LOST CREEK ISR, LLC
Lost Creek Project

LC East Amendment
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Section 3.5 Hydrology – Section 7.0 List of Preparers

Section 3.5

Hydrology

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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

The Permit Amendment Area is located in the Great Divide Basin, a topographically closed system which drains internally due to a divergence in the Continental Divide. Most of the surface water is runoff from precipitation or snowmelt, and most runoff quickly infiltrates, recharging shallow groundwater, evaporates, or is consumed by plants through evapotranspiration. Based on the loam and sandy-loam soils found at the site, the steady-state saturated infiltration rate under laboratory conditions is estimated at 0.2 to 0.8 in/hr (Hillel, 1980). However, the practical infiltration rate is likely much higher because saturated conditions are rare, and more macropores are present under field conditions and at large scales. Infiltration-excess (Hortonian) overland flow has not been observed at the site, except on the compacted soils found in existing 2-track roads.

Alluvial deposits, if any, along drainages are not extensive, and the shallow Battle Spring aquifer is typically under confined conditions, although locally unconfined conditions exist. The variation from unconfined to confined conditions is due to the interfingering of sands and shales throughout the Battle Spring Formation. The shallow water table is typically 100 to 200 feet below ground surface (ft bgs). There are no perennial or intermittent streams within the Permit Amendment Area or on adjacent lands. The only officially named drainages within the Permit Amendment Area are the East Battle Spring Draw and Stratton Draw, which are dry for the majority of the year (**Figure 3.5-1**).

A 1:24,000 USGS topographic map was imported into GIS, and used to conduct the drainage network analyses described in this section. Two primary watersheds, Battle Spring Draw and Stratton Draw, drain ninety-seven percent of the Permit Amendment Area. The Battle Spring Draw watershed is divided into east and west tributaries as shown on **Figure 3.5-1**. Likewise, the Stratton Draw watershed is also divided into east and west tributaries within the Permit Amendment Area. The entire Permit and Amendment Areas drain into the Battle Spring Flat, located approximately nine miles southwest of the Permit Amendment Area. Much of the water conveyed through the ephemeral channels does not reach Battle Spring Flat. Instead, it infiltrates into the alluvium and recharges the Battle Spring aquifer.

The existing drainages are incised, and have u-shaped trapezoidal cross-sectional morphologies. Vertical and slumping banks exist where active erosion is occurring. The channels near the downstream boundary of the Permit Amendment Area are incised three to 12 feet and are 10 to 15 feet wide. The channel side-slopes range in slope from 1:1 to approximately 2.5:1. The bed material in the larger draws is sandy textured and non-cohesive. Draws around the Permit Amendment Area are typically vegetated with sagebrush.

Annual runoff in the Permit Amendment Area is very low due to the high infiltration capacity and low annual precipitation. The channels are dry for the majority of the year. Drainages in the Permit Amendment Area are naturally ephemeral and primarily flow during spring snowmelt as saturated overland flow when soil moisture is at a maximum. The quantity of spring runoff is variable, depending on the amount of winter snowfall accumulation. Peak runoff from high intensity rain events can be significant; but surface flow is generally short-lived. Storm-water runoff after high intensity rain events is very rare because surface water infiltrates very rapidly or evaporates. Some intermittent and localized flow can occur near a small number of springs; but no surface runoff has been observed from springs within the Permit Amendment Area.

Runoff data are limited for the ephemeral and intermittent streams in the Great Divide Basin. There are two USGS streamflow gaging stations within 40 miles of the Permit Amendment Area, but they are on perennial streams and are not representative of drainages in the Permit Amendment Area. On April 6, 1976, the USGS measured the instantaneous discharge of Lost Soldier Creek, approximately 14.5 miles northeast of the Permit Amendment Area. The measurement of 0.2 cubic feet per second was taken during spring runoff so the source of water was predominantly snowmelt (USGS, 2006).

3.5.1.2 Surface Water Use

Surface-water permits with legal descriptions inside and within three miles of the Permit Area were queried using the Wyoming State Engineers Office (WSEO) Water Rights Database (WSEO, 2014). **Table 3.5-1** lists the three surface-water permits that exist within three miles of the Permit Amendment Area, and **Figure 3.5-2** shows their location relative to the Project area. The stated uses include irrigation, stock, and industrial.

There are three BLM wells in or within three miles of the Permit Amendment Area. These wells have stock ponds associated with them. The water-use permits for these ponds are associated with the wells that supply the ponds, i.e., they are not associated with any surface-water-use permits.

3.5.1.3 Surface-Water Quality

Under the WDEQ Water Quality Division (WQD) Classification, Battle Spring Draw and Stratton Draw are listed as Class 3B water bodies. Beneficial uses for Class 3B waters can include recreation, wildlife, "other aquatic life," agriculture, industry, and scenic value, but do not include drinking water, game fish, non-game fish, and fish consumption.

Historic surface-water quality within the study area was characterized using water quality data from the adjacent Lost Creek Project. The historic data set is small as surface-water sample analysis commenced in 2007, and there were not many events to sample. The water-quality data for the historic sampling locations are summarized in **Table 3.5-2**. Due to the limited runoff volume very few analyses could be performed. Priority was given to analyzing radionuclides at the expense of other Guideline 8 parameters.

In 2012, Nalgene Storm Water Samplers were installed to collect 0.26 gallon (1 L) grab samples of first flush stream flow during runoff events. These samplers were installed at eight locations in the Permit Amendment Area shown on **Figure 3.5-3**. Four samplers were installed to capture runoff as it enters the Permit Amendment Area from the upstream side, and the others four samplers capture runoff at the downstream permit boundary. The water samples were collected to characterize the quality of ephemeral surface runoff. The sampling locations were selected based on their topographic potential to concentrate ephemeral surface flow.

The water quality data for six of the eight surface-water samplers are summarized in **Table 3.5-3** and **Attachment 3.5-1** presents the laboratory raw water quality data. Dissolved uranium was present in only one sample at a very low concentration; slightly greater than the 0.0003 mg/L detection limit. Suspended uranium was detected in six of the eight samples tested at concentrations ranging from 0.024 to 0.106 mg/L.

There was only enough sample to analyze for radium-226 and thorium-230. **Table 3.5-3** show that: 1) dissolved radium-226 was detected in all samples at levels ranging from 0.11 to 5.1 pCi/L, 2) dissolved thorium-230 was also detected in all samples at levels ranging from 0.08 to 0.4 pCi/L, 3) suspended radium-226 was present in all samples at levels ranging from 0.001 to 105 pCi/L, and 4) suspended thorium-230 was also present in all samples at levels ranging from 0.006 to 47.8 pCi/L.

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, and data presented in previous applications/reports for the Permit and Amendment areas.

3.5.2.1 Regional Hydrogeology

The Project is located within the northeastern portion of the Great Divide Basin. The basin is topographically closed with all surface-water drainage being to the interior of the basin. Available data suggest that groundwater flow within the basin is predominately toward the interior of the basin (Collentine, 1981; Welder, 1966; and Mason, 2005). A generalized potentiometric surface map of the Battle Spring/Wasatch Formations, prepared by Welder and McGreevey (1966), indicates groundwater movement toward the center of the basin. Fisk (1967) suggests that aquifers within the Great Divide Basin may be in communication with aquifers in the Washakie Basin to the south and that groundwater may potentially move across the Wamsutter Arch between the basins.

The topographically elevated area known as the Green Mountains (Townships 26 and 27 North, between Ranges 90 to 94 West) was identified by Fisk as a major recharge area to aquifers within the northeastern portion of the Great Divide Basin (1967). The Rawlins Uplift, Rock Springs Uplift, and Creston Junction, located east, southwest, and southeast, respectively, from the Permit Area, were also identified as major recharge areas for aquifers within the Great Divide Basin (Fisk, 1967). The main discharge area for the Battle Spring/Wasatch aquifer system is to a series of lakes, springs and playa lakes beds near the center of the basin. Groundwater potentiometric elevations within the Tertiary aquifer system in the central portion of the basin are generally close to the land surface.

The Battle Spring Formation crops out over most of the northeastern portion of the Great Divide Basin, including much of the Permit Area. The Battle Spring Formation is considered part of the Tertiary aquifer system by Collentine et al. (1981). The Tertiary aquifer system is identified as "the most important and most extensively distributed and accessible groundwater source in the study area" (Collentine, 1981). This aquifer system includes the laterally equivalent Wasatch Formation (to the west and south) and the underlying Fort Union and Lance Formations. The base of the Tertiary aquifer system is marked by the occurrence of the Lewis Shale. The Lewis Shale is generally considered a regional aquitard, although this unit does produce limited amounts of water from sandstone lenses at various locations within the Great Divide Basin and to the south in the Washakie Basin.

Shallower aquifer systems that can be significant water supply aquifers within the Great Divide Basin include the Quaternary and Upper Tertiary aquifer systems. However, as previously stated, the Battle Spring Formation of the Tertiary aquifer system crops out over most of the northeast part of the basin; and the Quaternary and Upper Tertiary aquifer systems are absent or minimal in extent. The shallower aquifer systems are only important sources of groundwater in localized areas, typically along the margin of the basin where the Battle Spring Formation is absent. Aquifer systems beneath the Tertiary include the Mesaverde, Frontier, Cloverly, Sundance-Nugget and Paleozoic aquifer systems (Collentine, 1981). In the northeast Great Divide Basin, these aquifer systems are only important sources of water in the vicinity of outcrops near structural highs such as the Rawlins Uplift.

For purposes of this application, only hydrogeologic units younger than and including the Lewis Shale (Upper Cretaceous age) are described, with respect to general hydrologic properties and potential for groundwater supply. The Lewis Shale is an aquitard and is considered the base of the hydrogeologic sequence of interest within the Great Divide Basin. Units deeper than the Lewis Shale are generally too deep to economically develop for water supply or have elevated total dissolved solid (TDS) concentration that renders them unusable for human consumption. Exceptions to this can be found along the very eastern edge of the basin, tens of miles from the Permit Area, where some Lower Cretaceous and older units provide relatively good quality water from shallow depths. Hydrologic units of interest within the northeast Great Divide Basin are shown on the stratigraphic column on **Figure 3.5-5** and further described below, from deepest to shallowest:

- Lewis Shale (aquitard between Tertiary and Mesaverde aquifer systems);
- Fox Hills Formation
- Lance Formation (Tertiary aquifer system);
- Fort Union Formation (Tertiary aquifer system);
- Battle Spring Formation-Wasatch Formation (Tertiary aquifer system);
- Undifferentiated Tertiary Formations (Upper Tertiary aquifer system, including Bridger, Uinta, Bishop Conglomerate, Browns Park, and South Pass); and
- Undifferentiated Quaternary Deposits (Quaternary aquifer system).

Discussion of the regional characteristics for each of these hydrostratigraphic units is provided below.

Lewis Shale

The Lewis Shale underlies the Fox Hills Formation and is generally considered an aquitard in the Great Divide Basin. This unit is described by Welder and McGreevey (1966) as light to dark gray, carbonaceous shale with beds of siltstone and very fine-grained sandstone. The Lewis Shale is up to 2,700 feet thick, generally increasing in thickness toward the east side of the basin. In the Permit Area, the Lewis Shale is 1,200 feet thick. Small quantities of water may be available from the thin sandstone beds within this unit near the margins of the basin. The Lewis Shale acts as the confining unit between the Tertiary and Mesaverde aquifer systems.

Fox Hills Formation

Fox Hills Formation overlies the Lewis Shale and consists of very fine-grained sandstone, siltstone and coal beds. It is not considered to be an important aquifer in the Permit Area.

Lance Formation

Overlying the Fox Hills Formation is the Lance Formation, consisting, predominately, of very fine-to fine-grained lenticular, clayey, calcareous sandstone. Shale, coal, and lignite beds are present within the formation, which reaches a maximum thickness of approximately 4,500 feet (Welder, 1966). In the Permit Area, the Lance Formation is 2,950 feet thick.

Collentine and others (1981) include the Lance Formation (Aquifer) as the lower-most aquifer within the Tertiary aquifer system. However, the Lance Aquifer is included as part of the Mesaverde aquifer system by Freethey and Cordy (1991). Several stock wells, located along the eastern outcrop area of the basin, are completed in the Lance Aquifer. The stock wells have estimated yields of five to 30 gpm. Hydraulic conductivity for the Mesaverde aquifer system reported by Freethey and Cordy (1991) (which, by the authors' designation, includes the Fox Hills Sandstone, Lewis Shale, and Mesaverde Group, in addition to the Lance Aquifer) is reported to range from 0.0003 to 2.2 feet per day (ft/d). Because of the limited number of wells completed within the Lance Aquifer in the Great Divide Basin, there are insufficient data to develop representative potentiometric surface maps for this hydrologic unit. However, the potentiometric surface is most likely similar in orientation to that seen in the overlying Fort Union and Battle Spring/Wasatch aquifers, with inferred groundwater movement generally toward the center of the basin. No regionally extensive aquitards between the Fort Union and Lance Formation were identified or reported in the hydrologic studies, investigations, and reports reviewed for this permit application.

Fort Union Formation

The Paleocene-age Fort Union Formation is between the Lance Formation and the overlying Wasatch and Battle Spring Formations, reaching a maximum thickness of approximately 6,000 feet within the Great Divide/Washakie Basin area. In the Permit Area, it is 4,650 feet thick. The Fort Union Formation is present at or near land surface in a band around the Rock Springs Uplift and in the northeastern corner of the Great Divide Basin (Mason, 2005). The Fort Union Formation is described as a fine- to coarse-grained sandstone with coal and carbonaceous shale. Siltstone and claystone are present in the upper part of the formation (Welder, 1966).

A potentiometric surface map prepared by Naftz (1996) that groups the Fort Union aquifer with the Battle Spring/Wasatch aquifers, shows inferred movement of groundwater toward the basin center as shown on **Figure 3.5-4**.

The Fort Union aquifer is largely undeveloped and unknown as a source of groundwater supply except in areas where it occurs at shallow depths along the margins of the basin. Well yields from the Fort Union aquifer within the Great Divide and Washakie Basins range from three to 300 gpm. Estimates of transmissivity for the Fort Union aquifer are highly variable. Ahern (1981) estimated transmissivity of less than three square feet per day (ft^2/d) for ten Fort Union Formation oil fields in the Green River Basin. Collentine and others (1981) reported transmissivity of the Fort Union aquifer as characteristically less than 325 ft^2/d from oil well data.

Water quality within the shallow Tertiary aquifers generally represents sodium-bicarbonate to sodium-sulfate water types. TDS levels within the Wasatch aquifer in the west and south parts of the Great Divide Basin tend to be high relative to the US EPA's Secondary Drinking Water Standard (SDWS) of 500 mg/L, even within the shallow aquifers. TDS levels within the Battle Spring/ Wasatch aquifers are generally below 500 mg/L along the northern flank of the Great Divide Basin (which includes the Permit Area). Elevated TDS levels (greater than 3,000 mg/L) are present within the Wasatch aquifer along the eastern edge of the Washakie Basin and within the Fort Union and Lance aquifers along the east side of the Rock Springs uplift. Elsewhere within the Great Divide and Washakie Basins, TDS levels in the Tertiary aquifer system are typically between 1,000 and 3,000 mg/L (Collentine, 1981).

Battle Spring Formation- Wasatch Formation

The most important water-bearing aquifers within the Great Divide Basin are in the Wasatch Formation and the Battle Spring Formation. The Wasatch and Green River Formations grade into the Battle Spring Formation in the northeastern portion of the basin. The Battle Spring Formation is absent along the eastern margin of the Great Divide Basin near the county line between Sweetwater and Carbon Counties. The termination of the Battle Spring Formation to the east is controlled, largely, by structural features, including the Rawlins Uplift to the east and the Green Mountains to the north. A dry oil test in Section 14, Township 24 North, Range 90 West, located within a few miles of the eastern limit of the Battle Spring Formation, had a reported thickness of over 6,000 feet of fine- to coarse-grained sandstone that was interpreted by the American Stratigraphic Company as the Battle Spring Formation. Within the Permit Area, the Battle Spring/Wasatch Formations are 6,200 feet thick.

The Battle Spring Formation is described as an arkosic, fine- to coarse-grained sandstone with claystone and minor conglomerates. There are typically several water-bearing sands within the Battle Spring Formation. The Battle Spring aquifers are included in the Tertiary aquifer system, as defined by Collentine (1981).

Groundwater within the Battle Spring aquifers is typically under confined conditions, although locally unconfined conditions exist. The potentiometric surface within the Battle Spring aquifers is usually within 200 feet of the ground surface (Welder, 1966). Most wells drilled for water supply in this unit are less than 1,000 feet deep. The potentiometric surface map of Wasatch and Battle Spring aquifers indicates groundwater movement toward the center of the basin (Welder, 1966). From the Permit Area, the potentiometric surface dips to the southwest at approximately 50 feet per mile (ft/mi) (a hydraulic gradient of 0.01 foot per foot [ft/ft]). The hydraulic gradient becomes steeper near the margins of the basin, where recharge to the aquifer is occurring.

Collentine and others (1981) report that wells completed in the Battle Spring aquifers typically yield 30 to 40 gpm; but that yields as high as 150 gpm are possible. Collentine and others (1981) also reported that pump tests conducted on 26 wells completed within the Battle Spring aquifers resulted in transmissivity values ranging from 3.9 to 423 ft^2/d, although most wells were less than 67 ft^2/d. Specific capacity was less than one gallon per minute per foot for 23 of 26 wells tested.

Water quality within the Battle Spring aquifer is generally good in the northeast portion of the basin with TDS levels usually less than 1,000 mg/L and frequently less than 200 mg/L. Water type within the Battle Spring aquifer is typically sodium bicarbonate to sodium sulfate. Mason and Miller (2005) reviewed eighteen groundwater samples, collected from the Battle Spring aquifer, and observed that those samples represented some of the best overall quality of those studied in Sweetwater County. Sulfate levels can be elevated in Tertiary aquifers, but are generally low in the shallow aquifers of the Battle Spring Formation. Out of eighteen samples included in the Mason study, only one sample exceeded the WDEQ Class I Drinking Water Standard for sulfate of 250 mg/L. Most of the samples were also below the WDEQ TDS Class I Drinking Water Standard of 500 mg/L. Nitrate, fluoride and arsenic levels were below WDEQ and EPA standards for all of the samples.

Notable exceptions to the relatively good water quality included waters with elevated radionuclides. Uranium and radium-226 (Ra-226) concentrations exceeded their respective EPA Maximum Contaminant Levels (MCLs) of 0.03 mg/l and 5 pCi/l in some of the samples; radon-222 (Rn-222) concentrations were also relatively high in some samples (Mason, 2005); and the presence of high levels of uranium in Tertiary sediments and groundwater of the Great Divide Basin has been well documented. The Lost Creek Shroeckingerite deposit, located northwest of the Permit Area, is noted for high uranium levels in groundwater. Uranium-bearing coals are also present in Great Divide Basin. Sediments of the Battle Spring Formation were derived from the Granite Mountains and contain from 0.0005 to 0.001 percent uranium (Masursky, 1962). Based on historical exploration results, certain areas of the Battle Spring Formation (e.g., Lost Creek) contain much higher uranium concentrations.

Undifferentiated Tertiary and Quaternary Sediments

Undifferentiated Tertiary and Quaternary units above the Battle Spring/Wasatch Formations can be sources of water supply; but wells in the northeastern part of the Great Divide Basin are rare and generally limited to the margins of the basin where the Battle Spring Formation is not present. Commonly, along the margins of the basin, hydrostratigraphic units younger than the Battle Spring/Wasatch have been deposited on rocks of Cretaceous age or older. Water supply wells along the margins of the basin are often completed in both the older hydrostratigraphic units and Tertiary and Quaternary sediments. Water quality within these units tends to be variable and of limited quantity.

The undifferentiated Tertiary units consist of interbedded claystone, sandstone and conglomerate with the coarser grained facies providing suitable groundwater resources where present. The undifferentiated Tertiary units are absent within the Permit Area and are not discussed further.

The undifferentiated Quaternary units consist of clay, silt, sand, gravel and conglomerates that are poorly consolidated to unconsolidated (Welder, 1966). These units represent windblown, alluvial and lake deposits. Where present, these deposits can provide acceptable yields of groundwater of relatively good quality. Thin deposits of Quaternary sediments are present within surface drainages in the Permit Area but are usually above the water table and unsaturated. Therefore, Quaternary sediments are not an important groundwater source in the vicinity of the Project and are not described further.

3.5.2.2 Site Hydrogeology

LC ISR, LLC has been collecting lithologic, water level, water quality, and pump test data since 2007 as part of its ongoing evaluation of hydrologic conditions at the Project. Drilling and installation of borings and monitor wells is ongoing to provide supplemental data to further refine the site hydrologic conceptual model.

In 2012-2013, LC ISR installed 24 wells in LCE distributed between three test patterns. The new pumping and monitoring wells were drilled and completed using methods consistent with WDEQ/LQD permit requirements. The criteria for citing the three pump test patterns were: 1) sites located distant to known faults, 2) sites with limited exposure to historical exploration drill holes, and 3) sites located off the main mineralized trend.

The 24 new wells included: three (3) HJ Horizon and three (3) KM Horizon pump test wells, five (5) HJ Horizon monitor wells, five (5) KM Horizon monitor wells, three (3) monitor wells in the overlying FG Horizon, and five (5) monitor wells in the underlying N Horizon. **Table 3.5-4** provides coordinate and well completion information for each well by test cluster. **Figure 3.5-6** shows the well clustering locations in the North, Center and South test areas, as well as the distant observation well pairings.

In 2015, LC ISR, LLC determined that the L Horizon was a better choice for an underlying containing aquifer than was the previously identified N Horizon. Accordingly, six L Horizon wells were installed being evenly distributed between the three clusters. The rationale for choosing six wells was the need to properly determine L Horizon aquifer characteristics, which necessitates a minimum of two test wells, one observation and one pumping per cluster. For this evaluation, one fully penetrating well was installed as the pumping well and one partially penetrating observation well was constructed at each cluster. The six L Horizon wells and all wells monitored during the various tests are identified in **Table 3.5-5**.

3.5.2.3 Hydrostratigraphic Units

LC ISR, LLC has employed the following nomenclature for the hydrostratigraphic units of interest within the Project. The primary LCE uranium production zones are identified as the HJ and KM Horizons. The HJ Horizon is subdivided into the Upper (UHJ), Middle (MHJ) and Lower (LHJ) Sands. The HJ Horizon is bounded above and below by areally extensive confining units identified as the Lost Creek Shale and the Sagebrush Shale, respectively. Overlying the Lost Creek Shale is the FG Horizon. The deepest sand in the FG Horizon, the Lower FG (LFG) Sand, is the overlying aquifer to the HJ Horizon. Beneath the Sagebrush Shale is the KM Horizon. The uppermost sand within the KM Horizon, designated the Upper KM (UKM) Sand, is the underlying aquifer to the HJ Horizon. The upper portion of the L Horizon is the underlying aquifer to the KM Horizon.

Figure 3.5-5 depicts the stratigraphic relationship of these units. A brief description of each hydrostratigraphic unit follows, from shallowest to deepest.

DE Horizon

The DE Horizon outcrops in the southern two-thirds of the project site, but is absent in the northern one-third. In the southern part of the Permit Amendment Area, DE Horizon sands coalesce with sands of the underlying FG Horizon. The DE Horizon consists of a sequence of sands and discontinuous clay/shale units. The DE Horizon is the shallowest occurrence of groundwater within the Permit Amendment Area; although the horizon is not saturated in all portions of the Project area.

FG Horizon

Underlying the DE Horizon is the FG Horizon, which is continuous throughout the LC East Project. Due to the regional dip and trend length, the top of the FG Horizon outcrops over the eastern one-third of the Project Area deepening to 50 feet at the west property boundary. The total thickness is typically about 180 feet, but ranges between 160 and 180 feet. The FG Horizon transitions from confined to unconfined aquifer conditions moving southwest to northeast along Cross-Section B-B' **(Figure 2-1, Attachment D6-4, TR Document)**

Lost Creek Shale

Underlying the FG Horizon is the Lost Creek Shale. The Lost Creek Shale appears continuous across the Permit Amendment Area, ranging from five to 40 feet in thickness. Typically, this unit has a thickness of 10 to 20 feet. The Lost Creek Shale is the confining unit between the overlying aquifer FG Horizon and the HJ Horizon. The confining characteristics of the Lost Creek Shale have been demonstrated with pump tests, as described later in this application.

HJ Horizon

The HJ Horizon is one of the primary target for uranium production at the LC East Project. The HJ Horizon sands are generally composed of coarse-grained arkosic sands with thin lenticular intervals of fine sand, mudstone and siltstone. The sands are generally separated by thin clayey units that are not laterally extensive and, based on pump test results, do not act as confining units to prevent groundwater movement vertically between the HJ sand units. The total thickness of the HJ Horizon ranges from 120 to 130 feet, averaging approximately 110 feet. The top of the HJ Horizon is approximately 95 feet below ground surface (bgs) in the eastern Permit Amendment Area deepening to 360 feet bgs in the western part of the Permit Amendment Area. The underlying aquifer to the HJ Horizon is the KM Horizon, which is also a likely uranium production zone. Therefore, the deepest sand within the HJ Horizon, is also designated as the overlying aquifer to the KM Horizon.

Sagebrush Shale

Underlying the HJ Horizon is the Sagebrush Shale. It occurs at depths ranging from 100 to 510 feet bgs. The Sagebrush Shale is laterally extensive and ranges from two to 30 feet thick. The Sagebrush Shale is the lower confining unit to the HJ Production Zone. The confining characteristics of this unit have been demonstrated through pumping tests, as described in later sections of this application.

KM Horizon

The KM Horizon underlies the Sagebrush Shale, and is generally a massive coarse sandstone with lenticular fine sandstone intervals. The KM Horizon is the underlying aquifer to the HJ Horizon, but is also a targeted production zone within the Permit Amendment Area. The KM Horizon is continuous throughout the LC East Project. The top of the KM Horizon occurs at depths of approximately 100 feet near the eastern Project boundary deepening to 510 feet at the west property boundary (Section 20). The total thickness is typically about 125 feet, but ranges from 100 to 130 feet. The KM Horizon is fully confined throughout the project area.

The KM Horizon is the uppermost component of the composite KLM Horizon which is continuous throughout the LC East Project. The total thickness ranging from approximately 260 to 330 feet; the average thickness is approximately 305 feet (**Figure 3.5-5**). Within the composite KLM Horizon, the KM is the only Horizon which contains significant mineralization; and, thus is herein considered a Production Zone. Within the composite KLM Horizon, there is no confirmed areally extensive confining unit that isolates the KM, L and M Horizons from each other. Rather, there is a series of interfingered layers of mudstone, siltstone and shales. Some of these have historically been referred to as "No Name Shale", K Shale, LM Shale and MN Shale. Previous Lost Creek pump tests have evaluated some of these as potential lower aquitards to the KM Production Zone. These bedding units may show continuity over large areas but regional continuity has not been demonstrated. Thus, they cannot be considered truly confining units on a regional scale. However, due to the interfingering nature and low permeability of these units, they do limit and/or restrict vertical flow in the proposed production area (Petrotek, 2013 and **Attachment D6-4, TR Document**).

L Horizon

The L Horizon is continuous throughout the LC East Project, but commonly exhibits a much more shaley 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 L Horizon varies from approximately 640 feet in Section 20 to approximately 200 feet in the far north. The L Horizon is generally confined above by the K Shale throughout the project area. The total thickness is typically about 100 feet, but ranges from 60 to 120 feet. The L Horizon is generally confined above by the K Shale which averages 12 feet in thickness. The K Shale is regionally extensive but not fully contiguous, therefore it is not considered a confining unit.

MN Shale and N Horizon

The MN Shale is a zone of interfingered layers of mudstone, siltstone, and shale that separates the M Horizon from the deeper N Horizon (**Figure 3.5-5**). Based on geologic data, the MN Shale is not considered a true regional confining unit, as continuity is not observed over a regional scale. The MN Shale does limit and/or restrict vertical flow due to the interfingering of finer grained and lower permeability units. It ranges from approximately 10 to 30 feet thick, with a typical thickness of about 10 feet. As mentioned above, regional continuity of the MN Shale is not certain. Beneath the MN

Shale is the N Horizon and based on limited data, the total thickness of the N Horizon is approximately 100 feet.

3.5.2.4 Potentiometric Surface, Groundwater Flow Direction and Hydraulic Gradient

The LC ISR, LLC hydrologic evaluation of the Project included measurement of water levels in monitor wells completed in the HJ and KM Horizons, the overlying FG Horizon and the underlying L and N Horizons, to assess the potentiometric surface, groundwater flow direction and hydraulic gradient of those units.

2013 water level measurements, collected three-months post-testing, were used to construct preliminary potentiometric surface maps for the FG, HJ, KM, and N Horizons (**Figures 2-5** to **2-8**, **Attachment D6-4**, **TR Document**). 2016 L Horizon water level measurements, collected pre-testing, were used to construct the potentiometric surface map shown on **Plate 2-1, Attachment D6-5, TR Document**.

Due to the relative few data points from which to construct the potentiometric surfaces, the known regional direction of groundwater flow was used as a guide to constructing the maps. In addition, due to the lack of control, the potentiometric surfaces were constructed as though the faults were not present. However, based on prior Mine Unit 1 experience, the faults are known to act as low-flow barriers to groundwater movement thus the potentiometric surfaces maps are considered preliminary/conceptual. The role that the faults in Sections 20 and 21 play in influencing the movement of groundwater will be further evaluated during subsequent hydrologic mine unit investigations.

A review of the potentiometric surface figures revealed the following initial observations:

FG Horizon

Based on potentiometric surface elevations, the direction of groundwater flow within the FG Horizon is predominantly to the west-southwest. Calculated hydraulic gradients range from 0.008 ft/ft to 0.019 ft/ft (44 to 100 ft/mile) in the Project Area (**Figure 2-5, Attachment D6-4, TR Document**).

HJ Horizon

Based on potentiometric surface elevations, the direction of groundwater flow within the HJ Horizon is predominantly to the west-southwest. Calculated hydraulic gradients range from 0.005 ft/ft to 0.015 ft/ft (29 to 79 ft/mile) in the Project Area (**Figure 2-6, Attachment D6-4, TR Document**).

KM Horizon

Based on potentiometric surface elevations, the direction of groundwater flow within the KM Horizon is predominantly to the west-southwest. Calculated hydraulic gradients range from 0.009 ft/ft to 0.018 ft/ft (49 to 95 ft/mile) in the Project Area (**Figure 2-7, Attachment D6-4, TR Document**).

L Horizon

Based on potentiometric surface contours shown on **Plate 2-1** in **Attachment D6-5, TR Document**, the direction of groundwater flow within the L Horizon is predominantly to the south-southwest. The calculated hydraulic gradient ranges from approximately 0.016 ft/ft to 0.020 ft/ft (87 to 105 ft/mile) across the project area. Note that the groundwater gradient and flow direction are based on only three data points spread over three miles and bisected by numerous faults. Accordingly, the resulting gradient appears excessively large and the direction of flow does not conform to the regional conceptual model. As additional L Horizon monitor wells are installed in conjunction with the construction of mine units, the gradient and flow direction will likely change. Hence, **Plate 2-1** should be considered conceptual at best.

N Horizon

There are five N Horizon monitoring wells located in LCE. During the compilation of this report, it was discovered that monitor wells M-N2 and M-N3 are completed in both the M and N Horizons (**Well Completion Reports, Attachment D6-2, TR Document**). Therefore, the static water elevation in these two wells is not believed to be representative. However, the MN Shale that typically separates the two Horizons is not well defined at these well locations; thus, the M and N Horizons are likely in hydraulic communication anyway. Nevertheless, the static water level in monitor well M-N3 does not fit the regional trend and was therefore not used in constructing the potentiometric surface map (**Figure 2-8, Attachment D6-4, TR Document**). Subsequent hydrologic investigations will attempt to resolve the water level anomaly and better define the N Horizon potentiometric surface.

Vertical Hydraulic Gradients

Vertical hydraulic gradients were determined in 2013 by measuring water levels in closely grouped wells completed in different hydrostratigraphic units. Figure 1-2 (**Attachment D6-4, TR Document**) shows the location of the well groups used for the assessment of vertical hydraulic gradients Vertical hydraulic gradient from the FG to the HJ Horizon were evaluated at four locations where there were FG Horizon well completions, gradients from the HJ to the KM Horizon were evaluated at eight locations and at five locations for the KM to N Horizon calculation. Table 2-1, **(Attachment D6-4, TR Document)** summarizes the calculated vertical gradients between the FG, HJ, KM and N Horizons. The following bullets briefly summarize the general head differentials observed in all LCE monitored Horizons.

- The potentiometric surface in the FG Horizon is approximately 10 to 32 feet higher than in the underlying HJ Horizon;
- The potentiometric surface in the HJ Horizon is from 5 to 33 feet higher than the in underlying KM Horizon; and,
- The potentiometric surface in the KM Horizon is from 6 to 112 feet higher than in the underlying N Horizon.

After the construction of six L Horizon monitor well in 2016, water level measurements indicated the following:

- The potentiometric surface in the KM Horizon is approximately 10 to 20 feet higher than in the underlying L Horizon at the sites measured.

The vertical gradients indicate the potential for groundwater flow is downward in all cases. A downward potential is indicative of an area of recharge, as opposed to an upward potential that is normally indicative of an area of groundwater discharge. A downward gradient is consistent with the structural and stratigraphic location of the Project within the Great Divide Basin. Results are consistent with the regional conceptual model of decreasing heads with depth indicating proximity to areas of recharge in this portion of the Battle Spring Formation.

3.5.2.5 Aquifer Properties

Aquifer properties (transmissivity, storativity, and hydraulic conductivity), for the Battle Spring aquifers (HJ and KM Horizons) within the Permit Amendment Area, have been calculated from analysis of data from five long-term pump tests conducted in 2013. In 2016, additional aquifer testing on the L Horizon was performed. A brief summary of the pump test results and analyses are provided below. The full hydrologic reports are presented as **Attachments D6-4** (2013) and **D6-5** (2016) to the Technical Report.

2013 Pump Tests

The LC East Project is located contiguous to and east of the Lost Creek ISR Project as shown on **Figure 3.5-6**. The LCE Project lies within all or parts of Sections 1, 2, 3, 10, 11, 12, 14, 15, 20, 21, 22, 23, 27, 28, and 29 of T25N, R92W.

The LCE ore of interest is contained in the HJ and KM Horizons. Due to the length of the mineralized trend, LQD granted approval to perform regional pump tests at three different locations along the trend as shown on **Figure 3.5-6**. At each location, it was proposed to independently pump test the HJ and KM Horizons while observing monitoring wells completed in the same horizon, as well as those completed in the overlying and underlying horizons.

Figure 3.5-6 shows the location of wells used in the regional pump tests. The three clusters of pumping/observation wells installed over the length of the property are denoted as the North Cluster, Center Cluster and South Cluster. In addition, four clusters of observation wells were installed adjacent to or between the regional clusters. Pump tests were performed at three KM Horizon locations and two HJ Horizon locations. Due to insufficient saturation of the North Cluster HJ Horizon, no pump test was performed.

Each of the five long-term pump tests were run from three to seven days at pumping rates ranging from 39 to 61 gallons per minute. Sufficient drawdown was observed in the same-horizon monitor well for the calculation of aquifer properties.

Table 7-1, (**Attachment D6-4**, **TR Document**) presents a compilation of the analytical results for the two HJ Horizon pump tests. HJ Horizon transmissivity values computed from the Theis analysis ranged from 74 to 384 ft^2/day. Analysis using the Theis recovery method yielded values ranging from 54 to 318 ft^2/day. The lower end of this transmissivity range is generally consistent with the results obtained from previous Lost Creek HJ Horizon pump tests. Based on site specific aquifer thicknesses, the calculated mean hydraulic conductivity (K) values ranged from 0.78 to 3.20 ft./day.

Using the Theis method, calculated S values ranged between 1.15 x 10-4 and 3.03 x 10-4. Again, the calculated HJ Horizon storativity values are similar to previously obtained Lost Creek test results.

Table 7-1, (**Attachment D6-4**, **TR Document**) presents a compilation of the analytical results for the three KM Horizon pump tests. KM Horizon transmissivity values computed from the Theis analysis ranged from 86 to 251 ft^2/day. Analysis using the Theis recovery method yielded values ranging from 113 to 359 ft^2/day. The lower end of this transmissivity range is generally consistent with the results obtained from previous Lost Creek KM Horizon pump tests. Based on site specific aquifer thicknesses, the calculated mean hydraulic conductivity (K) values ranged from 1.07 to 3.26 ft./day.

Using the Theis method, calculated S values ranged between 7.35×10^{-5} and 1.97×10^{-2}. Again, the calculated KM Horizon storativity values are similar to previously obtained Lost Creek test results.

The following paragraphs summarize the hydrologic investigation findings:

- The pump tests result's demonstrated that: 1) there was hydrologic communication between the pumped well and one or more same-horizon observation wells, 2) there was no apparent hydraulic communication between the HJ and KM Horizons in any of the five pump test areas, and 3) there was no obvious hydraulic communication with the underlying N Horizon.

- The Center and South HJ Horizon tests, revealed only very minor hydrologic communication with the overlying FG Horizon. The water level drop in the FG Horizon was less than a barometrically corrected 7-inches in both tests.
- The computed aquifer characteristics (T, K and S) for the North and Center test areas are very similar to each other and comparable with values obtained from the Mine Unit 1 Regional and mine unit pump tests. However, the computed aquifer characteristics for the South test area were significantly higher (100 to 150%) than those T, K and S values for either the North, Center or MU1 test results.
- The pump test results demonstrate that the HJ and KM Horizons have sufficient transmissivity for ISR operations. Due to the higher transmissivity values observed in Sections 20 and 21, it may be possible to operate mine patterns at higher flow rates or with wider injector/producer spacing in these areas. Modeling and/or field testing will be required to confirm this hypothesis.
- The preliminary findings indicate that the mapped faults, located in Section 21 are not sealed, but act as low-flow boundaries.

2016 Pump Tests

A regulatory review of the Permit Amendment by the NRC in 2015 concluded that LC ISR had not adequately identified and hydrologically tested an underlying aquifer for the proposed KM Horizon ISR mining operation. In response to the regulatory agency's findings, and at their request, LC ISR conducted an in-depth computer modelling exercise using actual five-spot injection/production test data. The modeling goal was to evaluate the impact of mining the KM Horizon on the underlying L Horizon, as LC ISR was proposing the L Horizon as the underlying aquifer to monitor. The model results indicated that:

- The eleven-layer numerical model simulated hydrologic control during situ recovery from the KM Horizon (see **Attachment D6-6, TR Document**). The model simulations indicated that lixiviant can be controlled within the KM Horizon with no or little migration into the HJ or L Horizons. The model was also used to "force" an excursion by operating the mine unit out of balance. The model indicated that an excursion into the L Horizon can be successfully recovered using engineering controls. Finally, the model indicated that underlying monitor wells in the L Horizon should be focused on areas where the K shale is the thinnest.

Despite making the original modeling, the modeling results were subsequently rejected by NRC who then suggested that monitor wells be installed in the L Horizon and the aquifer hydrologically tested. Based on NRC's recommendation, LC ISR prepared a

Pump Test Plan that included the installation of six new L Horizon monitor wells for testing and water quality sampling. The Plan was submitted to LQD and NRC for approval. The agency's review comments were subsequently incorporated into a final test plan, which was initiated in the fall of 2016.

In preparation for conducting the LCE pump tests, the six new L Horizon wells were constructed during the 2016 summer drilling program. The new pumping and monitoring wells were drilled and completed using methods consistent with WDEQ/LQD permit requirements.

In order to properly determine L Horizon aquifer characteristics, a minimum of two test wells are required. For this evaluation, one fully penetrating well was installed as the pumping well and one partially penetrating observation well was constructed at each cluster. All wells monitored during the various tests are identified in **Table 3.5-5** and their location shown on **Figure 3.5-6**.

Six pump tests were conducted; three in the KM Horizon and three in the L Horizon. The KM Horizon pump tests were conducted to evaluate the hydraulic connectivity between the KM and L Horizons; or simply put, how well does the K Shale function as an aquitard? Subsequently, three L Horizon pump tests were conducted to establish aquifer characteristics, with a secondary objective of further evaluating the K Shale's confining characteristics from a bottom up perspective.

Table 7-1 **(Attachment D6-5, TR Document)** presents a compilation of the analytical results for the three L Horizon pump tests. L Horizon transmissivity values computed from the Hantush-Jacob analysis ranged from 79.5 to 259.5 gal/day/ft. Analysis using the Theis recovery method yielded values ranging from 67 to 262 gal/day/ft. Based on site specific aquifer thicknesses, the calculated mean hydraulic conductivity (K) values ranged from 5.0 to 13.1 gal/day/ft^2. Using the Hantush-Jacob method, calculated storativity values ranged between 2.20 x 10^{-4} and 3.67 x 10^{-5}.

A comparison of the 2013 KM Horizon pump test results with the 2016 L Horizon pump test results reveals very similar aquifer properties even though the tests were performed in two different stratigraphic horizons. This finding lends credence to the belief that the Battle Spring Formation is essentially one big sand package containing intermittent and often discontinuous shale lenses.

3.5.3 Groundwater Use

Groundwater use permits with legal descriptions inside and within three miles of the Permit Amendment Area were queried using the WSEO Water Rights Database (WSEO, 2014). **Tables 3.5-6** and **3.5-7** list the permits, including potentially active permits as well as abandoned and cancelled permits, which were issued by WSEO to parties other than LC ISR, LLC or its affiliates. The permit information includes, but is not limited to, location, uses, priority dates, status, yield, total depth, and static water depth. **Table 3.5-6** lists non LC ISR, LLC permits within one-half mile of the Permit Amendment Area; this table correlates with **Figure 3.5-7** that shows the permit locations. **Table 3.5-7** lists non LC ISR, LLC permits within three miles of the Permit Amendment Area; these locations are shown on **Figure 3.5-8**. The majority of the groundwater use permits, filed in the vicinity of the Permit Amendment Area, are for stock watering, monitoring, miscellaneous and mining-related purposes.

Table 3.5-8 provides a list of the permits issued by the WSEO to LC ISR, LLC or its affiliates (Ur-Energy and NFU Wyoming, LLC). At this time, there are 207 groundwater use permits of which 10 are designated water supply wells, 156 are monitor wells, two are disposal wells, 15 are test wells and 22 are industrial wells associated with ISR mining activities (four permits are for well re-work thus duplicates). Of the 207 permits only 24 are located within the Permit Amendment Area.

Installation of supplemental wells is on-going, and locations of wells currently used for water quality sampling and pump tests are shown on **Figure 3.5-6**. Currently, the Permit Amendment Area consumes a negligible amount of groundwater that is attributed to well development, monitoring, testing, and miscellaneous purposes related to uranium exploration.

The groundwater use permits within one-half mile unrelated to mining are those belonging to the BLM. In 1968 and 1980, the BLM Rawlins District was granted two permits by the WSEO (13834 and 55112, see below). Both permits, located inside the LCE Amendment Area, correspond to wells that supply water to a stock pond or storage tank (**Permits #1** and **#2** on **Figure 3.5-7**).

SEO Permit 13834 - Battle Spring Draw Well No. 4451;
SEO Permit 55113 - Battle Spring Well No. 4777

Battle Spring Draw Well No. 4451 seasonally pumps water into a stock tank (Township 25 North, Range 92 West, Section 21, NW¼, NE¼, NE¼). In 1968, a uranium exploration hole was drilled at this location; when water was encountered, plastic casing was installed and the well was developed. According to the State Engineers Office records, the well depth is 900 feet, with a reported static water level of 104 feet, and a permitted yield of 19 gallons per minute. However, the screened interval is not specified. On October 1, 2013, LC ISR, LLC E-logged the well. The results indicate that there is 240 feet of casing in the hole with a static water level at 148 feet bgs. Apparently, the hole caved just beneath the casing (maximum probe depth). BLM well No. 4451 has been sampled by LC ISR, LLC numerous times since 2009 (analytical results are presented in the KM Amendment documents). The results indicate high levels of radionuclides.

The Battle Spring Well No. 4777 was drilled as a stock well in 1981 to a depth of approximately 220 feet. The well is shallower than the sands targeted by LC ISR, LLC under the current Permit. A water use of 25 gpm is permitted. Battle Spring Well No. 4777 is located in Township 25 North, Range 92 West, Section 30, SE¼, NW¼.

In March 2014, LC ISR, LLC contacted BLM staff to inquire about the current status of these groundwater use permits. The BLM stated that the groundwater use permits are active, and the wells are being used for stock watering from earthen impoundments. A trailer mounted solar pump is moved from one well to the other seasonally.

Throughout the phases of the Project, LC ISR, LLC has committed to on-going correspondence with BLM to ensure that the stock reservoirs and wells are not impacted in a manner that restricts the intended use. LC ISR, LLC has committed to work with BLM to replace the water source if any wells are rendered unusable due to LC ISR's mining activities.

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 Amendment Area.

3.5.4.1 Regional Groundwater Quality

Water quality within the Great Divide Basin ranges from very poor to excellent. Groundwater in the near surface, more permeable aquifers, is generally of better quality than groundwater in deeper and less permeable aquifers. Groundwater with TDS less than 3,000 mg/L can generally be found at depths less than 1,500 feet within the Tertiary aquifer system, which includes the Battle Spring/Wasatch, Fort Union and Lance aquifers (Collentine et al., 1981).

Water quality for the Great Divide Basin is available from a large number of sources including the USGS National Water Information System (NWIS) database, the University of Wyoming Water Resources Data System (WRDS), and the USGS Produced Waters Database. Much of these data are tabulated in "Water Resources of Sweetwater County, Wyoming", a USGS Scientific Investigation Report by Mason and Miller (2005). However, the quality and accuracy of much of the data are difficult to assess. This section of the Permit Amendment describes general water quality of the Great Divide Basin, primarily by reference to these sources.

