within Section 16 in the eastern portions of the Permit Area. Orientation of these faults closely parallels that of the Main Fault. Displacement varies from 15 to 50 feet. They are east of the anticipated areas of KM production and therefore will have minimal, if any, effect on that production.

Pump-testing and monitoring on both sides of the 'main' fault in the Mine Unit 1 area have demonstrated that the fault plane acts as a substantial barrier to flow within the HJ and KM Horizons (see Section D6).

3.4.2.3 Ore Mineralogy and Geochemistry

Mineralogy has been studied in thin section and by x-ray diffraction analysis. These analyses were conducted in 2007 by Hazen Research (Hazen, 2007) which included samples from the KM Horizon derived from core (core-hole LC64C). Results indicate that the uranium in the KM is virtually identical to that in the HJ Horizon, occurring primarily as the mineral coffinite (uranium silicate) in the form of micron- to submicron-size inclusions disseminated in and on interstitial clay, possibly absorbed by cation exchange; also intimately interspersed through some of the pyrite and as partial coatings on quartz and biotite. Minor amounts of uraninite (uranium oxide) and brannerite (uranium-titanium oxide) have also been identified. Clay rich fractions are predominantly smectite (montmorillonite), with minor kaolinite.

The Hazen Research analysis concluded that uranium should be recoverable by an ISR operation because of the unconsolidated nature of the sandstone and expected diffusion of the lixiviant through the smectite minerals. Leach amenability tests as discussed in the original Permit Application included one set of core samples collected from the UKM Horizon (core-hole LC46C). Recoverability has been confirmed by these leach testing results, which revealed that the character of KM mineralization is virtually identical to that in the HJ Horizon.

Please refer to Section 3.4.2.3 of the original ER for additional details.

3.4.2.4 Historic Uranium Exploration Activities

See the original Environmental Report.

3.4.3 Seismology

See the original Environmental Report

TABLE OF CONTENTS

3.5 Hydrology

NUREG-1569 Section 2.7 states that "characterization of the hydrology at in situ leach uranium extraction facilities must be sufficient to establish the potential effects of in situ operations on the adjacent surface-water and groundwater resources and the potential effects of surface-water flooding on the in situ leach facility" (NRC, 2003). To meet these requirements, this section addresses surface water drainage characteristics and use (**Sections 3.5.1.1 and 3.5.1.2**), surface water quality (**Section 3.5.1.3**), regional and site hydrogeology (**Sections 3.5.2.1** and **3.5.2.2**), groundwater use (**Section 3.5.3**), regional and site groundwater quality (**Sections 3.5.4.1** and **3.5.4.2**), and the regional and site hydrologic conceptual models (**Sections 3.5.5.1** and **3.5.5.2**).

3.5.1 Surface Water

3.5.1.1 Drainage Characteristics

See the original Environmental Report.

3.5.2 Groundwater Occurrence

This section describes the regional and local groundwater hydrology including hydrostratigraphy, groundwater flow patterns, hydraulic gradient and aquifer parameters. The discussion is based on information from investigations performed within the Great Divide Basin, data presented in previous applications/reports for the Permit and Amendment areas, and the geologic information presented in **Appendix D5** of the KM Amendment Technical Report.

3.5.2.1 Regional Hydrogeology

No change. See original Environmental Report.

3.5.2.2 Site Hydrogeology

LC ISR, LLC has been collecting lithologic, water level, water quality, and pump test data as part of its ongoing evaluation of hydrologic conditions at the Project. Water level measurements, both historic and recent, provide data to assess potentiometric surface, hydraulic gradients and inferred groundwater flow directions for the aquifers of interest at the Project. Three long-term pump tests (**Attachment D6-2c** of the KM Amendment Technical Report) were used to: 1) evaluate hydrologic properties of the aquifers of interest, 2) to assess hydraulic characteristics of the confining units, 3) to evaluate impacts to the hydrologic system of the Lost Creek Fault (Fault) through the Permit Area, and 4) to evaluate aquifer injectivity characteristics. Results of Permit Area water quality sampling and analysis are presented in **Section D6.4.2**.