Mason and Miller (2005) noted that water quality in Sweetwater County is highly variable within even a single hydrogeologic unit, and that water quality tends to be better near outcrop areas where recharge occurs. They also noted that groundwater quality samples from the Quaternary and Tertiary aquifers are most likely biased toward better water quality and do not necessarily represent a random sampling for the following reasons: 1) Wells and springs that do not produce useable water usually are abandoned or not developed, 2) Deeper portions of the aquifers typically are not exploited as a groundwater resource because a shallower water supply may be available. As a result, these water sources do not become part of the sampled network of wells and springs that ultimately make up the available groundwater database. Groundwater quality samples from deeper Mesozoic and Paleozoic hydrostratigraphic units are often available where oil and gas production or exploration has occurred. Therefore, groundwater samples from older geologic units may have less bias in representing ambient groundwater quality than samples collected from Quaternary and Tertiary aquifers.

Water quality within the shallow Tertiary aquifers generally represents sodium-bicarbonate to sodium-sulfate water types. TDS levels within the Wasatch aquifer in the west and south parts of the Great Divide Basin tend to be high relative to the U.S. EPA's Secondary Drinking Water Standard (SDWS) of 500 mg/L; even within the shallow aquifers. TDS levels within the Battle Spring/Wasatch aquifers are generally less than 500 mg/L along the northern flank of the Great Divide Basin (which includes the Permit Amendment Area). Elevated TDS levels (greater than 3,000 mg/L) are present within the Wasatch aquifer along the eastern edge of the Washakie Basin and within the Fort Union and Lance aquifers along the east side of the Rock Springs uplift. Elsewhere within the Great Divide and Washakie Basins, TDS levels in the Tertiary aquifer system are typically between 1,000 and 3,000 mg/L (Collentine et al., 1981).

Low-TDS waters within the Battle Spring aquifer are predominately sodium-bicarbonate type waters. With increasing salinity, the water type tends to become more calcium-sulfate dominated. However, this trend is not exhibited in the Wasatch, Fort Union and Lance aquifers within the Great Divide and Washakie Basins. The Wasatch and Lance aquifers are characterized by predominately sodium-sulfate type waters, particularly near outcrop areas. The Fort Union is more variable in composition.

Water quality data for Tertiary aquifers away from the outcrop areas are sparse, but available data indicates that TDS levels increase rapidly away from the basin margins. Water samples collected from a Lance pump test in Section 14, Township 23 North, Range 99 West had reported TDS levels in excess of 35,000 mg/L. A Fort Union test in Section 25, Township 13 North, Range 95 West had TDS levels in excess of 60,000 mg/L, based on resistivity logs (Collentine et al., 1981). Water quality samples from produced water in the Wasatch and Fort Union Formations from an average depth of 3,500 feet had TDS values ranging from 1,050 to 153,000 mg/L with a median value of

13,900 mg/L (Mason and Miller, 2005). TDS from four wells completed in the Fort Union Formation located along the margins of the basin ranged from 800 to 3,400 mg/L (Welder and McGreevy, 1966).

A graph of TDS versus sampling depth for produced water samples from the Wasatch Formation in Sweetwater County prepared by Mason and Miller (2005) shows that at depths greater than 3,000 feet, TDS values are typically above 10,000 mg/L. It is noted that the Mason and Miller data set is small for a large area and may be biased by data from the southern part of the Great Divide Basin; few site-specific data directly applicable to the Permit Amendment Area are available.

Water quality within the Battle Spring aquifer is generally good in the northeast portion of the basin with TDS levels usually less than 1,000 mg/L and frequently less than 200 mg/L. Water type within the Battle Spring aquifer is typically sodium-bicarbonate to sodium-sulfate. Mason and Miller (2005) reviewed 18 groundwater samples collected from the Battle Spring aquifer and observed that those samples represented some of the best overall quality of those studied in Sweetwater County. Sulfate levels can be elevated in Tertiary aquifers, but are generally low in the shallow aquifers of the Battle Spring Formation. Out of 18 samples included in the Mason and Miller (2005) study, only one sample exceeded the WDEQ Class I Drinking Water Standard for sulfate of 250 mg/L. Most sample results were also less than the WDEQ TDS Class I Drinking Water Standard of 500 mg/L. Nitrate, fluoride and arsenic concentrations were less than WDEQ and EPA standards for all samples.

Notable exceptions to the relatively good water quality is the presence of elevated radionuclide constituents. Uranium and radium-226 (Ra-226) concentrations exceeded their respective EPA Maximum Contaminant Levels (MCLs) of 0.03 mg/L and 5 pCi/L in some of the samples; radon-222 (Rn-222) concentrations were also relatively high in some samples (Mason and Miller, 2005). The presence of high levels of uranium in Tertiary sediments and groundwater of the Great Divide Basin has been well documented. The Lost Creek Shroeckingerite deposit, located northwest of the Permit Amendment Area, is noted for high uranium levels in groundwater. Uranium-bearing coals are also present in the Great Divide Basin. Sediments of the Battle Spring Formation were derived from the Granite Mountains and contain from 0.0005 to 0.001 percent uranium (Masursky, 1962). Based on historical exploration results, certain areas of the Battle Spring Formation (e.g., Lost Creek) contain much higher uranium concentrations.

Water quality for aquifer systems deeper than the Tertiary (such as the Mesaverde aquifer system) are not described in this report; because they are several thousands of feet deep in the vicinity of the Project, and are separated from the Tertiary aquifer system by the Lewis Shale, a regional aquitard. The deeper aquifer systems of the Great Divide Basin will not impact nor be impacted by ISR activities at LC East.

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, 2013, and 2016.
Groundwater Monitoring Network and Parameters

In 2012, LC ISR, LLC installed 20 monitor wells in the FG, HJ, KM and N Horizons and initiated background sampling for WDEQ-LQD Guideline 8 parameters. At the request of LQD, four supplemental monitor wells were installed in 2013 and six supplemental (3 monitoring and 3 pump test observation wells) in 2016. Four quarters of water sampling have been completed for most background monitor wells. The location of LCEs background monitor wells are indicated on **Figure 3.5-6**.

Groundwater Quality Sampling Results – 2012/2013

LC ISR, LLC began background sampling in December 2012 at the following 20 locations:

- FG Horizon Monitor Wells: M-FG1 and M-FG2;
- HJ Horizon Monitor Wells: M-HJ1, M-HJ2A, M-HJ3, M-HJ4, M-HJ5, M-HJ6, and M-HJ7D;
- KM Horizon Monitor Wells: M-KM4A, M-KM5A, M-KM6, M-KM7, M-KM8, M-KM9 and M-KM10; and
- N Horizon Monitor Wells: M-N2, M-N3, M-N4 and M-N5A.

Following the 2013 monitor well installations, sampling commenced in December 2013 at these four wells:

- FG Horizon Monitor Well: M-FG5;
- HJ Horizon Monitor Well: M-HJ8;
- KM Horizon Monitor Well: M-KM11A; and
- N Horizon Monitor Well: M-N6.

Groundwater Quality Sampling Results – 2016

Following the 2016 monitor well installations, sampling commenced in October 2016 at these three wells:

- L Horizon Monitor Wells: M-L7, M-L9, M-L11A.

Only one round of sampling was completed in 2016; however, additional quarterly sampling will continue into 2017.

Results of the LC ISR, LLC background monitoring program are summarized in **Table 3.5-9**. The raw laboratory data was downloaded to the CD disk found in **Attachment 3.5**-2. In **Table 3.5-9**, those parameters that exceed specific WDEQ-WQD standards or EPA MCL criteria are shown in bold and color coded to the specific WQD or EPA criteria they exceed. **Table 3.5-10** presents the state Class-of-Use and federal Drinking Water Criteria for specific groundwater parameters.

A summary of water quality analytical results for each hydrostratigraphic Horizon of interest (FG, HJ, KM, L and N Horizons) is presented below.

FG Horizon Water Quality

Three wells completed in the FG Horizon were included in the background sampling program (M-FG1, M-FG2 and M-FG5). Sample analytical results from background monitor wells are presented in **Table 3.5-9**.

Background sampling results indicate that the FG Horizon monitor wells are calcium-bicarbonate to calcium-sulfate type water. TDS, iron and sulfate levels exceeded the WDEQ Class I Standards (500 mg/L, 0.3 mg/L and 250 mg/L, respectively) in two of the three wells. Selenium also exceeded the WDEQ Class I and II Standards in one FG Horizon well.

The chloride and magnesium levels in all three wells are low; less than 10 mg/L. One pH measurement from one background water sample exceeded the WDEQ Class I Standard (6.5 to 8.5 standard units).

Gross Alpha results exceeded the WDEQ Class I Standard (15.0 pCi/L) in all samples at every FG Horizon well location. Uranium levels exceeded the EPA MCL (0.03 mg/L) in all samples collected from two of the three FG monitor wells (M-FG2 being the exception). The average uranium concentration for the FG samples was 0.475 mg/L. All but one FG Horizon water sample exceeded the WDEQ Class I Standard (5.0 pCi/L) for radium 226+228.

HJ Horizon Water Quality

Seven wells completed in the HJ Horizon were included in the background sampling program (M-HJ1, M-HJ2A, M-HJ3, M-HJ4, M-HJ5, M-HJ6 and M-HJ8). Sample analytical results from all background monitor wells are included in **Table 3.5-9**.

Background sampling results indicate that the HJ monitor wells are calcium-bicarbonate to calcium-sulfate type water. With the exception of selenium and uranium, none of the remaining inorganic parameters exceeded the WDEQ Class-of-Use or EPA drinking water criteria. Selenium exceeded WDEQ Class I and II Standards in background well M-HJ6. Uranium levels exceeded the EPA MCL in monitor wells M-HJ3, M-HJ5 and M-HJ6.

Three quarterly water sample results from monitor well M-HJ8 indicated pH measurement that exceeded the WDEQ Class I and III Standards (6.5 to 8.5 standard units). Chloride levels in all wells are low (7 mg/L or less).

Gross Alpha results exceeded the WDEQ Class I Standard (15.0 pCi/L) in all samples at every HJ Horizon well. Uranium levels exceeded the EPA MCL (0.03 mg/L) in three of the seven wells. The average uranium concentration for the HJ samples was 0.475 mg/L. All water samples in every HJ Horizon monitor well exceeded the WDEQ Class I Standard (5.0 pCi/L) for radium 226+228.

KM Horizon Water Quality

Eight wells completed in the KM Horizon were included in the background sampling program (M-KM4A, M-KM5A, M-KM6, M-KM7, M-KM8, M-KM9, M-KM10, and M-KM11A). Sample analytical results from background monitor wells are included in **Table 3.5-9**.

Background sampling results indicate that the KM Horizon monitor wells are calcium-bicarbonate to calcium-sulfate type water. With the exception of pH, iron, selenium and uranium, none of the remaining inorganic parameters exceeded the WDEQ or EPA criteria. Four monitor wells had pH results that exceeded the WDEQ Class I and III Standards (6.5 to 8.5 standard units). Two monitor well iron results exceeded WDEQ Class I Standards (0.3 mg/L) and EPA Secondary Drinking Water Criteria (0.03 mg/L). Selenium exceeded the WDEQ Class II Standard in background well M-KM10. Uranium levels exceeded the EPA MCL in five different monitor wells.

Radium 226+228 levels exceeded the WDEQ Class I Standard (5.0 pCi/L) in seven of eight monitor wells, while Gross Alpha results exceed the WDEQ and EPA Standards (15 pCi/L) in all KM Horizon monitor wells at least once.

L Horizon Water Quality

Water quality data collection on the three supplemental L-Horizon monitors is in progress. One quarterly round of water samples was collected from the wells in the fourth quarter 2016. **Table 3.5-11** summarizes the analytical results to data.

An assessment of the results to date reveal that no analyte exceeded the **Table 3.5-10** parameter criteria except for iron, gross alpha and Ra226+228. The sample from monitor well M-L11A exceeded the secondary EPA MCL drinking water criteria for iron; samples from monitor wells M-L7 and M-11A exceeded the gross alpha limits for both the state and EPA criteria; and the sample from M-L7 exceeded the Ra226+228 threshold of 5.0 pCi/L set by both the state and EPA.

Table 3.5-11 analytical results indicate that the L Horizon background water quality is chemically similar to that contained in the overlying HJ and KM Horizons with the exception of the radionuclide parameters (**Table 3.5-9**), which are a function of the proximity to and amount of uranium mineralization present.

N Horizon Water Quality

Five wells completed in the N Horizon were included in the background sampling program (M-N2, M-N3, M-N4, M-N5A and M-N6). Sample analytical results from background monitor wells are presented in **Table 3.5-9**. Analytical results from baseline monitor wells M-N3 and M-N5A are not considered representative due to inadequate well purging prior to sample collection. Accordingly, those results are excluded from the following discussion. In future sampling events, the submersible sampling pumps in these two wells will be lowered to increase submergence thus allowing for more purge time.

Background sampling results indicate that the N Horizon monitor wells are calcium-bicarbonate to calcium-sulfate type water. The chloride levels in all wells are low; less than 5 mg/L. With the exception of four pH sample results and one iron sample result, none of the remaining inorganic parameters exceeded the WDEQ or EPA criteria.

None of the background water sample results exceeded the Gross Alpha WDEQ Class I Standard or EPA MCL criteria of 15.0 pCi/L. Only one water sample from monitor well M-N6 exceeded the uranium EPA MCL criteria (0.03 mg/L). All three N Horizon monitor well water samples exceeded the WDEQ Class I Standard (5.0 pCi/L) for radium 226+228.

Summary of Site Groundwater Quality

The Piper diagram shown on **Figure 3.5-9** presents the average background groundwater quality for all quarterly sampling events from the FG, HJ, KM and N Horizon monitor wells. The Piper diagram compares the average water quality between the individual Horizons. The Piper diagram shown on **Figure 3.5-10** presents the average water quality for the L, M, MN and N Horizons. The plots show that there isn't much difference in groundwater geochemistry between the various Horizons. Groundwater contained in the shallow Battle Spring aquifers that underlie the Permit Amendment Area is a calcium-sulfate to calcium-bicarbonate type water. There is some variability in water chemistry when the wells are compared individually, but those differences don't change the overall groundwater character type.

In summary, the concentration of trace constituents, boron, cadmium, chromium, copper, mercury, molybdenum, nickel, and vanadium were at or less than the detection limits for all samples analyzed. TDS, iron and sulfate values are relatively low, with occasional exceedances of WDEQ Class I Standards. Twenty-three out of 25 wells reported TDS and sulfate concentrations less than their respective Class I Standards. Iron exceeded the WDEQ Class I Standard and EPA MCL in two FG monitor wells (M-FG1 and M-FG5), two KM monitor wells (M-KM8 and M-KM9), one L Horizon well (M-L11A), and one N monitor well (M-N6). Selenium was elevated in excess of state and federal standards in three different Horizon monitor wells.

Every monitor well contained some dissolved uranium, but only 10 wells contained concentrations that exceeded the 0.03 mg/L uranium EPA MCL. Radium-226+228 results exceeded the WDEQ Class I Standard and EPA MCL (5.0 pCi/L) in all background wells with the exception of M-KM10 and M-L7; which is approximately 71 percent of the total samples analyzed. Gross Alpha results exceeded the WDEQ Class I Standard and EPA MCL in all FG, HJ and KM Horizon wells, two L Horizon wells, and one N Horizon well during at least one sampling event.

General water quality in the shallow Battle Spring aquifers within the Permit and Amendment Area tends to be relatively good, with the exception of the presence of radionuclides. However, elevated concentrations of radionuclides are 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

The Project is located within the northeastern portion of the Great Divide Basin. The Eocene Battle Spring Formation crops out over most of the northeastern portion of the

Great Divide Basin, including the Permit Amendment Area. The total thickness of the Battle Spring Formation in the vicinity of the Permit Amendment Area is approximately 6,200 feet. The Battle Spring Formation contains multiple aquifers that are a part of the Tertiary aquifer system. Groundwater flow within the Battle Spring aquifers is primarily toward the interior of the basin, southwest of the Project. Recharge to the Battle Springs aquifers within the Project Area is mostly the result of infiltration of precipitation to the north and northeast in the Green Mountains and Ferris Mountains. Based on available information, discharge from the Battle Spring aquifers is predominately to a series of lakes, springs and playa lake beds near the center of the basin. Some groundwater from the Battle Spring aquifers is discharged through pumping for stock watering, irrigation, industrial and domestic use.

The Battle Spring Formation is described as an arkosic fine- to coarse-grained sandstone with claystone and conglomerates. Groundwater within the Battle Spring aquifers is typically under confined (artesian) conditions, although locally unconfined conditions exist. The potentiometric surface within the Battle Spring aquifers is usually within 200 feet of the ground surface. Most wells drilled for water supply in this unit are less than 1,000 feet deep. Wells completed in the Battle Spring aquifers typically yield 30 to 40 gpm but yields as high as 150 gpm are possible.

Water quality within the shallow Tertiary aquifers generally represents sodium-bicarbonate to sodium-sulfate water types. TDS levels within the Battle Spring aquifers are generally less than 500 mg/L along the northern flank of the Great Divide Basin near areas of outcrop. Low TDS waters within the Battle Springs aquifer are predominately sodium-bicarbonate type waters. With increasing salinity, the water type tends to become more calcium-sulfate dominated. Notable exceptions to the relatively good water quality include waters with elevated radionuclides (uranium, Ra-226 and Ra-228). High levels of uranium are common in Tertiary sediments and groundwater of the Great Divide Basin. The Lost Creek Shroeckingerite deposit located northwest of the Project is noted for high uranium levels in groundwater. Uranium-bearing coals are present in the Wasatch Formation in the central part of the Great Divide Basin.

As described previously, the Battle Spring Formation crops out over most of the Permit and Amendment Area. The Battle Spring is the shallowest occurrence of groundwater within the Amendment Area. Water-bearing Quaternary and Tertiary units younger than the Battle Spring Formation are present several miles to the north and east and are hydraulically up-gradient of the Permit Amendment Area. Therefore, ISR operations conducted at the Project will have no impact on those shallower hydrostratigraphic units.

3.5.5.2 Site Groundwater Conceptual Model

Hydrostratigraphic Units

The hydrostratigraphic units of interest within the Battle Spring Formation, with respect to the Project include, from shallowest to deepest:

- FG Horizon (includes overlying aquifer to HJ Horizon):
  - subdivided into UFG, MFG and LFG Sands;
  - total thickness of horizon is 180 feet;
  - top of unit outcrops on the east side of the Permit Amendment Area and is present at a depth of 50 feet bgs on the west side;
  - LFG Sand is the overlying aquifer to HJ Horizon;
  - LFG Sand is 20 to 50 feet thick;
  - the FG Horizon is unconfined on the east side of the Permit Amendment Area becoming confined as you move westerly in a down dip direction; and
  - water level depths range from 110 feet bgs in the center of the Permit Amendment Area to 125 feet bgs on the west side.
- Lost Creek Shale (upper confining unit to the HJ Horizon):
  - laterally continuous across Permit Amendment Area;
  - five to 25 feet thick; and
  - confining properties demonstrated from water levels and pump tests.
- HJ Horizon (primary production zone):
  - subdivided into UHJ, MHJ and LHJ Sands, although sands are hydraulically connected;
  - coarse-grained arkosic sands with thin lenticular intervals of fine sand, mudstone and siltstone;
  - averages 115 feet thick;
  - top of unit is 95 to 260 feet bgs;
  - the HJ Horizon is unconfined on the east side of the Permit Amendment Area becoming confined as you move westerly in a down dip direction; and
  - water levels in the HJ Horizon range from 90 to 160 feet bgs.
- Sagebrush Shale (lower confining unit to the HJ Horizon and upper confining unit to the UKM Horizon):
  - laterally continuous across Permit Amendment Area;
  - five to 25 feet thick;
  - top of unit 90 to 285 feet bgs; and
  - confining properties demonstrated from water levels and pump tests.
- KM Horizon (production zone):
  - subdivided into UKM and LKM Sands;
  - massive coarse sandstones with thin lenticular fine sandstone intervals;
  - top of unit is 100 to 510 feet bgs;
  - UKM Sand is a targeted production zone and first underlying aquifer to the HJ production zone;
  - UKM Sand is 30 to 60 feet thick;
  - water levels in the UKM Sand are generally 145 to 175 feet bgs; and
  - L Horizon is the underlying aquifer to the KM Horizon, but will require additional hydrologic characterization.

- L Horizon (underlying aquifer to the KM production zone)
    - L Horizon is continuous throughout the LC East Project;
    - the horizon commonly exhibits a much more shaley character;
    - top of unit is approximately 640 feet deep in Section 20 and only 200 feet in the far north;
    - total thickness is typically 100, but ranges from 60 to 120 feet;
    - L Horizon is usually confined above by the K Shale throughout the project area, which averages 12 feet in thickness; and
    - K Shale is regionally extensive but not fully contiguous, therefore it is not considered a confining unit.

3.5.5.3 Potentiometric Surface and Hydraulic Gradients

Potentiometric surfaces for the FG, HJ, KM, and N Horizons are illustrated as contour maps on **Figures 2-5** to **2-8, Attachment D6-4, TR Document**. 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 surfaces of the HJ and KM Horizons indicates that groundwater flow across the Permit Amendment Area is to the west-southwest under hydraulic gradients between 0.005 to 0.018 ft/ft (29 to 95 ft/mi), which is generally consistent with the regional flow system. **Figures 2-6** and **2-7** show the groundwater flow direction across the Permit Amendment Area based on the potentiometric surface.

Groundwater flow direction and hydraulic gradients for the overlying FG Horizon is generally similar to that observed in the HJ and KM Horizons. Groundwater flow in the FG Horizon is toward the west-southwest at a hydraulic gradient ranging between 0.008 ft/ft to 0.019 ft/ft., between 0.005 to 0.015 ft/ft in the HJ Horizon, and 0.009 to 0.018 ft/ft in the KM Horizon (**Attachment D6-4, Figure 2-5, TR Document**). The L Horizon groundwater flow direction and gradient are not consistent with the regional conceptual regime due to insufficient data and the presence of numerous faults (**Attachment D6-5, Plate 2-1**). It is anticipated that with the completion of additional L Horizon monitoring wells, the flow direction and gradient will likely align with the regional regime.

The potentiometric heads decrease with depth. Differences in water level elevations between the FG, HJ, KM, L, and N Horizons indicate that confining units are present between the FG-HJ and HJ-KM hydrostratigraphic units.

Pump tests indicate the presence of confining units between the LFG and HJ aquifers and between the HJ and UKM Horizons, although some minor hydraulic communication exists between the FG and HJ Horizons. The hydraulic communication only becomes apparent when large stresses (head differences) are applied to the aquifers through pumping. Hydraulic communication between the HJ Horizon and overlying FG aquifer may be through historic boreholes that were improperly abandoned, leakage through the confining shale units, or contact of sands juxtaposed across a fault. Additional investigation will be completed prior to production of any mine units.

Vertical hydraulic gradients between the FG and HJ Horizons range from 0.10 to 0.34 ft/ft, between the HJ and KM Horizons 0.04 to 0.24 ft/ft, (**Table 2-1, Attachment D6-4**). and between the KM and L Horizons 0.012 to 0.143 ft/ft (**Table 2-1, Attachment D6-5**). These findings are consistent with the Lost Creek observations of 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 Sage Brush Shale.

3.5.5.4 Aquifer Properties

- Transmissivity values for the HJ Horizon range from 74 to 384 ft^2/d (554 to 2,872 gpd/ft). Storativity values for the HJ Horizon range from 1.15×10^{-4} to 3.03×10^{-4}.
- The range of KM Horizon transmissivity values are similar to the HJ aquifer characteristics (86 to 251 ft^2/d or 643 to 1,877 gpd/ft). Storativity values for the KM Horizon range from 4.53×10^{-5} to 1.97×10^{-2}.
- L Horizon transmissivity values computed from the Hantush-Jacob analysis ranged from 79.5 to 259.5 gal/day/ft. Analysis using the Theis recovery method yielded values ranging from 67 to 262 gal/day/ft. Using the Hantush-Jacob method, calculated storativity values ranged between 2.20×10^{-4} and 3.67×10^{-5}.

3.5.5.5 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, (less than 10 mg/L) making this parameter a good indicator for excursion monitoring.

Trace metals are generally less than WDEQ Class I Standards and EPA MCLs in the production zone, overlying and underlying aquifers. Iron, pH, sulfate, and selenium occasionally exceed their respective standards.

Uranium is present in all 25 background wells, but only 10 wells had concentration levels that exceed the EPA MCL of 0.03 mg/L. Radium-226+228 results exceeded the WDEQ Class I Standard and EPA MCL (5.0 pCi/L) in all background wells with the exception of M-KM10 and M-L7. Radium-226+228 results exceeded the EPA MCL in approximately 71 percent of the samples collected. Dissolved radionuclide levels are commonly elevated in groundwater associated with uranium-bearing sandstones.

3.5.5.6 Summary

The uranium bearing sandstones within the upper Battle Spring Formation are suitable targets for ISR operations as demonstrated by the successful operation at the adjacent Lost Creek mine where aquifer characteristics are comparable to LCE conditions. The primary upper production zone aquifer (HJ Horizon) is bounded by laterally extensive upper and lower confining units, as demonstrated by static water level differences and responses to pump tests. The lower production zone aquifer (KM Horizon) is bounded by a laterally extensive upper confining unit, and a lower stratigraphic unit comprised of interbedded silt and shaley sand layers. However, based on testing results to date, it is anticipated that the minor communication between the production zones and the overlying and underlying horizons can be managed through operational practices, detailed monitoring, and engineering operations.

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.

3.5.6 References

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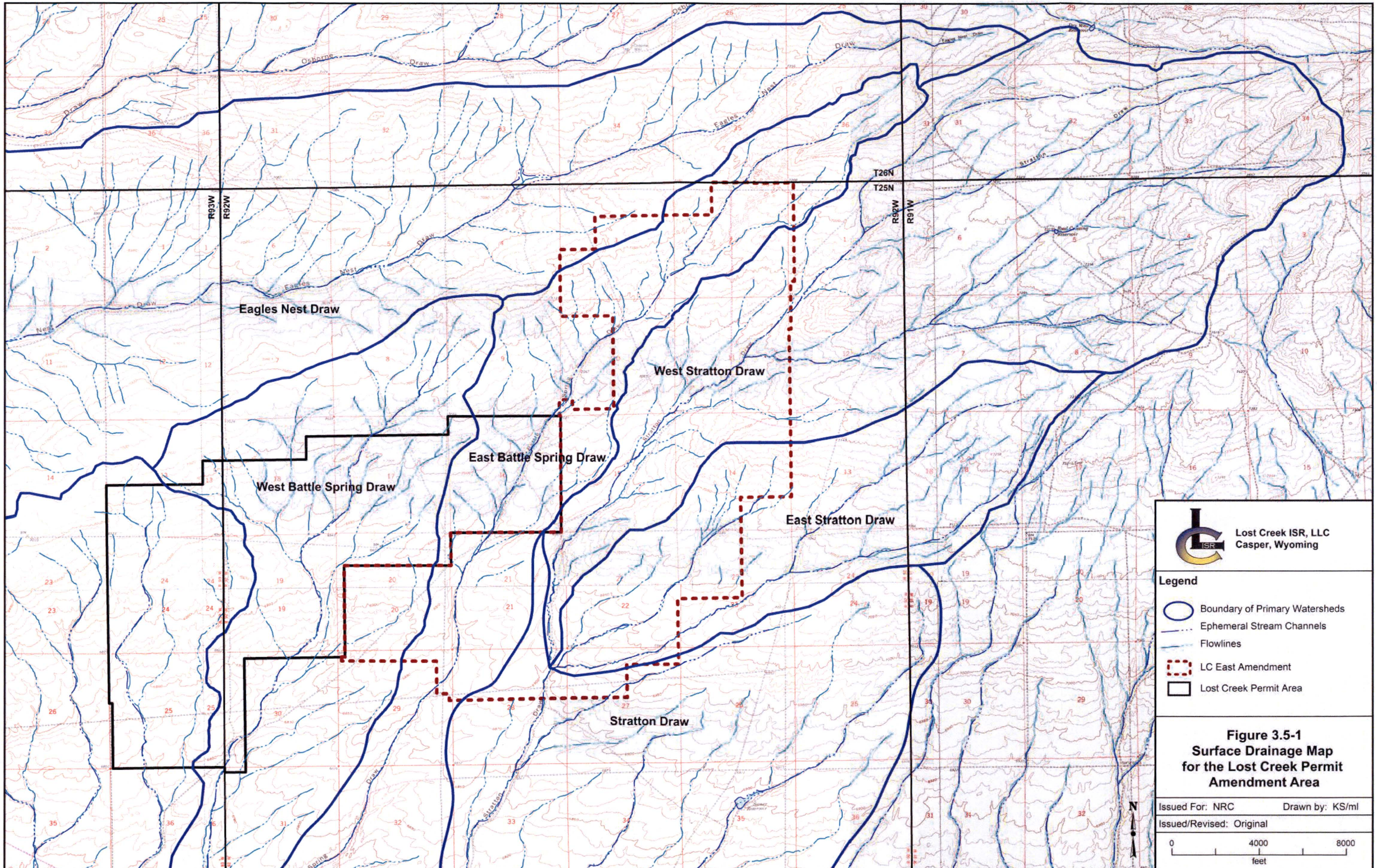

Figure 3.5-1
Surface Drainage Map
for the Lost Creek Permit
Amendment Area

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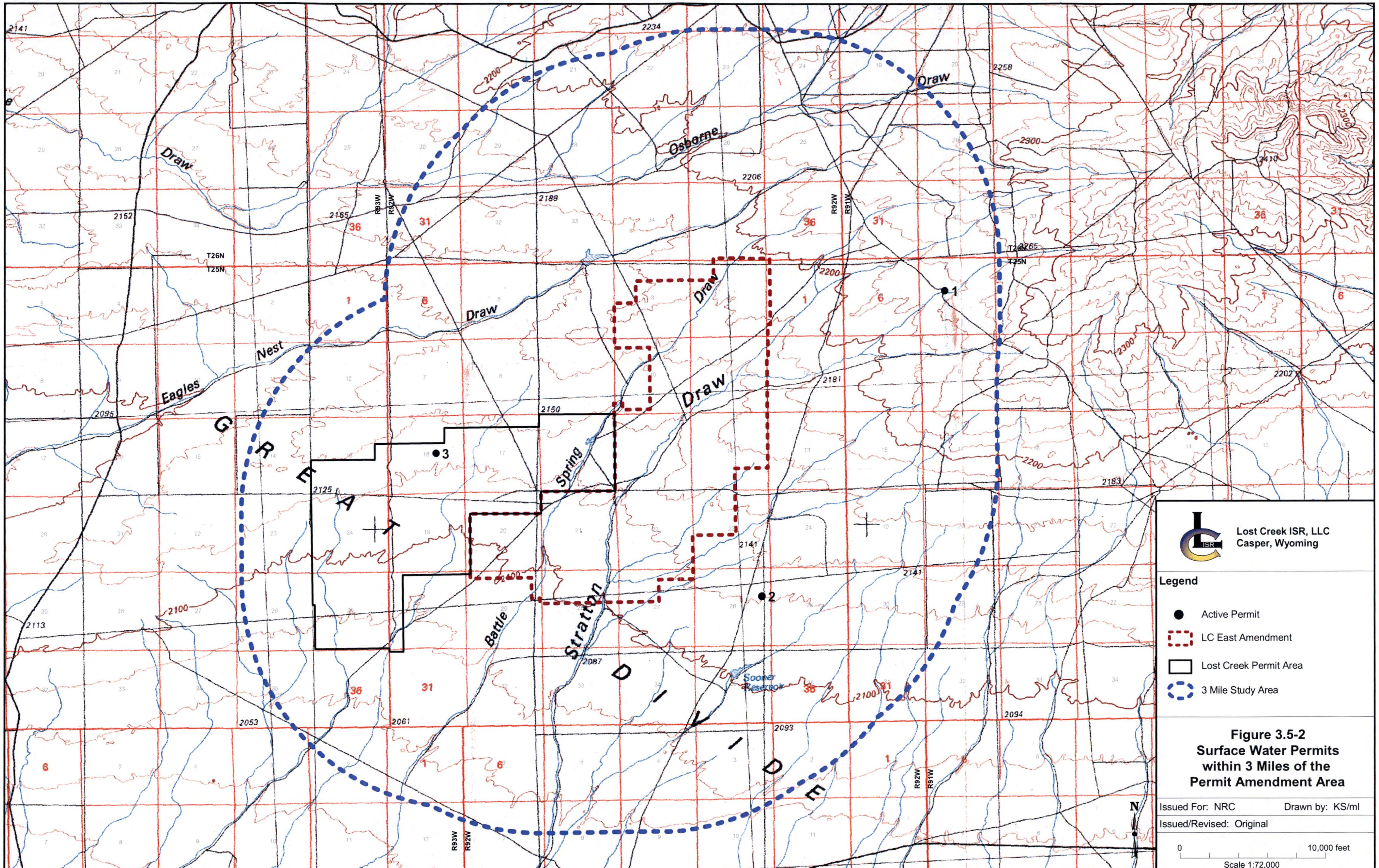

Figure 3.5-2
Surface Water Permits within 3 Miles of the Permit Amendment Area

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Issued/Revised: Original

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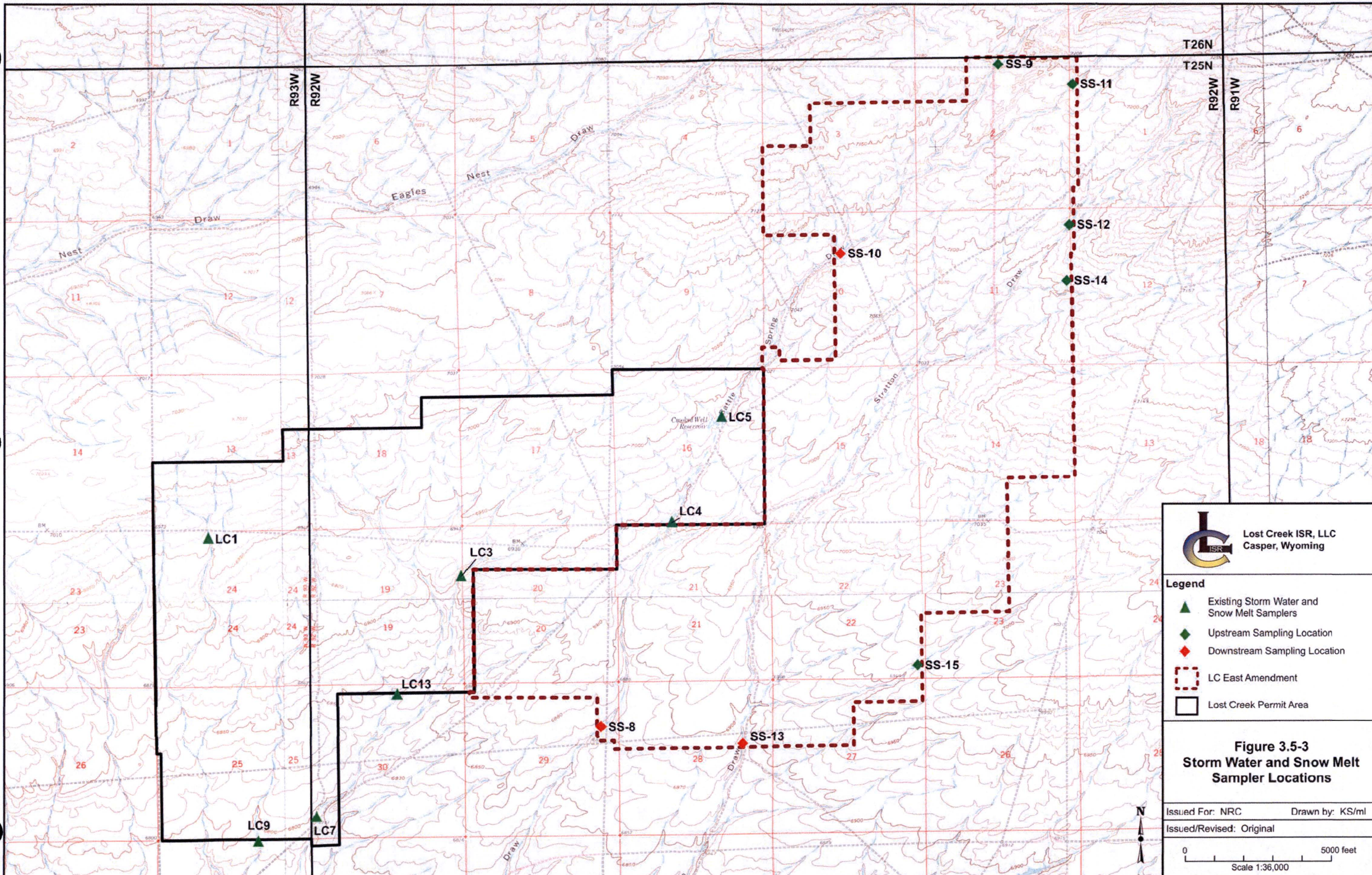

Figure 3.5-3
Storm Water and Snow Melt Sampler Locations

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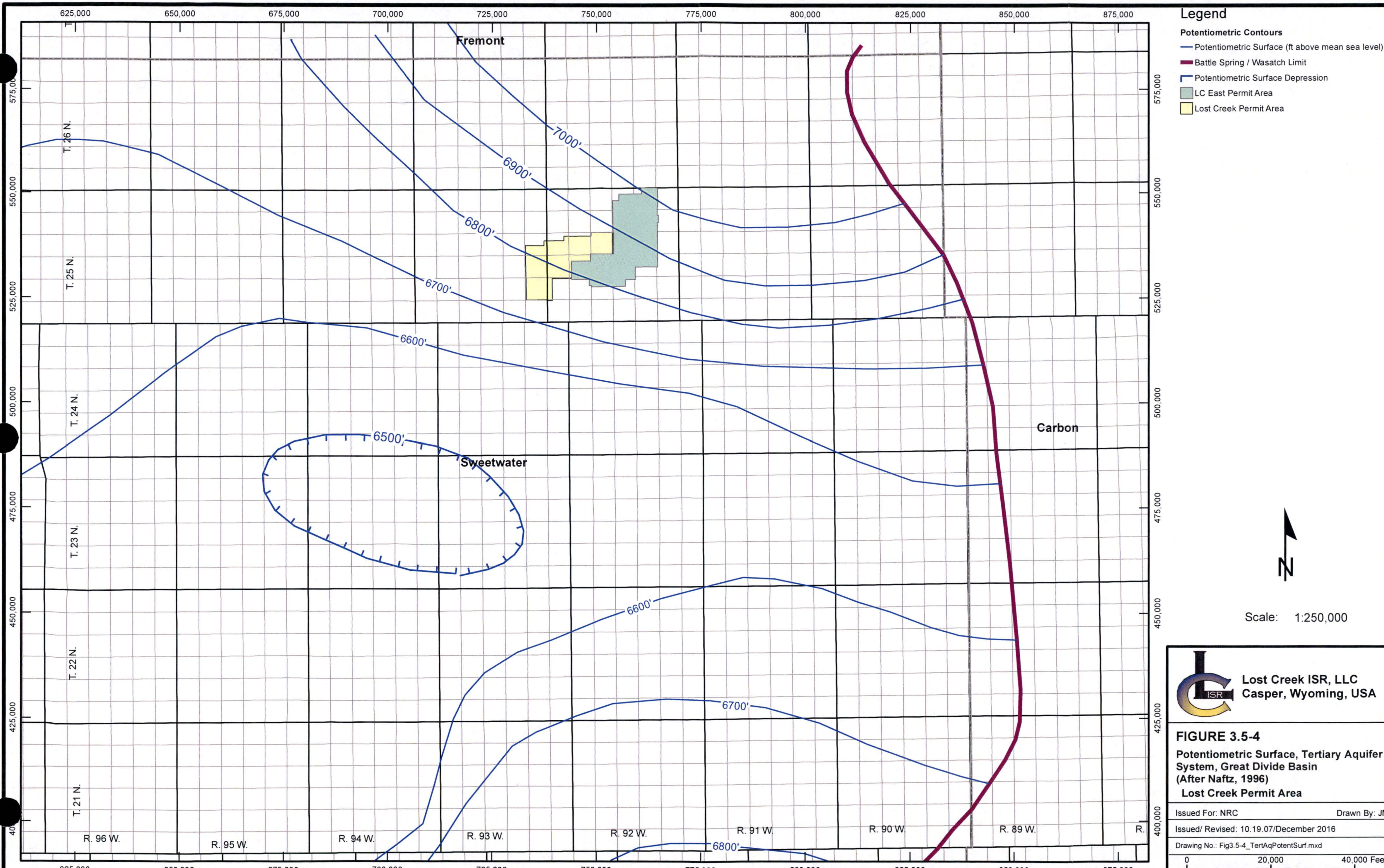

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FIGURE 3.5-4

Potentiometric Surface, Tertiary Aquifer System, Great Divide Basin (After Naftz, 1996) Lost Creek Permit Area

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Issued/ Revised: 10.19.07/December 2016

Drawing No.: Fig3.5-4_TertAqPotentSurf.mxd

Projection: NAD 27 StatePlane Wyoming West Central (feet)

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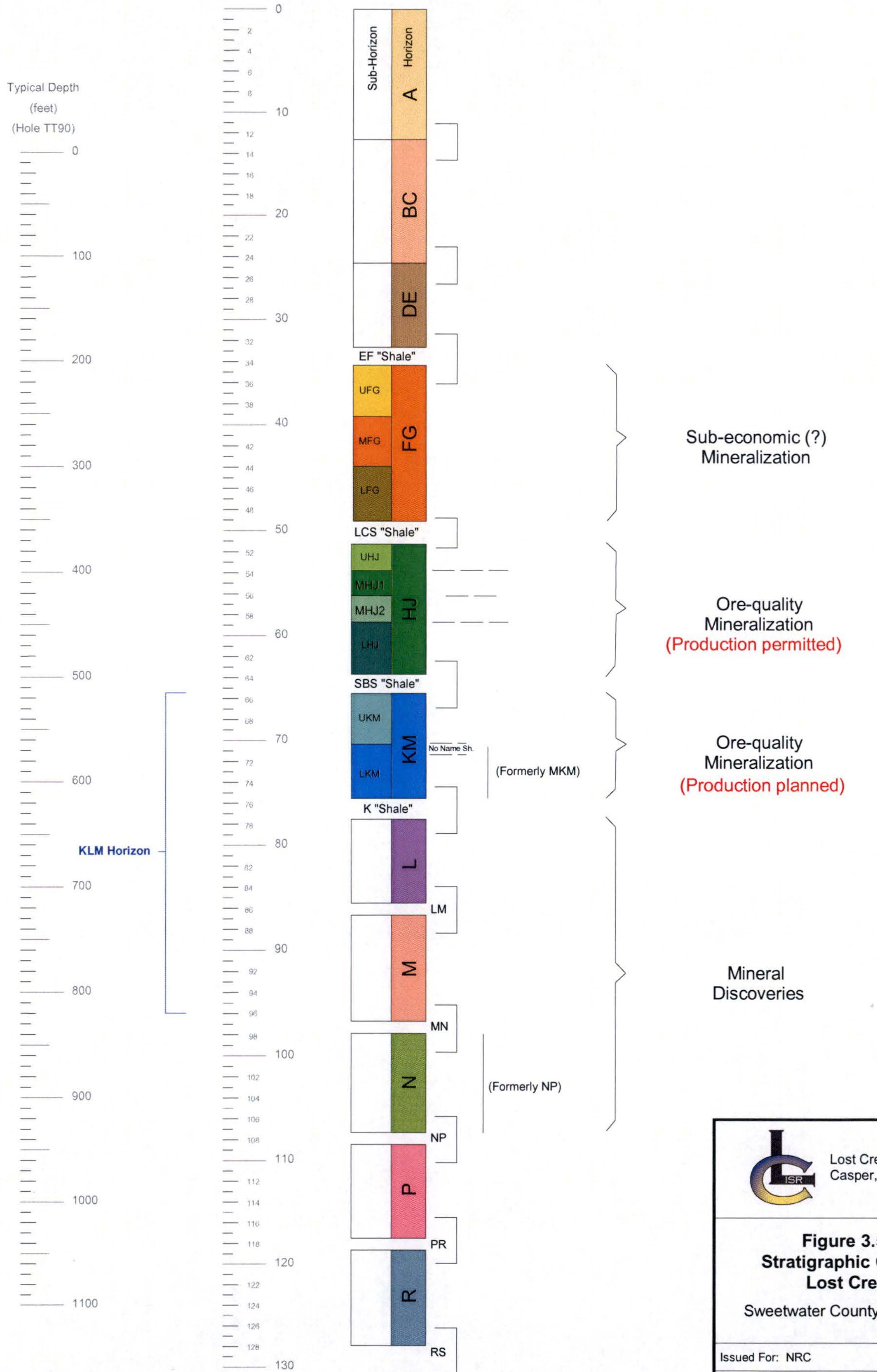

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Figure 3.5-5
Stratigraphic Column
Lost Creek

Sweetwater County, Wyoming

Issued For: NRC

Issued/Revised: Revised December 2016

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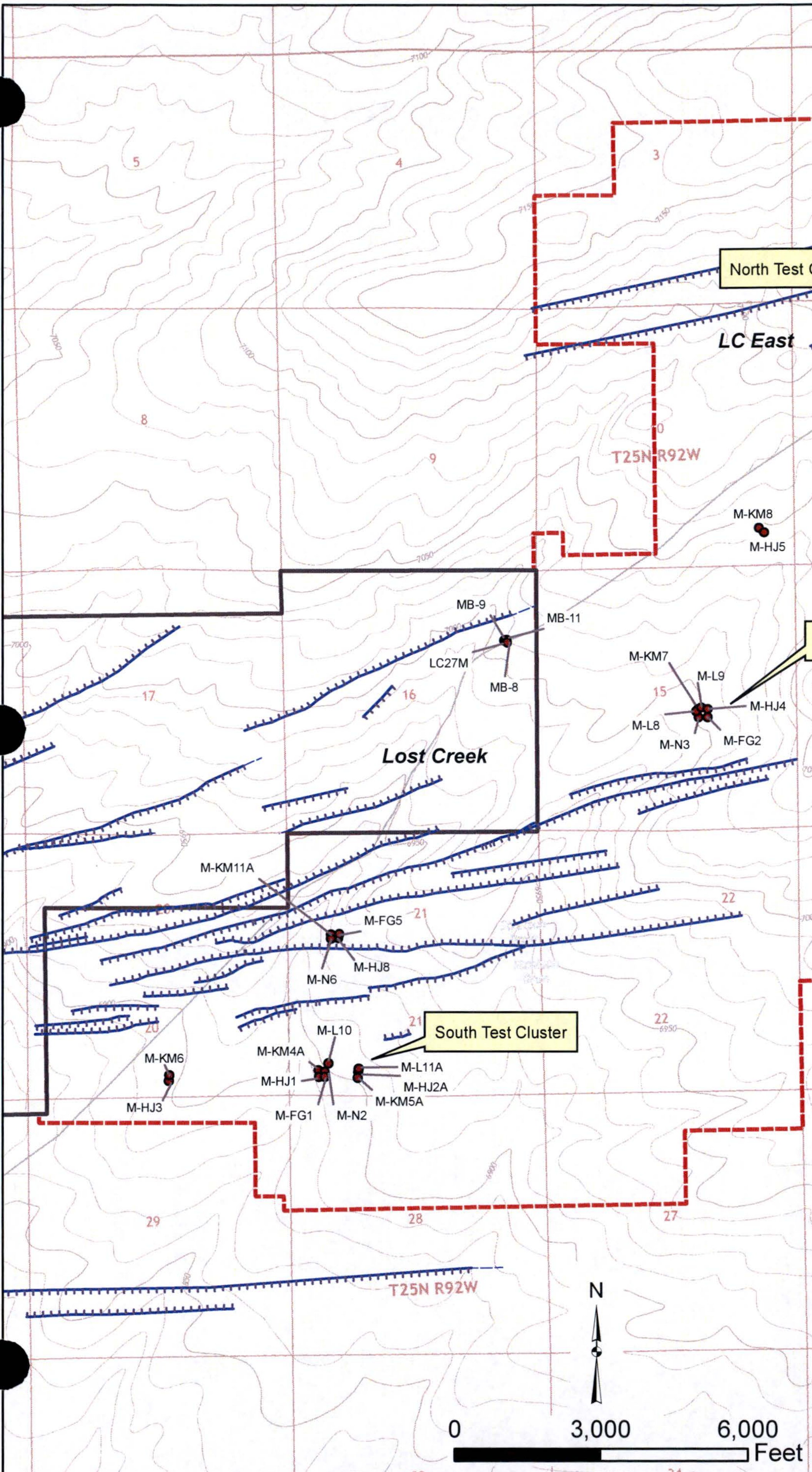

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Figure 3.5-6
LC East
Monitor and Pump Test Wells
T25N, R92W
Sweetwater County, Wyoming
Issued/Revised: December 2016

Legend

- Monitor Well
- Normal Fault
- Lost Creek East Permit Area
- Lost Creek Permit Area

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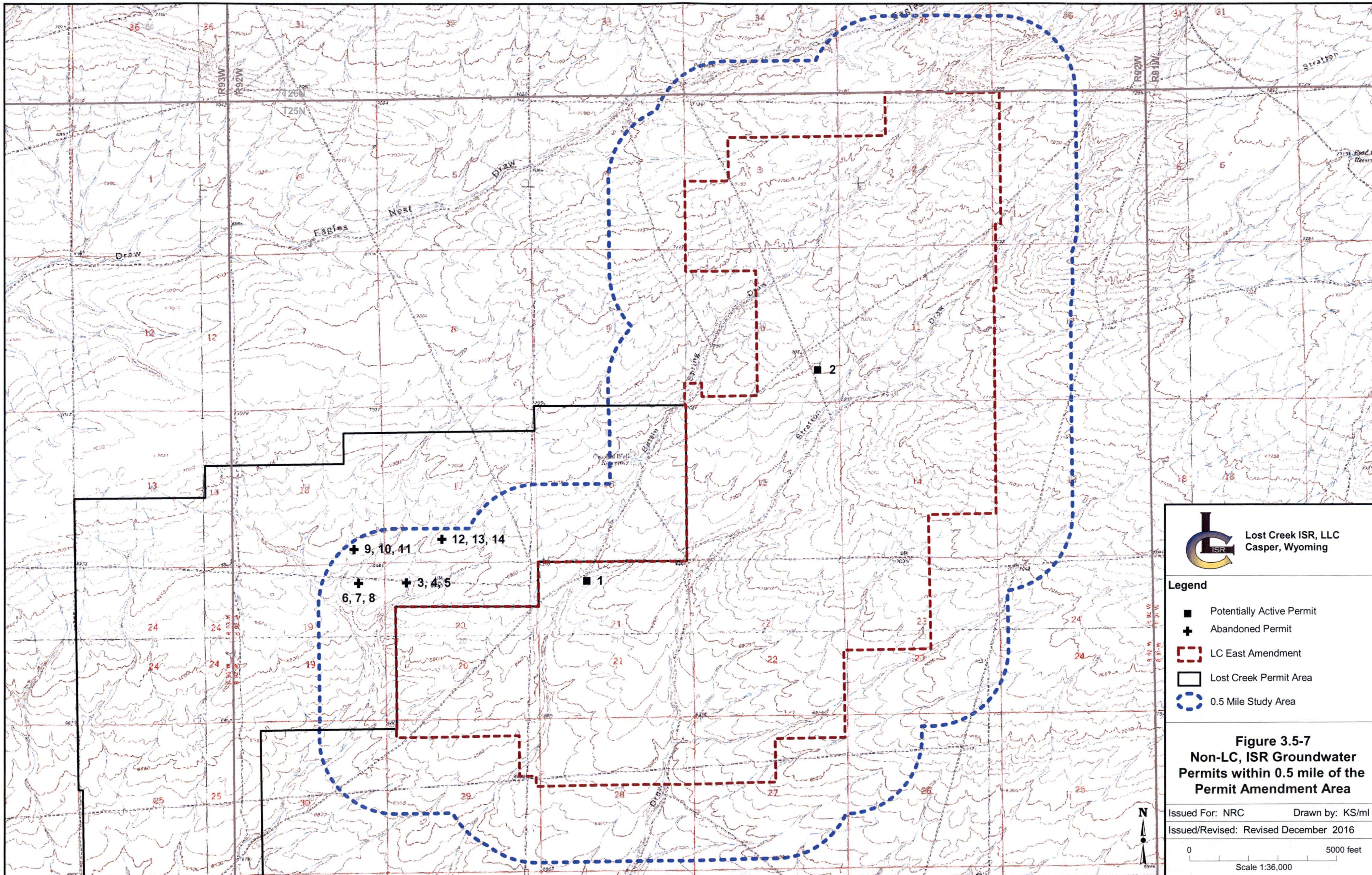

Figure 3.5-7
Non-LC, ISR Groundwater Permits within 0.5 mile of the Permit Amendment Area

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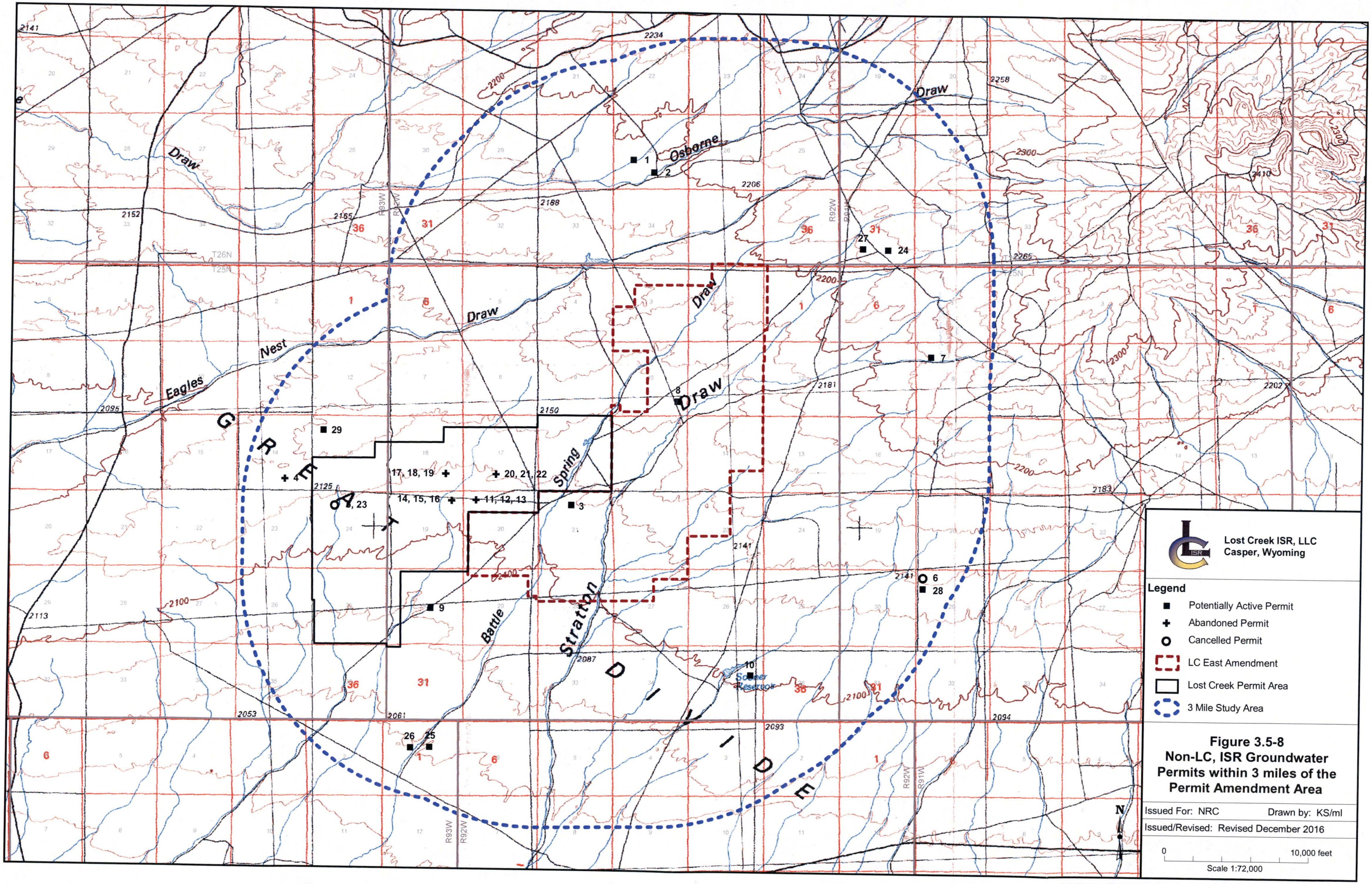

Figure 3.5-8
Non-LC, ISR Groundwater Permits within 3 miles of the Permit Amendment Area

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Drawn by: KS/ml
Issued/Revised: Revised December 2016

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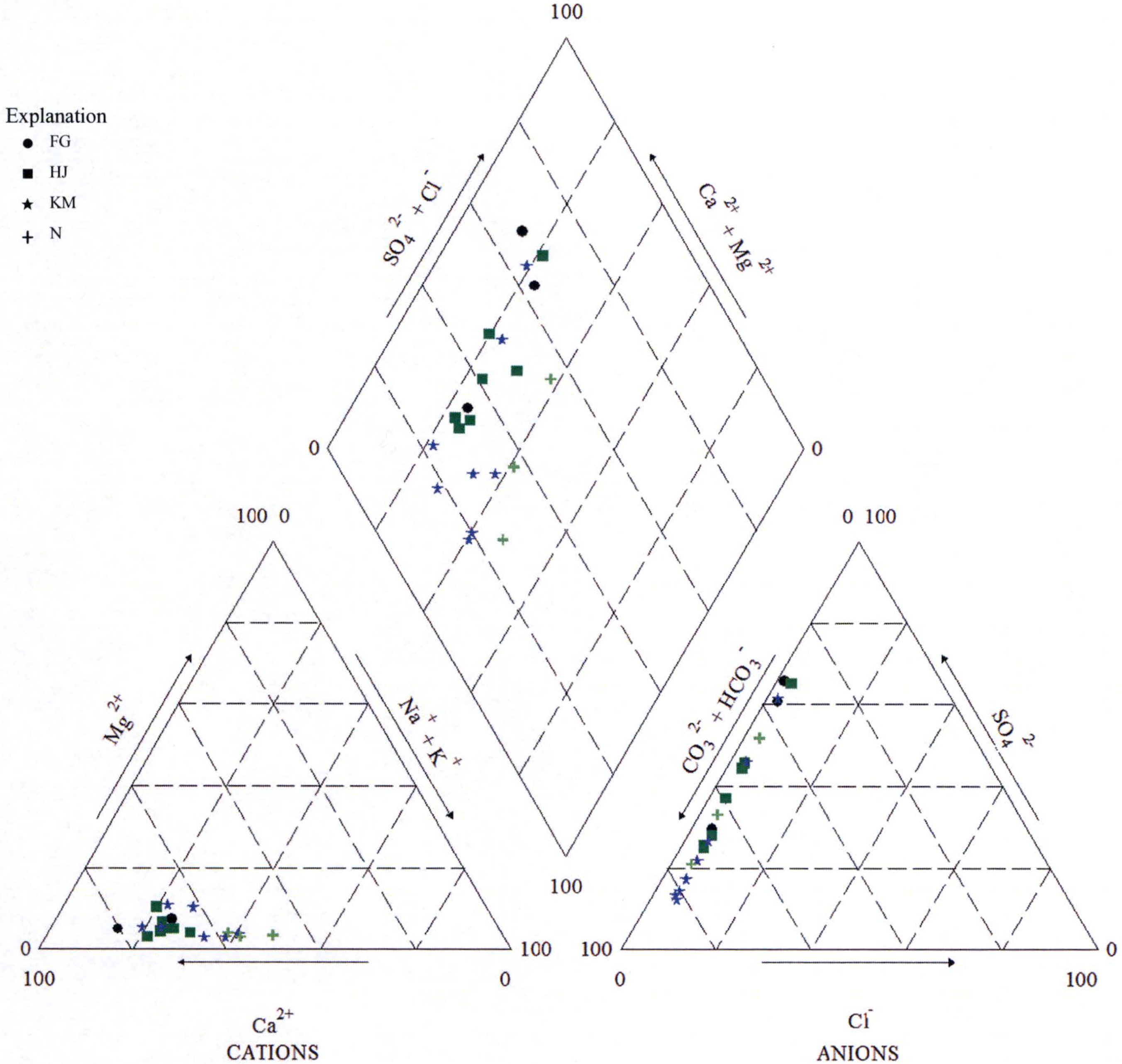

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Figure 3.5-9

Piper Diagram - Background Water Quality for Individual FG, HJ, KM, and N Horizon Wells

LC East Amendment

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Issued/Revised: Revised December 2016

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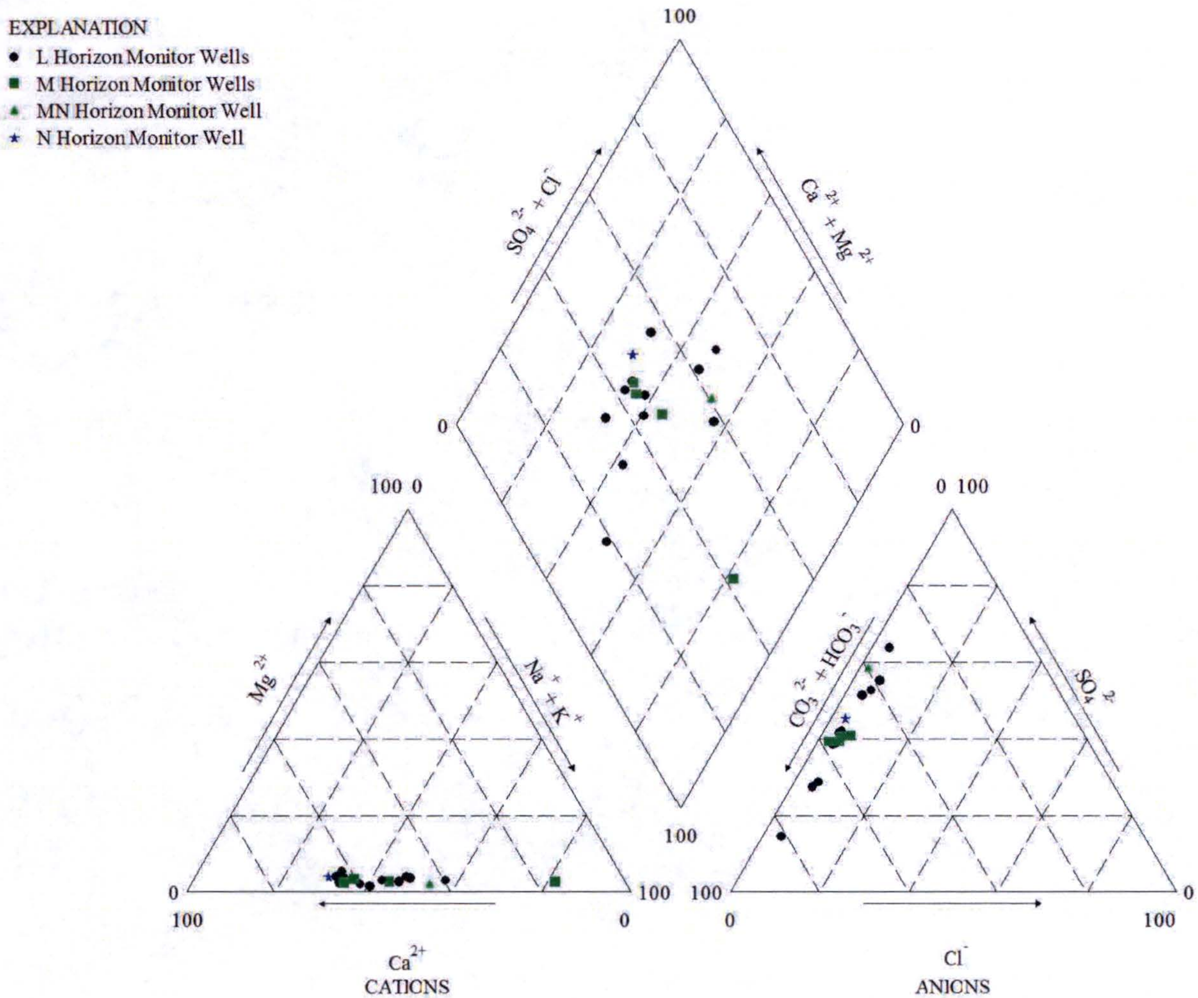

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FIGURE 3.5-10

Piper Diagram - Background Water Quality for Individual L, M, MN, and N Horizon Wells

LC East Amendment

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Issued / Revised: December 2016

Drawing No. Fig3.5-10_PiperDiagramIndiv_L_M_MN_N.dwg

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Table 3.5-1 Surface-Water Permits within Three Miles of the Permit Amendment Area (Page 1 of 1)

Last Revised April, 2014

Map ID	Permit Number	Applicant	Township	Range	Section	¼¼	Uses	Priority	Status	Permit Facility Name	Source	Amount (ac-ft)
1	P10542.0S		25 N	91 W	5	SENW	STO	12/29/1988	Complete	Road Crossing Stock Resevoir	Middle Fork	1.17
2	P3539.0R	Dora Robinson	25 N	92 W	26	SENE	IRR, SW, STO	3/15/1919	Expired	Robinson Reservoir	Corrall Creek	3.9
3	P13595.0R	Lost Creek ISR, LLS	25 N	92 W	18	NWSE	IND, SW	2/17/2010	Complete	Ponds 1 and 2	Blue Gulch	4.58

Table 3.5-2 Historic Water Quality Results for West/East Battle Spring Draw

Laboratory Analysis Report		Sample ID:	LC2	LC3	LC4	LC9	LC13
		Lab ID:	C13031024-001				
		Sample Matrix:	Stormwater	Stormwater	Stormwater	Stormwater	Stormwater
		Sample Date:	3/28/2013	10/23/2013	10/28/2013	10/23/2013	3/27/2013
		Report Date:	4/8/2013	12/12/2013	12/12/2013	11/25/2013	4/15/2013
Metals - Dissolved	RL	Units					
Uranium	0.0003	mg/L	0.0595	ND	0.0143	ND	0.0006
Metals - Suspended							
Uranium	0.0003	mg/L	ND				
Radionuclides - Dissolved							
Radium 226		pCi/L	1.40				
Radium 226 precision (+/-)		pCi/L	0.23				
Radium 226 MDC		pCi/L	0.20				
Thorium 230		pCi/L	0.2				
Thorium 230 precision (+/-)		pCi/L	0.2				
Thorium 230 MDC		pCi/L	0.2				
Radionuclides - Suspended							
Radium 226		pCi/L	0.002				
Radium 226 precision (+/-)		pCi/L	0.0008				
Radium 226 MDC		pCi/L	0.0008				
Thorium 230		pCi/L	0.0010				
Thorium 230 precision (+/-)		pCi/L	0.0003				
Thorium 230 MDC		pCi/L	0.0003				

RL = Analyte reporting limit.
ND = Not detected at the reporting limit.
MDC = Minimum detectable concentration.
mg/L = milligrams per liter.
pCi/L = picoCuries per liter.

Table 3.5-3 2013 Water Quality Results for Storm Water / Spring Snow Melt Samplers

Laboratory Analysis Report		Sample ID:	SS-8	SS-8	SS-9	SS-10	SS-12	SS-12	SS-13	SS-14
		Lab ID:	C13031028-001	C13110150-001	C13110150-002	C13100898-002	C13031028-002	C13110150-004	C13100898-003	C13110150-003
		Sample Matrix:	Stormwater	Stormwater	Stormwater	Stormwater	Stormwater	Stormwater	Stormwater	Stormwater
		Sample Date:	3/27/2013	10/23/2013	10/28/2013	10/23/2013	3/27/2013	10/29/2013	10/23/2013	10/29/2013
		Report Date:	4/15/2013	12/12/2013	12/12/2013	11/25/2013	4/15/2013	12/12/2013	11/25/2013	12/12/2013
Metals - Dissolved	RL	Units								
Uranium	0.0003	mg/L	ND	ND	ND	0.0005	ND	ND	ND	ND
Metals - Suspended										
Uranium	0.0006	mg/L	ND	0.0240	0.0447	0.0368	ND	0.106	0.0233	0.100
Radionuclides - Dissolved										
Radium 226		pCi/L	0.60	0.57	1.6	4.9	0.50	5.1	1.4	0.11
Radium 226 precision (+/-)		pCi/L	0.17	0.27	0.39	0.58	0.16	0.65	0.34	0.68
Radium 226 MDC		pCi/L	0.19	0.32	0.31	0.25	0.20	0.31	0.26	1.2
Thorium 230		pCi/L	0.2	0.3	0.2	0.4	0.3	0.2	0.08	0.4
Thorium 230 precision (+/-)		pCi/L	0.2	0.3	0.2	0.4	0.2	0.2	0.1	0.6
Thorium 230 MDC		pCi/L	0.2	0.4	0.3	0.6	0.2	0.3	0.3	1.3
Radionuclides - Suspended										
Radium 226		pCi/L	0.001	24	39	38	0.001	105	24	103
Radium 226 precision (+/-)		pCi/L	0.0006	3.4	4.3	4.9	0.0007	6.8	3.4	13
Radium 226 MDC		pCi/L	0.0008	1.9	1.9	2.6	0.0009	1.9	1.9	6.1
Thorium 230		pCi/L	0.0006	9.6	12.3	14.9	0.0008	47.8	8.8	41.8
Thorium 230 precision (+/-)		pCi/L	0.0002	2.6	3.3	3.1	0.0003	8.5	2.1	10.9
Thorium 230 MDC		pCi/L	0.0003	1.3	1.7	1.3	0.0003	1.5	1	4.9

RL = Analyte reporting limit.
ND = Not detected at the reporting limit.
MDC = Minimum detectable concentration.
mg/L = milligrams per liter.
pCi/L = picoCuries per liter.

Table 3.5-4 Well Completion Information by Cluster (2013 Wells) (Page 1 of 2)

Well ID	Well Type	Completion Horizon	NAD 83 Northing	NAD 83 Easting	Distance from Pumping Well (ft)	Ground Elevation (ft amsl)	MP Elev. (ft amsl)	Depth To SWL[1] (ft TOC)	SWL Elev. (ft amsl)	Screened Interval (ft bgs)	Total Screen Length (ft)
Northern Cluster Monitor Wells											
M-KM9	Pumping Well	KM	604,036.79	2,229,994.86	0	7092.31	7,094.98	144.32	6,950.66	285-370	85
M-HJ6	Overlying Obs. Well	HJ	604,051.04	2,230,244.38	250	7,094.37	7,097.16	141.35	6,955.81	153-240	87
M-N4	Underlying Obs. Well	N	604,174.64	2,230,126.67	191	7,095.74	7,098.83	259.62	6,839.21	615-650	35
M-KM10	Observation Well	KM	608,598.34	2,229,803.58	4,566	7,148.44	7,150.80	164.14	6,986.66	220-285	65
M-N5A	Underlying Obs. Well	N	608,449.31	2,229,938.28	4,413	7,150.57	7,153.29	253.42	6,899.87	550-580	30
M-HJ5	Overlying Obs. Well	HJ	601,893.94	2,226,868.24	3,790	7,045.52	7,047.52	135.75	6,911.77	220-300	80
M-KM8	Observation Well	KM	601,980.87	2,226,775.70	3,820	7,045.45	7,047.95	159.36	6,888.59	340-420	80
M-FG2	Overlying Obs. Well	FG	598,179.70	2,225,723.62	7,249	7,004.00	7,004.42	109.80	6,894.62	180-210	30
M-HJ4	Overlying Obs. Well	HJ	598,329.96	2,225,724.97	7,127	7,006.34	7,006.89	127.55	6,879.34	245-340	95
M-KM7	Observation Well	KM	598,334.23	2,225,536.77	7,238	6,998.43	6,999.20	152.60	6,846.60	380-460	80
M-N3	Underlying Obs. Well	M/N	598,178.32	2,225,539.26	7,360	7,001.02	7,003.33	292.00	6,711.33	660-700	40
LC27M	Observation Well	KM	599,720.80	2,221,566.14	9,469	7,009.95	7,012.32	191.38	6,820.94	433-456	23
Center Cluster Monitor Wells											
M-KM7	Pumping Well	KM	598,334.23	2,225,536.77	0	6,998.43	6,999.20	152.6	6846.60	380-460	80
M-FG2	Overlying Obs. Well	FG	598,179.70	2,225,723.62	242	7,004.00	7,004.42	109.80	6,894.62	180-210	30
M-HJ4	Overlying Obs. Well	HJ	598,329.96	2,225,724.97	188	7,006.34	7,006.89	127.55	6,879.34	245-340	95
M-N3	Underlying Obs. Well	M/N	598,178.32	2,225,539.26	156	7,001.02	7,003.33	292.00	6,711.33	660-700	40
M-HJ5	Overlying Obs. Well	HJ	601,893.94	2,226,868.24	3,801	7,045.52	7,047.52	135.75	6,911.77	220-300	80
M-KM8	Observation Well	KM	601,980.87	2,226,775.70	3,851	7,045.45	7,047.95	159.36	6,888.59	340-420	80
MB-08	Overlying Obs. Well	FG	599,682.73	2,221,637.15	4,126	7,008.94	7,010.40	171.85	6,838.55	230-260	30
MB-09	Overlying Obs. Well	HJ	599,729.08	2,221,601.97	4,175	7,010.34	7,012.19	184.44	6,827.75	340-370	30
LC27M	Observation Well	KM	599,720.80	2,221,566.14	4,206	7,009.95	7,012.32	191.38	6,820.94	433-456	23
South Cluster Monitor Wells											
M-KM4A	Pumping Well	KM	591,042.42	2,217,802.71	0	6,896.27	6,897.94	161.20	6,736.74	365-450	85
M-FG1	Overlying Obs. Well	FG	590,915.99	2,217,934.64	183	6,899.01	6,901.90	124.10	6,777.80	150-190	40
M-HJ1	Overlying Obs. Well	HJ	590,917.89	2,217,809.69	125	6,895.97	6,897.55	149.82	6,747.73	220-340	120
M-N2	Underlying Obs. Well	M/N	591,019.25	2,217,935.84	135	6,901.42	6,904.27	173.94	6,730.33	659-720	61
M-HJ2A	Overlying Obs. Well	HJ	590,894.76	2,218,596.42	807	6,902.03	6,904.25	155.62	6,748.63	213-340	127
M-KM5A	Observation Well	KM	591,006.21	2,218,600.20	798	6,904.56	6,906.91	170.37	6,736.54	370-470	100
M-HJ3	Overlying Obs. Well	HJ	590,830.74	2,214,766.97	3,043	6,893.52	6,895.47	157.66	6,737.81	250-370	120
M-KM6	Observation Well	KM	590,941.64	2,214,767.41	3,037	6,891.63	6,894.09	163.58	6,730.51	400-500	100
M-FG5	Overlying Obs. Well	FG	593,787.33	2,218,219.75	2,776	6,928.59	6,930.05	133.64	6,796.41	268-300	32
M-HJ8	Overlying Obs. Well	HJ	593,693.99	2,218,207.02	2,682	6,926.92	6,929.86	166.15	6,763.71	327-430	103
M-KM11A	Observation Well	KM	593,775.19	2,218,048.35	2,744	6,927.20	6,930.39	175.17	6,755.22	475-585	110
M-N6	Underlying Obs. Well	N	593,682.11	2,218,050.04	2,651	6,926.19	6,928.58	190.27	6,738.31	790-865	75

Table 3.5-4 Well Completion Information by Cluster (2013) (Page 2 of 2)

Well ID	Well Type	Completion Horizon	NAD 83 Northing	NAD 83 Easting	Distance from Pumping Well (ft)	Ground Elevation (ft amsl)	MP Elev. (ft amsl)	Depth To SWL[1] (ft TOC)	SWL Elev. (ft amsl)	Screened Interval (ft bgs)	Total Screen Length (ft)
Center Cluster Monitor Wells											
M-HJ4	Pumping Well	HJ	598,329.96	2,225,724.97	0	7,006.34	7,006.89	127.55	6,879.34	245-340	95
M-FG2	Overlying Obs. Well	FG	598,179.70	2,225,723.64	150	7,004.00	7,004.42	109.80	6,894.62	180-210	30
M-KM7	Underlying Obs. Well	KM	598,334.23	2,225,536.77	188	6,998.43	6,999.20	152.60	6,846.60	380-460	80
M-N3	Underlying Obs. Well	M/N	598,178.32	2,225,539.26	240	7,001.02	7,003.33	292.00	6,711.33	660-700	40
M-HJ5	Observation Well	HJ	601,893.94	2,226,868.24	3,743	7,045.52	7,047.52	135.75	6,911.77	220-300	80
M-KM8	Underlying Obs. Well	KM	601,980.87	2,226,775.70	3,799	7,045.45	7,047.95	159.36	6,888.59	340-420	80
MB-08	Overlying Obs. Well	FG	599,682.73	2,221,637.15	4,306	7,008.94	7,010.40	171.85	6,838.55	230-260	30
MB-09	Observation Well	HJ	599,729.08	2,221,601.97	4,354	7,010.34	7,012.19	184.44	6,827.75	340-370	30
LC27M	Underlying Obs. Well	KM	599,720.80	2,221,566.14	4,385	7,009.95	7,012.32	191.38	6,820.94	433-456	23
South Cluster Monitor Wells											
M-HJ1	Pumping Well	HJ	590,917.89	2,217,809.69	0	6,895.97	6,897.55	149.82	6,747.73	220-340	120
M-FG1	Overlying Obs. Well	FG	590,915.99	2,217,934.64	125	6,899.01	6,901.90	124.10	6,777.80	150-190	40
M-KM4A	Underlying Obs. Well	KM	591,042.42	2,217,802.71	125	6,896.27	6,897.94	161.2	6,736.74	365-450	85
M-N2	Underlying Obs. Well	M/N	591,019.25	2,217,935.84	162	6,901.42	6,904.27	173.94	6,730.33	659-720	61
M-HJ2A	Observation Well	HJ	590,894.76	2,218,596.42	787	6,902.03	6,904.25	155.62	6,748.63	213-340	127
M-KM5A	Underlying Obs. Well	KM	591,006.21	2,218,600.20	795	6,904.56	6,906.91	170.37	6,736.54	370-470	100
M-HJ3	Observation Well	HJ	590,830.74	2,214,766.97	3,044	6,893.52	6,895.47	157.66	6,737.81	250-370	120
M-KM6	Underlying Obs. Well	KM	590,941.64	2,214,767.41	3,042	6,891.63	6,894.09	163.58	6,730.51	400-500	100
M-FG5	Overlying Obs. Well	FG	593,787.33	2,218,219.75	2,899	6,928.59	6,930.05	133.64	6,796.41	268-300	32
M-HJ8	Observation Well	HJ	593,693.99	2,218,207.02	2,804	6,926.92	6,929.86	166.15	6,763.71	327-430	103
M-KM11A	Underlying Obs. Well	KM	593,775.19	2,218,048.35	2,867	6,927.20	6,930.39	175.17	6,755.22	475-585	110
M-N6	Underlying Obs. Well	N	593,682.11	2,218,050.04	2,775	6,926.19	6,928.58	190.27	6,738.31	790-865	75

Notes:
amsl = above mean sea level
bgs = below ground surface
ft = feet
NAD = North American Datum
MP = Measurement Point
[1] = Measurements 3/10/2014

Table 3.5-5 - Well Completion Information By Cluster - L Horizon Tests (2016)

Well ID	Well Type	Completion Horizon	NAD 83 Northing	NAD 83 Easting	Distance from Pumping Well (ft)	Ground Elevation (ft amsl)	MP Elev. (ft amsl)	Depth To SWL[1] (ft MP)	SWL[1] Elev. (ft amsl)	Screened Interval (ft bgs)	Total Screen Length (ft)
Northern Cluster Monitor Wells											
M-L7	Pumped Well	L	603,999.5	2,230,186.3	0	7,088.68	7,090.18	154.97	6,935.21	400-500	100
M-KM9	Overlying Obs. Well	KM	604,036.8	2,229,994.9	195	7,092.31	7,094.98	142.25	6,952.73	285-370	85
M-L6	Observation Well	L	604,040.0	2,230,042.8	149	7,087.86	7,089.81	158.04	6,931.77	433-443	10
M-N4	Underlying Obs. Well	N	604,174.6	2,230,126.7	185	7,095.74	7,098.83	258.85	6,839.98	615-650	35
Center Cluster Monitor Wells											
M-L9	Pumped Well	L	598,363.2	2,225,592.7	0	7,000.26	7,001.86	173.39	6,828.47	510-570	60
M-KM7	Overlying Obs. Well	KM	598,334.2	2,225,536.8	63	6,998.43	6,999.20	153.74	6,845.46	380-460	80
M-KM8	Overlying Obs. Well	KM	601,980.9	2,226,775.7	3,806	7,045.45	7,047.95	158.35	6,889.60	340-420	80
LC27M	Overlying Obs. Well	KM	599,720.8	2,221,566.1	4,249	7,009.95	7,012.32	191.95	6,820.37	433-456	23
MB11	Observation Well	L	599,739.4	2,221,626.9	4,198	7,010.38	7,012.60	202.00	6,810.60	560-590	30
M-L8	Observation Well	L	598,293.8	2,225,494.7	120	6,997.10	6,998.12	174.57	6,823.55	535-555	20
M-N3	Underlying Obs. Well	M/N	598,178.3	2,225,539.3	192	7,001.02	7,003.33	271.75	6,731.58	660-700	40
South Cluster Monitor Wells											
M-L11A	Pumped Well	L	591,077.01	2,218,613.1	0	6,906.85	6,909.13	173.28	6,735.85	505-565	60
M-KM4A	Overlying Obs. Well	KM	591,042.4	2,217,802.7	811	6,896.27	6,897.94	162.45	6,735.49	365-450	85
M-KM5A	Overlying Obs. Well	KM	591,006.2	2,218,600.2	72	6,904.56	6,906.91	169.97	6,736.94	370-470	100
M-L10	Observation Well	L	591,183.4	2,217,999.1	623	6,904.06	6,906.21	172.22	6,733.99	520-540	20
M-N2	Underlying Obs. Well	N	591,019.3	2,217,935.8	680	6,901.42	6,904.27	172.88	6,731.39	659-720	61

[1]SWL = Static Water Level

[1]TOC = Top of Casing

MP = Measuring Point

amsl = Above Mean Sea Level

bgs = Below Ground Surface

Table 3.5-6 Non-LC ISR, LLC Groundwater Use Permits within a 0.5 Mile Radius - Wyoming State Engineer Records December 2014 (Page 1 of 1)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
1	Well	P13834P	USDI BLM, Rawlins District	25 N	92 W	21	NENW	Stock	9/21/1968	Good Standing	Battle Spring Draw Well No. 4451	19	900	104
2	Well	P55112W	USDI BLM, Rawlins District	25 N	92 W	10	SESE	Stock	12/24/1980	Good Standing	Boundary Well No. 4775	5	280	155
3	Well	P61528W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1S	0	355	155.8
4	Well	P61529W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1M	0	440	173.8
5	Well	P61530W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1D	0	534	181.2
6	Well	P61531W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 3M	0	460	176.5
7	Well	P61532W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 2M	0	460	175.9
8	Well	P61533W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 1M	0	460	174.4
9	Well	P61534W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 19 18 1M	0	465	166.7
10	Well	P61535W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 19 18 1S	0	355	159.5
11	Well	P61536W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 92 18 1D	0	615	195.7
12	Well	P61537W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1S	0	340	170.53
13	Well	P61538W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1M	0	480	182.7
14	Well	P61539W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1D	0	529	204.5

[1] Each number represents a well. Well locations are shown on Figure 3.5-7.
[2] USDI BLM = United States Department of Interior's Bureau of Land Management.

Table 3.5-7 **Non-LC ISR, LLC Groundwater Use Permits within a 3 Mile Radius - Wyoming State Engineer Records December 2014** (Page 1 of 5)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼ [3]	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
1	Well	P10696P	INP	26 N	92 W	27	NESW	Stock	1/10/1942	Complete	Osbourne Draw Well #123	5	237	-1
2	Well	P8444P	INP	26 N	92 W	27	SWSE	Stock	12/31/1946	Complete	Osborne #1	10	280	250
3	Well	P13834P	USDI BLM, Rawlins District	25 N	92 W	21	NENW	Stock	9/21/1968	Good Standing	Battle Spring Draw Well No. 4451	19	900	104
	Well [5]	P9742W	Kennecott Uranium Company	24 N	94 W	34	NENE	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1	INP	INP	INP
	Use Point	P9742W	Kennecott Uranium Company	24 N	93 W	1	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	24 N	93 W	2	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	24 N	93 W	3	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	24 N	93 W	12	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	1	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	11	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	12	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	13	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	14	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	23	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	24	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	25	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	26	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	35	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
	Use Point	P9742W	Kennecott Uranium Company	25 N	93 W	36	INP	Stock, Industrial	7/15/1971	Adjudicated	J E S No. 1			
4	Well	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24	INP	INP	INP
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			

Table 3.5-7 Non-LC ISR, LLC Groundwater Use Permits within a 3 Mile Radius - Wyoming State Engineer Records December 2014 (Page 2 of 5)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼ [3]	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SESW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NESE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NWSE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NESW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NWSW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SWSW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENW	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
	Use Point	P35721W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNE	Stock, Miscellaneous	12/8/1976	Abandoned	TE 24			
5	Well	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENW	Miscellaneous	5/5/1977	Cancelled	TE 38	25	380	220
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SWSE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SESE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NESE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NWSE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSW	Miscellaneous	5/5/1977	Cancelled	TE 38			

Table 3.5-7 Non-LC ISR, LLC Groundwater Use Permits within a 3 Mile Radius - Wyoming State Engineer Records December 2014 (Page 3 of 5)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼ [3]	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENW	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENE	Miscellaneous	5/5/1977	Cancelled	TE 38			
	Use Point	P37637W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNE	Miscellaneous	5/5/1977	Cancelled	TE 38			
6	Well	P46274W	INP	25 N	91 W	29	NWNW	Miscellaneous	1/10/1979	Cancelled	Eagles Nest #1	INP	INP	INP
7	Well	P55111W	USDI BLM, Rawlins District	25 N	91 W	8	NWNW	Stock	12/24/1980	Complete	Road Crossing	5	300	199
8	Well	P55112W	USDI BLM, Rawlins District	25 N	92 W	10	SESE	Stock	12/24/1980	Good Standing	Boundary Well No. 4775	5	280	155
9	Well	P55113W	USDI BLM, Rawlins District	25 N	92 W	30	NWSE	Stock	12/24/1980	Good Standing	Battle Springs Well No. 4777	5	220	109
10	Well	P55114W	BLM - Rawlins District	25 N	92 W	35	SENE	Stock	12/24/1980	Good Standing	Sooner	5	320	237
11	Well	P61528W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1S	0	355	155.8
12	Well	P61529W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1M	0	440	173.8
13	Well	P61530W	Texasgulf Inc.	25 N	92 W	20	NWNW	Monitoring	6/11/1982	Abandoned	M25 92 20 1D	0	534	181.2
14	Well	P61531W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 3M	0	460	176.5
15	Well	P61532W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 2M	0	460	175.9
16	Well	P61533W	Texasgulf Inc.	25 N	92 W	19	NENE	Monitoring	6/11/1982	Abandoned	M25 92 19 1M	0	460	174.4
17	Well	P61534W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 19 18 1M	0	465	166.7
18	Well	P61535W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 19 18 1S	0	355	159.5
19	Well	P61536W	Texasgulf Inc.	25 N	92 W	18	SESE	Monitoring	6/11/1982	Abandoned	M25 92 18 1D	0	615	195.7
20	Well	P61537W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1S	0	340	170.53
21	Well	P61538W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1M	0	480	182.7
22	Well	P61539W	Texasgulf Inc.	25 N	92 W	17	SESW	Monitoring	6/11/1982	Abandoned	M25 92 17 1D	0	529	204.5
23	Well	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENW	Miscellaneous	8/10/1984	Cancelled	TE 38	25	380	220
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SESE	Miscellaneous	8/10/1984	Cancelled	TE 38			

Table 3.5-7 Non-LC ISR, LLC Groundwater Use Permits within a 3 Mile Radius - Wyoming State Engineer Records December 2014 (Page 4 of 5)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼ [3]	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NESE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	NWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	12	SWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SESW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NESW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWSW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWSW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	SENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	13	NENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SWSE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SESE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SWSW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	SESW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NESE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NESW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	14	NWSW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	NWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	23	SWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENW	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NENE	Miscellaneous	8/10/1984	Cancelled	TE 38			
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	NWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			

Table 3.5-7 Non-LC ISR, LLC Groundwater Use Permits within a 3 Mile Radius - Wyoming State Engineer Records December 2014 (Page 5 of 5)

ID [1]	Well or Use Point	Permit Number	Applicant [2]	Township	Range	Section	¼ of the ¼ [3]	Uses	Priority	Status	Permit Facility Name	Yield (gpm)	Well Depth (ft)	Static Well Depth (ft)
	Use Point	P68449W	USDI, BLM -- Texasgulf Inc.	25 N	93 W	24	SWNE	Miscellaneous	8/10/1984	Cancelled	TE 38			
24	Well	P97275W	Celsius Energy -- USDI, BLM	26 N	91 W	31	SWSE	Miscellaneous	9/19/1994	Cancelled	Eagle Water Well #1	100	570	220
25	Well	P147594W	Kennecott Uranium Company	24 N	93 W	1	SWNE	Monitoring	10/22/2002	Good Standing	TMW-90	INP	55	36.13
26	Well	P147595W	Kennecott Uranium Company	24 N	93 W	1	SENW	Monitoring	10/22/2002	Good Standing	TMW-91	INP	110	100.17
27	Well	P165566W	INP	26 N	91 W	31	SESW	Miscellaneous	3/8/2005	Cancelled	Eagle Water Well #1	100	570	300
28	Well	P183470W	USDI BLM, Rawlins District	25 N	91 W	29	NWNW	Stock, Miscellaneous	8/27/2007	Complete	Driller's Well	25	540	60
29	Well	[4]	USDI BLM, Rawlins District	25 N	93 W	13	NWNW	Stock			East Eagle Nest Draw Well	5	370	269

[1] Each number represents a well. Well locations are shown on Figure 3.5-8.
(yellow box) = Well within three miles of the Permit Area.
(white box) = Point of use within three miles of the Permit Area.

[2] USDI BLM = United States Department of Interior's Bureau of Land Management.

[3] INP = Information not provided by the online WSEO database.

[4] This well does not currently have an associated WSEO permit number.

[5] Well not located within the 3-mile radius, but some corresponding "Points of Use" are.