Figure D6-11h of the KM Amendment Technical Report shows the locations of all existing KM Horizon monitor wells in the Permit Area. **Table D6-5** of the KM Amendment Technical Report provides completion data for the monitor wells currently in use.

3.5.3 Groundwater Use

See the original Environmental Report.

3.5.4 Groundwater Quality

This section describes the regional and local groundwater quality based on information from investigations performed within the Great Divide Basin, data presented in previous applications/reports for the Permit Area, and recent data collected in the Permit Area.

3.5.4.1 Regional Groundwater Quality

See the original Environmental Report.

3.5.4.2 Site Groundwater Quality

Information regarding site water quality is primarily derived from background monitor wells installed by LC ISR, LLC in 2012 and 2013.

Groundwater Monitoring Network and Parameters

Within the Permit boundary, LC ISR, LLC installed 12 background monitoring wells in the L Horizon and sampled eight of the 12 wells for Guideline 8 parameters. The monitor well locations are shown on **Figure D6-24b** of the KM Amendment Technical Report and the analytical results presented in **Table D6-15b** of the KM Amendment Technical Report.

Within the Permit boundary, LC ISR, LLC installed nine background monitoring wells in the M Horizon and sampled five of the nine wells for Guideline 8 parameters. The monitor well locations are shown on **Figure D6-24b** of the KM Amendment Technical Report and the analytical results presented in **Table D6-15b** of the KM Amendment Technical Report.

Within the Permit boundary, LC ISR, LLC installed two new background monitoring wells in the N Horizon and sampled one well for Guideline 8 parameters. The monitor well locations are shown on **Figure D6-24b** of the KM Amendment Technical Report and the Guideline 8 parameter results presented in **Table D6-15b** of the KM Amendment Technical Report.

Groundwater Quality Sampling Results

Historic Results

This section is unchanged from the original permit document.

Baseline Sampling

LC ISR, LLC began baseline sampling of the L, M and N Horizons in 2009. The baseline sampling round included the following locations:

- L Horizon Wells: KMU-1, KMU-2, KMU-3, KMU-4, MB-11, MB-12A, MB-14, M-L2;
- M Horizon Wells: M-M1, M-M2, M-M3, LC229W, LC606W; and
- N Horizon Well: LC33W.

Results of the LC ISR, LLC baseline monitoring program for Horizons L, M and N are compiled in **Table D6-15b** of the KM Amendment Technical Report. In **Table D6-15b** of the KM Amendment Technical Report, those analytical results which exceed specific WDEQ WQD or EPA criteria are bolded/highlighted, and the WQD and EPA criteria used for the comparison are included in **Table D6-15c** of the KM Amendment Technical Report. The following bullets summarize the salient points gleaned from **Table D6-15b** of the KM Amendment Technical Report analysis:

- The trace constituents: barium, boron, cadmium, chromium, copper, mercury, molybdenum, nickel, selenium, vanadium, and zinc were at or less than the detection limits for all samples tested.

- As with all prior monitoring results, chloride values are low; less than 10 mg/L and typically 5 mg/L or less.

- The pH laboratory measures exceeded the WDEQ Class I Standard and EPA MCL Secondary Standard (6.5 – 8.5) in seven of the eight L monitoring wells, and in two of the three M monitoring wells. Where the pH standard was exceed, the values ranged from 8.5 to 9.5.

- The distribution of Total Dissolved Solids (TDS) (averaged from the four sampling events) is shown on **Figure D6-26c** of the KM Amendment Technical Report. None of the individual TDS analytical results exceeded the WDEQ Class I Standard or EPA MCL.

- The distribution of sulfate, averaged from June 2009 to December 2012, is shown on **Figure D6-26d** of the KM Amendment Technical Report. None of the individual sulfate analytical results exceeded the WDEQ Class I Standard or EPA MCL.