Table 3.5-8 LC ISR, LLC Affiliates Groundwater Use Permits - Wyoming State Engineer Records April 2014 (Page 1 of 7)

WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P169906.0W	09/12/2005	Cancelled	LOST CREEK ISR, LLC	LCIW	MIS	025N	093W	24	NE1/4NW1/4	25		
P175260.0W	06/09/2006	Complete	LOST CREEK ISR, LLC	LC15M, LC16M, LC17M, LC29M	MON	025N	092W	20	NW1/4NW1/4	0	565.00	184
P175261.0W	06/09/2006	Complete	USDI - BLM	LC18M, LC19M, LC20M,	MON	025N	092W	17	SW1/4SW1/4	0	543.00	201
P175262.0W	06/09/2006	Complete	USDI - BLM	LC21M, LC22M, LC23M, LC30M	MON	025N	093W	24	SW1/4NE1/4	0	630.00	219
P175263.0W	06/09/2006	Complete	USDI - BLM	LC24M	MON	025N	092W	17	SW1/4SW1/4	0	531.00	192
P175264.0W	06/09/2006	Complete	USDI - BLM	LC25M	MON	025N	092W	19	NE1/4NE1/4	0	349.00	164
P175265.0W	06/09/2006	Complete	USDI - BLM	LC26M	MON	025N	092W	20	NE1/4NE1/4	0	431.00	169
P175266.0W	06/09/2006	Complete	USDI - BLM	LC27M	MON	025N	092W	16	SE1/4NE1/4	0	456.00	188
P175267.0W	06/09/2006	Cancelled	USDI - BLM	LC28M	MON	025N	093W	25	SW1/4SW1/4	0		
P175268.0W	06/09/2006	Complete	USDI - BLM	LC31M	MON	025N	093W	25	SW1/4SW1/4	0	190.00	154
P179826.0W	2/28/2007	Unadjudicated	LOST CREEK ISR, LLC	LC 32W	MIS	025N	092W	17	NW1/4SE1/4	20	878.00	450
P179827.0W	02/28/2007	Unadjudicated	LOST CREEK ISR, LLC	LC 33W	MIS	025N	092W	20	NE1/4NE1/4	20	945.00	400
P179856.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT 101	MON	025N	092W	19	NE1/4NE1/4	0	477.00	174
P179857.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT-102	MON	025N	092W	19	NE1/4NE1/4	0	417.00	171
P179858.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT 103	MON	025N	092W	19	NE1/4NE1/4	0	450.00	188
P179859.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT 104	MON	025N	092W	20	NW1/4NW1/4	0	460.00	170
P179860.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT 105	MON	025N	092W	20	NW1/4NW1/4	0	438.00	170
P179861.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJT 106	MON	025N	092W	20	NW1/4NW1/4	0	162.00	151
P179862.0W	03/01/2007	Complete	USDI - BLM	HJT 107	MON	025N	092W	20	NE1/4NW1/4	0	163.00	162
P179863.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-101	MON	025N	092W	19	NE1/4NE1/4	0	535.00	199
P179864.0W	03/01/2007	Complete	USDI - BLM	HJMP-101	MON	025N	092W	19	NE1/4NE1/4	0	465.00	179
P179865.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-101	MON	025N	092W	19	NE1/4NE1/4	0	326.00	167
P179866.0W	03/01/2007	Complete	USDI - BLM	HJMV-102	MON	025N	092W	19	NE1/4NE1/4	0	525.00	179
P179867.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-102	MON	025N	092W	19	NE1/4NE1/4	0	435.00	171
P179868.0W	03/01/2007	Complete	USDI - BLM	HJMO-102	MON	025N	092W	19	NE1/4NE1/4	0	330.00	155
P179869.0W	03/01/2007	Complete	USDI - BLM	HJMU-103	MON	025N	092W	19	NE1/4NE1/4	0	540.00	190
P179870.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-103	MON	025N	092W	18	SE1/4SE1/4	0	432.00	168
P179871.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-103	MON	025N	092W	19	NE1/4NE1/4	0	327.00	156
P179872.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-104	MON	025N	092W	19	NE1/4NE1/4	0	550.00	193
P179873.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-104	MON	025N	092W	19	NE1/4NE1/4	0	430.00	173
P179874.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-104	MON	025N	092W	19	NE1/4NE1/4	0	326.00	160
P179875.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-105	MON	025N	092W	19	NE1/4NE1/4	0	542.00	191
P179876.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-105	MON	025N	092W	19	NE1/4NE1/4	0	463.00	168
P179877.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-105	MON	025N	092W	19	NE1/4NE1/4	0	323.00	157
P179878.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-106	MON	025N	092W	18	SE1/4SE1/4	0	546.00	192
P179879.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-106	MON	025N	092W	18	SE1/4SE1/4	0	480.00	170

Table 3.5-8 LC ISR, LLC Affiliates Groundwater Use Permits - Wyoming State Engineer Records April 2014 (Page 2 of 7)

WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P179880.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-106	MON	025N	092W	18	SE1/4SE1/4	0	326.00	159
P179881.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-107	MON	025N	092W	20	NW1/4NW1/4	0	580.00	188
P179882.0W	03/01/2007	Complete	USDI - BLM	HJMP-107	MON	025N	092W	20	NW1/4NW1/4	0	460.00	182
P179883.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-107	MON	025N	092W	20	NW1/4NW1/4	0	369.00	161
P179884.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-108	MON	025N	092W	18	SE1/4SE1/4	0	540.00	201
P179885.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-108	MON	025N	092W	18	SE1/4SE1/4	0	434.00	180
P179886.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-108	MON	025N	092W	18	SE1/4SE1/4	0	333.00	167
P179887.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-109	MON	025N	092W	20	NW1/4NW1/4	0	574.00	189
P179888.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-109	MON	025N	092W	20	NW1/4NW1/4	0	512.00	183
P179889.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-109	MON	025N	092W	20	NW1/4NW1/4	0	370.00	160
P179890.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-110	MON	025N	092W	17	SW1/4SW1/4	0	532.00	197
P179891.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-110	MON	025N	092W	17	SW1/4SW1/4	0	476.00	175
P179892.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-110	MON	025N	092W	17	SW1/4SW1/4	0	330.00	162
P179893.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-111	MON	025N	092W	17	SW1/4SW1/4	0	545.00	199
P179894.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-111	MON	025N	092W	17	SW1/4SW1/4	0	440.00	176
P179895.0W	03/01/2007	Complete	NFU WYOMING, LLC	HJMO-111	MON	025N	092W	17	SW1/4SW1/4	0	330.00	164
P179896.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-112	MON	025N	092W	20	NW1/4NW1/4	0	560.00	182
P179897.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-112	MON	025N	092W	20	NW1/4NW1/4	0	400.00	176
P179898.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-112	MON	025N	092W	20	NW1/4NW1/4	0	350.00	155
P179899.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-113	MON	025N	092W	20	NW1/4NW1/4	0	555.00	185
P179900.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-113	MON	025N	092W	20	NW1/4NW1/4	0	462.00	179
P179901.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-113	MON	025N	092W	20	NW1/4NW1/4	0	356.00	157
P179902.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMU-114	MON	025N	092W	20	NE1/4NW1/4	0	553.00	187
P179903.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMP-114	MON	025N	092W	20	NE1/4NW1/4	0	460.00	179
P179904.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	HJMO-114	MON	025N	092W	20	NE1/4NW1/4	0	360.00	156
P179905.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMU-101	MON	025N	092W	20	NW1/4NW1/4	0	630.00	191
P179906.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMP-101	MON	025N	092W	20	NW1/4NW1/4	0	575.00	190
P179907.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMO-101	MON	025N	092W	20	NW1/4NW1/4	0	487.00	178
P179908.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMU-102	MON	025N	092W	17	SW1/4SW1/4	0	580.00	190
P179909.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMP-102	MON	025N	092W	17	SW1/4SW1/4	0	498.00	189
P179910.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMO-102	MON	025N	092W	17	SW1/4SW1/4	0	420.00	165
P179911.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMU-103	MON	025N	092W	17	SW1/4SW1/4	0	590.00	196
P179912.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMP-103	MON	025N	092W	17	SW1/4SW1/4	0	537.00	196
P179913.0W	03/01/2007	Complete	LOST CREEK ISR, LLC	UKMP-103	MON	025N	092W	17	SW1/4SW1/4	0	430.00	173
P188852.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-01	MON	025N	093W	13	SW1/4SE1/4	0	280.00	233
P188853.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-02	MON	025N	093W	13	SW1/4SE1/4	0	450.00	242
P188854.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-03	MON	025N	093W	13	SW1/4SE1/4	0	587.00	259
P188855.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-04	MON	025N	093W	13	SW1/4SE1/4	0	640.00	274

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WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P188856.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-05	MON	025N	093W	25	SW1/4SW1/4	0	325.00	143
P188857.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-06	MON	025N	093W	25	SW1/4SW1/4	0	405.00	141
P188858.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-07	MON	025N	092W	16	SE1/4NE1/4	0	125.00	123
P188859.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-08	MON	025N	092W	16	SE1/4NE1/4	0	260.00	167
P188860.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-09	MON	025N	092W	16	SE1/4NE1/4	0	370.00	183
P188861.0W	09/26/2008	Complete	LOST CREEK ISR, LLC	MB-10	MON	025N	092W	18	SE1/4SE1/4	0	160.00	160
P189072.0W	10/09/2008	Cancelled	LOST CREEK ISR, LLC	DEEP WELL #1	MON	025N	093W	25	SW1/4SW1/4	0	9,933	5,270
P186493.0W	03/19/2008	Cancelled	LOST CREEK ISR, LLC	ENL. LC1W	MIS	025N	093W	24	NE1/4NW1/4	25		
P186494.0W	03/19/2008	Cancelled	LOST CREEK ISR, LLC	LC229W	MIS	025N	092W	18	SW1/4NE1/4	50		
P186531.0W	04/08/2008	Complete	LOST CREEK ISR, LLC	ENLARGEMENT OF WELL LC32W	MIS	025N	092W	17	NW1/4SE1/4	30		
P186532.0W	04/08/2008	Complete	LOST CREEK ISR, LLC	ENLARGEMENT OF WELL LC33W	MIS	025N	092W	20	NE1/4NE1/4	30		
P187664.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NWNW20PW	MON	025N	092W	20	NW1/4NW1/4	0	495.00	185
P187663.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SESE18PW	MON	025N	092W	18	SE1/4SE1/4	0	467.00	171
P187662.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENW20MP	MON	025N	092W	20	NE1/4NW1/4	0	439.00	172
P187661.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENW20MO	MON	025N	092W	20	NE1/4NW1/4	0	340.00	159
P187660.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENW20MU	MON	025N	092W	20	NE1/4NW1/4	0	541.00	188
P187659.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NWNE19MP	MON	025N	092W	19	NW1/4NE1/4	0	438.00	180
P187658.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NWNE19MO	MON	025N	092W	19	NW1/4NE1/4	0	342.00	165
P187657.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NWNE19MU	MON	025N	092W	19	NW1/4NE1/4	0	539.00	195
P187656.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENW19M	MON	025N	092W	19	NE1/4NW1/4	0	472.00	188
P187655.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SWNE19M	MON	025N	092W	19	SW1/4NE1/4	0	488.00	180
P187653.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENE19M	MON	025N	092W	19	NE1/4NE1/4	0	424.00	177
P187652.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NWNW20M	MON	025N	092W	20	NW1/4NW1/4	0	436.00	174
P187651.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	NENW20M	MON	025N	092W	20	NE1/4NW1/4	0	442.00	177
P187650.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SESW17M	MON	025N	092W	17	SE1/4SW1/4	0	436.00	173
P187649.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SWSW17M	MON	025N	092W	17	SW1/4SW1/4	0	428.00	177
P187648.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SESE18M	MON	025N	092W	18	SE1/4SE1/4	0	451.00	183
P187647.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SWSE18M	MON	025N	092W	18	SW1/4SE1/4	0	459.00	185
P187646.0W	07/03/2008	Complete	LOST CREEK ISR, LLC	SESW18M	MON	025N	092W	18	SE1/4SW1/4	0	459.00	183
P188083.0W	07/29/2008	Complete	LOST CREEK ISR	LC 28M	MIS	025N	093W	25	SW1/4SW1/4	25	557.00	155
P189580.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	MB-13	MON	025N	093W	25	SW1/4SW1/4	0	680.00	158
P189581.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	MB-12	MON	025N	093W	13	SW1/4SE1/4	17	770.00	277
P189582.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	MB-11	MON	025N	092W	16	SE1/4NE1/4	0	590.00	198
P189583.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMP-1	MON	025N	092W	20	NE1/4NE1/4	22	505.00	167
P189584.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMP-2	MON	025N	092W	17	SE1/4NE1/4	0	590.00	226
P189585.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMP-3	MON	025N	092W	17	SE1/4SW1/4	0	565.00	204

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WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P189586.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMP-4	MON	025N	092W	18	NE1/4SE1/4	0	600.00	217
P189587.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMP-5	MON	025N	092W	19	SW1/4NE1/4	0	585.00	184
P189588.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMU-1	MON	025N	092W	20	NE1/4NW1/4	0	675.00	192
P189589.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMU-2	MON	025N	092W	20	NW1/4NE1/4	0	650.00	194
P189590.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMU-3	MON	025N	092W	17	SE1/4SW1/4	0	650.00	205
P189591.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KMU-4	MON	025N	092W	19	NE1/4NE1/4	0	635.00	197
P189592.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KPW-1	MON	025N	092W	20	NE1/4NW1/4	0	610.00	188
P189593.0W	02/04/2009	Complete	LOST CREEK ISR, LLC	KPW-2	MON	025N	092W	19	NE1/4NE1/4	0	590.00	193
P189618.0W	02/06/2009	Complete	LOST CREEK ISR, LLC	MB-14	MON	025N	093W	24	SW1/4NE1/4	0	740.00	222
P189619.0W	02/06/2009	Cancelled	LOST CREEK ISR, LLC	MB-15	MON	025N	092W	18	SE1/4SE1/4	0		
P190176.0W	04/20/2009	Complete	LOST CREEK ISR LLC	NWNE20	MON	025N	092W	20	NW1/4NE1/4	0	438.00	174.7
P190300.0W	03/30/2009	Complete	LOST CREEK ISR, LLC	LC606	MIS	025N	093W	25	SE1/4SW1/4	45	740.00	147
P13595.0R	02/17/2010	Complete	LOST CREEK ISR LLC	PONDS 1 AND 2	IND_SW	025N	092W	18	NW1/4SE1/4			
P192101.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-M3	MON	025N	092W	20	NW1/4NE1/4	0		
P192102.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-M2	MON	025N	092W	20	NE1/4NW1/4	0		
P192103.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-UKM1	MON	025N	092W	20	NE1/4NW1/4	0		
P192104.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-L1	MON	025N	092W	20	NE1/4NW1/4	0		
P192105.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-L2	MON	025N	092W	20	NW1/4NE1/4	0		
P192106.0W	01/22/2010	Incomplete	LOST CREEK ISR LLC	M-M1	MON	025N	092W	20	NE1/4NW1/4	0		
P192649.0W	03/15/2010	Incomplete	NFU WYOMING LLC	LCS1W	MIS	025N	092W	29	NE1/4SE1/4	30		
P193897.0W	09/02/2010	Complete	LOST CREEK ISR, LLC	TW1-1	MON	025N	092W	18	SW1/4SE1/4	0	483.00	167
P193898.0W	09/02/2010	Incomplete	LOST CREEK ISR, LLC	TW1-2	MON	025N	092W	19	NE1/4NW1/4	25		
P193899.0W	09/01/2010	Complete	LOST CREEK ISR, LLC	OW1-1	MON	025N	092W	19	NW1/4NE1/4	0	525.00	188
P194688.0W	12/17/2010	Incomplete	LOST CREEK ISR, LLC	M-M4	MON	025N	092W	20	NE1/4NW1/4	0		
P194689.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-M5	MON	025N	092W	20	NW1/4NE1/4	0	775.00	204
P194690.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-M6	MON	025N	092W	17	SE1/4SW1/4	0	750.00	209
P194691.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-M7	MON	025N	092W	20	NW1/4NW1/4	0	770.00	195
P194692.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-L4	MON	025N	092W	20	SE1/4NW1/4	0	670.00	197
P194693.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-L3	MON	025N	092W	20	NW1/4NW1/4	0	700.00	189
P194694.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-KM2	MON	025N	092W	20	NE1/4NW1/4	0	580.00	193
P194695.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-KM1	MON	025N	092W	20	NW1/4NE1/4	0	590.00	194
P194696.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	KPW-3	MON	025N	092W	20	NE1/4NW1/4	0	590.00	97
P194697.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-N1	MON	025N	092W	20	NE1/4NW1/4	0	850.00	205
P194698.0W	12/17/2010	Complete	LOST CREEK ISR, LLC	M-M8	MON	025N	092W	18	SE1/4SE1/4	0	740.00	203
P194699.0W	12/17/2010	Incomplete	LOST CREEK ISR, LLC	M-L5	MON	025N	092W	18	SE1/4SE1/4	0		
P194708.0W	12/20/2010	Complete	LOST CREEK ISR, LLC	5S-KM5	MON	025N	092W	20	NW1/4NE1/4	0	610.00	190
P194709.0W	12/20/2010	Incomplete	LOST CREEK ISR, LLC	5S-L1	MON	025N	092W	20	NE1/4NW1/4	0		
P194710.0W	12/20/2010	Complete	LOST CREEK ISR, LLC	5S-M1	MON	025N	092W	20	NE1/4NW1/4	0	900.00	210

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WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P194711.0W	12/20/2010	Cancelled	LOST CREEK ISR, LLC	5S-KM1	TST	025N	092W	20	NE1/4NW1/4	0	540.00	192.8
P194712.0W	12/20/2010	Cancelled	LOST CREEK ISR, LLC	5S-KM2	TST	025N	092W	20	NE1/4NW1/4	0	540.00	190.1
P194713.0W	12/20/2010	Cancelled	LOST CREEK ISR, LLC	5S-KM3	TST	025N	092W	20	NE1/4NW1/4	0	540.00	192.2
P194714.0W	12/20/2010	Cancelled	LOST CREEK ISR, LLC	5S-KM4	TST	025N	092W	20	NE1/4NW1/4	0	540.00	192.2
P196123.0W	06/07/2011	Complete	NFU WYOMING LLC	LCN1W	MIS	025N	092W	06	SE1/4SE1/4	25	380.00	224
P198439.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-DE1	MON	025N	092W	21	SE1/4SW1/4	0		
P198440.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-FG1	MON	025N	092W	21	SE1/4SW1/4	0		
P198441.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ1	TST	025N	092W	21	SW1/4SW1/4	0		
P198442.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-KM4	TST	025N	092W	21	SW1/4SW1/4	0		
P198443.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-N2	MON	025N	092W	21	SE1/4SW1/4	0		
P198444.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ2	MON	025N	092W	21	SE1/4SW1/4	0		
P198445.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-KM5	MON	025N	092W	21	SE1/4SW1/4	0		
P198446.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ3	MON	025N	092W	20	SW1/4SE1/4	0		
P198447.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-KM6	MON	025N	092W	20	SW1/4SE1/4	0		
P198448.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-DE2	MON	025N	092W	15	NW1/4SE1/4	0		
P198449.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-FG2	MON	025N	092W	15	NW1/4SE1/4	0		
P198450.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ4	TST	025N	092W	15	SW1/4NE1/4	0		
P198451.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-KM7	TST	025N	092W	15	SE1/4NW1/4	0		
P198452.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-N3	MON	025N	092W	15	NE1/4SW1/4	0		
P198453.0W	06/05/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ5	MON	025N	092W	10	SE1/4SE1/4	0		
P198454.0W	06/06/2012	Incomplete	LOST CREEK ISR, LLC	M-KM8	MON	025N	092W	10	SE1/4SE1/4	0		
P198455.0W	06/06/2012	Incomplete	LOST CREEK ISR, LLC	M-FG3	MON	025N	092W	11	SW1/4NE1/4	0		
P198456.0W	06/06/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ6	TST	025N	092W	11	SW1/4NE1/4	0		
P198457.0W	06/06/2012	Incomplete	LOST CREEK ISR, LLC	M-KM9	TST	025N	092W	11	SE1/4NW1/4	0		
P198458.0W	06/06/2012	Incomplete	LOST CREEK ISR, LLC	M-N4	MON	025N	092W	11	NW1/4SE1/4	0		
P198500.0W	06/27/2012	Incomplete	LOST CREEK ISR, LLC	M-FG4	MON	025N	092W	02	NE1/4SW1/4	0		
P198501.0W	06/27/2012	Incomplete	LOST CREEK ISR, LLC	M-HJ7	MON	025N	092W	02	NE1/4SW1/4	0		
P198502.0W	06/27/2012	Incomplete	LOST CREEK ISR, LLC	M-KM10	MON	025N	092W	02	NE1/4SW1/4	0		
P198503.0W	06/27/2012	Incomplete	LOST CREEK ISR, LLC	M-N5	MON	025N	092W	02	NE1/4SW1/4	0		
P198794.0W	05/17/2012	Incomplete	LOST CREEK ISR, LLC	LC229W	MIS	025N	092W	18	NW1/4SE1/4	150	1000.00	300
P198897.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	NWNE19P (UP TO 280 WELLS)	IN+F180:F189D_GW; MIS	025N	092W	19	NW1/4NE1/4	14000		
P198898.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	NENE19P (UP TO 190 WELLS)	IND_GW; MIS	025N	092W	19	NE1/4NE1/4	9500		
P198899.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	SWSE18P (UP TO 10 WELLS)	IND_GW; MIS	025N	092W	18	SW1/4SE1/4	500		
P198900.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	SESE18P (UP TO 100 WELLS)	IND_GW; MIS	025N	092W	18	SE1/4SE1/4	5000		

Table 3.5-8 LC ISR, LLC Affiliates Groundwater Use Permits - Wyoming State Engineer Records April 2014 (Page 6 of 7)

WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P198901.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	NWNW20P (UP TO 170 WELLS)	IND_GW; MIS	025N	092W	20	NW1/4NW1/4	8500		
P198902.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	NENW20P (UP TO 140 WELLS)	IND_GW; MIS	025N	092W	20	NE1/4NW1/4	7000		
P198903.0W	07/06/2012	Incomplete	LOST CREEK ISR, LLC	SWSW17P (UP TO 50 WELLS)	IND_GW; MIS	025N	092W	17	SW1/4SW1/4	2500		
P198926.0W	08/22/2012	Incomplete	LOST CREEK ISR, LLC	LC1007W	MIS	025N	092W	18	SW1/4SE1/4	50		
P198928.0W	09/06/2012	Incomplete	LOST CREEK ISR, LLC	LC1008W	MIS	025N	093W	13	SW1/4SW1/4	50		
P199978.0W	03/20/2013	Incomplete	LOST CREEK ISR, LLC	LC1148W	IND_GW; MIS	025N	092W	18	NW1/4SE1/4	150		
P200456.0W	06/07/2013	Incomplete	LOST CREEK ISR, LLC	M-HJ203	TST	025N	093W	24	SE1/4NE1/4	0		
P200772.0W	07/18/2013	Incomplete	LOST CREEK ISR, LLC	PW201	TST	025N	093W	24	SE1/4NE1/4	0		
P200773.0W	07/18/2013	Incomplete	LOST CREEK ISR, LLC	PW202A	TST	025N	092W	19	NW1/4NW1/4	0		
P200774.0W	07/18/2013	Incomplete	LOST CREEK ISR, LLC	M-HJ211	TST	025N	092W	19	NW1/4NW1/4	0		
P200775.0W	07/18/2013	Incomplete	LOST CREEK ISR, LLC	M-HJ202A	TST	025N	093W	24	SE1/4NE1/4	0		
P201133.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SESE13P (UP TO 6 WELLS)	IND_GW; MIS	025N	093W	13	SE1/4SE1/4	300		
P201134.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SWSW18P (UP TO 17 WELLS)	IND_GW; MIS	025N	092W	18	SW1/4SW1/4	850		
P201135.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NENE24P (UP TO 87 WELLS)	IND_GW; MIS	025N	093W	24	NE1/4NE1/4	4350		
P201136.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NWNW19P (UP TO 230 WELLS)	IND_GW; MIS	025N	092W	19	NW1/4NW1/4	11500		
P201137.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NENW19P (UP TO 460 WELLS)	IND_GW; MIS	025N	092W	19	NE1/4NW1/4	23000		
P201138.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NWNE19P (UP TO 35 WELLS)	IND_GW; MIS	025N	092W	19	NW1/4NE1/4	1750		
P201139.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SENW24P (UP TO 12 WELLS)	IND_GW; MIS	025N	093W	24	SE1/4NW1/4	600		
P201140.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SWNE24P (UP TO 357 WELLS)	IND_GW; MIS	025N	093W	24	SW1/4NE1/4	17850		
P201141.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SENE24P (UP TO 202 WELLS)	IND_GW; MIS	025N	093W	24	SE1/4NE1/4	10100		
P201142.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SWNW19P (UP TO 202 WELLS)	IND_GW; MIS	025N	092W	19	SW1/4NW1/4	10100		
P201143.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SENW19P (UP TO 46 WELLS)	IND_GW; MIS	025N	092W	19	SE1/4NW1/4	2300		
P201144.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	SWNE19P (UP TO 6 WELLS)	IND_GW; MIS	025N	092W	19	SW1/4NE1/4	300		
P201145.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NWSE24P (UP TO 29 WELLS)	IND_GW; MIS	025N	093W	24	NW1/4SE1/4	1450		

Table 3.5-8 LC ISR, LLC Affiliates Groundwater Use Permits - Wyoming State Engineer Records April 2014 (Page 7 of 7)

WR Number	Priority Date	Summary WR Status	Company	Facility Name	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow (CFS) / Appropriation (GPM)	Total Depth (Ft)	Static Water Level (Ft)
P201146.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NESE24P (UP TO 12 WELLS)	IND_GW; MIS	025N	093W	24	NE1/4SE1/4	600		
P201147.0W	09/20/2013	Incomplete	LOST CREEK ISR, LLC	NWSW19P (UP TO 58 WELLS)	IND_GW; MIS	025N	092W	19	NW1/4SW1/4	2900		

Note:
GW = Groundwater
IND = Industrial
MIS = Miscellaneous
MON = Monitor Well
TST = Test Well
SW = Surface Water

Table 3.5-9 Analytical Results for Background Monitor Wells (Page 1 of 4)

Well	Date	Alkalinity, Total as CaCO3 (mg/L)	Carbonate as CO3 (mg/L)	Bicarbonate as HCO3 (mg/L)	Ca (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Mg (mg/L)	Nitrogen, Ammonia as N (mg/L)	Nitrogen, Nitrate+Nitrite as N (mg/L)	K (mg/L)	Silica (mg/L)	Na (mg/L)	Sulfate (mg/L)	Conductivity @ 25 C (umhos/cm)	pH (s.u.)	Solids, Total Dissolved TDS @ 180 C (mg/L)	Al (mg/L)	As (mg/L)	Ba (mg/L)	Bo (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Hg (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)	Fe total (mg/L)	Mn total (mg/L)
M-FG1	12/13/12	106	ND	130	45	5	0.2	3	ND	0.5	3	12.7	17	46	320	8.42	211	ND	0.005	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	0.018	**0.933**	ND	0.03	ND	ND
M-FG1	12/27/12	---	---	---	43	---	---	3	---	---	3	12.9	17	---	---	---	---	ND	0.003	0.09	ND	ND	ND	---	0.04	ND	0.004	ND	0.001	ND	0.017	**0.841**	ND	0.09	---	---
M-FG1	02/14/13	---	ND	122	39	5	0.2	3	ND	ND	3	12.3	18	43	301	**8.53**	203	ND	0.002	0.1	ND	ND	ND	ND	0.16	0.004	0.01	ND	ND	ND	0.013	**0.539**	ND	0.05	0.27	ND
M-FG1	05/20/13	106	ND	129	42	6	0.2	3	ND	ND	3	11.8	18	42	309	8.41	190	ND	ND	0.1	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	0.002	**0.329**	ND	0.04	**0.65**	0.02
M-FG1	09/18/13	114	ND	139	43	5	0.2	3	0.09	ND	2	12.6	17	40	307	8.14	189	ND	ND	ND	ND	ND	ND	ND	0.07	ND	0.01	ND	ND	ND	0.011	**0.320**	ND	0.02	**0.61**	0.02
M-FG2	12/18/12	160	ND	196	157	5	ND	6	0.05	ND	4	19.4	30	**307**	879	7.97	**654**	ND	0.003	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	0.0181	ND	0.03	0.11	0.02
M-FG2	03/05/13	146	ND	178	154	5	ND	6	ND	ND	5	19.3	32	**299**	840	7.74	**637**	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	0.0098	ND	ND	0.10	0.02
M-FG2	05/16/13	157	ND	192	145	5	ND	6	ND	ND	4	18.6	30	**295**	854	7.73	**638**	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	0.0131	ND	0.01	0.14	0.03
M-FG5	10/10/13	---	ND	170	108	7	0.1	5	ND	ND	21	16.3	29	**218**	703	8.16	**505**	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.063**	**0.638**	ND	0.02	ND	ND
M-FG5	12/30/13	---	ND	171	111	7	0.1	5	ND	ND	10	17.6	27	**208**	695	7.80	478	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.053**	**0.719**	ND	0.03	ND	ND
M-FG5	02/13/14	---	ND	178	110	7	0.1	6	ND	ND	7	17.8	25	**202**	713	7.97	490	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	**0.048**	**0.638**	ND	0.04	**1.75**	0.04
M-FG5	04/04/14	---	ND	180	115	7	0.1	6	ND	ND	6	18.0	27	203	688	7.74	497	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.053	**0.7060**	ND	0.02	ND	ND
M-HJ1	12/17/12	---	ND	140	46	6	0.2	2	ND	ND	2	15.6	18	39	318	7.99	193	ND	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.004	0.0212	ND	ND	0.04	ND
M-HJ1	02/14/13	---	ND	144	46	6	0.2	2	ND	ND	2	16.0	19	39	320	7.94	213	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0208	ND	ND	0.04	ND
M-HJ1	05/21/13	117	ND	143	47	6	0.2	2	ND	ND	2	15.1	19	39	321	7.91	207	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0219	ND	ND	0.08	ND
M-HJ2A	12/13/12	127	ND	155	51	6	0.1	3	ND	ND	2	15.3	18	45	354	8.00	224	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0297	ND	ND	0.08	ND
M-HJ2A	12/27/12	---	---	---	52	---	---	3	---	---	2	15.8	19	---	---	---	---	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005	ND	ND	ND	ND	0.0297	ND	0.04	---	---
M-HJ2A	02/14/13	---	ND	158	51	6	0.1	3	ND	ND	2	15.6	18	44	351	7.92	234	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0294	ND	ND	0.06	ND
M-HJ2A	09/18/13	130	ND	159	50	6	0.2	2	ND	ND	2	15.9	17	44	349	7.86	213	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0261	ND	ND	0.06	ND
M-HJ3	12/21/12	110	ND	134	44	6	0.2	2	ND	ND	3	15.7	18	44	321	8.08	213	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0390**	ND	ND	ND	ND
M-HJ3	03/14/13	111	ND	136	43	6	0.2	2	ND	ND	3	15.0	19	44	320	8.02	205	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0252	ND	ND	ND	ND
M-HJ3	06/03/13	113	ND	137	45	6	0.2	2	ND	ND	2	15.4	19	44	313	8.10	204	0.04	ND	ND	ND	ND	ND	ND	ND	ND	0.004	ND	ND	ND	0.001	0.0204	ND	ND	ND	0.004
M-HJ3	09/19/13	114	ND	139	43	6	0.2	2	ND	ND	2	15.1	17	45	319	8.03	191	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0178	ND	ND	0.04	ND
M-HJ4	12/18/12	104	ND	126	53	5	0.1	2	0.05	ND	2	14.2	27	88	396	8.04	254	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	0.170	ND	ND	ND	0.01
M-HJ4	03/04/13	124	ND	152	58	5	0.1	2	ND	ND	2	13.5	27	96	412	8.00	273	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.154	ND	ND	ND	0.01
M-HJ4	05/20/13	109	ND	133	60	5	0.2	2	ND	0.8	2	14.0	29	97	424	7.99	269	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	0.164	ND	ND	ND	0.01
M-HJ4	09/18/13	113	ND	137	59	5	0.1	2	ND	ND	2	14.2	25	104	436	7.97	275	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.158	ND	ND	0.04	0.01
M-HJ5	12/18/12	115	ND	141	55	5	0.2	2	ND	ND	2	17.2	20	69	374	8.05	242	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	**0.0728**	ND	ND	0.04	ND
M-HJ5	02/06/13	---	ND	144	60	5	0.2	3	ND	ND	2	20.2	19	68	381	7.92	252	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	**0.0613**	ND	ND	ND	0.01
M-HJ5	05/13/13	120	ND	144	54	5	0.2	2	ND	ND	2	16.4	20	70	385	7.94	241	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	**0.0633**	ND	ND	ND	0.01
M-HJ5	09/19/13	121	ND	147	54	5	0.2	2	ND	ND	2	17.2	18	72	379	7.95	241	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	**0.0595**	ND	ND	0.03	0.01
M-HJ6	12/28/12	119	10	125	56	5	0.2	5	0.10	0.6	3	15.2	17	83	406	8.34	273	ND	0.002	ND	ND	ND	ND	ND	ND	0.001	0.01	ND	ND	ND	**0.041**	**0.325**	ND	0.02	ND	0.01
M-HJ6	02/19/13	114	ND	139	62	5	0.2	5	ND	0.6	2	15.3	18	91	416	7.87	272	ND	0.003	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND	ND	**0.059**	**0.372**	ND	0.03	ND	ND
M-HJ6	05/15/13	123	ND	150	62	6	0.1	5	ND	0.6	2	14.3	18	91	421	7.86	282	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.056**	**0.395**	ND	0.02	ND	ND
M-HJ6	10/23/13	---	ND	140	63	5	0.1	5	ND	0.5	2	16.4	16	91	429	7.81	262	ND	0.003	ND	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	**0.057**	**0.4150**	ND	0.02	ND	ND
M-HJ8	10/09/13	---	7	91	76	6	0.1	2	0.08	ND	5	15.7	26	177	562	**8.79**	364	ND	0.025	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.0234	ND	ND	ND	ND
M-HJ8	10/23/13	---	9	111	88	7	0.1	2	ND	ND	5	16.4	26	178	583	**8.90**	392	ND	0.015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.0273	ND	ND	ND	ND
M-HJ8	12/30/13	---	9	120	87	7	0.1	3	ND	ND	4	14.4	26	181	581	**8.86**	409	ND	0.008	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	ND	0.0293	ND	ND	ND	ND
M-HJ8	02/13/14	---	ND	129	92	7	0.1	4	ND	ND	4	15.5	27	184	623	8.48	422	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0281	ND	0.01	ND	ND
M-HJ8	04/04/14	---	ND	139	96	7	0.1	4	ND	ND	3	16.0	27	188	607	8.24	436	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0332	ND	ND	ND	ND
M-KM4A	12/11/12	---	ND	86	32	5	0.2	1	0.07	ND	6	16.0	25	51	275	**9.04**	187	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0275	ND	ND	ND	ND
M-KM4A	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM4A	02/14/13	---	ND	103	29	4	0.2	1	ND	ND	3	13.1	21	35	254	8.45	170	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0308**	ND	ND	ND	ND
M-KM4A	05/21/13	89	ND	108	31	5	0.2	1	ND	ND	2	12.9	22	33	258	8.32	164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0281	ND	ND	ND	ND
M-KM4A	10/03/13	---	ND	120	31	4	0.2	1	ND	ND	2	13.9	20	34	261	8.33	155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0257	ND	ND	0.04	ND
M-KM5A	12/13/12	81	ND	99	25	4	0.2	1	ND	ND	3	12.3	22	30	236	**8.51**	148	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0206	ND	ND	ND	ND
M-KM5A	12/27/12	---	---	---	22	---	---	1	---	---	3	13.1	22	---	---	---	---	ND	ND	ND	ND	ND	ND	---	ND	ND	0.001	ND	0.003	ND	ND	0.0171	ND	0.06	---	---
M-KM5A	02/19/13	86	ND	104	24	4	0.2	1	ND	ND	2	13.1	19	16	208	8.32	128	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0192	ND	0.01	ND	ND
M-KM5A	05/21/13	87	ND	106	24	4	0.2	1	ND	ND	2	12.2	19	15	211	8.23	135	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0184	ND	ND	ND	ND
M-KM5A	09/18/13	89	ND	109	24	4	0.2	1	ND	ND	2	12.9	18	16	209	8.23	119	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0175	ND	ND	ND	ND
Report Limit		5	5	5	1	1	0.1	1	0.05	0.1	1	0.2	1	1	1	0.01	10	0.1	0.001	0.1	0.1	0.005	0.05	0.01	0.03	0.001	0.01	0.001	0.1	0.05	0.001	0.0003	0.1	0.01	0.03	0.01
Method		A2320 B	A2320 B	A2320 B	E200.7	E300.0	A4500-F C	E200.7	A4500-NH3 G	E353.2	E200.7	E200.7	E200.7	E300.0	A2510 B	A4500-H B	A2540 C	E200.7	E200.8	E200.7	E200.7	E200.7	E200.7	E200.7	E200.7	E200.8	E200.7	E200.8	E200.7	E200.7	E200.8	E200.8	E200.7	E200.7	E200.8	E200.8

--- = No Analysis Performed
ND = Non-Detect

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class I)
BOLD Concentration exceeds WQD Domestic Class-of-Use (Class II)
BOLD Concentration exceeds WQD Domestic Class-of-Use (Class III)
BOLD Concentration exceed EPA criteria

Highlight for concentration exceeding WQD criteria is based on the lowest criteris exceeded.

Blank and duplicate samples were omitted from this table and are presented in Attachment D6-4.

Table 3.5-9 Analytical Results for Background Monitor Wells (Page 2 of 4)

Well	Date	Gross Alpha (pCi/L)	Gross Alpha precision (±) (pCi/L)	Gross Alpha MDC (pCi/L)	Gross Beta (pCi/L)	Gross Beta precision (±) (pCi/L)	Gross Beta MDC (pCi/L)	Ra-226 (pCi/L)	Ra-226 precision (±) (pCi/L)	Ra-226 MDC (pCi/L)	Ra-228 (pCi/L)	Ra-228 precision (±) (pCi/L)	Ra-228 MDC (pCi/L)	A/C Balance (± 5) (%)	Anions (meq/L)	Cations (meq/L)	Solids, Total Dissolved Calculated (mg/L)	TDS Balance (0.80 - 1.20)	Silver (mg/L)	Uranium suspended (mg/L)
M-FG1	12/13/12	**649**	11.6	3.1	229	7.7	6.5	**14.0**	0.71	0.16	**1.5**	1.0	1.6	0.0306	3.28	3.28	200	1.05	---	---
M-FG1	12/27/12	---	---	---	---	---	---	**13.0**	0.68	0.14	**3.0**	0.70	0.90	---	---	---	---	---	ND	---
M-FG1	02/14/13	**292**	5.3	1.9	113	3.3	2.7	**7.6**	0.64	0.22	**0.8**	1.0	1.6	-0.870	3.11	3.06	190	1.07	---	---
M-FG1	05/20/13	**255**	5.0	1.6	17.1	2.2	2.6	**3.8**	0.37	0.14	**1.6**	1.0	1.5	0.410	3.18	3.21	190	0.98	---	0.0012
M-FG1	09/18/13	**181**	7.2	4.3	70.7	6.5	8.4	1.9	0.28	0.15	2.3	1	1.5	-1.13	3.27	3.20	200	0.97	---	0.0004
M-FG2	12/18/12	**67.2**	3.4	2.6	24.1	2.2	2.9	**11**	0.59	0.19	**9.0**	1.4	1.7	-0.297	9.74	9.68	630	1.04	---	---
M-FG2	03/05/13	**66.1**	3.7	2.4	23.5	2.0	2.7	**11**	0.63	0.16	**7.7**	1.0	1.1	2.27	9.28	9.71	610	1.04	---	---
M-FG2	05/16/13	**36.1**	3.1	3.4	16.8	2.5	3.7	**12**	0.71	0.19	**8.2**	1.1	1.3	-1.49	9.42	9.15	600	1.06	---	ND
M-FG5	10/10/13	**530**	8.6	2.3	66.4	3.3	3.0	**2.6**	0.32	0.16	**3.4**	0.9	1.3	0.564	7.54	7.63	490	1.02	---	ND
M-FG5	12/30/13	**635**	9.9	2.7	65	3.3	2.9	**3.0**	0.34	0.17	**3.6**	0.9	1.3	0.500	7.34	7.42	480	1.01	---	ND
M-FG5	02/13/14	**552**	8.9	2.5	56.9	3.3	3.0	**2.9**	0.41	0.22	**5.2**	1.4	1.9	-0.56	7.35	7.27	470	1.04	---	0.0031
M-FG5	04/04/14	**564**	9.1	2.6	74.9	3.5	3.1	**3.0**	0.32	0.15	**5.3**	1.0	1.2	0.94	7.38	7.52	480	1.05	---	ND
M-HJ1	12/17/12	**27.3**	2.8	2.8	10.0	3.6	5.7	**3.5**	0.34	0.14	**3.4**	0.8	1.1	-0.140	3.29	3.28	---	0.960	---	---
M-HJ1	02/14/13	**21.7**	1.7	1.5	9.6	1.8	2.7	**4.6**	0.56	0.27	**2.7**	1.2	1.8	-0.185	3.34	3.33	200	1.04	---	---
M-HJ1	05/21/13	**22.4**	1.7	1.4	10.9	2.0	3.0	**4.3**	0.42	0.17	**2.5**	1.0	1.5	1.19	3.33	3.41	200	1.01	---	ND
M-HJ2A	12/13/12	**38.7**	2.1	1.6	17.2	1.9	2.5	**3.2**	0.39	0.19	**4.5**	1.4	2.0	-0.763	3.68	3.63	220	1.01	---	---
M-HJ2A	12/27/12	---	---	---	---	---	---	**3.1**	0.34	0.14	**2.9**	0.8	1.1	---	---	---	---	---	ND	---
M-HJ2A	02/14/13	**22.1**	1.7	1.6	5.6	1.6	2.5	**4.2**	0.45	0.21	**4.6**	1.0	1.4	-1.25	3.70	3.61	220	1.05	---	---
M-HJ2A	09/18/13	**26.2**	2.0	1.9	11.8	1.7	2.5	**3.4**	0.41	0.19	**4.8**	1.3	1.8	-3.29	3.72	3.48	220	0.97	---	ND
M-HJ3	12/21/12	**41.1**	2.3	1.2	15.3	1.7	2.4	**3.5**	0.38	0.14	**2.9**	0.8	1.1	-0.408	3.28	3.25	200	1.05	---	---
M-HJ3	03/14/13	**23.9**	1.8	1.3	10.0	1.6	2.4	**3.2**	0.31	0.14	**3.5**	0.9	1.2	-1.75	3.31	3.19	200	1.01	---	---
M-HJ3	06/03/13	**21.9**	1.8	1.4	9.6	1.6	2.4	**3.3**	0.36	0.17	**2.2**	1.3	1.9	-0.391	3.35	3.32	210	0.99	ND	ND
M-HJ3	09/19/13	**20.4**	1.8	2.0	7.6	1.9	2.9	**3.1**	0.31	0.12	**2.8**	0.9	1.3	-4.04	3.37	3.11	200	0.950	---	ND
M-HJ4	12/18/12	**128**	3.6	1.7	26.2	2.3	2.9	**10.0**	0.61	0.20	**8.7**	1.5	1.8	-0.443	4.05	4.01	260	0.990	---	---
M-HJ4	03/04/13	**115**	3.6	2.1	21.0	2.2	2.9	**9.1**	0.66	0.20	**2.4**	1.1	1.6	-3.49	4.64	4.33	280	0.960	---	---
M-HJ4	05/20/13	**102**	3.4	1.8	28.2	2.1	2.6	**7.4**	0.53	0.15	**3.4**	1.1	1.5	1.38	4.40	4.52	280	0.950	---	ND
M-HJ4	09/18/13	**111**	3.5	1.7	29.3	2.2	2.6	**8.7**	0.55	0.14	**2.0**	1.1	1.6	-3.58	4.57	4.25	280	0.980	---	ND
M-HJ5	12/18/12	**63.7**	2.6	1.5	20.2	1.9	2.5	**4.0**	0.29	0.12	**4.8**	0.9	1.1	-0.0901	3.88	3.87	240	0.990	---	---
M-HJ5	02/06/13	**57.1**	2.5	1.5	10.5	1.9	2.7	**3.5**	0.37	0.14	**4.4**	0.9	1.1	2.39	3.92	4.11	250	0.990	---	---
M-HJ5	05/13/13	**59.3**	2.8	2.1	20.0	2.0	2.7	**7.1**	0.58	0.20	**3.5**	1.0	1.3	-2.97	4.02	3.78	250	0.980	---	ND
M-HJ5	09/19/13	**46.6**	2.3	1.3	14.2	2.0	2.9	**2.7**	0.29	0.12	**4.4**	1.0	1.3	-4.58	4.05	3.70	240	0.980	---	ND
M-HJ6	12/28/12	**282**	5.2	1.4	54.3	3.0	2.8	**9.0**	0.60	0.17	**4.1**	0.8	1.0	-3.45	4.30	4.01	260	1.04	---	---
M-HJ6	02/19/13	**386**	6.3	1.6	100	3.2	2.5	**11**	0.68	0.18	**2.5**	0.9	1.3	-0.473	4.39	4.34	270	0.990	---	---
M-HJ6	05/15/13	**292**	5.5	1.4	94.1	3.2	2.7	**11**	0.73	0.21	**2.4**	1.0	1.4	-2.69	4.57	4.33	280	1.01	---	ND
M-HJ6	10/23/13	**263**	5.1	1.5	62.2	2.8	2.7	**11**	0.58	0.14	**2.4**	0.8	1.2	-1.60	4.45	4.31	280	0.95	---	ND
M-HJ8	10/09/13	**55.5**	2.6	1.8	10.0	1.9	2.7	**7.7**	0.61	0.24	**3.2**	1.1	1.6	-3.01	5.57	5.25	360	1.00	---	ND
M-HJ8	10/23/13	**56.2**	2.8	2.3	14.1	2.0	2.7	**8.2**	0.50	0.14	**3.0**	0.9	1.2	-1.31	6.02	5.86	390	1.00	---	ND
M-HJ8	12/30/13	**64.4**	3.2	2	12.1	2.0	2.8	**7.5**	0.51	0.16	**3.0**	1.0	1.5	-3.23	6.22	5.83	390	1.04	---	ND
M-HJ8	02/13/14	**67.2**	3.4	2.6	11.2	2.2	3.1	**9.2**	0.66	0.20	**4.4**	1.2	1.7	-0.41	6.25	6.20	400	1.04	---	0.0281
M-HJ8	04/04/14	**51.4**	3.1	2.7	11.1	2.1	3.1	**7.6**	0.49	0.15	**4.0**	0.8	1.0	-0.11	6.44	6.42	420	1.05	---	ND
M-KM4A	12/11/12	**29.3**	1.8	1.3	14.5	1.8	2.6	1.7	0.32	0.23	3.1	1.1	1.6	3.57	2.78	2.98	190	0.990	---	---
M-KM4A	12/27/12	---	---	---	---	---	---	**1.7**	0.25	0.14	**5.3**	0.8	0.9	---	---	---	---	---	---	---
M-KM4A	02/14/13	**28.2**	1.7	1.2	11.2	1.9	2.7	2.0	0.34	0.22	2.5	1.0	1.5	-1.44	2.60	2.53	160	1.05	---	---
M-KM4A	05/21/13	**25.0**	1.7	1.4	6.9	1.7	2.5	1.7	0.27	0.16	2.8	1.0	1.5	1.49	2.60	2.68	160	1.00	---	ND
M-KM4A	10/03/13	**26.3**	1.7	1.4	5.6	1.6	2.5	2.0	0.31	0.21	2.0	0.9	1.4	-5.78	2.89	2.57	150	1.01	---	ND
M-KM5A	12/13/12	**17.8**	1.5	1.3	6.1	1.7	2.6	**1.7**	0.29	0.19	**3.6**	1.3	1.9	0.616	2.38	2.41	150	0.990	---	---
M-KM5A	12/27/12	---	---	---	---	---	---	**1.4**	0.24	0.14	**3.9**	0.7	0.9	---	---	---	---	---	ND	---
M-KM5A	02/19/13	**22.5**	1.6	1.3	5.6	1.7	2.5	1.6	0.27	0.18	1.6	0.8	1.3	-0.300	2.18	2.17	140	0.950	---	---
M-KM5A	05/21/13	**15.7**	1.4	1.4	5.6	1.7	2.6	1.6	0.27	0.16	1.5	1.0	1.5	0.0848	2.18	2.18	130	1.01	---	ND
M-KM5A	09/18/13	**19.1**	1.6	1.5	5.4	1.9	2.9	1.9	0.30	0.18	2.3	1.4	2.1	-3.16	2.24	2.10	130	0.890	---	ND
Report Limit		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.001	0.0003
Method		E900.0	E900.0	E900.0	E900.0	E900.0	E900.0	E903.0	E903.0	E903.0	RA-05	RA-05	RA-05	A1030 E	A1030 E	A1030 E	A1030 E	A1030 E	E200.8	E200.8

Well	Date	Pb-210 (pCi/L)	Pb-210 precision (±) (pCi/L)	Pb-210 MDC (pCi/L)	Po-210 (pCi/L)	Po-210 precision (±) (pCi/L)	Po-210 MDC (pCi/L)	Th-230 (pCi/L)	Th-230 precision (±) (pCi/L)	Th-230 MDC (pCi/L)	Pb-210 suspended (pCi/L)	Pb-210 suspended precision (±) (pCi/L)	Pb-210 suspended MDC (pCi/L)	Po-210 suspended (pCi/L)	Po-210 suspended precision (±) (pCi/L)	Po-210 suspended MDC (pCi/L)	Ra-226 suspended (pCi/L)	Ra-226 suspendedprecision (±) (pCi/L)	Ra-226 suspended MDC (pCi/L)	Th-230 suspended (pCi/L)	Th-230 suspended precision (±) (pCi/L)	Th-230 suspended MDC (pCi/L)
M-FG1	12/13/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-FG1	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-FG1	02/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-FG1	05/20/13	-0.3	0.9	1.6	0.3	0.5	0.7	0.04	0.08	0.2	3.2	1.3	2	1.4	1.1	1.1	0.47	0.15	0.14	0.07	0.08	0.2
M-FG1	09/18/13	-0.06	0.6	1.0	0.6	0.7	0.9	0.02	0.07	0.2	0.8	0.6	0.9	0.9	1.2	1.4	0.02	0.18	0.31	0.1	0.1	0.2
M-FG2	12/18/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-FG2	03/05/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-FG2	05/16/13	0.7	1.1	1.9	0.5	0.7	0.9	0.02	0.06	0.2	0.5	1.7	2.8	0.2	0.5	1.0	0.08	0.10	0.15	0.06	0.07	0.1
M-FG5	10/10/13	1.0	0.6	1.0	-0.02	0.3	0.8	0.02	0.07	0.1	0.02	0.5	0.9	-0.04	0.4	1.1	0.07	0.21	0.36	0.05	0.1	0.2
M-FG5	12/30/13	0.09	0.6	1.0	0.6	0.5	0.9	0.0006	0.05	0.1	-0.2	0.6	1.1	0.2	0.5	1.5	0.29	0.17	0.22	0.05	0.09	0.2
M-FG5	02/13/14	0.0	0.6	1.0	0.4	0.6	0.8	0.10	0.08	0.1	0.9	0.3	0.5	1.2	1.1	1.1	1.4	0.24	0.20	0.3	0.2	0.2
M-FG5	04/04/14	1.3	0.6	1.0	0.8	0.7	0.9	0.08	0.09	0.2	0.4	0.6	1.0	-0.1	0.6	1.6	-0.08	0.07	0.14	0.02	0.1	0.2
M-HJ1	12/17/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ1	02/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ1	05/21/13	0.7	0.8	1.2	0.2	0.6	1.1	0.06	0.08	0.2	0.3	0.5	0.8	0.5	0.6	0.7	0.03	0.06	0.10	0.09	0.1	0.2
M-HJ2A	12/13/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ2A	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ2A	02/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ2A	09/18/13	-0.3	0.6	1.0	0.3	0.6	0.9	0.06	0.07	0.1	0.1	0.5	0.9	0.2	0.6	1.1	-0.003	0.16	0.29	0.08	0.1	0.3
M-HJ3	12/21/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ3	03/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ3	06/03/13	0.8	0.8	1.3	-0.04	0.3	0.9	0.02	0.05	0.1	0.2	0.5	0.9	0.2	0.6	1.0	0.10	0.10	0.15	0.06	0.1	0.2
M-HJ3	09/19/13	0.3	0.6	1.0	-0.05	0.5	1.4	0.03	0.07	0.2	-0.1	0.5	0.9	0.2	0.7	1.2	0.15	0.19	0.28	0.08	0.1	0.2
M-HJ4	12/18/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ4	03/04/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ4	05/20/13	1.1	1.0	1.6	0.6	0.8	1.1	0.005	0.06	0.2	-0.1	1.1	1.8	0.2	0.7	1.4	0.04	0.09	0.14	0.03	0.06	0.1
M-HJ4	09/18/13	0.9	0.6	1.0	0.4	0.6	0.9	0.06	0.09	0.2	-0.2	0.5	0.9	0.2	0.7	1.2	0.03	0.16	0.28	0.2	0.2	0.3
M-HJ5	12/18/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ5	02/06/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ5	05/13/13	0.9	1.1	1.7	0.1	0.6	1.4	-0.01	0.05	0.2	0.8	1.1	1.7	0.3	0.7	1.0	-0.02	0.07	0.14	0.03	0.06	0.1
M-HJ5	09/19/13	1.2	0.7	1.1	0.2	0.5	0.8	0.03	0.08	0.2	-0.1	0.6	0.9	0.2	0.8	1.6	0.07	0.18	0.3	0.06	0.10	0.3
M-HJ6	12/28/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ6	02/19/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ6	05/15/13	3.6	1.2	1.8	0.3	0.5	0.8	0.007	0.05	0.1	1.6	1.1	1.8	0.08	0.5	1.1	0.11	0.09	0.13	0.05	0.07	0.1
M-HJ6	10/23/13	1.3	0.6	0.9	0.9	0.8	0.8	0.05	0.08	0.2	0.7	0.6	1.0	0.9	0.9	1.2	-0.20	0.14	0.31	0.04	0.07	0.2
M-HJ8	10/09/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-HJ8	10/23/13	3.5	0.6	0.9	1.3	1.1	1.2	0.03	0.06	0.1	0.4	0.6	1.0	0.9	0.8	1.0	0.16	0.22	0.33	0.10	0.10	0.2
M-HJ8	12/30/13	1.1	0.6	1	0.04	0.5	1.4	7.5	0.51	0.16	0.08	0.6	1.1	0.2	0.7	2.0	0.29	0.18	0.23	-0.03	0.07	0.2
M-HJ8	02/13/14	2.1	0.6	1.0	0.3	0.5	0.8	0.06	0.07	0.1	0.6	0.3	0.5	0.2	0.8	1.4	0.01	0.11	0.19	0.20	0.20	0.2
M-HJ8	04/04/14	2.8	0.7	1.0	0.3	0.7	1.4	-0.008	0.04	0.1	1.7	0.6	0.9	1.0	1.1	1.2	0.10	0.09	0.14	0.09	0.10	0.2
M-KM4A	12/11/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM4A	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM4A	02/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM4A	05/21/13	0.9	0.8	1.3	0.1	0.5	0.9	0.05	0.08	0.2	-0.03	0.5	0.8	0.1	0.5	0.9	0.06	0.07	0.10	0.05	0.1	0.2
M-KM4A	10/03/13	0.5	0.6	1.0	0.1	0.5	0.9	0.09	0.09	0.1	0.2	0.6	0.9	0.0	0.3	0.7	0.34	0.16	0.12	0.09	0.1	0.2
M-KM5A	12/13/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM5A	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM5A	02/19/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM5A	05/21/13	0.9	0.8	1.2	0.1	0.4	0.8	-0.008	0.05	0.2	-0.1	0.5	0.9	0.4	0.6	0.8	0.02	0.06	0.10	0.10	0.1	0.2
M-KM5A	09/18/13	0.2	0.6	1.0	0.09	0.3	0.7	0.07	0.09	0.2	0.1	0.5	0.9	0.2	0.7	1.3	-0.04	0.14	0.27	0.06	0.1	0.3
Report Limit		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Method		E909.0	E909.0	E909.0	E912.0	E912.0	E912.0	E908.0	E908.0	E908.0	E909.0	E909.0	E909.0	E912.0	E912.0	E912.0	E903.0	E903.0	E903.0	E908.0	E908.0	E908.0

--- = No Analysis
ND = Non-Detect

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class I)
Highlight for concentration exceeding WQD criteria is based on the lowest criteris exceeded.

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class II)

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class III)

BOLD Concentration exceed EPA criteria

Blank and duplicate samples were omitted from this table and are presented in Attachment D6-4.

Table 3.5-9 Analytical Results for Background Monitor Wells (Page 3 of 4)

Well	Date	Alkalinity, Total as CaCO3 (mg/L)	Carbonate as CO3 (mg/L)	Bicarbonate as HCO3 (mg/L)	Ca (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Mg (mg/L)	Nitrogen, Ammonia as N (mg/L)	Nitrogen, Nitrate+Nitrite as N (mg/L)	K (mg/L)	Silica (mg/L)	Na (mg/L)	Sulfate (mg/L)	Conductivity @ 25 C (umhos/cm)	pH (s.u.)	Solids, Total Dissolved TDS @ 180 C (mg/L)	Al (mg/L)	As (mg/L)	Ba (mg/L)	Bo (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Hg (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)	Fe total (mg/L)	Mn total (mg/L)
M-KM6	12/21/12	118	ND	144	70	7	0.1	3	0.10	ND	2	17.0	25	111	471	7.99	321	ND	ND	ND	ND	ND	ND	ND	0.05	0.002	ND	ND	ND	ND	ND	0.0095	ND	0.02	0.05	ND
M-KM6	03/14/13	120	ND	147	67	6	0.1	3	0.08	ND	2	16.2	24	105	464	7.76	307	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.0085	ND	ND	0.04	ND
M-KM6	06/03/13	126	ND	153	69	6	0.1	3	ND	ND	2	16.6	25	104	450	7.99	307	0.04	ND	ND	ND	ND	ND	ND	ND	ND	0.007	ND	ND	ND	ND	0.0075	ND	ND	0.03	0.007
M-KM6	09/19/13	125	ND	153	69	7	0.1	3	0.08	ND	2	16.3	23	106	457	7.95	301	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0073	ND	ND	0.04	ND
M-KM7	12/19/12	94	ND	114	29	4	0.2	1	ND	ND	2	14.8	21	15	222	8.33	144	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0334**	ND	ND	0.11	ND
M-KM7	03/04/13	95	ND	116	25	4	0.2	1	ND	ND	2	13.3	20	15	218	8.37	131	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0330**	ND	ND	0.16	ND
M-KM7	05/20/13	94	ND	115	26	2	0.2	ND	ND	ND	2	13.6	20	8	224	8.32	135	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0359**	ND	ND	ND	ND
M-KM7	09/18/13	95	ND	116	24	4	0.2	ND	ND	ND	2	14.0	19	16	212	8.20	122	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0316**	ND	ND	0.06	ND
M-KM8	12/18/12	104	10	106	36	5	0.2	ND	0.11	ND	4	15.8	23	34	279	**9.01**	175	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0067	ND	ND	0.06	ND
M-KM8	02/06/13	103	7	112	37	5	0.2	ND	ND	ND	3	18.1	22	31	279	**8.93**	184	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.0053	ND	ND	**0.36**	ND
M-KM8	05/13/13	106	ND	122	34	5	0.2	1	0.06	ND	3	15.6	19	29	278	8.42	180	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0058	ND	ND	**0.34**	ND
M-KM8	10/10/13	---	ND	133	37	5	0.2	1	ND	ND	2	16.7	20	28	274	8.02	166	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0060	ND	ND	**1.28**	0.01
M-KM9	12/19/12	---	ND	121	35	5	0.2	2	ND	0.3	3	15.0	19	21	256	**8.74**	164	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.007	**0.253**	ND	ND	0.06	ND
M-KM9	02/19/13	105	ND	128	33	4	0.2	3	ND	0.4	2	14.8	16	15	243	8.06	148	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.009	**0.299**	ND	ND	0.29	ND
M-KM9	05/15/13	106	ND	128	30	5	0.2	3	ND	0.4	1	14.2	15	15	246	8.03	157	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.009	**0.314**	ND	ND	**0.37**	ND
M-KM9	10/10/13	---	ND	131	32	5	0.2	3	ND	0.4	1	14.5	16	15	242	8.00	147	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.009	**0.297**	ND	0.02	0.14	ND
M-KM10	12/21/12	113	ND	137	44	7	0.2	4	ND	0.9	2	16.9	17	38	322	8.06	211	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.023**	**0.248**	ND	0.01	0.05	ND
M-KM10	03/05/13	120	ND	147	44	6	0.1	4	ND	1.0	2	17.2	15	26	302	7.97	187	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.020**	**0.245**	ND	0.01	0.09	ND
M-KM10	05/16/13	120	ND	147	39	6	0.1	4	ND	1.0	1	15.5	13	26	305	7.91	193	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.018	**0.240**	ND	0.01	ND	ND
M-KM10	09/19/13	122	ND	149	40	6	0.1	4	ND	1.0	2	16.4	14	26	300	7.93	179	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.019	**0.230**	ND	ND	ND	ND
M-KM11A	10/09/13	---	ND	136	94	6	0.1	3	0.07	ND	5	17.2	27	198	636	8.28	429	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0274	ND	ND	0.03	ND
M-KM11A	10/23/13	---	ND	143	101	6	0.1	4	ND	ND	5	18.1	28	197	642	7.94	431	ND	0.002	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	**0.0301**	ND	0.01	0.04	ND
M-KM11A	12/30/13	---	ND	148	96	6	0.1	4	ND	ND	4	15.9	26	195	645	7.79	451	ND	0.001	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	ND	0.0210	ND	ND	0.05	0.01
M-KM11A	02/13/14	---	ND	152	99	7	0.1	4	ND	ND	5	16.6	28	199	668	7.90	451	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	0.0163	ND	0.01	0.06	0.01
M-KM11A	04/04/14	---	ND	153	99	7	0.1	4	ND	ND	4	16.8	28	200	637	7.79	461	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	0.0198	ND	ND	0.07	0.01
M-N2	12/11/12	---	ND	109	29	4	0.2	1	ND	ND	1	20.5	27	25	232	8.24	157	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0006	ND	ND	0.06	ND
M-N2	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N2	02/14/13	---	ND	112	23	4	0.2	ND	ND	ND	1	14.8	26	24	236	8.19	161	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0005	ND	ND	0.17	ND
M-N2	05/21/13	89	ND	109	24	4	0.2	1	ND	ND	1	14.8	27	24	237	8.13	155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0008	ND	ND	0.11	ND
M-N2	09/18/13	91	ND	112	23	4	0.2	ND	ND	ND	1	15.2	25	26	238	8.17	139	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0009	ND	ND	0.05	ND
M-N3	12/28/12	1770	39	ND	525	2	0.5	ND	**0.90**	ND	150	2.2	113	22	7650	**12.7**	**1640**	ND	ND	**6.2**	ND	ND	ND	0.03	ND	**0.026**	ND	ND	ND	ND	0.002	0.0015	ND	0.42	ND	ND
M-N3	02/19/13	1480	34	ND	460	2	0.4	ND	**0.91**	ND	143	1.2	111	41	6600	**12.6**	**1460**	ND	ND	1.8	ND	ND	ND	0.06	0.04	**0.022**	ND	ND	ND	ND	ND	0.0007	ND	0.31	0.24	ND
M-N3	05/16/13	1590	43	ND	459	2	0.4	ND	**0.86**	ND	150	0.6	125	31	7040	**12.5**	**1510**	0.2	ND	1.8	ND	ND	ND	0.04	ND	**0.032**	ND	ND	ND	ND	ND	0.0016	ND	0.26	**0.38**	ND
M-N4	12/19/12	89	8	93	40	4	0.2	ND	0.12	ND	6	16.6	31	66	324	**9.15**	211	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0017	ND	ND	0.04	ND
M-N4	02/19/13	85	10	83	30	4	0.2	ND	ND	ND	4	16.0	28	52	287	**8.94**	189	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0016	ND	0.01	0.11	ND
M-N4	05/15/13	92	ND	107	30	4	0.2	1	ND	ND	3	16.3	24	44	283	8.41	187	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0021	ND	ND	0.24	ND
M-N4	09/19/13	105	ND	123	33	4	0.2	1	ND	ND	2	17.9	23	43	295	8.21	184	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0017	ND	ND	ND	ND
M-N5A	12/19/12	81	5	88	96	4	0.1	2	0.13	ND	4	16.6	47	**278**	710	**8.86**	**512**	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0010	ND	0.01	ND	ND
M-N5A	03/05/13	61	9	57	84	3	0.1	2	0.15	ND	7	17.0	57	**262**	671	**9.21**	483	ND	0.001	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	ND	0.0017	ND	0.09	0.20	ND
M-N5A	05/23/13	152	29	ND	74	3	0.2	ND	**0.52**	ND	15	13.8	97	**227**	1220	**11.8**	**535**	0.4	0.001	0.1	ND	ND	ND	ND	ND	0.010	ND	ND	ND	ND	ND	ND	ND	0.05	0.04	ND
M-N5A	09/19/13	57	31	ND	60	3	0.1	ND	0.28	ND	8	15.2	76	**248**	684	**10.4**	455	0.1	0.001	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	0.004	0.0018	ND	ND	ND	ND
M-N6	10/10/13	---	ND	95	43	5	0.1	1	ND	ND	6	14.1	37	103	388	**8.73**	254	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0032	ND	ND	**0.31**	ND
M-N6	12/30/13	---	ND	99	41	5	0.1	2	ND	ND	5	14.8	34	99	386	**8.51**	248	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0008	ND	ND	ND	ND
M-N6	02/12/14	---	ND	110	46	5	0.1	2	ND	ND	4	16.5	33	99	416	8.32	268	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0010	ND	ND	0.04	ND
M-N6	04/04/14	---	ND	115	48	5	0.1	2	ND	ND	3	16.5	36	106	416	8.16	280	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0136	ND	ND	ND	ND
Report Limit		5	5	5	1	1	0.1	1	0.05	0.1	1	0.2	1	1	1	0.01	10	0.1	0.001	0.1	0.1	0.005	0.05	0.01	0.03	0.001	0.01	0.001	0.1	0.05	0.001	0.0003	0.1	0.01	0.03	0.01
Method		A2320 B	A2320 B	A2320 B	E200.7	E300.0	A4500-F C	E200.7	A4500-NH3 G	E353.2	E200.7	E200.7	E200.7	E300.0	A2510 B	A4500-H B	A2540 C	E200.7	E200.8	E200.7	E200.7	E200.7	E200.7	E200.7	E200.7	E200.8	E200.7	E200.8	E200.7	E200.7	E200.8	E200.8	E200.7	E200.7	E200.8	E200.8

--- = No Analysis Performed

ND = Non-Detect

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class I)

Highlight for concentration exceeding WQD criteria is based on the lowest criteris exceeded.

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class II)

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class III)

BOLD Concentration exceed EPA criteria

Blank and duplicate samples were omitted from this table and are presented in Attachment D6-4.

Table 3.5-9 Analytical Results for Background Monitor Wells (Page 4 of 4)

Well	Date	Gross Alpha (pCi/L)	Gross Alpha precision (±) (pCi/L)	Gross Alpha MDC (pCi/L)	Gross Beta (pCi/L)	Gross Beta precision (±) (pCi/L)	Gross Beta MDC (pCi/L)	Ra-226 (pCi/L)	Ra-226 precision (±) (pCi/L)	Ra-226 MDC (pCi/L)	Ra-228 (pCi/L)	Ra-228 precision (±) (pCi/L)	Ra-228 MDC (pCi/L)	A/C Balance (± 5) (%)	Anions (meq/L)	Cations (meq/L)	Solids, Total Dissolved Calculated (mg/L)	TDS Balance (0.80 - 1.20)	Silver (mg/L)	Uranium suspended (mg/L)
M-KM6	12/21/12	**23.8**	1.9	1.5	10.2	1.6	2.4	**3.1**	0.36	0.15	**5.9**	0.8	0.9	-0.0087	4.85	4.85	310	1.040	---	---
M-KM6	03/14/13	**20.0**	1.7	1.4	8.2	1.5	2.3	**4.8**	0.37	0.14	**4.7**	0.9	1.1	-1.33	4.78	4.65	300	1.020	---	---
M-KM6	06/03/13	**18.6**	2.0	1.6	4.8	2.2	3.6	**3.3**	0.36	0.17	**5.2**	1.4	1.9	-0.348	4.86	4.83	310	1.000	ND	ND
M-KM6	09/19/13	12.4	1.5	1.5	9.1	1.9	2.9	**2.5**	0.27	0.11	**5.2**	1.0	1.2	-2.13	4.90	4.70	300	0.990	---	ND
M-KM7	12/19/12	**28.8**	1.9	1.3	10.5	1.7	2.5	2.1	0.30	0.15	2.0	0.7	0.9	3.38	2.31	2.47	150	0.980	---	---
M-KM7	03/04/13	**26.0**	1.8	1.7	6.5	1.8	2.7	**3.1**	0.38	0.19	**1.9**	1.0	1.5	-2.29	2.33	2.22	140	0.940	---	---
M-KM7	05/20/13	**29.1**	1.8	1.5	7.0	1.7	2.6	2.2	0.30	0.15	2.5	1.1	1.6	4.68	2.11	2.31	130	1.02	---	ND
M-KM7	09/18/13	**27.3**	1.8	1.4	6.8	1.7	2.6	**2.9**	0.36	0.17	**2.8**	1.4	2.1	-4.83	2.35	2.13	140	0.870	---	ND
M-KM8	12/18/12	**15.6**	1.4	1.3	7.2	1.9	2.8	1.6	0.19	0.12	3.2	0.8	1.1	0.155	2.95	2.96	180	0.950	---	---
M-KM8	02/06/13	11.5	1.3	1.4	3.3	1.7	2.7	1.5	0.23	0.12	2.8	0.7	1.0	1.93	2.86	2.98	180	0.990	---	---
M-KM8	05/13/13	10.4	1.3	1.5	3.5	1.7	2.7	**2.6**	0.37	0.21	**4.4**	1.0	1.4	-4.19	2.89	2.66	170	1.030	---	0.0007
M-KM8	10/10/13	9.2	1.4	1.7	3.3	1.6	2.6	0.91	0.20	0.15	1.5	0.8	1.2	-0.602	2.93	2.89	180	0.920	---	0.0015
M-KM9	12/19/12	**178**	4.5	1.3	85.2	2.7	2.5	**4.3**	0.42	0.14	**2.0**	0.6	0.9	2.10	2.68	2.79	170	0.980	---	---
M-KM9	02/19/13	**269**	5.0	1.5	60.0	2.8	2.6	**4.5**	0.44	0.17	**1.5**	0.8	1.3	-0.0172	2.58	2.58	160	0.950	---	---
M-KM9	05/15/13	**218**	4.5	1.2	61.5	2.9	2.9	3.8	0.42	0.19	0.8	0.8	1.3	-3.70	2.59	2.41	150	1.03	---	0.0023
M-KM9	10/10/13	**183**	4.3	1.9	18.3	2.1	2.6	**4.0**	0.38	0.15	**2.1**	0.8	1.2	-0.408	2.60	2.57	160	0.95	---	0.0004
M-KM10	12/21/12	**203**	4.7	1.4	62.2	2.4	2.3	1.0	0.22	0.15	1.4	0.7	1.1	0.290	3.30	3.32	200	1.030	---	---
M-KM10	03/05/13	**203**	4.7	1.3	51.2	2.4	2.4	1.1	0.22	0.16	2.1	0.9	1.3	0.366	3.20	3.22	190	0.960	---	---
M-KM10	05/16/13	**162**	4.0	1.8	51.6	2.6	2.7	1.2	0.24	0.18	2.3	0.9	1.3	-4.75	3.20	2.91	190	1.030	---	ND
M-KM10	09/19/13	**164**	3.9	1.5	37.5	2.5	2.7	0.68	0.15	0.11	1.8	0.8	1.3	-3.74	3.21	2.98	190	0.950	---	ND
M-KM11A	10/09/13	**74.8**	3.2	2.4	17.5	2.0	2.7	**14**	0.76	0.20	**5.1**	1.0	1.3	-3.06	6.61	6.21	420	1.02	---	---
M-KM11A	10/23/13	**61.1**	2.8	1.9	14.7	2.0	2.7	**14**	0.65	0.14	**4.5**	0.9	1.2	0.540	6.63	6.70	430	0.99	---	ND
M-KM11A	12/30/13	**64.7**	3.3	2.3	14.5	2.1	2.9	**13**	0.68	0.17	**4.4**	1.1	1.5	-2.070	6.66	6.39	420	1.06	---	ND
M-KM11A	02/13/14	**51.7**	2.8	1.6	11.2	2.2	3.2	**11**	0.73	0.20	**6.1**	1.3	1.7	-1.89	6.83	6.57	440	1.03	---	ND
M-KM11A	04/04/14	**39**	2.5	1.8	11.5	2.0	2.9	**10**	0.57	0.15	**5.6**	1.0	1.2	-1.90	6.85	6.60	440	1.05	---	ND
M-N2	12/11/12	7.8	1.2	1.4	2.5	1.6	2.6	1.9	0.33	0.23	3.0	1.1	1.5	6.50	2.42	2.76	170	0.940	---	---
M-N2	12/27/12	---	---	---	---	---	---	**1.2**	0.22	0.14	**9.5**	0.9	0.9	---	---	---	---	---	---	---
M-N2	02/14/13	3.3	0.9	1.3	4.7	1.6	2.6	2.4	0.35	0.21	1.8	0.9	1.4	-1.98	2.46	2.36	150	1.05	---	---
M-N2	05/21/13	2.1	0.9	1.3	2.9	1.5	2.5	2.2	0.31	0.16	0.8	0.9	1.5	1.98	2.40	2.50	150	1.01	---	ND
M-N2	09/18/13	3.9	1.2	1.7	5.3	2.0	3.1	**2.4**	0.34	0.17	**3.6**	1.2	1.7	-2.93	2.48	2.34	150	0.91	---	ND
M-N3	12/28/12	8.9	5.9	9.3	132	8.7	11.1	1.3	0.22	0.14	2.3	0.6	0.9	-1.37	36.0	35.0	1900	0.870	---	---
M-N3	02/19/13	12.7	6.2	9.5	107	7.8	10.3	1.6	0.24	0.14	1.3	0.7	1.0	1.77	30.4	31.5	1600	0.890	---	---
M-N3	05/16/13	0.6	6.2	10.4	98.7	9.3	12.8	4.3	0.43	0.18	0.5	0.9	1.5	-0.497	32.6	32.2	1700	0.880	---	---
M-N4	12/19/12	7.5	1.3	1.5	7.6	1.6	2.4	1.5	0.27	0.15	3.0	0.7	1.0	3.92	3.29	3.56	220	0.950	---	---
M-N4	02/19/13	5.0	1.0	1.3	7.8	1.7	2.6	**1.1**	0.23	0.17	**3.9**	0.9	1.2	-0.272	2.91	2.89	190	0.990	---	---
M-N4	05/15/13	5.0	1.0	1.4	6.6	1.7	2.6	1.8	0.29	0.19	2.7	0.9	1.3	-3.95	2.88	2.66	180	1.030	---	0.0004
M-N4	09/19/13	5.4	1.2	1.7	6.0	1.7	2.7	**2.0**	0.25	0.11	**3.5**	0.9	1.2	-5.14	3.11	2.8	190	0.970	---	ND
M-N5A	12/19/12	6.9	1.5	2.0	10.9	1.7	2.6	**2.6**	0.34	0.15	**6.6**	0.9	1.0	-3.15	7.51	7.05	500	---	---	---
M-N5A	03/05/13	**15.6**	1.8	1.7	9.2	1.7	2.5	**1.5**	0.24	0.14	**4.6**	0.9	1.2	1.67	6.78	7.02	470	1.02	---	---
M-N5A	05/23/13	5.4	1.5	2.2	16.6	1.9	2.7	**2.6**	0.31	0.14	**3.8**	0.9	1.3	2.95	7.85	8.33	520	1.02	---	0.0008
M-N5A	09/19/13	3.6	1.7	2.6	12.6	1.9	2.8	**1.4**	0.22	0.12	**5.9**	1.1	1.3	1.58	6.41	6.61	450	1.01	---	ND
M-N6	10/10/13	11.3	1.4	1.6	10.0	1.7	2.5	**1.8**	0.27	0.15	**3.5**	0.9	1.2	0.134	3.95	3.96	260	0.97	---	0.0004
M-N6	12/30/13	7.9	1.5	1.9	9.5	1.9	2.8	**2.0**	0.28	0.17	**3.6**	1.1	1.5	-0.804	3.85	3.79	250	0.98	---	ND
M-N6	02/12/14	10.3	1.4	1.5	9.3	1.9	2.9	**2.2**	0.34	0.20	**6.8**	1.3	1.7	-0.8	4.02	3.95	260	1.02	---	ND
M-N6	04/04/14	6.7	1.2	1.4	9.4	2.0	3.0	**2.3**	0.28	0.15	**5.9**	1.0	1.2	-0.37	4.24	4.21	280	1.01	---	ND
Report Limit		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.001	0.0003
Method		E900.0	E900.0	E900.0	E900.0	E900.0	E900.0	E903.0	E903.0	E903.0	RA-05	RA-05	RA-05	A1030 E	A1030 E	A1030 E	A1030 E	A1030 E	E200.8	E200.8

Well	Date	Pb-210 (pCi/L)	Pb-210 precision (±) (pCi/L)	Pb-210 MDC (pCi/L)	Po-210 (pCi/L)	Po-210 precision (±) (pCi/L)	Po-210 MDC (pCi/L)	Th-230 (pCi/L)	Th-230 precision (±) (pCi/L)	Th-230 MDC (pCi/L)	Pb-210 suspended (pCi/L)	Pb-210 suspended precision (±) (pCi/L)	Pb-210 suspended MDC (pCi/L)	Po-210 suspended (pCi/L)	Po-210 suspended precision (±) (pCi/L)	Po-210 suspended MDC (pCi/L)	Ra-226 suspended (pCi/L)	Ra-226 suspendedprecision (±) (pCi/L)	Ra-226 suspended MDC (pCi/L)	Th-230 suspended (pCi/L)	Th-230 suspended precision (±) (pCi/L)	Th-230 suspended MDC (pCi/L)
M-KM6	12/21/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM6	03/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM6	06/03/13	0.2	0.8	1.3	0.3	0.6	1.0	0.01	0.06	0.2	0.2	0.5	0.9	0.4	0.7	1.1	0.19	0.11	0.15	0.04	0.1	0.3
M-KM6	09/19/13	0.4	0.8	1.3	0.07	0.4	1.0	0.07	0.09	0.2	0.2	0.5	0.9	0.2	0.6	1.2	0.03	0.17	0.3	0.03	0.09	0.2
M-KM7	12/19/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM7	03/04/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM7	05/20/13	0.2	1.0	1.6	0.4	0.6	0.8	0.04	0.08	0.2	0.3	1.1	1.8	0.6	0.8	1.2	0.008	0.09	0.15	0.03	0.07	0.2
M-KM7	09/18/13	0.06	0.6	1.0	0.0	0.3	0.7	0.05	0.09	0.2	0.01	0.5	0.9	-0.07	0.8	2.1	0.27	0.21	0.29	0.07	0.1	0.3
M-KM8	12/18/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM8	02/06/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM8	05/13/13	0.7	1.0	1.7	0.3	0.6	1.0	0.008	0.06	0.2	1.3	1.0	1.7	0.8	0.8	0.9	0.44	0.14	0.13	0.3	0.2	0.2
M-KM8	10/10/13	0.05	0.6	1.0	0.4	0.7	1.1	0.04	0.07	0.1	0.7	0.6	0.9	0.5	0.7	1.1	1.5	0.37	0.32	0.5	0.2	0.2
M-KM9	12/19/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM9	02/19/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM9	05/15/13	1.6	1.1	1.8	1.1	0.8	0.7	0.07	0.09	0.2	6.2	1.3	1.8	1.8	1.2	0.8	3.3	0.33	0.13	0.4	0.2	0.1
M-KM9	10/10/13	1.3	0.6	1.0	1.6	1.2	1.1	0.2	0.2	0.2	1.9	0.6	1.0	0.9	0.8	0.7	1.0	0.35	0.36	0.2	0.2	0.2
M-KM10	12/21/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM10	03/05/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM10	05/16/13	0.9	1.0	1.6	0.2	0.5	1.0	0.1	0.09	0.1	0.2	1.1	1.8	0.2	0.7	1.4	0.12	0.10	0.13	0.1	0.1	0.1
M-KM10	09/19/13	0.2	0.6	1.0	-0.03	0.3	0.7	0.02	0.08	0.2	-0.1	0.6	0.9	-0.03	0.6	1.6	-0.003	0.16	0.29	0.2	0.2	0.3
M-KM11A	10/09/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-KM11A	10/23/13	1.2	0.6	0.9	0.6	0.8	1.1	0.03	0.07	0.2	1.5	0.6	0.9	0.5	0.8	1.2	0.19	0.21	0.31	0.1	0.1	0.2
M-KM11A	12/30/13	1.3	0.6	1.0	0.2	0.3	0.7	0.04	0.07	0.1	0.5	0.6	0.9	-0.06	0.5	1.7	0.18	0.14	0.20	0.08	0.09	0.2
M-KM11A	02/13/14	1.7	0.6	1.0	0.4	0.6	0.9	0.06	0.05	0.07	0.2	0.3	0.5	0.2	0.6	1.0	0.30	0.14	0.18	0.3	0.2	0.3
M-KM11A	04/04/14	2.0	0.7	1.0	0.0	0.4	0.9	0.02	0.05	0.1	1.2	0.6	1.0	0.2	0.7	1.3	0.07	0.08	0.13	0.06	0.1	0.2
M-N2	12/11/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N2	12/27/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N2	02/14/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N2	05/21/13	1.0	0.8	1.2	-0.02	0.4	1.0	0.01	0.07	0.2	0.2	0.5	0.9	0.8	0.8	0.8	0.17	0.08	0.10	0.1	0.2	0.2
M-N2	09/18/13	0.3	0.6	1.0	0.3	0.7	1.2	0.06	0.08	0.2	-0.08	0.5	0.9	-0.04	0.5	1.2	-0.02	0.15	0.28	0.006	0.09	0.2
M-N3	12/28/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N3	02/19/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N3	05/16/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N4	12/19/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N4	02/19/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N4	05/15/13	0.3	0.9	1.6	0.6	0.7	0.9	0.04	0.07	0.1	0.06	1.1	1.8	0.3	0.6	1.0	0.14	0.10	0.14	0.1	0.1	0.2
M-N4	09/19/13	0.7	0.6	1.0	0.3	0.7	1.3	0.10	0.10	0.2	0.2	0.6	0.9	-0.05	0.7	1.7	0.12	0.18	0.29	0.1	0.1	0.3
M-N5A	12/19/12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N5A	03/05/13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-N5A	05/23/13	0.1	0.7	1.3	-0.04	0.4	1.1	2.6	0.31	0.14	0.06	0.3	0.5	0.0001	0.0004	0.0009	0.45	0.11	0.11	0.2	0.1	0.2
M-N5A	09/19/13	0.4	0.6	1.0	0.4	0.6	0.9	-0.004	0.05	0.2	-0.5	0.5	0.9	0.0	0.4	1.0	0.03	0.17	0.29	0.04	0.09	0.2
M-N6	10/10/13	0.4	0.6	1.0	-0.02	0.3	0.8	0.07	0.10	0.2	0.5	0.6	1.0	0.3	0.6	0.9	0.49	0.27	0.34	0.2	0.1	0.2
M-N6	12/30/13	0.4	0.6	1.0	0.0	0.3	0.9	0.02	0.07	0.2	0.07	0.6	1.1	0.7	0.9	1.8	0.20	0.16	0.23	0.04	0.1	0.2
M-N6	02/12/14	0.5	0.6	1.0	0.4	0.6	0.8	0.1	0.07	0.1	0.3	0.3	0.5	0.2	0.6	1.1	-0.08	0.09	0.18	0.2	0.2	0.2
M-N6	04/04/14	0.2	0.6	1.1	0.2	0.7	1.4	0.001	0.10	0.2	0.2	0.6	1.1	0.2	0.7	1.4	0.02	0.09	0.16	0.001	0.1	0.2
Report Limit		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Method		E909.0	E909.0	E909.0	E912.0	E912.0	E912.0	E908.0	E908.0	E908.0	E909.0	E909.0	E909.0	E912.0	E912.0	E912.0	E903.0	E903.0	E903.0	E908.0	E908.0	E908.0

--- = No Analysis

ND = Non-Detect

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class I)

Highlight for concentration exceeding WQD criteria is based on the lowest criteris exceeded.

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class II)

Blank and duplicate samples were omitted from this table and are presented in Attachment D6-4.

BOLD Concentration exceeds WQD Domestic Class-of-Use (Class III)

BOLD Concentration exceed EPA criteria

Table 3.5-10 State and Federal Groundwater Quality Criteria for Specified Parameters (Page 1 of 1)

Parameter	WQD Class-of-Use Criteria			EPA Drinking Water Criteria		
	Domestic (Class I)	Agriculture (Class II)	Livestock (Class III)	MCL	Treatment Action Level	Secondary Standard
Aluminum	--	5.0	5.0	--	--	0.05 to 0.2
Ammonia	0.5	--	--	--	--	--
Arsenic	0.05	0.1	0.2	0.010	--	--
Barium	2.0	--	--	2.0	--	--
Boron	0.75	0.75	5.0	--	--	--
Cadmium	0.005	0.01	0.05	0.005	--	--
Chloride	250.0	100.0	2000.0	--	--	250.0
Chromium	0.1	0.1	0.05	0.005	--	--
Copper	1.0	0.2	0.5	--	1.0	--
Fluoride	4.0	--	--	4.0	--	2.0
Iron	0.3	5.0	--	--	--	0.03
Gross Alpha (pCi/L, including Radium-226, excluding Radon & Uranium)	15.0	15.0	15.0	15.0	--	--
Lead	0.015	5.0	0.1	--	0.015	--
Manganese	0.05	0.2	--	0.05	--	--
Mercury	0.002	--	0.00005	0.002	--	--
Nickel	--	0.2	--	--	--	--
Nitrate	10.0	--	--	10.0	--	--
pH (standard units)	6.5 - 8.5	4.5 - 9.0	6.5 - 8.5	--	--	6.5 - 8.5
Radium-226+Radium-228 (pCi/L)	5.0	5.0	5.0	5.0	--	--
Selenium	0.05	0.02	0.05	0.05	--	--
Sulfate	250.0	200.0	3000.0	--	--	250.0
Total Dissolved Solids	500.0	2000.0	5000.0	--	--	500.0
Uranium	--	--	--	0.03	--	--
Vanadium	--	0.1	0.1	--	--	--
Zinc	5.0	2.0	25.0	--	--	5.0

All concentrations are in mg/L unless otherwise noted. Dashes indicate no criteria have been established.

WQD Class-of-Use criteria are from Table I in Chapter 8 (Quality Standards for Wyoming Groundwater) of the WQD Rules & Regulations, available at http://deq.state.wy.us/wqd/WQDrules/Chapter_08.pdf, accessed on April 3, 2014.

EPA Drinking Water Criteria are from http://www.epa.gov/safewater/consumer/pdf/mcl.pdf, accessed on April 3, 2014.