- With the exception of one L monitor well (MB-12A), none of the monitoring wells exceeded the EPA uranium MCL of 0.03 mg/L in any quarter. The average distribution of uranium at individual wells from June 2009 to December 2012 is shown on **Figure D6-28c** of the KM Amendment Technical Report.

- The average distribution of radium-226+228 is shown on **Figure D6-28d** of the KM Amendment Technical Report. The WDEQ Class I Standard and EPA MCL for radium-226+228 is 5.0 pCi/L. **Table D6-15b** of the KM Amendment Technical Report identifies those wells in each Horizon that exceed the radium-226+228 EPA MCL.

Piper diagrams were developed to compare groundwater quality between individual wells (**Figure D6-27c** of the KM Amendment Technical Report) and between different Horizons (**Figure D6-27d** of the KM Amendment Technical Report). The individual well comparison plots the average value for each of the wells for all of the samples analyzed. The piper diagram comparing different aquifers represents the average water quality for all wells sampled within individual Horizons (L, M and N). Groundwater within the shallow Battle Springs aquifers/Horizons beneath the Permit Area is a calcium-sulfate to calcium-bicarbonate type water. There is some variability in water chemistry when the wells are compared individually, but not much (LC606W being the exception).

Summary of Site Groundwater Quality

General water quality in the L, M, and N Horizon monitor wells, located within the Permit Area, tends to be relatively good, with the exception of the presence of radionuclides. TDS and sulfate values are all less than the WDEQ Class I standards. Laboratory pH measurements exceeded the WDEQ Class I Standard and EPA MCL Secondary Standard in 82 percent of the monitor wells sampled. Radium-226+228 exceeds the EPA MCL in approximately 60 percent of the samples collected (**Table D6-16b** of the KM Amendment Technical Report) from the M and N Horizons. An elevated concentration of these constituents is consistent with the presence of uranium orebodies.

3.5.5 Hydrologic Conceptual Model

A hydrologic conceptual model of the Project and surrounding area has been developed to provide a framework that allows LC ISR, LLC to make decisions regarding optimal methods for extracting uranium from mineralized zones, and to minimize environmental and safety concerns caused by ISR operations.

LC ISR, LLC will use ISR technology at the Project to extract uranium from permeable uranium-bearing sandstones within the upper portion of the Battle Spring Formation, at depths ranging from 350 to 900 feet. A conceptual hydrologic model of the Project is summarized below.

3.5.5.1 Regional Groundwater Conceptual Model

See the original Environmental Report.

3.5.5.2 Site Groundwater Conceptual Model

Hydrostratigraphic Units

See the original Environmental Report.

Potentiometric Surface and Hydraulic Gradients

Potentiometric surfaces for the DE, LFG, and HJ Horizons are illustrated as contour maps on **Figures 2.7-11a, b and d** of the original Technical Report). Depiction of these surfaces on the cross sections were generated by tracking the intersection of the plane of the cross section profile with the potentiometric contours for the given horizons.

Potentiometric surface of the HJ Horizon indicates that groundwater flow across the permit area is to the west-southwest under a hydraulic gradient of 0.005 to 0.006 ft/ft (15.8 to 31.6 ft/mi), generally consistent with the regional flow system. The Lost Creek Fault acts as a hydraulic barrier to groundwater flow as demonstrated from water level differences of 15 feet across the Fault within the HJ Horizon and the pump test results. However, the Fault does not appear to strongly affect either the direction of flow or the hydraulic gradient within the HJ Horizon. **Figure 2.7-11d** (in the original Technical Report) shows that the groundwater flow direction across the permit area, based on the potentiometric surface, is toward the west southwest on both sides of the Fault. The reason for the minimal impact of the Fault on groundwater flow direction within the permit area is because the Fault is only present across a small portion of the permit area, dying out to the east-northeast and west-southwest. The hydraulic gradient north of the Fault is approximately 0.005 ft/ft whereas on the south side of the Fault the hydraulic gradient is approximately 0.006 ft/ft. The pump tests indicate minor leakage of groundwater across the Fault when large head differences exist within the HJ aquifer across the Fault.

Groundwater flow direction and hydraulic gradients for the overlying (DE and FG) and underlying aquifers (UKM) are generally similar to that of the HJ Horizon. Groundwater flow on both sides of the Lost Creek Fault is toward the west-southwest at hydraulic gradients between 0.005 ft/ft to 0.007 ft/ft as shown in the potentiometric maps for the DE, LFG and HJ Horizons. The potentiometric heads decrease with depth. Differences in water level elevations between the LFG, HJ and UKM aquifers indicate that confining units are present between these hydrostratigraphic units.

Pump tests indicate the presence of confining units between the LFG and HJ aquifers and between the HJ and UKM aquifers, although some minor hydraulic communication exists between those units. The hydraulic communication only becomes apparent when large stresses (head differences) are applied to the aquifers through pumping.

Vertical hydraulic gradients range from -0.020 to 0.37 ft/ft between the LFG, HJ and UKM aquifers and consistently indicate decreasing hydraulic head with depth. The vertical gradients indicate the potential for groundwater flow is predominately downward. The vertical gradients also support the confining nature of the Lost Creek and Sagebrush Shale. The vertical gradient between the DE and LFG aquifers is minimal, consistent with observations that those hydrostratigraphic units coalesce in places within the Permit Area. An exception to this occurs in the eastern portion of the site where the vertical gradient between the DE and LFG aquifers is 0.28, indicating a strong downward potential.

Potentiometric surfaces for the L and M Horizons are illustrated as contour maps on **Figures D6-11i** and **D6-11j** and also on Cross Sections in **Plates D5-2a to D5-2h of the** KM Amendment Technical Report. Depiction of these surfaces on the cross sections were generated by tracking the intersection of the plane of the cross section profile with the potentiometric contours for the given horizons. The Figures and Plates show that the hydraulic gradient and groundwater flow direction across the permit area are similar to that seen in the overlying KM and HJ Horizons.

A downward gradient to successively deeper Horizons (KM to L, L to M, and M to N) is consistent with the structural and stratigraphic location of the Project within the Great Divide Basin.

Aquifer Properties

Transmissivity values for the HJ Horizon range from 35 to 400 ft^2/d (260 to 3,000 gpd/ft). Based on long-term pump test results, the estimated "effective" transmissivity (because of the impacts of the Lost Creek Fault) is 60 to 80 ft^2/d (450 to 600 gpd/ft) on both sides of the Fault. Because of the boundary effect of the Fault (e.g., the system is not an infinite-acting aquifer), the actual transmissivity of the aquifer, without impacts from the Fault, would be higher. Using the effective transmissivity and an average thickness of 120 feet, the "effective" hydraulic conductivity of the HJ Horizon is in the range of 0.5 to 0.67 ft/d. The actual hydraulic conductivity of the aquifer is probably between one and 1.5 ft/d. Storativity of the HJ Horizon ranges from 5.0×10^{-5} to 5.0×10^{-4}.

Based on more limited testing, the transmissivity of the LFG aquifer is lower than for the HJ Horizon ranging from 4.4 to 40 ft^2/d (30 to 300 gpd/ft). The range of transmissivity of the UKM aquifer is similar to but slightly lower than the HJ aquifer, ranging from 26 to 115 ft^2/d (195 to 860 gpd/ft). Transmissivity of the DE Horizon is variable, ranging from 1.3 to 130 ft^2/d (10 to 1,000 gpd/ft). Storativity values have not been determined for the overlying aquifer at this time because no multi-well pump tests have been conducted within that Horizon. However, it is expected that storativity values in the FG Horizon will be similar to the range observed in the HJ Horizon. The DE Horizon is at least partially under *unconfined* conditions and therefore will have a specific yield instead of a storage coefficient. As discussed in the previous section, the long-term, multi-well pump tests performed in the fall of 2007 provided data on the degree of connection between the overlying and underlying aquifers relative to the HJ Horizon.