Table 3.5-11 - L Horizon Background Water Quality Summary

Analyte	Test Type	Units	M-L7	M-L9	M-L11A	Method Test No.
Total Alkalinity as $CaCO_3$	TOT	mg/L	108	98	93	A2320 B
Carbonate as CO_3	TOT	mg/L	<5	<5	<5	A2320 B
Bicarbonate as HCO_3	TOT	mg/L	132	119	113	A2320 B
Calcium	TOT	mg/L	40	23	30	E200.7
Chloride	TOT	mg/L	7	4	5	E300.0
Fluoride	TOT	mg/L	0.2	0.1	0.2	A4500-F C
Magnesium	TOT	mg/L	2	<1	1	E200.7
Nitrogen, Ammonia as N	TOT	mg/L	<0.05	<0.05	<0.05	A4500-NH3 G
Nitrogen, Nitrate as N	TOT	mg/L	<0.1	<0.1	<0.1	E353.2
Nitrogen, Nitrate+Nitrite as N	TOT	mg/L	<0.1	<0.1	<0.1	E353.2
Nitrogen, Nitrite as N	TOT	mg/L	<0.1	<0.1	<0.1	A4500-NO2 B
Potassium	TOT	mg/L	2	2	2	E200.7
Silica	TOT	mg/L	15.1	16.6	14.9	E200.7
Sodium	TOT	mg/L	23	26	26	E200.7
Sulfate	TOT	mg/L	49	18	39	E300.0
Specific Conductance at 25 °C	Physical	umhos/cm	315	231	271	A2510 B
Laboratory pH	Physical	s.u.	8.1	8.3	8.31	A4500-H B
TDS Dried at 180 °C	Physical	mg/L	206	141	174	A2540 C
Sodium Adsorption Ratio (SAR)	Physical	Unitless	1.0	1.4	1.3	USDA20B
Aluminum	DIS	mg/L	<0.03	<0.03	<0.03	E200.7
Arsenic	DIS	mg/L	0.001	0.002	<0.001	E200.8
Barium	DIS	mg/L	<0.05	<0.05	<0.05	E200.7
Boron	DIS	mg/L	<0.05	<0.05	<0.05	E200.7
Cadmium	DIS	mg/L	<0.001	<0.001	<0.001	E200.8
Chromium	DIS	mg/L	<0.005	<0.005	<0.005	E200.8
Copper	DIS	mg/L	<0.005	<0.005	<0.005	E200.8
Iron	DIS	mg/L	<0.03	<0.03	<0.03	E200.7
Lead	DIS	mg/L	<0.001	<0.001	<0.001	E200.8
Manganese	DIS	mg/L	0.008	0.01	0.003	E200.7
Mercury	DIS	mg/L	<0.0001	<0.0001	<0.0001	E200.8
Molybdenum	DIS	mg/L	0.001	<0.001	0.001	E200.8
Nickel	DIS	mg/L	<0.005	<0.005	<0.005	E200.8
Selenium	DIS	mg/L	<0.001	<0.001	<0.001	E200.8
Vanadium	DIS	mg/L	<0.01	<0.01	<0.01	E200.7
Zinc	DIS	mg/L	<0.01	<0.01	<0.01	E200.7
Iron	TOT	mg/L	<0.03	0.03	**0.11**	E200.8
Manganese	TOT	mg/L	0.010	0.008	0.004	E200.8
Uranium	TOT	mg/L	0.0246	0.0019	0.0191	E200.8
Gross Alpha	DIS	pCi/L	**23.9**	9.0	**16**	E900.0
Gross Alpha precision (±)	DIS	pCi/L	5.2	2.5	3.5	E900.0
Gross Alpha MDC	DIS	pCi/L	1.7	1.6	1.2	E900.0
Gross Beta	DIS	pCi/L	8.5	5.4	4.2	E900.0
Gross Beta precision (±)	DIS	pCi/L	1.7	1.6	1.5	E900.0
Gross Beta MDC	DIS	pCi/L	2.9	3.0	3.0	E900.0
Radium-226	DIS	pCi/L	**2.5**	1.8	3.0	E903.0
Radium-226 precision (±)	DIS	pCi/L	0.57	0.43	0.68	E903.0
Radium-226 MDC	DIS	pCi/L	0.19	0.19	0.20	E903.0
Radium-228	DIS	pCi/L	**3.8**	3.1	0.8	RA-05
Radium-228 precision (±)	DIS	pCi/L	1.1	0.9	1.1	RA-05
Radium-228 MDC	DIS	pCi/L	1.2	1.2	1.8	RA-05
A/C Balance	TOT	%	-2.49	-2.58	-0.25	A1030E
Anions	TOT	meq/L	3.38	2.52	2.81	A1030E
Cations	TOT	meq/L	3.22	2.40	2.80	A1030E
TDS Ratio	TOT	mg/L	1.00	0.92	0.98	A1030E

DIS = Dissolved
ND = Not detected at minimum detectable concentration
TOT = Total
Physical = Physical Properties
Bold = Exceeds State of EPA Water Quality Criteria

ATTACHMENT 3.5-1

Surface Water Quality
Laboratory Reports

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ANALYTICAL SUMMARY REPORT

April 15, 2013

UR Energy USA Inc
10758 W Centennial Rd Ste 200
Ken Caryl Ranch, CO 80127

Workorder No.: C13031028

Project Name: Lost Creek East Stormwater

Energy Laboratories, Inc. Casper WY received the following 2 samples for UR Energy USA Inc on 3/28/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C13031028-001	SS8	03/27/13 0:00	03/28/13	Aqueous	Sample Filtering Metals by ICP-MS, Suspended Uranium, Dissolved Digestion, Total Metals Radium 226, Dissolved Radium 226, Suspended Thorium, Isotopic Thorium, Suspended Isotopic
C13031028-002	SS12	03/27/13 0:00	03/28/13	Aqueous	Same As Above

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:

Report Proofing Specialist

Digitally signed by
Sheri M. Mead
Date: 2013.04.16 08:39:08 -06:00

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	04/15/13
Project:	Lost Creek East Stormwater	**Collection Date:**	03/27/13
Lab ID:	C13031028-001	**DateReceived:**	03/28/13
Client Sample ID	SS8	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	04/02/13 19:13 / cp
METALS - SUSPENDED							
Uranium	ND	mg/L		0.0003		E200.8	04/12/13 23:08 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	0.60	pCi/L				E903.0	04/08/13 18:15 / lmc
Radium 226 precision (±)	0.17	pCi/L				E903.0	04/08/13 18:15 / lmc
Radium 226 MDC	0.19	pCi/L				E903.0	04/08/13 18:15 / lmc
Thorium 230	0.2	pCi/L	U			E908.0	04/05/13 09:23 / dmf
Thorium 230 precision (±)	0.2	pCi/L				E908.0	04/05/13 09:23 / dmf
Thorium 230 MDC	0.2	pCi/L				E908.0	04/05/13 09:23 / dmf
RADIONUCLIDES - SUSPENDED							
Radium 226	0.001	pCi/L				E903.0	04/08/13 16:00 / trs
Radium 226 precision (±)	0.0006	pCi/L				E903.0	04/08/13 16:00 / trs
Radium 226 MDC	0.0008	pCi/L				E903.0	04/08/13 16:00 / trs
Thorium 230	0.0006	pCi/L				E908.0	04/08/13 17:19 / dmf
Thorium 230 precision (±)	0.0002	pCi/L				E908.0	04/08/13 17:19 / dmf
Thorium 230 MDC	0.0003	pCi/L				E908.0	04/08/13 17:19 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
U - Not detected at minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc.	**Report Date:**	04/15/13
Project:	Lost Creek East Stormwater	**Collection Date:**	03/27/13
Lab ID:	C13031028-002	**DateReceived:**	03/28/13
Client Sample ID	SS12	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	04/02/13 19:26 / cp
METALS - SUSPENDED							
Uranium	ND	mg/L		0.0003		E200.8	04/12/13 23:12 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	0.50	pCi/L				E903.0	04/08/13 18:15 / lmc
Radium 226 precision (±)	0.16	pCi/L				E903.0	04/08/13 18:15 / lmc
Radium 226 MDC	0.20	pCi/L				E903.0	04/08/13 18:15 / lmc
Thorium 230	0.3	pCi/L				E908.0	04/05/13 09:23 / dmf
Thorium 230 precision (±)	0.2	pCi/L				E908.0	04/05/13 09:23 / dmf
Thorium 230 MDC	0.2	pCi/L				E908.0	04/05/13 09:23 / dmf
RADIONUCLIDES - SUSPENDED							
Radium 226	0.001	pCi/L				E903.0	04/08/13 16:00 / trs
Radium 226 precision (±)	0.0007	pCi/L				E903.0	04/08/13 16:00 / trs
Radium 226 MDC	0.0009	pCi/L				E903.0	04/08/13 16:00 / trs
Thorium 230	0.0008	pCi/L				E908.0	04/08/13 17:19 / dmf
Thorium 230 precision (±)	0.0003	pCi/L				E908.0	04/08/13 17:19 / dmf
Thorium 230 MDC	0.0003	pCi/L				E908.0	04/08/13 17:19 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 04/15/13
Project: Lost Creek East Stormwater **Work Order:** C13031028

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8							Analytical Run: ICPMS2-C_130402A			
Sample ID: ICV		Initial Calibration Verification Standard							04/02/13 12:45	
Uranium		0.0501	mg/L	0.00030	100	90	110			
Method: E200.8									Batch: R172033	
Sample ID: LRB		Method Blank				Run: ICPMS2-C_130402A			04/02/13 13:10	
Uranium		ND	mg/L	1E-05						
Sample ID: LFB		Laboratory Fortified Blank				Run: ICPMS2-C_130402A			04/02/13 13:14	
Uranium		0.0538	mg/L	0.00030	108	85	115			
Sample ID: C13031028-001BMS		Sample Matrix Spike				Run: ICPMS2-C_130402A			04/02/13 19:16	
Uranium		0.0525	mg/L	0.00030	105	70	130			
Sample ID: C13031028-001BMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_130402A			04/02/13 19:19	
Uranium		0.0526	mg/L	0.00030	105	70	130	0.2	20	
Method: E200.8							Analytical Run: ICPMS2-C_130412A			
Sample ID: ICV		Initial Calibration Verification Standard							04/12/13 14:32	
Uranium		0.0494	mg/L	0.00030	99	90	110			
Method: E200.8									Batch: 37001	
Sample ID: MB-37001		Method Blank				Run: ICPMS2-C_130412A			04/12/13 22:30	
Uranium		6.97E-05	mg/L	0.00030						
Sample ID: LCS2-37001		Laboratory Control Sample				Run: ICPMS2-C_130412A			04/12/13 22:33	
Uranium		0.0987	mg/L	0.0014	99	85	115			
Sample ID: C13031011-001GMS		Sample Matrix Spike				Run: ICPMS2-C_130412A			04/12/13 22:43	
Uranium		0.000111	mg/L	0.00030	110	70	130			
Sample ID: C13031011-001GMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_130412A			04/12/13 22:46	
Uranium		0.000110	mg/L	0.00030	109	70	130		20	

Qualifiers:

RL - Analyte reporting limit. ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 04/15/13

Project: Lost Creek East Stormwater **Work Order:** C13031028

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0										Batch: 37001
Sample ID: C13031011-001GMS		Sample Matrix Spike				Run: G5000W_130402A				04/08/13 16:00
Radium 226		0.092	pCi/L		99	70	130			
Sample ID: C13031011-001GMSD		Sample Matrix Spike Duplicate				Run: G5000W_130402A				04/08/13 16:00
Radium 226		0.095	pCi/L		104	70	130	3.3	20.8	
Sample ID: LCS-37001		Laboratory Control Sample				Run: G5000W_130402A				04/08/13 16:00
Radium 226		21	pCi/L		100	80	120			
Sample ID: MB-37001	3	Method Blank				Run: G5000W_130402A				04/08/13 16:00
Radium 226		-0.003	pCi/L							U
Radium 226 precision (±)		0.2	pCi/L							
Radium 226 MDC		0.3	pCi/L							
Method: E903.0										Batch: RA226-6572
Sample ID: C13031026-001EMS		Sample Matrix Spike				Run: TENNELEC-3_130401C				04/08/13 18:15
Radium 226		28	pCi/L		122	70	130			
Sample ID: C13031026-001EMSD		Sample Matrix Spike Duplicate				Run: TENNELEC-3_130401C				04/08/13 18:15
Radium 226		28	pCi/L		121	70	130	0.2	15.2	
Sample ID: MB-RA226-6572	3	Method Blank				Run: TENNELEC-3_130401C				04/09/13 09:27
Radium 226		0.2	pCi/L							
Radium 226 precision (±)		0.05	pCi/L							
Radium 226 MDC		0.07	pCi/L							
Sample ID: LCS-RA226-6572		Laboratory Control Sample				Run: TENNELEC-3_130401C				04/09/13 09:27
Radium 226		13	pCi/L		110	80	120			

Qualifiers:

- Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 04/15/13

Project: Lost Creek East Stormwater **Work Order:** C13031028

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E908.0										Batch: RA-TH-ISO-1815
Sample ID: LCS-RA-TH-ISO-1815	Laboratory Control Sample				Run: ALPHANALYST_130402A					04/05/13 09:22
Thorium 230		6.4	pCi/L		106	80	120			
Sample ID: C13030895-001FMS	Sample Matrix Spike				Run: ALPHANALYST_130402A					04/05/13 09:22
Thorium 230		13	pCi/L		103	70	130			
Sample ID: C13030895-001FMSD	Sample Matrix Spike Duplicate				Run: ALPHANALYST_130402A					04/05/13 09:22
Thorium 230		14	pCi/L		111	70	130	7.4	26.6	
Sample ID: MB-RA-TH-ISO-1815	3	Method Blank			Run: ALPHANALYST_130402A					04/05/13 09:23
Thorium 230		0.04	pCi/L							U
Thorium 230 precision (±)		0.04	pCi/L							
Thorium 230 MDC		0.06	pCi/L							
Method: E908.0										Batch: 37001
Sample ID: C13031011-001GMS	Sample Matrix Spike				Run: ALPHANALYST_130402B					04/08/13 17:19
Thorium 230		0.045	pCi/L		105	70	130			
Sample ID: C13031011-001GMSD	Sample Matrix Spike Duplicate				Run: ALPHANALYST_130402B					04/08/13 17:19
Thorium 230		0.041	pCi/L		96	70	130	8.4	29.9	
Sample ID: LCS-37001	Laboratory Control Sample				Run: ALPHANALYST_130402B					04/08/13 17:19
Thorium 230		25	pCi/L		99	80	120			
Sample ID: MB-37001	3	Method Blank			Run: ALPHANALYST_130402B					04/08/13 17:19
Thorium 230		0.1	pCi/L							U
Thorium 230 precision (±)		0.1	pCi/L							
Thorium 230 MDC		0.3	pCi/L							

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: UR-ENERGY USA	Project Name, PWS, Permit, Etc.: LOST CREEK EAST STORMWATER	Sample Origin State: WY	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address (Required): ☐ No Hard Copy Email:	Contact Name: MIKE GAITHER Phone/Fax: (307) 265-2373 X321	Cell:	Sampler: (Please Print) CTK
	Invoice Contact & Phone:	Purchase Order:	Quote/Bottle Order:

Invoice Address (Required):

☐ No Hard Copy Email:

Special Report/Formats:

- ☐ DW
- ☐ POTW/WWTP
- ☐ State: ______
- ☐ Other: ______
- ☐ EDD/EDT (Electronic Data) Format: ______
- ☐ LEVEL IV
- ☐ NELAC

Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other; DW - Drinking Water

ANALYSIS REQUESTED (MG 3/29/2013): Unat (DSS + SUSP); Ra226 (DSS + SUSP); Th230 (DSS + SUSP); Pb210 (DSS + SUSP); Po210 (DSS + SUSP); SEE ATTACHED; Standard Turnaround (TAT); RUSH

➡ Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

#	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	~~Total~~ Unat DSS + SUSP	~~Total~~ Ra226 DSS + SUSP	~~Total~~ Th230 DSS + SUSP	~~Total~~ Pb210 DSS + SUSP	~~Total~~ Po210 DSS + SUSP	Comments
1	SS8	3/27/2013		W	✓	✓	✓	✓	✓	PRIORITY –
2	SS12	↓		↓	✓	✓	✓	✓	✓	- U-NAT
3										- Ra226
4										
5										
6	MG 3/28/2013									C13031028
7										
8										
9										
10										

LABORATORY USE ONLY

- Shipped by: Hand
- Cooler ID(s): 1830/2719
- Receipt Temp: 5.4 °C
- On Ice: Y (N)
- Custody Seal On Bottle: Y (N)
- Custody Seal On Cooler: Y (N)
- Intact: Y N
- Signature Match: Y N

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
M. GAITHER	3/28/2013 1625 ~~1425~~	[signature]			
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ______	Lab Disposal: ______		Received by Laboratory:	3-28-13 / 1625	[signature]

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ANALYTICAL SUMMARY REPORT

November 25, 2013

UR Energy USA Inc
10758 W Centennial Rd Ste 200
Ken Caryl Ranch, CO 80127

Workorder No.: C13100898

Project Name: Lost Creek East Stormwater

Energy Laboratories, Inc. Casper WY received the following 3 samples for UR Energy USA Inc on 10/24/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C13100898-001	LC 9	10/23/13 0:00	10/24/13	Aqueous	Sample Filtering Uranium, Dissolved Uranium, Suspended Digestion, Total Metals Radium 226, Dissolved Radium 226, Suspended Thorium, Isotopic Thorium, Suspended Isotopic
C13100898-002	SS-10	10/23/13 0:00	10/24/13	Aqueous	Same As Above
C13100898-003	SS-13	10/23/13 0:00	10/24/13	Aqueous	Same As Above

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:

Report Proofing Specialist

Digitally signed by
Sheri M. Mead
Date: 2013.11.25 16:20:11 -07:00

CLIENT: UR Energy USA Inc
Project: Lost Creek East Stormwater
ample Delivery Group: C13100898

Report Date: 11/25/13

CASE NARRATIVE

TH230 ANALYSIS
USNRC Regulatory Guide 4.14 provides guidance on Minimum Detectable Concentrations (MDC) that should be achieved in samples for this radionuclide. The sample-specific MDC for this sample could not be achieved due to lack of sufficient sample volume. Please consult with your local regulatory agency prior to using these results for compliance purposes.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	11/25/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/23/13
Lab ID:	C13100898-002	**DateReceived:**	10/24/13
Client Sample ID:	SS-10	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	0.0005	mg/L		0.0003		E200.8	10/25/13 20:45 / clm
METALS - SUSPENDED							
Uranium	0.0368	mg/L	D	0.0008		E200.8	11/06/13 04:01 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	4.9	pCi/L				E903.0	11/06/13 17:42 / lmc
Radium 226 precision (±)	0.58	pCi/L				E903.0	11/06/13 17:42 / lmc
Radium 226 MDC	0.25	pCi/L				E903.0	11/06/13 17:42 / lmc
Thorium 230	0.4	pCi/L	U			E908.0	11/05/13 09:21 / dmf
Thorium 230 precision (±)	0.4	pCi/L				E908.0	11/05/13 09:21 / dmf
Thorium 230 MDC	0.6	pCi/L				E908.0	11/05/13 09:21 / dmf
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	38	pCi/L				E903.0	11/06/13 01:47 / trs
Radium 226 precision (±)	4.9	pCi/L				E903.0	11/06/13 01:47 / trs
Radium 226 MDC	2.6	pCi/L				E903.0	11/06/13 01:47 / trs
Thorium 230	14.9	pCi/L				E908.0	11/14/13 16:09 / dmf
Thorium 230 precision (±)	3.1	pCi/L				E908.0	11/14/13 16:09 / dmf
Thorium 230 MDC	1.3	pCi/L				E908.0	11/14/13 16:09 / dmf

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	11/25/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/23/13
Lab ID:	C13100898-003	**DateReceived:**	10/24/13
Client Sample ID:	SS-13	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	10/25/13 20:48 / clm
METALS - SUSPENDED							
Uranium	0.0233	mg/L	D	0.0006		E200.8	11/06/13 04:03 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	1.4	pCi/L				E903.0	11/06/13 17:42 / lmc
Radium 226 precision (±)	0.34	pCi/L				E903.0	11/06/13 17:42 / lmc
Radium 226 MDC	0.26	pCi/L				E903.0	11/06/13 17:42 / lmc
Thorium 230	0.08	pCi/L	U			E908.0	11/05/13 09:21 / dmf
Thorium 230 precision (±)	0.1	pCi/L				E908.0	11/05/13 09:21 / dmf
Thorium 230 MDC	0.3	pCi/L				E908.0	11/05/13 09:21 / dmf
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	24	pCi/L				E903.0	11/06/13 01:47 / trs
Radium 226 precision (±)	3.4	pCi/L				E903.0	11/06/13 01:47 / trs
Radium 226 MDC	1.9	pCi/L				E903.0	11/06/13 01:47 / trs
Thorium 230	8.8	pCi/L				E908.0	11/14/13 16:09 / dmf
Thorium 230 precision (±)	2.1	pCi/L				E908.0	11/14/13 16:09 / dmf
Thorium 230 MDC	1	pCi/L				E908.0	11/14/13 16:09 / dmf

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 11/25/13

Project: Lost Creek East Stormwater **Work Order:** C13100898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8							Analytical Run: ICPMS2-C_131025A			
Sample ID: ICV		Initial Calibration Verification Standard							10/25/13 18:49	
Uranium		0.0507	mg/L	0.00030	101	90	110			
Method: E200.8									Batch: R180047	
Sample ID: LRB		Method Blank				Run: ICPMS2-C_131025A			10/25/13 15:02	
Uranium		ND	mg/L	1E-05						
Sample ID: LFB		Laboratory Fortified Blank				Run: ICPMS2-C_131025A			10/25/13 16:01	
Uranium		0.0506	mg/L	0.00030	101	85	115			
Sample ID: C13100898-003BMS		Sample Matrix Spike				Run: ICPMS2-C_131025A			10/25/13 20:52	
Uranium		0.0516	mg/L	0.00030	103	70	130			
Sample ID: C13100898-003BMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_131025A			10/25/13 21:08	
Uranium		0.0521	mg/L	0.00030	104	70	130	0.9	20	
Method: E200.8							Analytical Run: ICPMS2-C_131106A			
Sample ID: ICV		Initial Calibration Verification Standard							11/06/13 03:35	
Uranium		0.0526	mg/L	0.00030	105	90	110			
Method: E200.8									Batch: 39586	
Sample ID: MB-39586		Method Blank				Run: ICPMS2-C_131106A			11/06/13 03:37	
Uranium		0.001	mg/L	0.0006						
Sample ID: LCS2-39586		Laboratory Control Sample				Run: ICPMS2-C_131106A			11/06/13 03:38	
Uranium		0.0935	mg/L	0.00058	92	85	115			
Sample ID: C13100892-001HMS		Sample Matrix Spike				Run: ICPMS2-C_131106A			11/06/13 03:43	
Uranium		0.0854	mg/L	0.00030	102	70	130			
Sample ID: C13100892-001HMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_131106A			11/06/13 03:45	
Uranium		0.0874	mg/L	0.00030	104	70	130	2.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc | **Report Date:** 11/25/13
Project: Lost Creek East Stormwater | **Work Order:** C13100898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0										Batch: 39586
Sample ID: C13100898-001CDUP	3	Sample Duplicate				Run: BERTHOLD 770-2_131030A				11/06/13 01:47
Radium 226		22	pCi/L					19	43.5	
Radium 226 precision (±)		3.5	pCi/L							
Radium 226 MDC		2.2	pCi/L							
Sample ID: C13100898-003CMS		Sample Matrix Spike				Run: BERTHOLD 770-2_131030A				11/06/13 01:47
Radium 226		270	pCi/L		114	70	130			
Sample ID: LCS-39586		Laboratory Control Sample				Run: BERTHOLD 770-2_131030A				11/06/13 04:06
Radium 226		22.2	pCi/Filter		103	80	120			
Sample ID: MB-39586	3	Method Blank				Run: BERTHOLD 770-2_131030A				11/06/13 04:06
Radium 226		0.01	pCi/Filter							U
Radium 226 precision (±)		0.2	pCi/Filter							
Radium 226 MDC		0.4	pCi/Filter							
Method: E903.0										Batch: RA226-6926R
Sample ID: C13100909-001FMS		Sample Matrix Spike				Run: TENNELEC-3_131029B				11/06/13 22:10
Radium 226		39	pCi/L		125	70	130			
Sample ID: C13100909-001FMSD		Sample Matrix Spike Duplicate				Run: TENNELEC-3_131029B				11/06/13 22:10
Radium 226		40	pCi/L		130	70	130	2.5	18.8	
Sample ID: MB-RA226-6926	3	Method Blank				Run: TENNELEC-3_131029B				11/06/13 22:10
Radium 226		0.1	pCi/L							U
Radium 226 precision (±)		0.1	pCi/L							
Radium 226 MDC		0.2	pCi/L							
Sample ID: LCS-RA226-6926		Laboratory Control Sample				Run: TENNELEC-3_131029B				11/06/13 22:10
Radium 226		13	pCi/L		117	80	120			

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration
ND - Not detected at the reporting limit.
U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 11/25/13

Project: Lost Creek East Stormwater **Work Order:** C13100898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E908.0									Batch: RA-TH-ISO-1948	
Sample ID: LCS-RA-TH-ISO-1948		Laboratory Control Sample				Run: ALPHANALYST_131030A			11/05/13 09:20	
Thorium 230		6.0	pCi/L		88	80	120			
Sample ID: C13100714-002FMS		Sample Matrix Spike				Run: ALPHANALYST_131030A			11/05/13 09:20	
Thorium 230		15	pCi/L		110	70	130			
Sample ID: C13100714-002FMSD		Sample Matrix Spike Duplicate				Run: ALPHANALYST_131030A			11/05/13 09:20	
Thorium 230		12	pCi/L		86	70	130	24	40	
Sample ID: MB-RA-TH-ISO-1948	3	Method Blank				Run: ALPHANALYST_131030A			11/05/13 13:33	
Thorium 230		0.2	pCi/L							
Thorium 230 precision (±)		0.2	pCi/L							
Thorium 230 MDC		0.2	pCi/L							
Method: E908.0									Batch: 39586	
Sample ID: C13101014-001AMS		Sample Matrix Spike				Run: ALPHANALYST_131106A			11/11/13 13:07	
Thorium 230		5.14E-05	pCi/Filter		111	70	130			
Sample ID: C13101014-001AMSD		Sample Matrix Spike Duplicate				Run: ALPHANALYST_131106A			11/11/13 13:07	
Thorium 230		4.34E-05	pCi/Filter		94	70	130	17	27.1	
Sample ID: MB-39586	2	Method Blank				Run: ALPHANALYST_131106A			11/11/13 13:07	
Thorium 230		0.1	pCi/Filter							
Thorium 230 MDC		0.1	pCi/Filter							
Sample ID: LCS-39586		Laboratory Control Sample				Run: ALPHANALYST_131106A			11/11/13 13:07	
Thorium 230		16.5	pCi/Filter		93	80	120			
Method: E908.0									Batch: R180928	
Sample ID: C13100892-001HMS		Sample Matrix Spike				Run: ALPHANALYST_131112A			11/14/13 16:08	
Thorium 230		18	pCi/L		97	70	130			
Sample ID: C13100892-001HMSD		Sample Matrix Spike Duplicate				Run: ALPHANALYST_131112A			11/14/13 16:08	
Thorium 230		19	pCi/L		104	70	130	8.3	39.1	
Sample ID: MB-39586	3	Method Blank				Run: ALPHANALYST_131112A			11/14/13 16:09	
Thorium 230		0.07	pCi/L							U
Thorium 230 precision (±)		0.1	pCi/L							
Thorium 230 MDC		0.3	pCi/L							
Sample ID: LCS-39586		Laboratory Control Sample				Run: ALPHANALYST_131112A			11/14/13 16:09	
Thorium 230		19	pCi/L		109	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 11/25/13

Project: Lost Creek East Stormwater **Work Order:** C13100898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Batch: R180047	
Sample ID: LRB		Method Blank				Run: ICPMS2-C_131025A			10/25/13 15:02	
Uranium		ND	mg/L	1E-05						
Method: SW6020									Batch: 39586	
Sample ID: C13101014-004ADIL		Serial Dilution				Run: ICPMS2-C_131106A			11/06/13 04:18	
Uranium		3.06E-10	mg/L	0.00030					20	N
Sample ID: C13101014-007AMS		Sample Matrix Spike				Run: ICPMS2-C_131106A			11/06/13 04:24	
Uranium		0.546	mg/filter	0.00030	109	75	125			
Sample ID: C13101014-007AMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_131106A			11/06/13 04:26	
Uranium		0.543	mg/filter	0.00030	109	75	125	0.5	20	
Sample ID: MB-39586		Method Blank				Run: ICPMS2-C_131106A			11/06/13 03:37	
Uranium		0.001	mg/filter	9E-05						
Sample ID: LCS2-39586		Laboratory Control Sample				Run: ICPMS2-C_131106A			11/06/13 03:38	
Uranium		0.0935	mg/filter	0.00030	92	85	115			

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

Workorder Receipt Checklist

UR Energy USA Inc C13100898

Login completed by:	Tessa Parke	Date Received:	10/24/2013
Reviewed by:	BL2000\khelm	Received by:	dw
Reviewed Date:	10/28/2013	Carrier name:	Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☐	No ☑	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	6.0°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☑	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Due to low sample volume we will only be able to run uranium, radium 226, and thorium 230. Samples for dissolved metals and radiochemistry were subsampled, filtered and preserved with 2 mL HNO3 in lab upon receipt to pH <2. According to 40CFR136, samples for dissolved metals should be filtered and preserved within 15 minutes of collection.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page ___ of ___

PLEASE PRINT (Provide as much information as possible.)

Company Name: UR Energy USA	Project Name, PWS, Permit, Etc.: Lost Creek ~~East Background~~ East Stormwater	Sample Origin State:	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address (Required): 5880 Enterprise Drive Suite 200 Casper, Wy 82609 ☐ No Hard Copy Email:	Contact Name: Mike Gaither Phone/Fax: 307 265-2373 x 321 Cell: mike.gaither@UR-energy		Sampler: (Please Print) Denise R. Weller
	Invoice Contact & Phone: Chuck Kelsey 307 265 2373 x 413	Purchase Order:	Quote/Bottle Order:
Invoice Address (Required): SAME ☐ No Hard Copy Email:			

Special Report/Formats:
☐ DW ☐ EDD/EDT (Electronic Data)
☐ POTW/WWTP Format: ______
☐ State: ______ ☐ LEVEL IV
☐ Other: ______ ☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: LIMITED VOLUME - PRIORITY IS UNAT + Ra226.

Shipped by: Hand
Cooler ID(s): Client
Receipt Temp 6.0 °C
On Ice: Y N
Custody Seal On Bottle Y N On Cooler Y N
Intact Y N
Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	U-Nat (Diss + Susp)	Ra-226 (Diss + Susp)	Th-230 (Diss+Susp)	Pb-210 (Diss + Susp)	Po-210 (Diss + Susp)
1	LC9	10-23		W	✓	✓	✓	✓	✓
2	SS-10	↓		W	✓	✓	✓	✓	✓
3	SS-13	↓		W	✓	✓	✓	✓	✓
4									
5									
6									
7									
8									
9									
10									

mdc 10/24/2013

LABORATORY USE ONLY
C13100898

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Denise R. Weller	10-23	Denise R. Weller	Eric Stonaker	10-23 13:45	Eric Stonaker
Eric Stonaker	10-23-2013 19:30	Eric Stonaker	D Hutchins	10/24/13 11:30	D Hutchins
Sample Disposal: Return to Client:		Lab Disposal:	Received by Laboratory:	10-24-13 1130	

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ANALYTICAL SUMMARY REPORT

December 12, 2013

UR Energy USA Inc
10758 W Centennial Rd Ste 200
Ken Caryl Ranch, CO 80127

Workorder No.: C13110150

Project Name: Lost Creek East Stormwater

Energy Laboratories, Inc. Casper WY received the following 4 samples for UR Energy USA Inc on 11/5/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C13110150-001	SS-8	10/23/13 0:00	11/05/13	Aqueous	Sample Filtering Uranium, Dissolved Uranium, Suspended Digestion, Total Metals Radium 226, Dissolved Radium 226, Suspended Thorium, Isotopic Thorium, Suspended Isotopic
C13110150-002	SS-9	10/28/13 13:21	11/05/13	Aqueous	Same As Above
C13110150-003	SS-14	10/29/13 14:06	11/05/13	Aqueous	Same As Above
C13110150-004	SS-12	10/29/13 14:25	11/05/13	Aqueous	Same As Above

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:

Report Proofing Specialist

Digitally signed by
Sheri M. Mead
Date: 2013.12.12 15:44:25 -07:00

CLIENT: UR Energy USA Inc
Project: Lost Creek East Stormwater
Report Date: 12/12/13
ample Delivery Group: C13110150

CASE NARRATIVE

PREP COMMENTS
The prep hold time for the filtration of dissolved metals was exceeded by up to 11.4 days.

RA226 ANALYSIS
USNRC Regulatory Guide 4.14 provides guidance on Minimum Detectable Concentrations (MDC) that should be achieved in samples for this radionuclide. The sample-specific MDC for this sample could not be achieved due to lack of sufficient sample volume. Please consult with your local regulatory agency prior to using these results for compliance purposes.

TH230 ANALYSIS
USNRC Regulatory Guide 4.14 provides guidance on Minimum Detectable Concentrations (MDC) that should be achieved in samples for this radionuclide. The sample-specific MDC for this sample could not be achieved due to lack of sufficient sample volume. Please consult with your local regulatory agency prior to using these results for compliance purposes.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	12/12/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/23/13
Lab ID:	C13110150-001	**DateReceived:**	11/05/13
Client Sample ID:	SS-8	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	11/12/13 15:37 / clm
METALS - SUSPENDED							
Uranium	0.0240	mg/L	D	0.0006		E200.8	11/16/13 05:44 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	0.57	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 precision (±)	0.27	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 MDC	0.32	pCi/L				E903.0	11/18/13 09:49 / trs
Thorium 230	0.3	pCi/L	U			E908.0	12/05/13 14:26 / dmf
Thorium 230 precision (±)	0.3	pCi/L				E908.0	12/05/13 14:26 / dmf
Thorium 230 MDC	0.4	pCi/L				E908.0	12/05/13 14:26 / dmf
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	24	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 precision (±)	3.4	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 MDC	1.9	pCi/L				E903.0	11/20/13 11:45 / plj
Thorium 230	9.6	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 precision (±)	2.6	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 MDC	1.3	pCi/L				E908.0	12/10/13 12:20 / dmf

Report Definitions:

- RL - Analyte reporting limit.
- QCL - Quality control limit.
- MDC - Minimum detectable concentration
- U - Not detected at minimum detectable concentration
- MCL - Maximum contaminant level.
- ND - Not detected at the reporting limit.
- D - RL increased due to sample matrix.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	12/12/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/28/13 13:21
Lab ID:	C13110150-002	**DateReceived:**	11/05/13
Client Sample ID:	SS-9	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	11/12/13 15:38 / clm
METALS - SUSPENDED							
Uranium	0.0447	mg/L	D	0.0006		E200.8	11/16/13 05:47 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	1.6	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 precision (±)	0.39	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 MDC	0.31	pCi/L				E903.0	11/18/13 09:49 / trs
Thorium 230	0.2	pCi/L	U			E908.0	12/05/13 14:26 / dmf
Thorium 230 precision (±)	0.2	pCi/L				E908.0	12/05/13 14:26 / dmf
Thorium 230 MDC	0.3	pCi/L				E908.0	12/05/13 14:26 / dmf
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	39	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 precision (±)	4.3	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 MDC	1.9	pCi/L				E903.0	11/20/13 11:45 / plj
Thorium 230	12.3	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 precision (±)	3.3	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 MDC	1.7	pCi/L				E908.0	12/10/13 12:20 / dmf

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	12/12/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/29/13 14:25
Lab ID:	C13110150-004	**DateReceived:**	11/05/13
Client Sample ID:	SS-12	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	11/12/13 15:43 / clm
METALS - SUSPENDED							
Uranium	0.106	mg/L	D	0.0006		E200.8	11/16/13 05:57 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	5.1	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 precision (±)	0.65	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 MDC	0.31	pCi/L				E903.0	11/18/13 09:49 / trs
Thorium 230	0.2	pCi/L	U			E908.0	12/05/13 14:26 / dmf
Thorium 230 precision (±)	0.2	pCi/L				E908.0	12/05/13 14:26 / dmf
Thorium 230 MDC	0.3	pCi/L				E908.0	12/05/13 14:26 / dmf
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	105	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 precision (±)	6.8	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 MDC	1.9	pCi/L				E903.0	11/20/13 11:45 / plj
Thorium 230	47.8	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 precision (±)	8.5	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 MDC	1.5	pCi/L				E908.0	12/10/13 12:20 / dmf

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	UR Energy USA Inc	**Report Date:**	12/12/13
Project:	Lost Creek East Stormwater	**Collection Date:**	10/29/13 14:06
Lab ID:	C13110150-003	**DateReceived:**	11/05/13
Client Sample ID:	SS-14	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Uranium	ND	mg/L		0.0003		E200.8	11/12/13 15:42 / clm
METALS - SUSPENDED							
Uranium	0.100	mg/L	D	0.002		E200.8	11/16/13 05:54 / clm
RADIONUCLIDES - DISSOLVED							
Radium 226	0.11	pCi/L	U			E903.0	11/18/13 09:49 / trs
Radium 226 precision (±)	0.68	pCi/L				E903.0	11/18/13 09:49 / trs
Radium 226 MDC	1.2	pCi/L				E903.0	11/18/13 09:49 / trs
Thorium 230	0.4	pCi/L	U			E908.0	12/05/13 14:26 / dmf
Thorium 230 precision (±)	0.6	pCi/L				E908.0	12/05/13 14:26 / dmf
Thorium 230 MDC	1.3	pCi/L				E908.0	12/05/13 14:26 / dmf
- See Case Narrative regarding Ra226 analysis.							
- See Case Narrative regarding Th230 analysis.							
RADIONUCLIDES - SUSPENDED							
Radium 226	103	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 precision (±)	13	pCi/L				E903.0	11/20/13 11:45 / plj
Radium 226 MDC	6.1	pCi/L				E903.0	11/20/13 11:45 / plj
Thorium 230	41.8	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 precision (±)	10.9	pCi/L				E908.0	12/10/13 12:20 / dmf
Thorium 230 MDC	4.9	pCi/L				E908.0	12/10/13 12:20 / dmf

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 12/12/13

Project: Lost Creek East Stormwater **Work Order:** C13110150

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8							Analytical Run: ICPMS2-C_131115A			
Sample ID: ICV		Initial Calibration Verification Standard							11/15/13 13:58	
Uranium		0.0511	mg/L	0.00030	102	90	110			
Method: E200.8									Batch: 39726	
Sample ID: MB-39726		Method Blank				Run: ICPMS2-C_131115A			11/16/13 05:34	
Uranium		ND	mg/L	0.0006						
Sample ID: LCS2-39726		Laboratory Control Sample				Run: ICPMS2-C_131115A			11/16/13 05:37	
Uranium		0.0962	mg/L	0.00058	96	85	115			
Sample ID: C13110150-004CMS		Sample Matrix Spike				Run: ICPMS2-C_131115A			11/16/13 06:00	
Uranium		0.668	mg/L	0.00063	104	70	130			
Sample ID: C13110150-004CMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_131115A			11/16/13 06:16	
Uranium		0.672	mg/L	0.00063	105	70	130	0.6	20	
Method: E200.8							Analytical Run: ICPMS4-C_131112A			
Sample ID: ICV		Initial Calibration Verification Standard							11/12/13 10:43	
Uranium		0.0505	mg/L	0.00030	101	90	110			
Method: E200.8									Batch: R180688	
Sample ID: LRB		Method Blank				Run: ICPMS4-C_131112A			11/12/13 10:56	
Uranium		ND	mg/L	9E-06						
Sample ID: LFB		Laboratory Fortified Blank				Run: ICPMS4-C_131112A			11/12/13 11:32	
Uranium		0.0483	mg/L	0.00030	97	85	115			
Sample ID: C13110212-002BMS		Sample Matrix Spike				Run: ICPMS4-C_131112A			11/12/13 15:58	
Uranium		0.0593	mg/L	0.00030	106	70	130			
Sample ID: C13110212-002BMSD		Sample Matrix Spike Duplicate				Run: ICPMS4-C_131112A			11/12/13 15:59	
Uranium		0.0598	mg/L	0.00030	107	70	130	0.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 12/12/13

Project: Lost Creek East Stormwater **Work Order:** C13110150

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0										Batch: 39726
Sample ID: C13110150-003CMS		Sample Matrix Spike			Run: BERTHOLD 770-1_131114A				11/20/13 11:45	
Radium 226		1000	pCi/L		120	70	130			
Sample ID: C13110150-003CMSD		Sample Matrix Spike Duplicate			Run: BERTHOLD 770-1_131114A				11/20/13 11:45	
Radium 226		1000	pCi/L		124	70	130	2.8	20.6	
Sample ID: LCS-39726		Laboratory Control Sample			Run: BERTHOLD 770-1_131114A				11/20/13 11:45	
Radium 226		25	pCi/L		118	80	120			
Sample ID: MB-39726	3	Method Blank			Run: BERTHOLD 770-1_131114A				11/20/13 11:45	
Radium 226		-0.2	pCi/L							U
Radium 226 precision (±)		0.2	pCi/L							
Radium 226 MDC		0.3	pCi/L							
Method: E903.0										Batch: RA226-6953
Sample ID: TAP WATER-MS		Sample Matrix Spike			Run: BERTHOLD 770-2_131112A				11/18/13 11:46	
Radium 226		13	pCi/L		108	70	130			
Sample ID: TAP WATER-MSD		Sample Matrix Spike Duplicate			Run: BERTHOLD 770-2_131112A				11/18/13 11:46	
Radium 226		12	pCi/L		104	70	130	4.9	22.2	
Sample ID: MB-RA226-6953	3	Method Blank			Run: BERTHOLD 770-2_131112A				11/18/13 13:30	
Radium 226		0.03	pCi/L							U
Radium 226 precision (±)		0.1	pCi/L							
Radium 226 MDC		0.2	pCi/L							
Sample ID: LCS-RA226-6953		Laboratory Control Sample			Run: BERTHOLD 770-2_131112A				11/18/13 13:30	
Radium 226		12	pCi/L		102	80	120			

Qualifiers:

_ - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: UR Energy USA Inc **Report Date:** 12/12/13

Project: Lost Creek East Stormwater **Work Order:** C13110150

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E908.0									Batch: RA-TH-ISO-1963	
Sample ID: LCS-RA-TH-ISO-1963		Laboratory Control Sample				Run: ALPHANALYST_131121C			12/05/13 14:26	
Thorium 230		5.3	pCi/L		83	80	120			
Sample ID: C13110391-001DMS		Sample Matrix Spike				Run: ALPHANALYST_131121C			12/05/13 14:26	
Thorium 230		10	pCi/L		75	70	130			
Sample ID: C13110391-001DMSD		Sample Matrix Spike Duplicate				Run: ALPHANALYST_131121C			12/05/13 14:26	
Thorium 230		13	pCi/L		95	70	130	23	44.3	
Sample ID: MB-RA-TH-ISO-1963	3	Method Blank				Run: ALPHANALYST_131121C			12/05/13 14:27	
Thorium 230		0.05	pCi/L							U
Thorium 230 precision (±)		0.10	pCi/L							
Thorium 230 MDC		0.2	pCi/L							
Method: E908.0									Batch: 39726	
Sample ID: C13110150-004CMS		Sample Matrix Spike				Run: ALPHANALYST_131203D			12/10/13 12:20	
Thorium 230		170	pCi/L		108	70	130			
Sample ID: C13110150-004CMSD		Sample Matrix Spike Duplicate				Run: ALPHANALYST_131203D			12/10/13 12:20	
Thorium 230		150	pCi/L		91	70	130	12	42.6	
Sample ID: MB-39726	3	Method Blank				Run: ALPHANALYST_131203D			12/10/13 12:20	
Thorium 230		0.1	pCi/L							U
Thorium 230 precision (±)		0.2	pCi/L							
Thorium 230 MDC		0.5	pCi/L							
Sample ID: LCS-39726		Laboratory Control Sample				Run: ALPHANALYST_131203D			12/10/13 12:20	
Thorium 230		18	pCi/L		96	80	120			

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

Workorder Receipt Checklist

UR Energy USA Inc C13110150

Login completed by:	Debra Williams	Date Received:	11/5/2013
Reviewed by:	BL2000\khelm	Received by:	cav
Reviewed Date:	11/5/2013	Carrier name:	Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	3.4°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

PLEASE PRINT (Provide as much information as possible.)

Company Name: UR-Energy USA	Project Name, PWS, Permit, Etc. Lost Creek EAST Stormwater	Sample Origin State: Wy	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address (Required): 5880 Enterprise Dr. Suite 200 Casper, Wy 82609 ☐ No Hard Copy Email:	Contact Name: Mike Gaither Phone/Fax: (307) 265-2373 X 321 Cell: mikegaither@ur-energy.		Sampler: (Please Print) Denise R. Weller
	Invoice Contact & Phone: Chuck Kelsey (307) 265-2373 X 413	Purchase Order:	Quote/Bottle Order:
Invoice Address (Required): same ☐ No Hard Copy Email:			

Special Report/Formats:
- ☐ DW
- ☐ POTW/WWTP
- ☐ State: ______
- ☐ Other: ______
- ☐ EDD/EDT (Electronic Data) Format: ______
- ☐ LEVEL IV
- ☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH — Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	U-Nat (diss + susp)	Ra 226 (diss + susp)	Th 230 (diss + susp)	Pb 210 (diss + susp)	Po 210 (diss + susp)
1	SS-8	10-23	~~1321~~	W	✓	✓	✓	✓	✓
2	SS-9	10-23	1321	W	✓	✓	✓	✓	✓
3	~~GWS~~ SS-14	10-23	1406	W	✓	✓	✓	✓	✓
4	~~GWM~~ SS-12	10-23	1425	W	✓	✓	✓	✓	✓
5									
6									
7									
8									
9									
10									

MDG 11/5/2013

Comments:
LIMITED VOLUME. ANALYSIS PRIORITY IS Unat Ra226 Th230

INSUFFICIENT VOL FOR Pb + Po MDG 11/5/2013

LABORATORY USE ONLY
Shipped by: Hand
Cooler ID(s): Client
Receipt Temp 3.4 °C
On Ice: Y (N)
Custody Seal On Bottle Y (N)
On Cooler Y (N)
Intact Y N
Signature Match Y N

C13110150

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Denise R. Weller	10-25-13 / 3:30pm	Denise R. Weller	Eric Stoecker	11/4/13 6:10	Eric Stoecker
D Hutchins	11/5/13 10:15	D Hutchins			
			Received by Laboratory:	11/5/13 10:35	

Sample Disposal: Return to Client: ______ Lab Disposal: ______

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ATTACHMENT 3.5-2

Groundwater Quality
Laboratory Reports

Section 3.6
Ecology

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

3.6 Ecology

The Permit Area is located in the Wyoming Basin ecoregion (Chapman, 2004) at an elevation of approximately 7,000 ft amsl. With approximately 260 feet of relief, sub-zero winter temperatures, and less than ten inches of annual precipitation, vegetation development and species diversity are limited.

Appropriate state and federal agencies, including WDEQ, WGFD, BLM, US Fish and Wildlife Service (FWS), were consulted on the scope of work for the proposed ecological surveys and presence or absence of species of special concern.

3.6.1 Vegetation

This report presents the results of vegetation studies conducted on the LC East Amendment Area to the LC East ISR Uranium Mine (WDEQ Permit No. 788) on October 8, 2012 and June 26-27, 2013. The sampling methodology for the project follows the information presented in the Wyoming Department of Environmental Quality (WDEQ) – Land Quality Division (LQD) Guideline No. 2 – Vegetation for Non-Coal Operations. Prior to the initiation of field work for the project, the sampling methodology was reviewed and accepted by Craig Smith of the WDEQ-LQD. The sampling methodology is presented in **Attachment 3.6-1**. The vegetation sampling was completed by BKS Environmental Associates, Inc. of Gillette, Wyoming.

3.6.1.1 Description of the Study Area

The Amendment Area is located near the center of the Great Divide Basin within Sweetwater County approximately 50 miles north of Rawlins, Wyoming. The elevation is approximately 7,000 feet above mean sea level. The Amendment Area is located in all or portions of Sections 1, 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 27, 28, and 29, T25N, R92W. The Amendment Area encompasses approximately 5,724 acres. The Western Regional Climate Center (WRCC) meteorological station closest to the Amendment Area with a long period of record is the Muddy Gap, Wyoming station (WRCC 2013). This station is 28 miles northeast of the Amendment Area, and temperature, precipitation, snowfall, and snow depth data have been collected since 1949.

At Muddy Gap, the mean annual precipitation was 9.87 inches. The prevailing monthly wind direction was from the west-northwest and west for most of the year, with some variability occurring in the spring. The annual average wind speed at a height of ten meters was 20.7 feet per second (6.3 meters per second). Additionally, a Lost Creek (LC) meteorological station was installed in May 2007 within the Lost Creek Permit Area to collect on-site data. The LC station showed a mean annual precipitation of approximately 7.5 inches during 2007-2009.

Most of the Amendment Area consists of flat upland areas and gentle south facing slopes that are dissected by southerly-flowing ephemeral washes. There are no perennial streams on the Amendment Area. The vegetation is dominated by big sagebrush (*Artemisia tridentata*) which occurs throughout both upland and lowland areas. Big sagebrush is well adapted to the cold winter temperatures and limited precipitation that characterize the Amendment Area. Numerous other species occur, but none are as successful as big sagebrush. Because of the differences in the density and stature of big sagebrush within the Lost Creek ISR Uranium Mine permit area and the Amendment Area, two sagebrush shrubland vegetation communities were identified and mapped: Upland Big Sagebrush Shrubland and Lowland Big Sagebrush Shrubland. These vegetation communities were defined on the basis of topographic position, with the Lowland Big Sagebrush vegetation community occurring in the deeper soils along the ephemeral drainages. Barren, wind-blown areas throughout the Amendment Area support Mixed Grass/Mat Cushion Grassland, but were not identified and mapped in the Lost Creek ISR Uranium Mine permit area.

Limited amounts of annual precipitation (less than ten inches) and freezing winter temperatures create a cold desert climate which tends to restrict vegetation development. Plant communities tend to be dominated by shrubs, cushion plants, or cacti rather than by herbaceous species.

3.6.1.2 Methods

3.6.1.2.1 Vegetation Community Mapping

Vegetation community mapping was conducted on October 8, 2012. Three vegetation communities were identified within the Amendment Area: Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland (see **Figures 3.6-1**, **3.6-2** and **3.6-3**). Vegetation communities were mapped using 2011 U.S. Department of Agriculture National Agricultural Imagery Program (NAIP) true color ortho aerial imagery and verified through field surveys. Disturbed areas and water present within the Amendment Area were also identified and mapped, based on the scale of the available mapping.

All areas within ½ mile of the Amendment Area were mapped based on review of NAIP true color ortho aerial imagery and known expression of the NAIP true color ortho aerial imagery within the Amendment Area, based on the October 2012 field surveys. Field verification of the vegetation communities within the ½ mile buffer was not necessary, and vegetation sampling was not conducted within the ½ mile buffer.