Between 2007 and 2012, six additional pump tests were performed in the KM Horizon as discussed in **Section D6.2.2.3** of the KM Amendment Technical Report. The pump test locations are shown on **Figure D6-13b** of the KM Amendment Technical Report, the aquifer properties summarized in **Table D6-11** of the KM Amendment Technical Report, and individual transmissivity values presented on **Figure D6-17b** of the KM Amendment Technical Report.

Transmissivity values for the KM Horizon range from 26 to 224 ft^2/d (195 to 1,675 gpd/ft). As shown in **Table D6-11** of the KM Amendment Technical Report, transmissivity is slightly variable north and south of the Lost Creek Fault, but the storativity is rather consistent at about 1.2×10^{-4}.

Water Quality

Water quality within the hydrostratigraphic units of interest (the production zones and overlying and underlying aquifers) is generally good with respect to major chemistry. TDS and sulfate levels are typically less than their respective WDEQ Class I Standards and EPA SDWS, although occasionally, regulatory standards are exceeded. Chloride levels are low, (typically less than 10 mg/L) making this parameter a good indicator for excursion monitoring.

Trace metal concentrations are generally less than their WDEQ Class I Standards and EPA MCLs in the production zone and underlying aquifers. Exceptions include aluminum and iron. Aluminum concentrations exceeded EPA Secondary Drinking Water criteria (0.05 to 0.2 mg/L) in four L Horizon wells. Total iron concentrations exceeded the WDEQ Class I Standard (0.3 mg/L) in two L Horizon wells. Iron concentrations also exceeded the EPA's Secondary Drinking Water Standard (0.03 mg/L) in five L Horizon wells and three M/N Horizon wells. Lab pH measurements exceeded the WDEQ Class I/II Standards and the EPA Secondary Standard in nine different monitor wells.

Table D6-15b of the KM Amendment Technical Report shows that uranium is present in all wells, but only one monitor well contained concentrations that exceed the EPA MCL of 0.03 mg/L. Radium-226+228 levels exceed the EPA MCL and WDEQ Class I Standard (5.0 pCi/L) in six L Horizon wells, three M Horizon wells and one N Horizon well. Dissolved radionuclide levels are commonly elevated in groundwater associated with uranium-bearing sandstones.

Summary

The uranium bearing sandstones within the upper Battle Spring Formation appear to be suitable targets for ISR operations. The proposed production zone aquifer (KM Horizon) is bounded by a laterally extensive upper confining unit, as demonstrated by static water level differences and responses to pump tests. The L Horizon represents the underlying horizon to the KM production orebody. The hydrogeological relationship of the L, M, and N Horizons to the KM remains under investigation. However, based on previous "Regional" and "Permit Area" scale pump test results, there is demonstrated hydrogeologic communication between the KM Horizon and the underlying Horizons. The degree of communication diminishes with depth.

Future "Mine Unit" scale pump tests results combined with site specific geologic and hydrologic data, will be utilized to determine the appropriate operations monitoring scheme for each planned Mine Unit.

Aquifer properties (transmissivity, hydraulic conductivity and storativity) are within the ranges observed at other ISR operations that have successfully extracted uranium reserves. Water quality is generally consistent throughout the hydrostratigraphic units of interest. Elevated radionuclides are present in the groundwater, but this is consistent with the presence of uranium ore deposits within the sandstones. The Lost Creek Fault acts as a hydraulic barrier to groundwater flow and will need to be accounted for in mine unit design and operation.

TABLE OF CONTENTS

3.6 Ecology

See the original Environmental Report.

TABLE OF CONTENTS

3.7 Meteorology, Climatology and Air Quality

See the original Environmental Report for information on meteorology, climate and air quality.

TABLE OF CONTENTS

3.8 Noise

See the original Environmental Report for information on noise.

TABLE OF CONTENTS

3.9 Existing Historic and Cultural Resources

Requesting NRC confidentiality. Section submitted separately.

TABLE OF CONTENTS

3.10 Visual/Scenic Resources

See the original Environmental Report

TABLE OF CONTENTS

3.11 Socioeconomic Conditions

See the original Environmental Report.

TABLE OF CONTENTS

3.12 Background Radiological Characteristics

A baseline radiological survey was performed within the LC East Area to establish and document the pre-operation radiological environment. The primary goals were to: detect surface areas having anomalously high radiological activity; establish preliminary surface background radiological levels in water resources; and provide source data for MILDOS radiation dispersion and dose calculation modeling.

To detect areas of anomalously high radiological activity, sodium iodide (NaI) detectors linked to data loggers and a GPS were used to take hundreds of thousands of gamma measurements throughout the Permit Area. These measurements were correlated with radiation levels in soil samples, and with gamma levels measured by High-Pressure Ionization Chambers (HPICs) (**Attachment D10-1** of the KM Amendment Technical Report). Radiological analysis was completed on quarterly groundwater and stormwater samples, and the results are presented in **Appendix D61** of the KM Amendment Technical Report. The results of natural gamma readings collected from OSLs, airborne radionuclides sampled by a high volume air station and Rn-222 readings from track etch cups are presented in **Tables D10-1, D10-2** and **D10-3 1** of the KM Amendment Technical Report respectively. The revised MILDOS model is included as **Attachment D10-21** of the KM Amendment Technical Report.

Because there is no perennial surface water in the Permit Area, sediment sampling was not conducted.

4.0 ENVIRONMENTAL IMPACTS, MITIGATION, AND MONITORING

This section includes evaluations of the potential impacts of the Project on the various environmental characteristics of the Permit Area described in **Section 3**. The impacts of the Preferred Alternative described in **Section 2**, including cumulative impacts, are evaluated first. Mitigation and monitoring associated with the Preferred Alternative are also included in this section.

4.1 Land Use

4.1.1 Land Use Impacts from Preferred Alternative

The type of land use impacts from the preferred alternative are consistent with those previously reviewed for the original license application and consist of power lines, secondary roads, wellfields, trunk lines and header houses. The majority of the disturbance considered under this amendment request is coincident with previously approved disturbance. See **Plate OP-2b** of the LC East Amendment Technical Report for a complete rendering of the proposed disturbance at Lost Creek. **Table OP-2** of the LC East Amendment Technical Report provides the acreages of each disturbance proposed.

No new plants, Class I UIC wells or holding ponds are proposed as part of this action.

Construction and operation of the Project will have adverse impacts on the existing land uses at the Permit Area. However, most of these impacts would be temporary, because of the sequential nature of the ISR operations and because of ongoing reclamation.

4.1.1.1 Potential Interference with Existing and Future Land Uses

Much of the land area proposed for mining is already fenced to prevent cattle usage as described in the original Technical Report. The two proposed KM Mine units (numbers 3 and 12) will fall within the previously approved fenced area. Expansion of HJ Mine Units 4 and 5 will require the extension of fencing both west and east respectively.

No other land uses will be directly impacted by the production activity. Other land uses that may be indirectly affected include hunting and other dispersed recreation, such as OHV use. However, there is an abundance of similar land surrounding the Permit Area, so the indirect impacts are not considered significant.

The planned post-operational use of these lands is grazing and wildlife habitat. Since the lands will be reclaimed after operations, the Project is compatible with the planned future use.

Land Use Plans and Regulations

Please see the original Lost Creek ER.

4.1.1.2 Short-term and Long-term Impacts

Please see the original Lost Creek Environmental Report.

4.1.2 Land Use Impacts from Other Alternatives

No other alternatives are considered since this proposal is an expansion of an existing facility.

4.1.3 Mitigation of Impacts for the Preferred Alternative

No mitigation of land use impacts is anticipated.

4.1.4 Monitoring for the Preferred Alternative

No monitoring of land use impacts is anticipated.

4.2 Transportation

4.2.1 Preferred Alternative

See the original Environmental Report for an assessment of transportation.

4.2.1.1 Shipments of Supplies to the Process Facilities

See the original Environmental Report.