3.6.1.2.2 Selection of Sample Point Locations

A computerized systematic grid (through ArcGIS) was used to randomly locate 50 sample points within each vegetation community occurring within the Amendment Area. These computer generated random locations were uploaded to a hand-held Global Positioning System (GPS) unit for actual location in the field. Sample points were sampled in numerical order until the minimum sample size was attained and then, until either sample adequacy was met or the required maximum number of samples had been collected. Disturbed areas were excluded from sampling.

3.6.1.2.3 Sample Intensity and Sample Site Location

A total of 69 points were sampled within the Amendment Area. Twenty points were sampled within the Lowland Big Sagebrush Shrubland, and twenty points were sampled within the Upland Big Sagebrush Shrubland vegetation communities. Twenty-nine points were sampled within the Mixed Grass/Mat Cushion Grassland vegetation community. Sample site locations are shown on the Amendment Area vegetation map (**Figures 3.6-1, 3.6-2**, and **3.6-3**).

3.6.1.2.4 Cover Sampling of Vegetation Communities

Line-transect point-intercept methods were used to collect percent absolute cover data within the Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities. Percent cover measurements were taken from point-intercepts at one-meter intervals along a 50-meter cover transect using a laser point device at each sample location. Each 50-meter point-intercept cover transect began at its specified random origin point and extended in a random compass direction. Transects that exceeded the boundaries of the vegetation community being sampled were redirected back into its vegetation community at a 90-degree angle from the original transect direction at the point of intercept. In instances where a 90-degree angle of reflection did not place the cover transect within the sampled vegetation community, a 45-degree angle of reflection was used.

Each 50-meter cover transect represented a single sample point within the given vegetation community. Each point-intercept represented 2% of the cover measurement. Percent cover measurements recorded "first-hit" point-intercepts by live foliar vegetation species, litter, rock, or bare ground. "Second-hits" on vegetation were recorded, but used only for the purpose of constructing a plant species list for each vegetation community.
Percent vegetation cover is the vertical projection of the general outline of plants to the ground surface. All "first-hit" point-intercepts of living vegetation and growth, produced during the current growing season and cryptograms were counted toward total vegetation cover. Total vegetation cover data was summarized by computing absolute (mean) cover, relative cover (% of total vegetation cover), frequency, and relative frequency (% of total plot occurrences for each plant species).

Total ground cover equals the sum of cover values for percent vegetation, percent litter, and percent rock. Litter included all non-living organic material that is recognizable. Rock fragments were recorded when equal to or greater than one-square centimeter in size (i.e., sheet flow, minimum non-erodible particle size). Total ground cover measurements were expressed in absolute percentages for each sample point.

3.6.1.2.5 Shrub and Tree Density

Although shrub density sampling is not required for non-coal sites, this data was collected in conjunction with the cover sampling. Shrub density sampling was accomplished by counting each individual full, sub, and half shrub located within one meter of either side of the 50-meter cover transect (100-square meter belt transect). The number of individual shrub occurrences was recorded by species. The number of shrub density belt transects equaled the number of 50-meter cover transects within each vegetation community. Data was tabulated by computing the mean density per square meter and mean density per acre. Sample adequacy was not calculated for shrub density transects. General approximations of shrub heights were recorded; however, shrub height measurements were not summarized for purposes of this report. No trees were encountered.

3.6.1.2.6 Species Diversity and Composition

Species diversity was assessed by recording all plant species observed within the same 100-square meter belt transect used for determining shrub density. These observations provide a measurement of the total species diversity for each vegetation community. Species diversity data was reported as the average number of species per 100-square meter belt transect and total number of species within each vegetation community, based on the 2013 field survey. The total number of species with greater than 2% relative vegetation cover within each vegetation community was also determined. Species diversity calculations did not include Species Lacking Credible Value (SLCV): halogeton (*Halogeton glomeratus*), Japanese brome (*Bromus japonicus*), cheatgrass (*Bromus tectorum*), summer cypress (*Bassia sieversiana*), and Russian thistle (*Salsola tragus*), Wyoming State Designated Noxious Weeds, or Sweetwater County Declared Weeds. The number of species diversity belt transects equaled the number of 50-meter cover transects within each vegetation community.

A comprehensive plant species list was compiled from plant species encountered during 2012 vegetation mapping and 2013 quantitative vegetation sampling. The plant species list includes plant species sampled in cover transects, as well as plant species observed along the belt transect. Species observed during vegetation community mapping, threatened and endangered habitat and plant species surveys, wetland surveys, and plant species survey. Plant species were compiled by lifeform and vegetation community. Scientific nomenclature follows the Rocky Mountain Vascular Plants of Wyoming (Dorn, 3rd Edition).

3.6.1.2.7 Sample Adequacy

Sample adequacy was tested for each of the sampled vegetation communities, using the following formula:

$$n_{min} = \frac{2(sz)^2}{(dx)^2}$$

Where n_{min} = the number of sample points needed in a given vegetation community

- s = sample standard deviation
- z = 1.28 from WDEQ Guideline 2
- d = 0.1 from WDEQ Guideline 2
- x = sample mean for total vegetation cover or total ground cover

Confidence levels were determined as outlined in WDEQ-LQD Guideline 2.

3.6.1.2.8 Extended Reference Area

For the purposes of this permit application, Extended Reference Area (EXREFA) means a native land unit which will be used to evaluate revegetation success for each of the same native vegetation communities which were affected by the mining operation. All Lowland Big Sagebrush Shrubland, Upland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities unaffected by the mining operation, within the permit area of the Lost Creek ISR Uranium Mine and/or the Amendment Area, will serve as the EXREFA. The EXREFA will remain unaffected over the course of the mining operation and will be as large as practical, at least two acres, considering land ownership patterns and land management history. One EXREFA, for each of the native vegetation communities affected by the mining operations, will be used to evaluate revegetation success within the Lost Creek ISR Uranium Mine and the Amendment Area.

3.6.1.2.9 Cropland and Hayland Productivity

There are no croplands within the Amendment Area. The area is used for livestock grazing, but no crops are produced. In addition to grazing by domestic livestock (cattle), wild horses, pronghorn, and other wildlife graze the Amendment Area.

3.6.1.3 Results

3.6.1.3.1 Description of Vegetation Communities

The Amendment Area is located in the Great Divide Basin, where the vegetation on upland areas is consistently dominated by big sagebrush. The vegetation development within the

Amendment Area is consistent with these regional patterns. Within the Amendment Area, two vegetation communities dominated by big sagebrush (*Artemisia tridentata*) and one dominated by graminoids and cushion plants were identified and mapped (**Figures 3.6-1, 3.6-2**, and **3.6-3**). The areal extent of each of these vegetation communities are presented in **Table 3.6-1**. In the sections that follow, each vegetation community is described based on data collected in June 2013 and on general observations made during vegetation community mapping.

3.6.1.3.1.1 Upland Big Sagebrush Shrubland Vegetation Community

The Upland Big Sagebrush Shrubland vegetation community comprised approximately 5,370 of the 5,724 acre Amendment Area (93.8%) (**Table 3.6-1**). This vegetation community was generally found on shallow, coarse-textured soils within the Amendment Area. Within this vegetation community there were rolling hills and long moderately steep to gently sloping hillsides. These long hillsides create rolling topography, often extending from ridgetops to edges of ephemeral drainages (**Figure 3.6-4**).

Native full shrubs were the dominant lifeform within the Upland Big Sagebrush Shrubland vegetation community. Common shrub species included big sagebrush and sticky-leaved rabbitbrush (*Chrysothamnus viscidiflorus*). These species were also present within the Lowland Big Sagebrush Shrubland vegetation community; however, within the Upland Big Sagebrush Shrubland the shrubs were smaller is size due to shallow soils and harsh winter conditions. Grass and forb species were also observed within this vegetation community, but not as abundantly as shrubs.

Cover

Twenty, 50-meter cover transects were sampled within this vegetation community in 2013. Absolute total vegetation cover was 30.5% (**Table 3.6-2**). Absolute bare soil, litter, and rock percentages were 45.8%, 22.2%, and 1.5%, respectively. Absolute total ground cover was 54.2%. Native full shrubs were the dominant lifeform with 62.6% relative vegetation cover, followed by native cool season perennial grasses with 18.0% relative vegetation cover. Big sagebrush provided the highest relative vegetation cover at 61.6%, while Hoods phlox (*Phlox hoodii*) provided the next highest relative vegetation cover at 8.2%. Raw data is presented in **Table 1 of Attachment 3.6-1**.

Shrub and Tree Density

Shrub density within the Upland Big Sagebrush Shrubland vegetation community was 3.0 shrubs/square meter or 12,074 shrubs/acre (**Table 3.6-3**). Big sagebrush was the dominant shrub species. Raw data is presented in **Table 2 of Attachment 3.6-1**. No trees were observed within the Upland Big Sagebrush Shrubland vegetation community.

Species Diversity and Composition

Six lifeforms and 24 plant species were observed within the Upland Big Sagebrush Shrubland vegetation community (**Table 3.6-8**). The mean number of plant species observed per belt transect was 7.9. Native cool season perennial grasses were the most common lifeform encountered with nine plant species observed. Native perennial forbs were the second most common lifeform with seven plant species observed. Raw data is presented in **Table 1 of Attachment 3.6-2**.

3.6.1.3.1.2 Lowland Big Sagebrush Shrubland Vegetation Community

The Lowland Big Sagebrush Shrubland vegetation community comprised approximately 325 of the 5,724acre Amendment Area (5.7%) (**Table 3.6-1**). This vegetation community was generally found on deep coarse-textured soils in or surrounding ephemeral drainages within the Amendment Area, generally crossing the Amendment Area from north to south. The increased potential soil moisture allows greater growth by shrub species; therefore, individual shrubs occurring within and along the drainages tended to be much larger than the shrubs occurring on the upland areas (**Figure 3.6-5**).

Native full shrubs were the dominant lifeform within the Lowland Big Sagebrush Shrubland vegetation community. Common native full shrub species included big sagebrush, sticky-leaved rabbitbrush, and rubber rabbitbrush (*Ericameria nauseosa*). Big sagebrush and sticky-leaved rabbitbrush were also present within the Upland Big Sagebrush Shrubland vegetation community; however, the densities and size of individual plants was distinctly different between the two communities. Grass and forb species were also observed within this vegetation community, but not as abundantly as shrubs.

Cover

Twenty, 50-meter cover transects were sampled within this vegetation community in 2013. Absolute total vegetation cover was 41.8% (**Table 3.6-4**). Absolute bare soil and litter percentages were 20.7% and 37.5%, respectively. Absolute total ground cover was 79.3%. Native full shrubs were the dominant lifeform with 88.8% relative vegetation cover, followed by native cool season perennial grasses with 8.4% relative vegetation cover. Big sagebrush provided the highest relative vegetation cover at 79.2%, while rubber rabbitbrush provided the next highest relative vegetation cover at 5.5%. Sandberg bluegrass (*Poa secunda*) provided 3.1% relative cover. Raw data is presented in **Table 3 of Attachment 3.6-2**.

Shrub and Tree Density

Shrub density within the Lowland Big Sagebrush Shrubland vegetation community was 2.9 shrubs/square meter or 11,738 shrubs/acre (**Table 3.6-5**). Big sagebrush was the dominant shrub species. Raw data is presented in **Table 4 of Attachment 3.6-2**. No trees were observed within the Lowland Big Sagebrush Shrubland vegetation community.

Species Diversity and Composition

Nine lifeforms and 29 plant species were observed within the Lowland Big Sagebrush Shrubland vegetation community (**Table 3.6-8**). The mean number of plant species observed per belt transect was 6.65. Native cool season perennial grasses were the most common lifeform encountered with 10 plant species observed. Native perennial forbs were the second most common lifeform with six plant species observed. Raw data is presented in **Table 3 of Attachment 3.6-2**.

3.6.1.3.1.3 Mixed Grass/Mat Cushion Grassland Vegetation Community

The Mixed Grass/Mat Cushion Grassland vegetation community comprised approximately 27.04 of the 5,724.36 acre Amendment Area (0.47%) (**Table 3.6-1**). This vegetation community was generally found in coarse-textured soils. Within this vegetation community there were exposed sandy hilltops and eroded areas on hillsides. These eroded areas on hillsides create depressions within the landscape with limited vegetation and more bare ground than surrounding areas (**Figure 3.6-6**).

Native perennial forbs were the dominant lifeform within the Mixed Grass/Mat Cushion Grassland vegetation community. Common perennial forb species included Hoods phlox, stemless goldenweed (*Stenotus acaulis*), and musk phlox (*Phlos muscoides*). Shrub species were generally scattered within this vegetation community and included big sagebrush, rubber rabbitbrush, and winterfat (*Krascheninnikovia lanata*).

Cover

Twenty-nine, 50-meter cover transects were sampled within this vegetation community in 2013. Absolute total vegetation cover was 19.7% (**Table 3.6-6**). Absolute bare soil, litter, and rock percentages were 64.1%, 15.2%, and 1.0%, respectively. Absolute total ground cover was 35.9%. Native perennial forbs were the dominant lifeform with 33.7% relative vegetation cover, followed by native cool season perennial grasses with 23.8% relative vegetation cover. Hoods phlox provided the highest relative vegetation cover at 16.9%, while big sagebrush provided the next highest relative vegetation cover at 16.5%. Raw data is presented in **Table 5 of Attachment 3.6-2**.

Shrub and Tree Density

Shrub density within the Mixed Grass/Mat Cushion Grassland vegetation community was 0.6 shrubs/square meter or 2,434 shrubs/acre (**Table 3.6-7**). Big sagebrush was the dominant shrub species. Raw data is presented in **Table 6 of Attachment 3.6-2**. No trees were observed within the Mixed Grass/Mat Cushion Grassland vegetation community.

Species Diversity and Composition

Eight lifeforms and 27 plant species were observed within the Mixed Grass/Mat Cushion Grassland vegetation community (**Table 3.6-8**). The mean number of plant species observed per belt transect was 8.1. Native perennial forbs were the most common lifeform encountered with 10 plant species observed. Native cool season perennial grasses were the second most common lifeform with seven plant species observed. Raw data is presented in **Table 5 of Attachment 3.6-2**.

3.6.1.3.2 Weeds, Selenium Indicators, Endangered and Threatened Species, and Species of Local Concern

Surveys for Wyoming State Designated Noxious Weeds (Wyoming Weed and Pest Council 2013) and Sweetwater County Declared Weeds (Wyoming Weed and Pest Council 2012) were conducted in conjunction with baseline vegetation mapping, sampling, and threatened and endangered plant species surveys (**Table 3.6-9**). No Noxious Weeds or Declared Weeds were observed during these surveys.

No selenium indicator species were sampled or observed within the Amendment Area.

No threatened, endangered or plant species of special concern were observed on the Amendment Area (WYNDD 2013). A complete evaluation of rare plant species is presented in **Attachment 3.6-3**.

3.6.1.3.3 Species Composition

As part of all field work, observations were made regarding the species composition in each of the vegetation communities (**Table 3.6-8**). Forty-three species were observed within the Amendment Area. Within the Upland Big Sagebrush Shrubland vegetation community, 24 species were observed or sampled, within the Lowland Big Sagebrush Shrubland vegetation community, 29 species were observed or sampled, and within the Mixed Grass/Mat Cushion Grassland vegetation community 27 species were observed or sampled. The relatively low number of species is a reflection of the overall homogeneity of the environmental conditions on the site.

3.6.1.3.4 Sample Adequacy

Twenty, 50-meter cover transects were sampled within the Upland Big Sagebrush Shrubland and Lowland Big Sagebrush Shrubland vegetation communities. Twenty-nine, 50-meter cover transects were sampled within Mixed Grass/Mat Cushion Grassland vegetation community. The sample adequacy formula, outlined in WDEQ-LQD Guideline 2, was utilized to determine the minimum required size of the sample population. All vegetation communities met sample adequacy (**Table 3.6-10**).

3.6.1.4 Discussion

The 5,724 acre Amendment Area consists of three vegetation communities: Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland. The Upland Big Sagebrush Shrubland was the dominant vegetation community and occupied 93.8% of the Amendment Area. Lowland Big Sagebrush Shrubland accounted for 5.7%, and Mixed Grass/Mat Cushion Grassland accounted for 0.5%. Previously disturbed areas accounted for <0.5%, and water accounted for <0.5% of the Amendment Area.

Total vegetation cover ranged from 19.7% to 41.8%. Total ground cover ranged from 35.9% to 79.3%. Species diversity ranged from 24 to 29 plant species across the vegetation communities, with a total of 43 plant species observed. The dominant shrub species was big sagebrush. Sandberg bluegrass and prairie junegrass (*Koeleria macrantha*) were the dominant perennial grasses. The dominant perennial forb species was Hoods phlox.

No threatened or endangered plant species habitat or individuals were encountered within the Amendment Area. No Wyoming State Designated Noxious Weeds or Sweetwater County Declared Weeds were observed.

The vegetation that occurs within the Amendment Area is typical and representative of the vegetation within the Great Divide Basin region, and is very similar to the vegetation observed in the original Lost Creek ISR Uranium Mine permit area. The major vegetation communities are dominated by big sagebrush which is the major species in the region. Overall, the Amendment Area tends to be very homogeneous. The lack of perennial streams and minimal topographic variation restricts the overall species diversity. No wetland areas occur, however, concentrated grazing was evident surrounding water developments within the Amendment Area and multiple ephemeral drainages dissect the Amendment Area.

The three vegetation communities tend to have distinct boundaries between them and can be distinguished on aerial imagery (**Figures 3.6-1, 3.6-2, and 3.6-3**). As the soil profile depths become shallower at the edge of the ephemeral drainages, the big sagebrush gradually become smaller and the overall character of the vegetation changes from lowland to upland as the vegetation cover decreases. The smallest big sagebrush plants occur on the hilltops, where the plants are subject to blowing ice and snow in the winter and the vegetation is dependent on the shallower soil profiles.

3.6.1.5 Conclusions

- Most of the vegetation on the Amendment Area is typical of the vegetation found throughout the Great Divide Basin and is similar to the vegetation observed within the original Lost Creek ISR Uranium Mine permit area.
- No Wyoming State Designated Noxious or Sweetwater County Declared weeds were noted within the Amendment Area.
- No selenium indicator species were observed within the Amendment Area.
- No plant species of special concern were observed on the Amendment Area.
- A total of 43 species were observed on the Amendment Area. Overall, the species composition consisted of species that would be expected in big sagebrush shrublands.
- The Upland Big Sagebrush Shrubland was composed of 30.5% total vegetation cover, 22.2% and 1.5% cover by litter and rock, respectively, and 45.8% bare soil.
- The Lowland Big Sagebrush Shrubland was composed of 41.8% total vegetation cover, 37.5% cover by litter, and 20.7% bare soil.
- The Mixed Grass/Mat Cushion Grassland was composed of 19.7% total vegetation cover, 15.2% and 1.0% cover by litter and rock, respectively, and 64.1% bare soil.
- Sample adequacy requirements were met for all vegetation communities sampled.

3.6.2 Aquatic Life and Wetlands

After conducting field investigations and research, aquatic life and wetlands were determined to not exist within the boundaries of the Permit Area. Surface water may be present seasonally, but does not sustain aquatic life or wetland species.

3.6.3 Wildlife

Lost Creek ISR, LLC is submitting this Baseline Wildlife Assessment as part of the amendment request to include the LC East Project in the existing Lost Creek Permit to Mine 788. The LC East Project is contiguous with and generally south and east of the Lost Creek Permit area. The sampling methodology for the project follows the guidelines of the Wyoming Department of Environmental Quality (WDEQ) – Land Quality Division (LQD) Guideline No. 5 – Wildlife (WDEQ 1995). The work scope also follows Bureau of Land Management (BLM) recommendations. The work scope is also designed to mirror the existing Lost Creek projects baseline wildlife surveys and ongoing wildlife monitoring plan (LWR 2012).

Ecologically, the LC East Project is located in the Wyoming Basin ecoregion (Chapman et al. 2004), at an elevation of approximately 7,000 ft amsl. With approximately 260 feet of relief, sub-zero winter temperatures, and less than ten inches of annual precipitation, vegetation development and species diversity are limited. The topography is characterized by rolling plains with small, ephemeral drainages dissecting the area. There are no perennial water sources within the study area. The entire Permit Area covers approximately 5,724 acres.

The abundance, habitat requirements, seasonal fluctuations, and distribution of species were evaluated. Species of particular interest included:

- Threatened or Endangered species, Candidate species, BLM Sensitive Species, and Migratory Birds of High Federal Interest (MBHFI);
- commercially or recreationally valuable species;
- species affecting the well-being of species of special concern;
- species critical to the structure and function of the ecological system; and
- biological indicator species of radionuclides or chemical pollutants in the environment.

Appropriate state and federal agencies, including the WDEQ, WGFD, BLM, and the U.S. Fish and Wildlife Service (FWS), were consulted on the scope of work for the proposed ecological surveys and presence or absence of species of special concern.

Wildlife inventories of the Permit Area were conducted in 2011, 2012, and 2103. Wildlife inventories were designed to provide baseline data for permitting the ISR Project and to ensure that wildlife species and habitats are afforded adequate protection during construction, operations, and restoration. Potential impacts to, and monitoring and mitigation of the wildlife resources are discussed Section 4.0.

Data collection for the wildlife surveys included file searches of state and federal agency documents, and field surveys for raptors, sage-grouse, and breeding birds. Wildlife studies focused on threatened and endangered (T&E) species, MBHFI, raptors, sage-grouse leks and nesting habitat, breeding bird surveys, Wyoming pocket gophers, and pygmy rabbits, as well as a general wildlife inventory of the Permit Area.

For most surveys, the study area was the same as the Permit Area. In order to identify the off-site habitat and individuals that could be affected by Project activities, the study area for sage-grouse included a larger sage-grouse study area, and the study area for raptors included an additional one-mile buffer around the perimeter. Land ownership of the study area is under the jurisdiction of BLM and the State of Wyoming.

The field surveys and reports specific to the Project were completed by Eric Berg, Craig Severn, and Andre Duvalle of LWR, all qualified wildlife biologists or ecologists. Personnel contacted from WGFD include Greg Hiatt (2011, 2012, 2013) and Scott Gamo (2012). The contacted BLM personnel included Heath Cline and Charles Morton (2011, 2012, 2013).

3.6.3.1 Wildlife Habitat and Species Description

The wildlife habitat in the Permit Area is predominantly Upland Big Sagebrush and Lowland Big Sagebrush plant communities (**Figures 3.6-1, 3.6-2, 3.6-3**). Other wildlife habitats include Mixed Grass/Mat Cushion Grassland communities, and disturbed lands.

The Upland Big Sagebrush wildlife habitat is generally found on flat and rolling hills. This habitat is important for pronghorn antelope, mule deer, sage-grouse, Wyoming pocket gophers, and reptiles. Raptors often hunt in big sagebrush habitat, and sage-grouse leks are often located on ridge tops and openings within this community.

The Lowland Big Sagebrush wildlife habitat is found along drainages. This habitat type has significantly higher and denser vegetation cover than the Upland Big Sagebrush. The Lowland Big Sagebrush wildlife habitat also provides important cover for resident and migratory birds (including nesting migrants), reptiles, pygmy rabbits, and other small mammals. The taller big sagebrush provides nesting sites for raptors and forage for ungulates and sage-grouse during winters with extreme snowfall.

A list of wildlife species that potentially occur in the Permit Area is provided in **Table 3.6-11**. A total of 44 wildlife species have been found within the Permit Area. Of these, 19 species are birds, 22 species are mammals, and three species are reptiles. Species known to exist in the study area, either by observation or the presence of identifying signs, are noted in **Table 3.6-11**.

3.6.3.2 Methods

File and Data Searches

Locations of raptor nest sites, sage-grouse leks, prairie dog towns, big game ranges, and T&E species were obtained from GIS data from the BLM and WGFD. The WGFD publications WGFD Atlas of Species (WGFD 2009), the WGFD Wildlife Observation System (WOS, WGFD 2013) and the Wyoming Interagency Spatial Database and Online Management System (Wisdom 2013) were reviewed for the Permit Area (**Attachment 3.6-4**).

Past surveys completed for the Lost Creek Project were also reviewed for the LC East Project (LWR 2009, 2010, 2011, 2012).

Field Surveys

Field surveys for sage-grouse leks, raptor nest sites, big game, pygmy rabbits, and breeding birds were completed in the area in 2012; additional sage-grouse-lek and nesting raptor surveys were completed during the spring of 2013. Wyoming pocket gopher surveys were completed during August and September of 2013. The presence of other wildlife species or their identifying signs was also recorded, all observed species are included in **Table 3.6-11**. ~~Breed~~ing bird surveys were conducted within the Permit Area; surveys for raptor nests and big game also included one-mile buffer areas. Pygmy rabbit surveys were conducted in random transects within the Permit Area. The sage-grouse study area included a much larger study area and was the same as the sage-grouse study area for the Lost Creek Project.

General field surveys were completed by traversing the Permit Area and the surrounding area using high-wing aircraft or four-wheel drive vehicles, and on foot. Binoculars and spotting scopes were used for observations. Specific survey methods for individual species or groups of species are presented in **Attachment 3.6-5**. Wildlife surveys were completed according to a work plan developed in consultation with the WGFD, WDEQ, and BLM. The scope of field work was finalized in consultation with BLM in Rawlins, Wyoming (LWR 2011, 2012). The field survey protocols were consistent with recommendations by both the BLM and WGFD (**Attachment 3.6-6**).

3.6.3.3 Results

The following sections provide results from the file searches and field studies, along with relevant figures, tables, and maps. **Table 3.6-11** provides a list of wildlife species that have the potential to occur in the study area. **Attachment 3.6-4** includes the WGFD WOS and Atlas record of wildlife species previously observed in the Permit Area.

Big Game

Big game surveys were completed in and around the LC East Project area during the fall, winter, spring, and early summer. Based on these surveys the relative abundance of big game observed during the course of field work was recorded and is presented in **Table 3.6-12**.

Pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis* were the only big game animals recorded in or near the Permit Area during field observations in 2012 and 2013. WGFD observations in **Attachment 3.6-4** indicate that pronghorn are the most abundant big game species in the study area. Pronghorn use of the ~~study~~ area, as determined by WGFD and BLM, is shown in **Figure 3.6-7**. The Permit Area is classified as Winter/Yearlong Range. Winter/Yearlong Range is the area where a population of animals makes general use of the habitat on a year-round basis, and there is a significant influx of animals between December and April. The study area comprises a portion of the Red Desert Antelope Herd Unit (WGFD Hunt Area PR161). Based on the most current Annual Big Game Herd Unit Job Completion Reports (JCRs; WGFD 2012), the Red Desert Antelope Herd had an average population of 13,356 pronghorn from 2007-2011. Pronghorn are common throughout the study area. Pronghorn were most abundant on the Permit Area during the early summer. Pronghorn observed during big game surveys are shown on **Figure 3.6-8**.

A map of mule deer use of the study area is presented in **Figure 3.6-7**. The Permit Area is out of mule deer range. Areas described as "out of range" contain few animals or the available habitat is of limited importance to the species. Mule deer use in the area is sporadic and not common.

Elk use of the study area is mapped in **Figure 3.6-7**. Elk likely use the Permit Area as transitional range while moving to other areas. The WGFD data defines the seasonal range of the elk to be outside of the Permit Area. Elk observed during big game surveys are shown on **Figure 3.6-8**.

The Permit Area is classified as out of moose (*Alces alces*) range, as determined by WGFD and BLM; **Figure 3.6-7**); no moose or sign of moose were observed in the study area.

Upland Game Birds

Greater sage-grouse (*Centrocercus urophasianus;* hereafter, sage-grouse) and mourning doves (*Zenaida macroura*) were the only upland game birds noted in the study area. Sage-grouse may inhabit the area year-long, but mourning doves are migrants and only inhabit the area from spring into early fall.

The LC East Project is located within a WGFD mapped sage-grouse core management area (Wyoming 2011). Lost Creek ISR, LLC (Lost Creek) has prepared a Disturbance Density Calculation Tool (DDCT) review for the LC East project. The DDCT was completed according to BLM and WGFD requirements and submitted to these agencies for review.

Detailed studies for sage-grouse have been completed for the LC East Project in conjunction with the already permitted Lost Creek Project. Sage-grouse monitoring areas were established to include both affected and control leks. Sage-grouse monitoring areas are shown on **Figure 3.6-9**. Lek search and lek count protocols were used to assess potential impacts of ISR activities on sage-grouse populations. The objective of lek counts was to track male breeding population size within the SG Monitoring Areas through the life of the Project. The objective of lek searches was to determine if new leks become active within the SG Monitoring Areas during the life of the Project. Lek counts were conducted following protocol outlined by the WGFD Sage-grouse Technical Committee, and BLM and lek searches were conducted from the ground following protocol outlined in Connelly et al. (2003).

There are two leks located within the LC East Permit Area (Prospects South and Green Ridge). Two other leks are located within 2-miles of the Permit Area (Prospects, and the inactive Crooked Well lek). Affected leks (leks assumed to be impacted according to DDCT protocol) for LC East include: Prospects South, Green Ridge, Crooked Well, Prospects, Prospects South, Sand Gully, Eagles Nest Draw, Discover, Discover South, Discover East, Sooner Oil, Sooner, Harrier and Upper Osborne and Southland Well. Lek counts and lek status for 2012 and 2013 are shown on **Table 3.6-13**. Lek names and locations are shown on **Figure 3.6-9.**

Lek Searches (searches for new leks) were completed in 2010 by ground (over the large sage-grouse monitoring area; LWR 2010) and by air in 2013 (over the Lost Creek DDCT area; an area that overlaps LC East). Breeding sage-grouse may be displaced by some ISR activities and thereby occupy other active leks or form new leks farther from those activities. Thus, periodic lek searches will be required to document new leks and thereby accurately assess the population-level response of sage-grouse to ISR activities.

Brood survey routes and wing surveys were used to assess potential impacts of ISR activities on sage-grouse productivity (i.e., juvenile recruitment). Because suitable summering habitats are not abundant throughout the potential impact area (i.e., the Total Affected Area), surveys were designed to monitor summer habitats used by females who were potentially influenced by activity during the breeding, nesting, and/or early brood-rearing seasons. Late brood-rearing and barren female summer locations from radio-equipped birds were used to identify summer concentration areas for birds that used nesting or early brood-rearing habitats closely associated with the Lost Creek Permit Area. Brood-rearing transects were established based on this telemetry data. Eight permanent walking transects 1000-m in length were established in each of these areas. Transects were surveyed twice during a one-week period in late July, from sunrise to two hours after sunrise, to ensure the monitoring period covered sage-grouse feeding times. All grouse observed were counted and classified (adult male, adult female, young of the year). **Table 3.6-14** summarizes the results of the brood transects in 2012 and 2013.

Radio-equipped female sage-grouse captured from leks situated near the Lost Creek permit area were monitored to determine seasonal habitat selection and demographics (e.g., survival and productivity) for the population breeding near the mining activity area. This data provides the information necessary to establish pre-development conditions for comparison to post-development effects, following a before-after control-impact (BACI) analytical design. Figures **3.6-13, 3.6-14, 3.6-15, and 3.6-16** show the locations of relocated sage-grouse, by season, within the sage-grouse study area.

This comprehensive sage-grouse monitoring plan was designed to accomplish definitive monitoring of the effects of ISR activities on populations. The established monitoring actions can be used to assess reactions of sage-grouse populations to mining activity and to guide potential mitigation actions, if needed.

Raptors

Four nesting raptor surveys were completed on the permit area and in the surrounding 1-mile buffer area in 2012 and 2013. Prior to completing raptor surveys, GIS data was reviewed for known and historic raptor nests. Raptor nest surveys included: one early February survey looking for signs of golden eagle (*Aquila chrysaetos*) and great-horned owl (*Bubo virginianus*) nesting and courtship; one late March survey to locate any great-horned owl or golden eagle nests; one late April survey to locate active raptor nests (all species), and one late June survey to locate any new nests and to determine nest success. Surveys were conducted on foot or using four-wheel-drive vehicles; additional surveys were completed by air during sage-grouse lek searches. Raptor observations were made using binoculars and a high-powered spotting scope. Nest site activity and production surveys were conducted according to protocols vetted by the BLM, Rawlins District (LWR 2012). Special effort was made to avoid disturbance to any active nests while completing the wildlife surveys.

Table 3.6-15 summarizes the results of the 2013 nesting raptor survey for LC East. Nest locations are shown on **Figure 3.6-14**. No golden eagles or great-horned owl nests or breeding activity were found during the February and March surveys. The April and June surveys documented four active ferruginous hawk (*Buteo regalis)* nests within or near the 1-mile buffer of the permit area boundary (note: two nests were just outside the 1-mile boundary). The ferruginous hawk is a BLM sensitive species and Migratory Bird of High Federal Interest (MBHFI). Of the four active nests, only two were successful in 2013. All active nests are located on nest platforms.

Nest success in 2013 and 2012 was poor compared to 2010 and 2011. In 2011 all active ferruginous hawk nests in the area were successful (LWR 2011). In 2012 there were three active nests with only one bird fledged (LWR 2012). In 2013 there were four active nests with 3 birds fledged (**Table 3.6-15**). A severe drought (very low precipitation, accompanied by high temperatures) occurring during the summers of 2012 and 2013 likely influenced nest success. Prey densities were also lower during the summer of 2013, likely a reflection of the drought conditions.

Several other raptor species were recorded within the study area, but nests were not documented. These species include the Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), golden eagle, American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), and turkey vulture (*Cathartus aura*). Although appropriate conditions exist for northern harrier and American kestrel nests within the Permit Area, specific nest sites were not located. Northern goshawk (*Accipeter gentilis*), merlin (*Falco columbarius*), and peregrine falcons (*Falco* peregrinus) were not observed in the study area.

Waterfowl and Shorebirds

Specific waterfowl and shorebird surveys were not completed. The Permit Area does not support any wetlands or perennial water sources. Waterfowl and shorebird use of the Permit Area is infrequent. The nearest good waterfowl and shorebird habitat is at the Chain Lakes, approximately 9-miles south of the Permit Area.

Passerine and Breeding Birds

A breeding bird survey of all representative habitats of the Permit Area was conducted during the peak of the nesting season in June 2012, following methods recommended in WDEQ-LQD Wildlife Guideline No. 5 Wildlife (1994). Surveys took place in the morning between 0500 to 0930 hours. Two 3,280-foot (1,000-meter) transects were established in each major habitat within the Permit Area.

All avian species observed are documented in the species list in **Table 3.6-11**. A total of 32 passerine species have been recorded on the site. The most common species in the Permit Area were the horned lark (*Eremophila alpestris*), Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*).

Table 3.6-16 shows the results of the 2012 breeding bird survey completed in the Permit Area. **Figure 3.6-15** shows the breeding bird transect locations. Higher numbers of breeding birds were located in the lowland sagebrush habitat than in the upland habitat. Five species were located during the survey. The most common species was the horned lark, followed respectively by the sage sparrow, Brewer's sparrow, vesper sparrow (*Pooecetes gramineus*), and sage thrasher.

Migratory Birds of High Federal Interest

MBHFI and other wildlife species were inventoried during all site visits. This was accomplished by searching all suitable or potentially suitable habitats and recording all species encountered.

Several MBHFI species are known to occur in the region **(Attachment 3.6-7)**. Level I MBHFI species are described by FWS as in need of conservation, while Level II MBHFI species are described as in need of monitoring. Level I MBFHI species in the region include the bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk, Swainson's hawk, peregrine falcon, burrowing owl (*Athene cunicularia*), sage-grouse, mountain plover (*Charadrius monatnus*), Brewer's sparrow, and sage sparrow. Of these, the ferruginous hawk, sage-grouse, Brewer's sparrow, and sage sparrow were documented in the Permit Area; the mountain plover and burrowing owl have been noted in adjacent areas (WGFD 2009).

Level II species documented in the Permit Area include the sage thrasher, loggerhead shrike (*Lanius ludovicianus*), and vesper sparrow. Level II MBHFI species known to exist in the region, but not documented in the study area, include the merlin, Cassin's kingbird (*Tyrannus vociferans*), black-billed cuckoo (*Coccyzus erythropthalmus*), loggerhead shrike, lark sparrow (*Chondestes grammacus*), and lark bunting (*Calamospiza melanocorys*). Nesting breeding bird surveys are summarized in **Table 3.6-16**.

The ferruginous hawk nests in the study area were previously discussed in this appendix, as were sage-grouse and their leks. The breeding Brewer's sparrow, sage sparrow, sage thrasher, and vesper sparrow were found in sagebrush habitats of the Permit Area. The loggerhead shrike has been observed in the Permit Area during the spring and early summer and is assumed to be breeding in the area.

No mountain plover were observed on or near the Permit Area during spring and early summer of 2011, 2012, or 2013. No mountain plover have been observed in the general area during any recent surveys (LWR 2009, 2010, 2011, 2012). The Permit Area was evaluated for mountain plover habitat. The extensive tall shrub cover and absence of grassland or open shrub habitats make the Permit Area poorly suited to the mountain plover. Small open areas (grassland and disturbed areas) do occur in the Permit Area, but are isolated. Mountain plover prefer open grasslands, bare ground, disturbed areas, prairie dog colonies and sparse shrubland habitats for nesting. Good potential mountain plover habitat occurs several miles to the south and west of the Permit Area. However, since no good potential mountain plover habitat exists in the study area and no mountain plover were observed during other field studies, it is unlikely that mountain plovers inhabit the Permit Area.

Other Mammals

All mammal species and identifying signs observed during the field studies were recorded and are documented on the species list in **Table 3.6-11**. A total of 22 mammal species were recorded in the study area. The most common species seen were the white-tailed jackrabbit (*Lepus townsendii*), desert cottontail (*Sylvilagus audubonii*), Wyoming ground squirrel (*Urocitellus elegans*), deer mouse (*Peromyscus maniculatus*), and meadow vole (*Microtus pennsylvanicus*). The coyote (*Canis latrans*) was the most abundant predator.

Two wild horse Herd Management Areas (HMAs) overlap with the Permit Area. The Permit Area is within the Stewart Creek HMA and the Lost Creek HMA. Horses were observed in all habitats of the study area.

Aerial and ground surveys of the entire Permit Area were used to locate prairie dog towns. There were no active colonies in the Permit Area.

Desert cottontail and white-tailed jackrabbit populations were evaluated using spotlight surveys completed within native habitat in the Permit Area. Surveys were completed in the early evening (after nightfall) using a 1,000,000-candlepower spotlight. One survey was completed in June 2012 and another in early September 2012. Three transects were established along approximately 1.5 miles of road within the Permit Area. **Figure 3.6-16** shows the transect locations. These transects will continue to be used in annual wildlife monitoring surveys. Only four jackrabbits were observed during 2012 surveys (**Table 3.6-17**). Rabbit numbers observed in 2012 on the LC East Permit Areas were much lower than those observed in 2010 and 2011 on the adjacent Lost Creek Project area (LWR 2010, 2011), possibly a result of the extreme drought in 2012.

Surveys for the pygmy rabbit (*Brachylagus idahoensis*), a BLM sensitive species, were completed during late summer 2012. Survey methods followed BLM guidelines (Ulmschneider et al. 2004). Four 0.5-mile long survey transects were completed in the LC East Permit Area. The survey transects were chosen based on vegetation mapping, aerial photos, and on the ground conditions. Transects were located within areas of thick lowland sagebrush cover in swales and ravines. Meandering transects were walked in these corridors and transect routes were recorded using GPS.

Indicators of pygmy rabbit presence included tracks, pellets, burrows, and rabbit observations. All burrow locations were located using GPS and recorded (UTMs, NAD83, zone 13). Where several active burrows were present in the same area (one burrow complex), one GPS reading was taken for the complex. Data was recorded on standard data forms, and photographs were taken to illustrate representative habitat.

A total of 31 locations of burrows or other possible indicators of pygmy rabbits were recorded. Evidence of pygmy rabbit use was present along all four transects. No pygmy rabbits were sighted during the surveys. However, pygmy rabbits have been seen within the LC East Permit Area during other studies. **Table 3.6-18** provides a summary of burrow locations and burrow status. **Figure 3.6-16** shows the locations of transects, burrows, and other indicators that were identified during the survey effort. Prior surveys also found that lowland sagebrush habitats within the adjacent Lost Creek Project were occupied by pygmy rabbits (LWR 2009, 2010, 2011, 2012).

Wyoming pocket gopher (*Thomomys clusius*) surveys were completed within areas of most likely potential disturbance of the Permit Area during the summer and fall of 2013. The general protocol for Wyoming pocket gopher trapping follows the same methods recommended by the BLM and WNDD (WNDD 2009, 2010, BLM 2010). The BLM was consulted to develop the trapping protocol (Cline 2013). Meandering transects (approximately 150 meters apart) were completed within areas of potential ground disturbance for LC East. All burrow complexes located were mapped and characterized, and data was recorded on

WNDD Mound Survey Data Sheets. Tunnel measurements were completed at each active burrow complex. Tunnels of diameter less than 55mm are most likely Wyoming pocket gophers; tunnels over 80mm are most likely northern pocket gophers (*Thomomys talpoides*; WNDD 2010).

All active burrows with a tunnel diameter that was greater than 55mm and less than 80mm were trapped. All burrow complexes with burrow diameters of less than 55mm were assumed to be occupied by Wyoming pocket gophers; burrows greater than 80mm were assumed to be occupied by northern pocket gophers. In addition, three burrow complexes with burrows less than 55mm were trapped to confirm Wyoming pocket gopher presence. Sherman live traps were set at each trapping location. The number of traps set at each site depended on the amount of recent activity (3-5 traps). Traps were set in the evening and checked at sunrise and mid-day. Traps were covered with black plastic and buried with at least 6-inches of dirt. Traps were baited with cilantro and carrots. Polyester bedding material was inserted into each trap.

Figure 3.6-17 shows the results of the Wyoming pocket gopher trapping for LC East. Four Wyoming pocket gophers and two northern pocket gophers were trapped. A total of an additional 31 burrow complexes are assumed to be occupied by Wyoming pocket gophers in the LC East Permit Area (**Table 3.6-19**).

T&E and State-Listed Species of Concern

Threatened, endangered, and candidate wildlife species surveys were completed during all site visits by searching suitable habitats for target species. Federal listed species that could potentially occur in the Permit Area are in **Table 3.6-20**.

The black-footed ferret (*Mustela nigripes*; endangered) is the only federally listed species that may occur in the vicinity of the Permit Area (UFWS 2013). The bald eagle has been delisted and could potentially be found in the Permit Area during migration. The bald eagle has not been recorded in the study area (**Attachment 3.6-4**). A black-footed ferret survey was not required, since black-footed ferrets live exclusively in prairie dog colonies, which are not present within the Permit Area.

State-listed wildlife species and BLM sensitive species (Wisdom 2013, WGFD 2009, BLM 2008) and their probability of occurrence in the Permit Area are listed in **Table 3.6-21**. Surveys were conducted for pygmy rabbits and Wyoming pocket gopher, as discussed earlier. Both species are present within the Permit Area. Other state sensitive or BLM sensitive species known to occur in the Permit Area include: Swainson's hawk, ferruginous hawk, short-eared owl (*Asio flammeus*), loggerhead shrike, grasshopper sparrow (*Ammodramum savannarum*), sage thrasher, Brewer's sparrow, sage sparrow, and chestnut-collared longspur (*Calcarius ornatus*). These species were observed on-site during breeding bird surveys and raptor surveys, or in incidental sightings.

Reptiles and Amphibians

Specific reptile and amphibian surveys were not completed for the Project except for greater spadefoot toad (*Spea intermontana*) surveys. Several species were observed during general surveys, as noted in **Table 3.6-11**. These included the greater short-horned lizard (*Phrynosoma hernandesi*), prairie rattlesnake (*Crotalus viridis*), and western terrestrial garter snake (*Thamnophis elegans*). Surveys for the greater spade foot toad were completed along both Stratton and Battle Springs Draws within the Permit Area during the summers of 2009 and 2010 as part of the Lost Creek Project. No greater spadefoot toads were located within or near the Permit Area (LWR 2009, 2010).

Fish

The Permit Area is predominately dry shrubland, and there is no aquatic habitat for most of the year. Several intermittent drainages (Battle Springs Draw, Stratton Draw) occur in the Permit Area. No fish or other aquatic life are known to occur in the study area.