4.2.1.2 Shipments of Yellowcake Slurry from On-Site Facilities to an Off-Site Dryer

See the original Environmental Report.

4.2.1.3 Shipments of Material for Off-site Disposal

See the original Environmental Report.

4.2.1.4 Post-Reclamation Impacts

See the original Environmental Report.

4.2.1.5 Cumulative Impacts from the Preferred Alternative

See the original Environmental Report. The cumulative impacts described in the original ER are likely too conservative since the degree of uranium exploration in the region has essentially ceased due to low commodity prices. There are no new uranium development projects within at least 15 miles of the LC East Project. Likewise, cumulative impacts from oil and gas development are likely to be on the decline, at least temporarily, due to low prices.

4.2.2 Mitigation of the Preferred Alternative

See the original Environmental Report.

4.2.3 Monitoring of the Preferred Alternative

See the original Environmental Report.

4.3 Soils

4.3.1 Soil Impacts from the Preferred Alternative

Impacts to soil will be consistent with those described in the original Environmental Report. The acreages of the new KM mine units as well as the expanded HJ mine units are shown in **Table OP-2** of the LC East Amendment Technical Report.

4.3.2 Mitigation and Monitoring of Soil Impacts

See the original Environmental Report.

4.4 Geology

The impacts, monitoring and mitigation will be consistent with those described in the original Environmental Report.

4.5 Hydrology

The impacts, monitoring and mitigation will be consistent with those described in the original Environmental Report.

4.6 Ecology

The impacts, monitoring and mitigation will be consistent with that described in the original Environmental Report.

4.7 Air Quality and Noise

The impacts, monitoring and mitigation are expected to be consistent with those described in the original Environmental Report.

4.8 Historic and Cultural Resources

Requesting NRC confidentiality. Section submitted separately.

4.9 Impacts on Visual and Scenic Resources

The impacts, monitoring and mitigation are expected to be consistent with those described in the original Environmental Report.

4.10 Socioeconomics

4.10.1 Socioeconomic Impacts from the Preferred Alternative

The number of employees is not expected to change as a result of the proposed actions. Only the duration of the project as a whole is expected to increase due to having additional pounds available for extraction.

The annual tax payment will increase slightly if Lost Creek ISR, LLC decides to increase the wellfield production rate from 1 million pounds per year to 1.2 million pounds per year and/or toll mill product from another facility at a rate of up to 1,000,000 pounds of dried U_3O_8 per year.

4.10.1.1 Labor Force and Income

See the original Environmental Report.

4.10.1.2 Economic Effects

See the original Environmental Report.

4.10.1.3 Housing and Public Facilities and Services

See the original Environmental Report.

4.10.1.4 Quality of Life

See the original Environmental Report.

4.10.1.5 Cumulative Impacts

See the original Environmental Report.

4.10.2 Mitigation of Socioeconomic Impacts

Mitigation of socioeconomic impacts is not anticipated.

4.10.3 Monitoring on Socioeconomic Impacts

No monitoring of socioeconomic impacts is anticipated.

4.11 Environmental Justice

See the original Environmental Report.

4.12 Public and Occupational Health

See the original Environmental Report.

4.13 Waste Management

See the original Environmental Report.

TABLE OF CONTENTS

5.0 COST-BENEFIT ANALYSIS

The costs and benefits are expected to be in-line with those expressed in the original Environmental Report.

TABLE OF CONTENTS

6.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The environmental consequences are expected to be of the same type described in the original Environmental Report.

TABLE OF CONTENTS

7.0 LIST OF PREPARERS

In support of the KM Amendment, the individuals and organizations listed below contributed to the preparation of this Environmental Report as well as the Technical Report and the Permit-to-Mine Application.

Outside Contractors

Two Lines Inc. – MILDOS Model

Company Employees

John Cash	Vice President
John Cooper	Geologist
Steve Hatten	President
Mel Lahr	Senior GIS Specialist
Kevin Shelburne	Senior Hydrologist