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Figure 3.6-5 Photo of the Lowland Big Sagebrush Shrubland Vegetation Community*

* Photo taken at 42° 8' 25.11" N; 107° 48' 11.98" W, June 2013

Figure 3.6-6 Photo of Mixed Grass/Mat Cushion Grassland Vegetation Community *

* Photo taken at 42° 8' 30.04" N; 107° 46' 35.04" W, June 2013

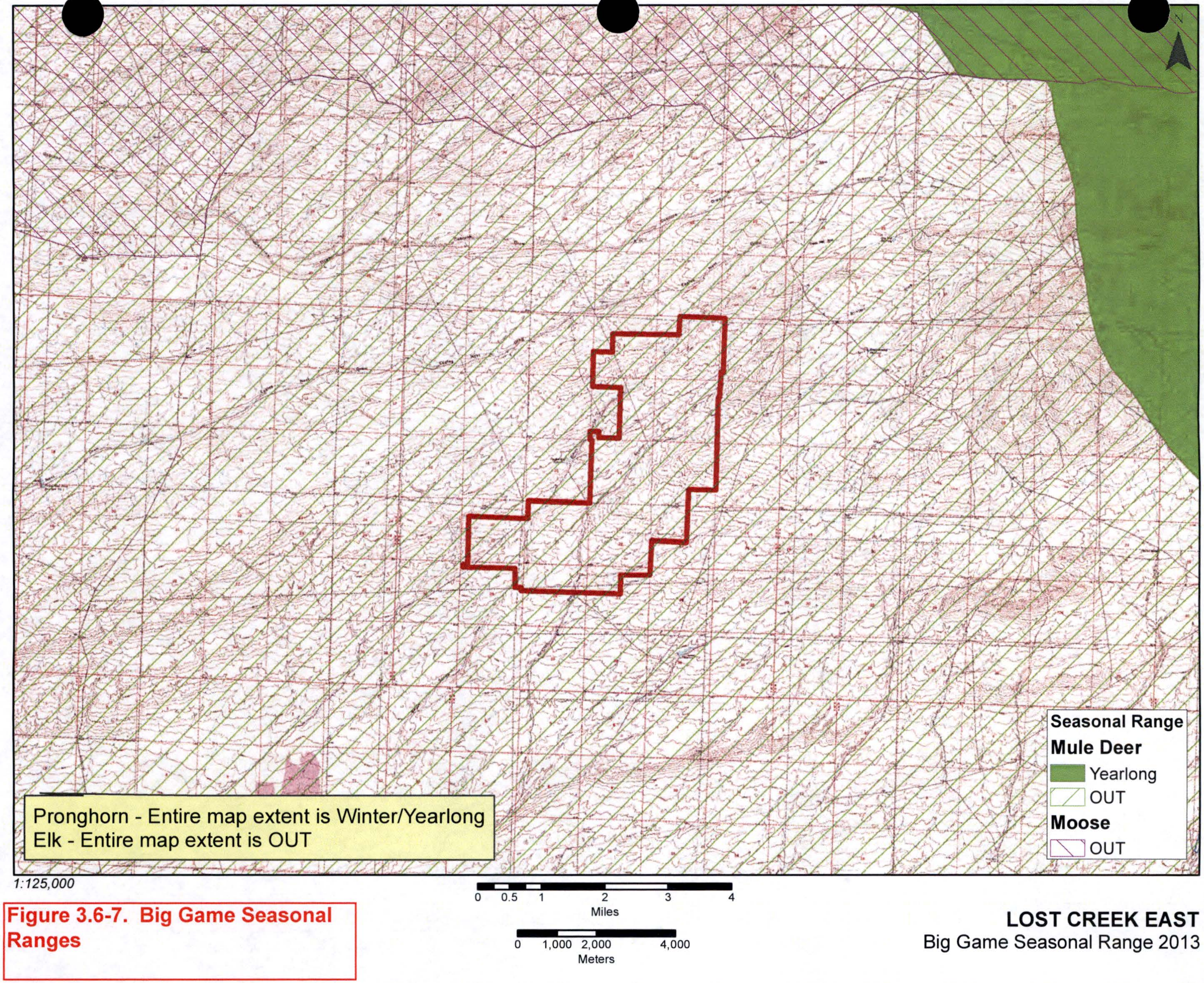


Figure 3.6-7. Big Game Seasonal Ranges

LOST CREEK EAST
Big Game Seasonal Range 2013

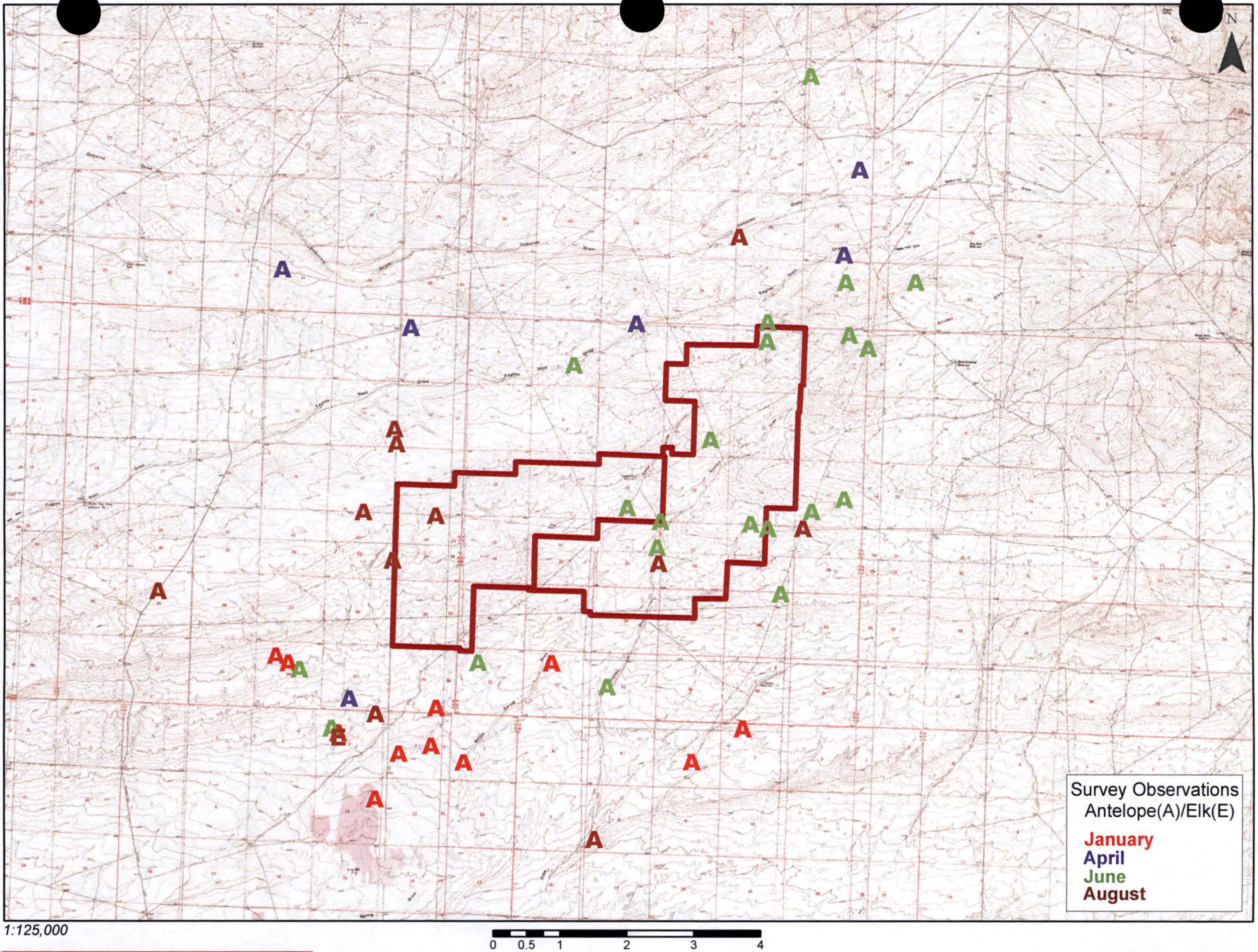
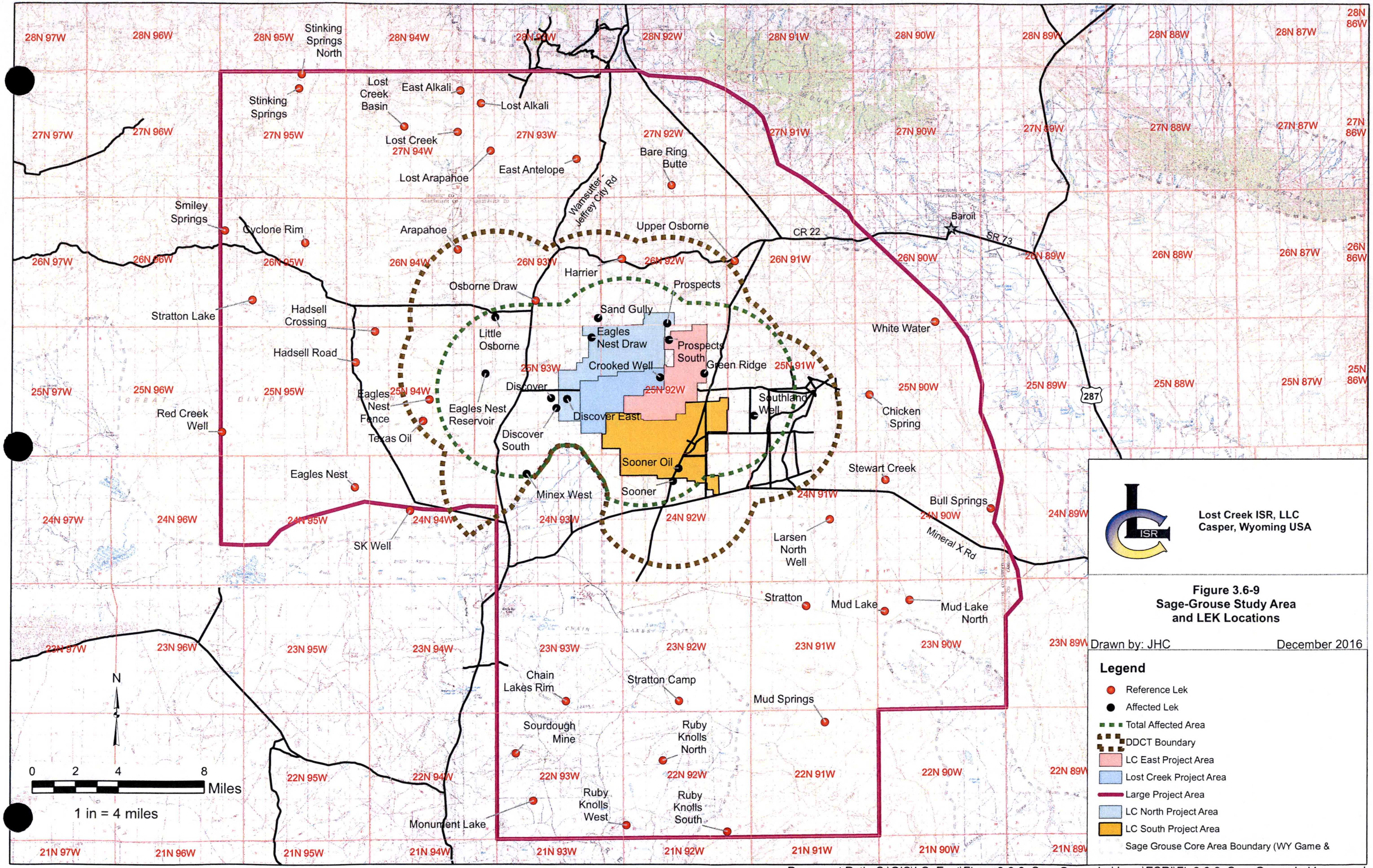


Figure 3.6-8 Big Game Surveys

LOST CREEK
Big Game Survey 2012-13



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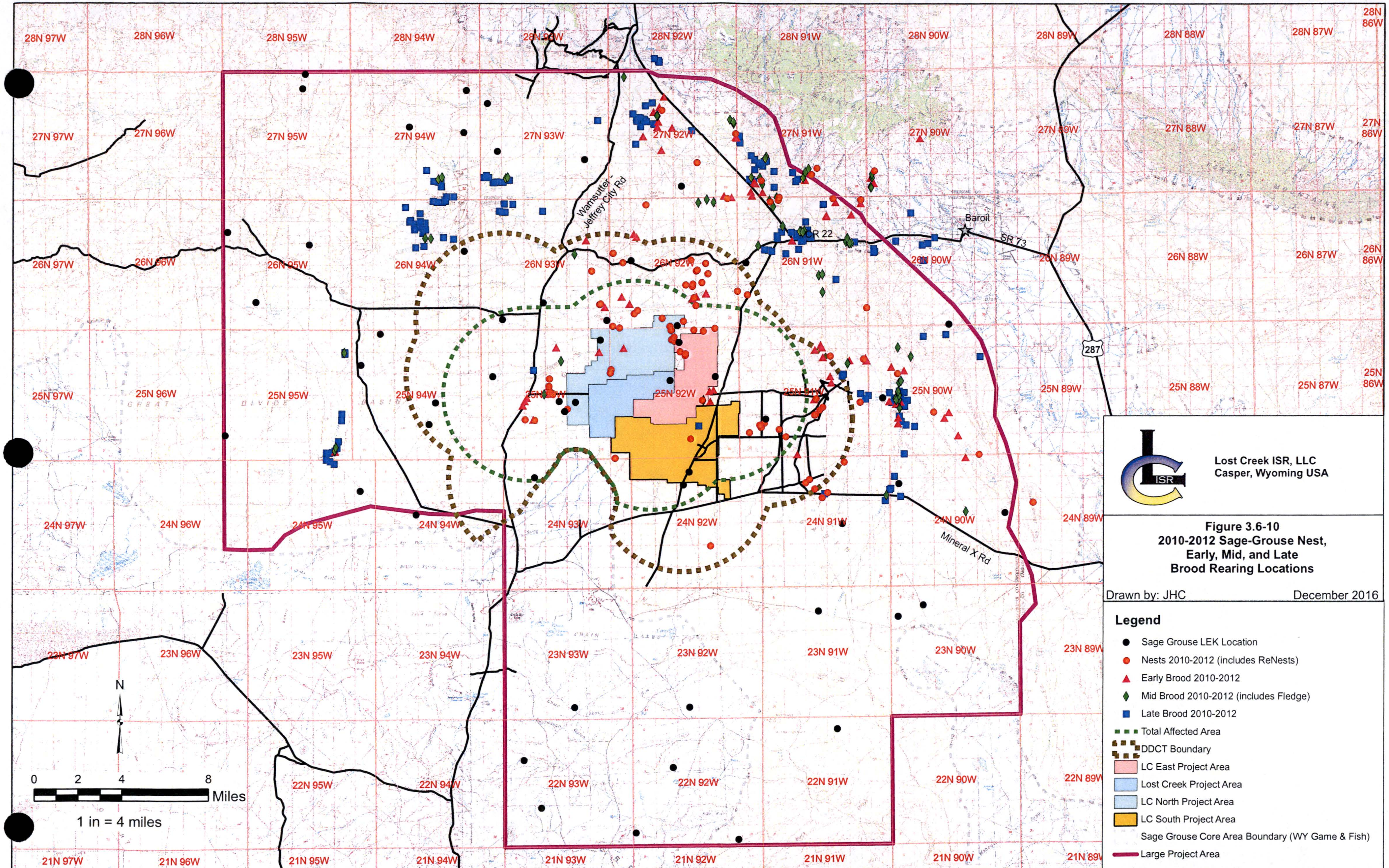

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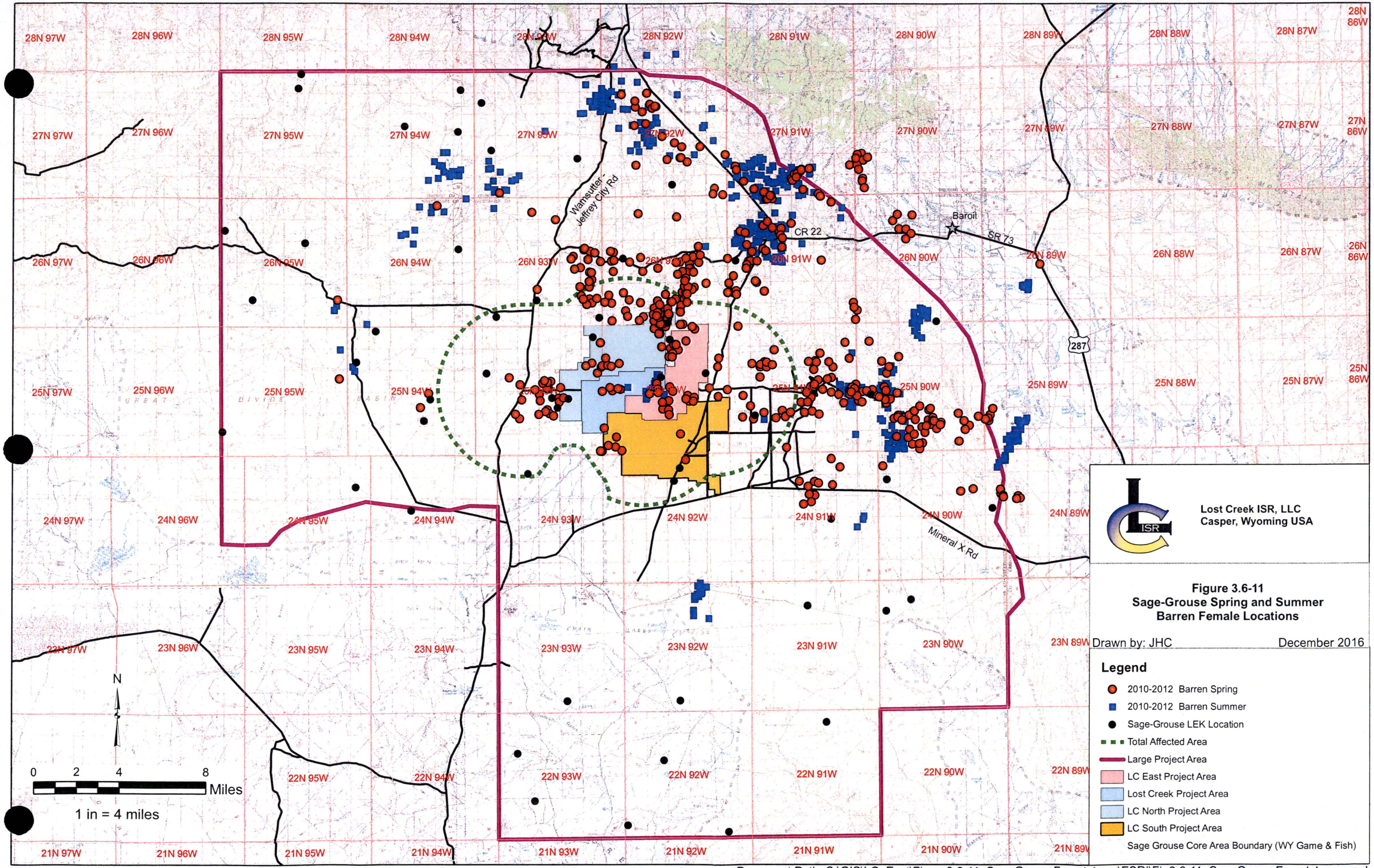

Figure 3.6-11
Sage-Grouse Spring and Summer Barren Female Locations

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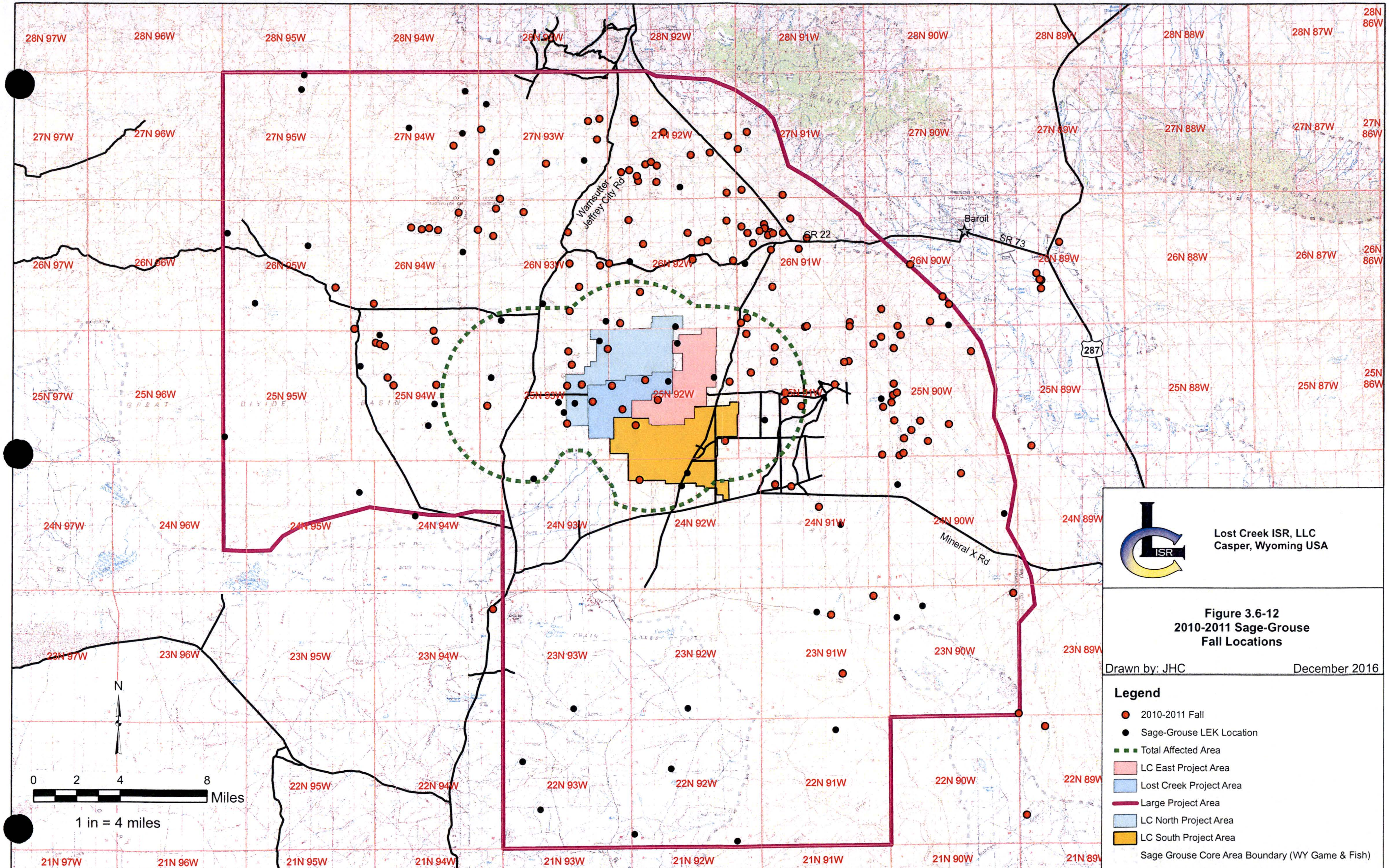

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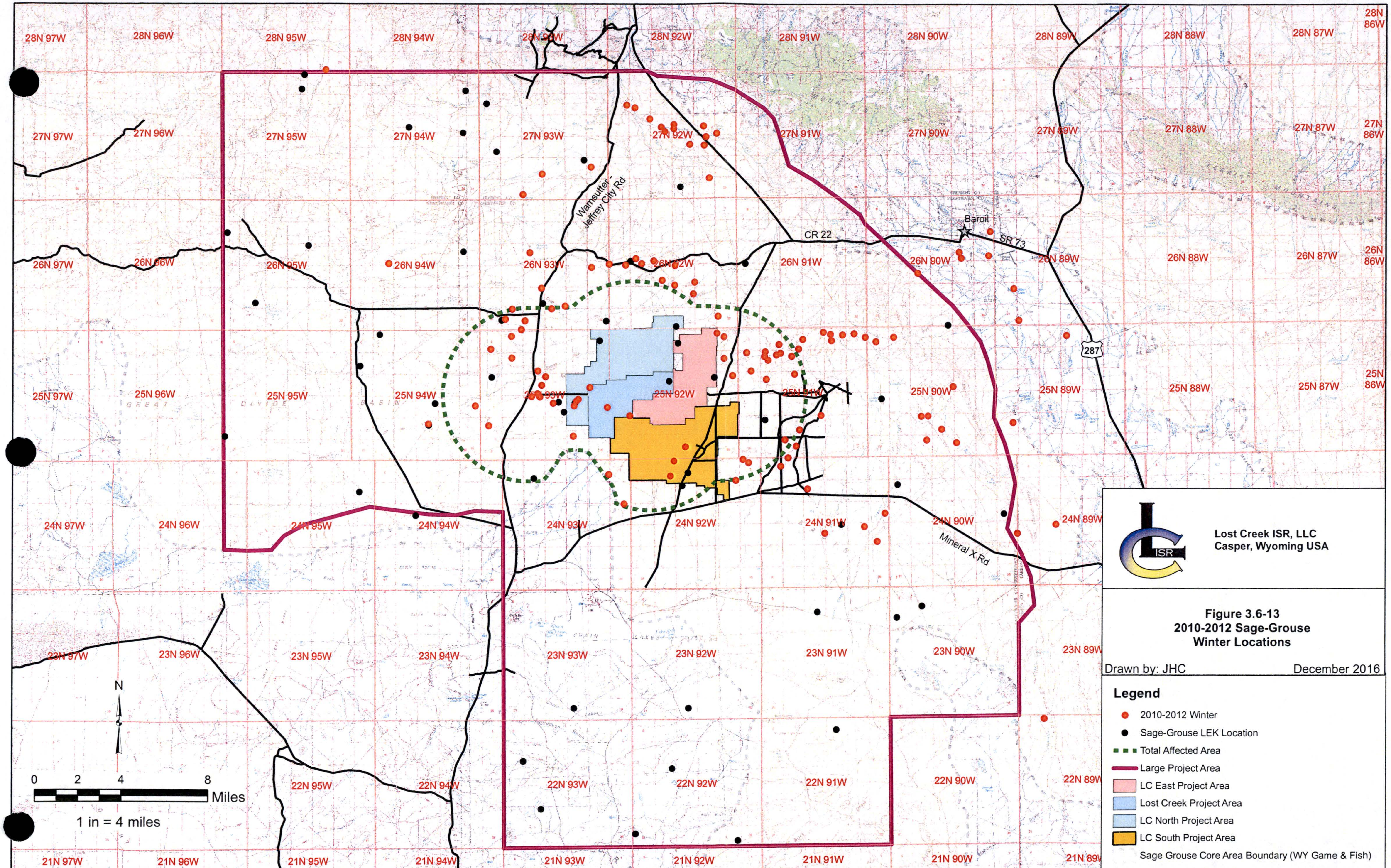

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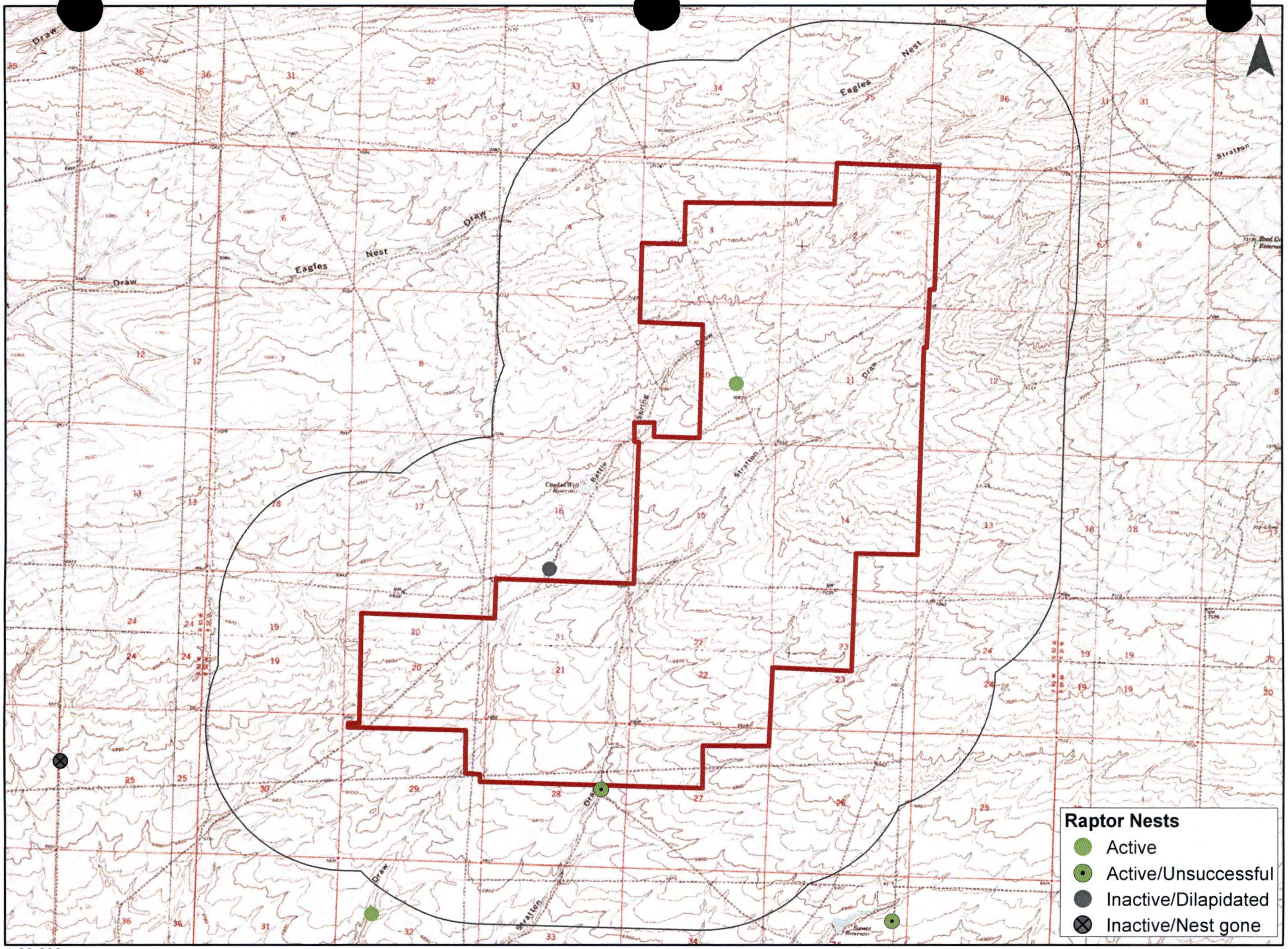

1:60,000

0 0.5 1 2
Miles

0 500 1,000 2,000
Meters

Figure 3.6-14, Nesting Raptor Survey

LOST CREEK EAST
Raptor Nest Survey 2013

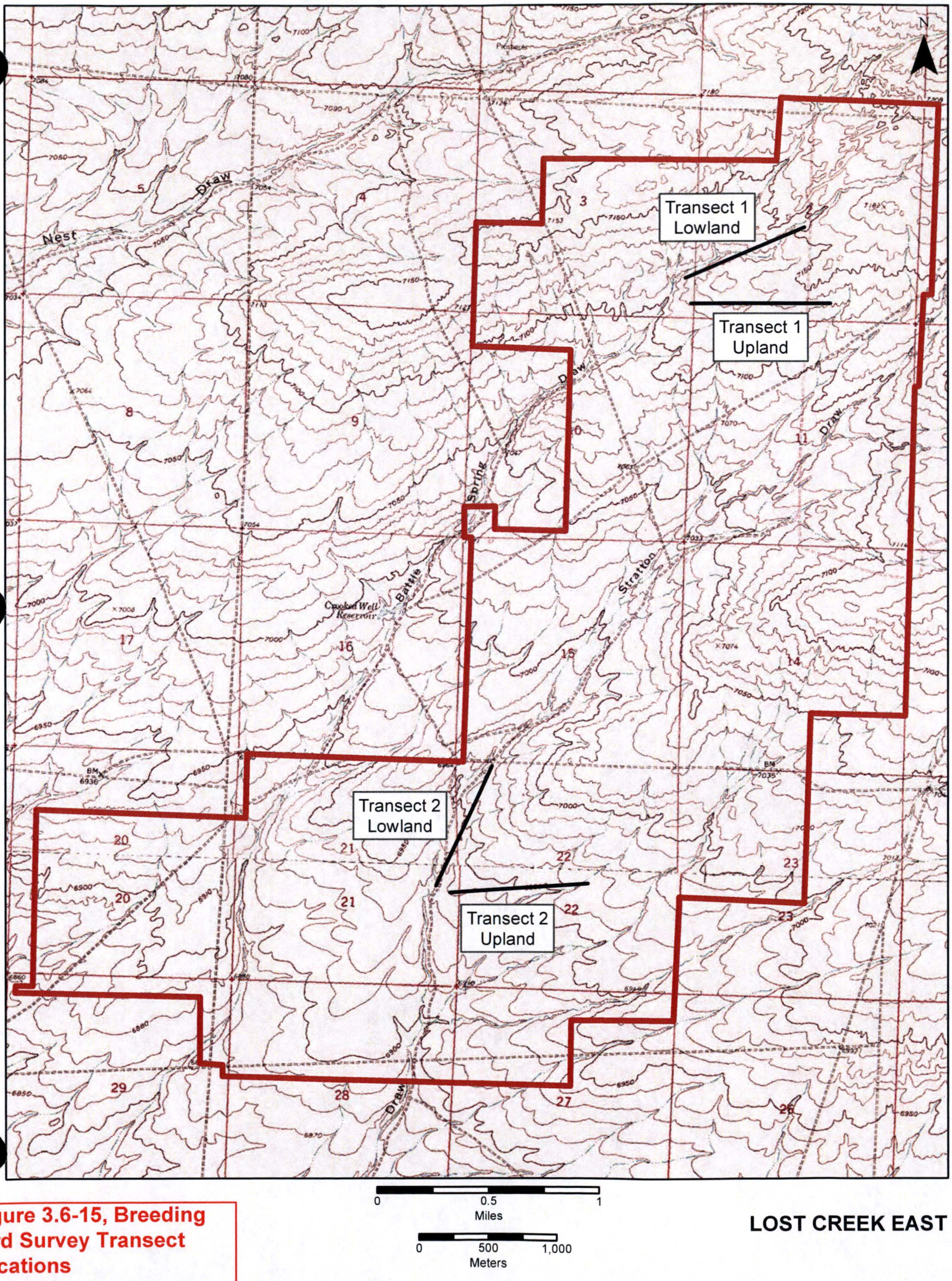

Figure 3.6-15, Breeding Bird Survey Transect Locations

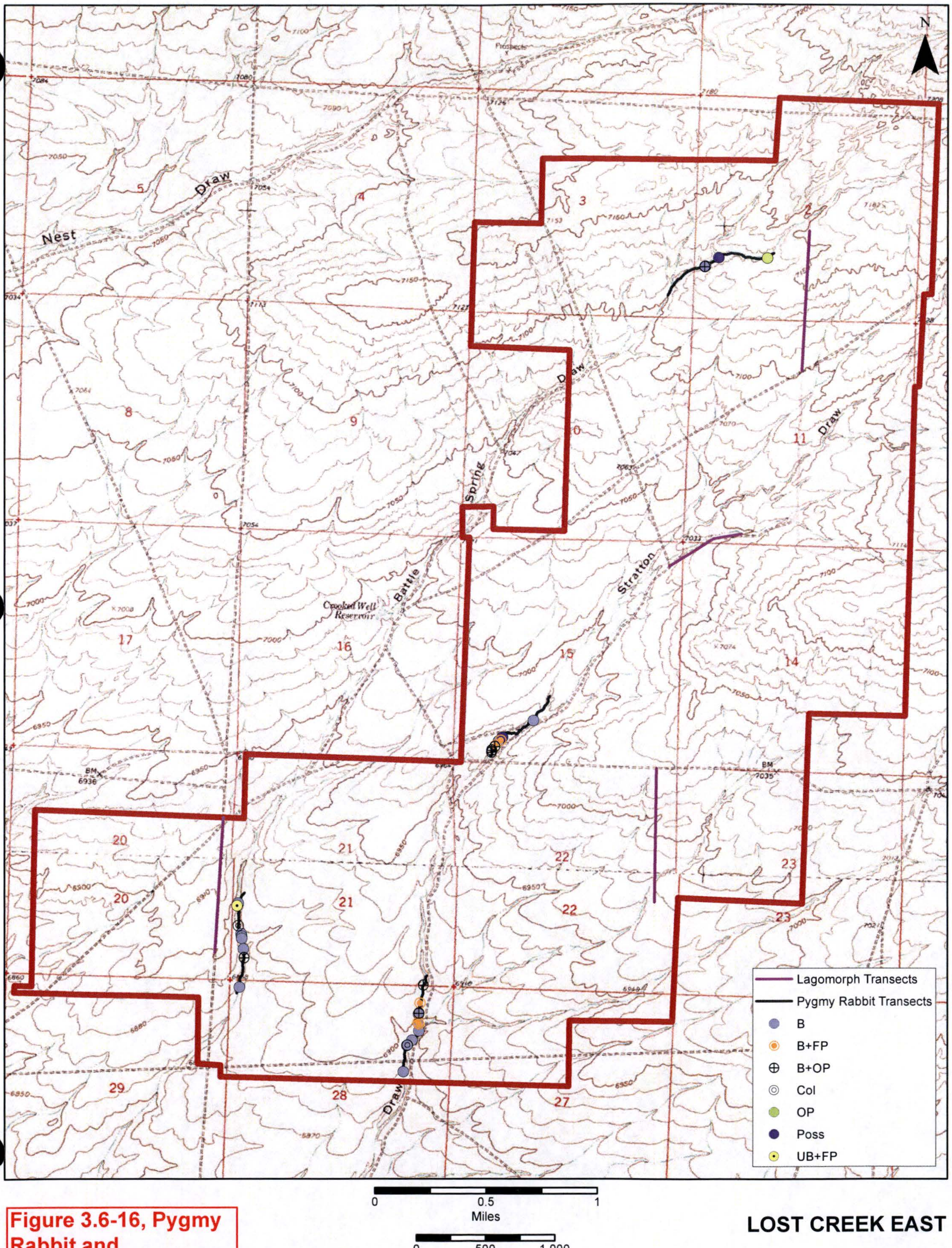

Figure 3.6-16, Pygmy Rabbit and Lagomorph Survey

LOST CREEK EAST

Pygmy Rabbit & Lagomorph Survey *1:36,000*

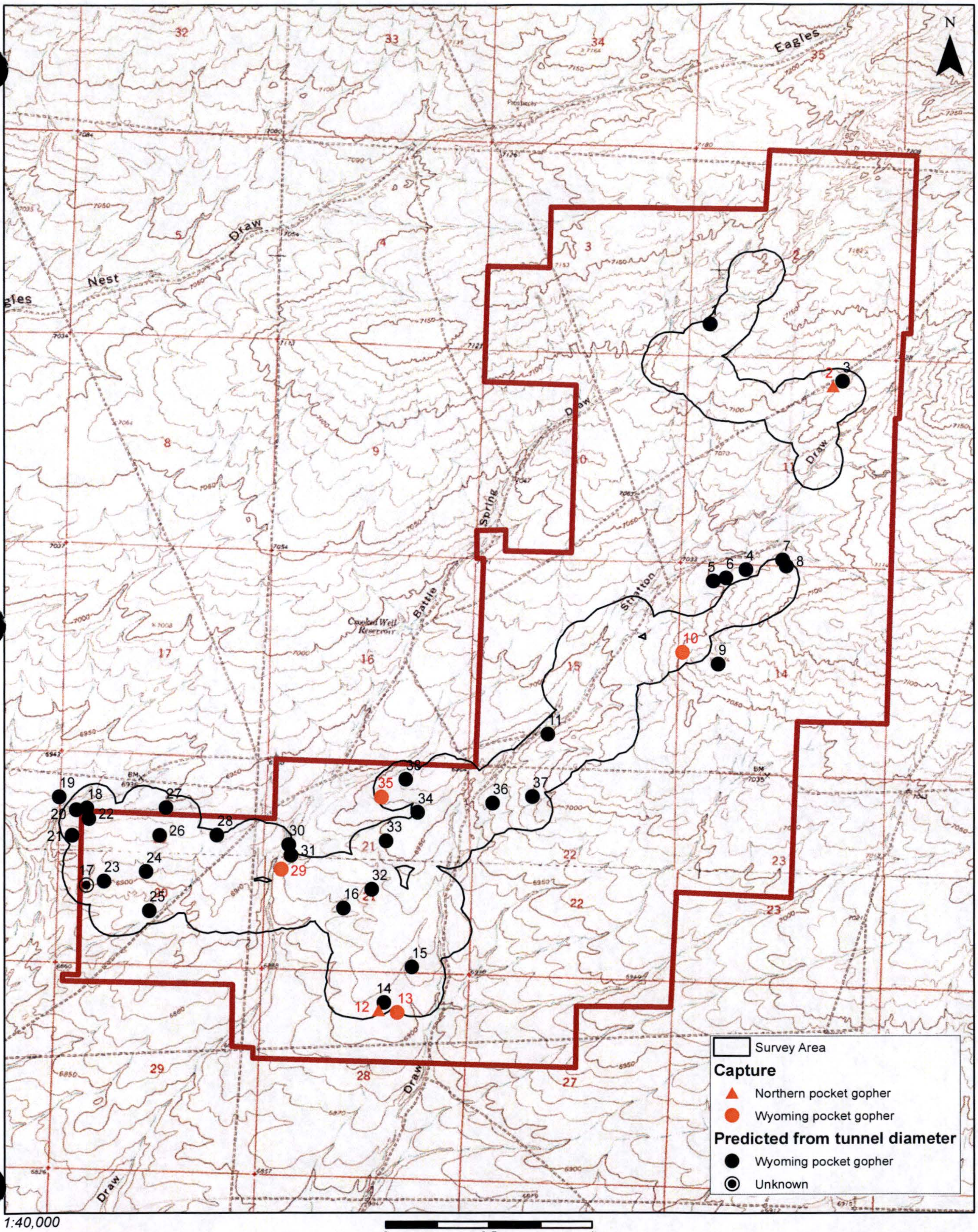

Figure 3.6-17, Wyoming Pocket Gopher Surveys

LOST CREEK EAST

Wyoming Pocket Gopher Survey 2013

Table 3.6-1 **Aerial Extent of Vegetation Communities**

Vegetation Community	Study Area (Proposed Permit Boundary)		½ Mile Buffer Area	
	Acres	Percent of Area	Acres	Percent of Area
Upland Big Sagebrush Shrubland	5,370	93.8	5,425	93.4
Lowland Big Sagebrush Shrubland	325	5.7	372	6.4
Mixed Grass/Mat Cushion Grassland	27	0.5	--	--
Disturbed	2	<0.5	11	0.2
Water	<1	<0.5	--	--
Total	5,724	100	5,808	100

Table 3.6-2 Cover Parameters of the Upland Big Sagebrush Shrubland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Native Cool Season Perennial Grasses									
Achnatherum hymenoides	0.6	2.1	1.6	0	6	15	3.2	5.3	6
Elymus lanceolatus	0.4	1.3	1.0	0	4	15	3.2	4.6	7
Elymus smithii	0.2	0.7	0.9	0	4	5	1.1	1.8	11
Elymus spicatus	0.5	1.6	1.6	0	6	10	2.1	3.9	8
Hesperostipa comata	1.3	4.3	2.1	0	8	40	8.5	13.2	5
Koeleria macrantha	0.4	1.3	1.0	0	4	15	3.2	4.6	7
Poa secunda	2.1	6.9	3.0	0	10	45	9.6	17.1	4
Sub-Total	**5.5**	**18.0**	**4.0**	**--**	**--**	**145**	**30.8**	**50.5**	**--**
Native Perennial Forbs									
Eremogone hookeri	0.3	1.0	1.3	0	6	5	1.1	2.1	10
Phlox hoodii	2.5	8.2	2.2	0	8	75	16.0	24.9	2
Stenotus acaulis	0.1	0.3	0.4	0	2	5	1.1	1.4	12
Sub-Total	**2.9**	**9.5**	**3.1**	**--**	**--**	**85**	**18.1**	**28.4**	**--**
Native Full Shrubs									
Artemisia tridentata	18.8	61.6	4.7	10	28	100	21.3	88.4	1
Chrysothamnus viscidiflorus	0.3	1.0	1.0	0	4	10	2.1	3.2	9
Sub-Total	**19.1**	**62.6**	**4.6**	**--**	**--**	**110**	**23.4**	**91.6**	**--**
Native Half &Sub-Shrubs									
Krascheninnikovia lanata	0.4	1.3	1.0	0	4	15	3.2	4.6	7
Sub-Total	**0.4**	**1.3**	**1.0**	**--**	**--**	**15**	**3.2**	**4.6**	**--**

Table 3.6-2 (Cont.) Cover Parameters of the Upland Big Sagebrush Shrubland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Native Succulents									
Opuntia polyacantha	0.1	0.3	0.4	0	2	5	1.1	1.4	12
Sub-Total	**0.1**	**0.3**	**0.4**	--	--	**5**	**1.1**	**1.4**	--
Cryptograms									
Moss	0.0	0.0	0.0	0	0	0	0.0	0.0	13
Lichen	2.5	8.2	3.0	0	10	110	23.4	23.4	3
Algae	0.0	0.0	0.0	0	0	0	0.0	0.0	13
Fungi	0.0	0.0	0.0	0	0	0	0.0	0.0	13
Sub-Total	**2.5**	**8.2**	**3.0**	--	--	**110**	**23.4**	**23.4**	--

Totals	**Mean**	**Std. Dev.**
Total Vegetation	28.0	5.5
Total Vegetation w/Cryptograms	30.5	6.4
Litter	22.2	10.1
Rock	1.5	3.0
Total Ground Cover	54.2	8.9
Bare Soil	45.8	8.9

† Based on data from twenty 50-meter point intercept transects sampled June 2013

*I.V. Stands for Importance Value

Table 3.6-3 Shrub and Sub-Shrub Densities of the Upland Big Sagebrush Shrubland

Species	Mean (Number/Plot)	Relative Density	Std. Dev. n-1 (Number/Plot)	Mean (Number/ sq. m.)	Mean (Number/Acre)
Native Full Shrubs					
Artemisia tridentata	284.4	95.3	102.1	2.8	11,508
Chrysothamnus viscidiflorus	7.4	2.5	18.7	0.1	298
Total Native Full Shrubs	**291.7**	**97.8**	**103.2**	**2.9**	**11,805**
Native Half & Sub-Shrubs					
Gutierrezia sarothrae	0.2	0.1	0.5	<0.1	6
Krascheninnikovia lanata	3.7	1.2	9.8	<0.1	150
Linanthus pungens	2.8	0.9	10.0	<0.1	113
Total Native Half &Sub-Shrubs	**6.7**	**2.2**	**18.8**	**0.1**	**269**
Total	**298.4**	**100**	**106.7**	**3.0**	**12,074**

Table 3.6-4 Cover Parameters of the Lowland Big Sagebrush Shrubland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Native Cool Season Perennial Grasses									
Achnatherum hymenoides	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Elymus lanceolatus	0.2	0.5	0.9	0	4	5	1.4	1.8	10
Elymus smithii	0.5	1.2	0.9	0	2	25	6.8	8.0	5
Festuca idahoensis	0.9	2.2	1.9	0	6	20	5.4	7.6	6
Hesperostipa comata	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Koeleria macrantha	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Poa secunda	1.3	3.1	2.1	0	6	35	9.5	12.6	4
Sub-Total	**3.5**	**8.4**	**2.9**	**--**	**--**	**115**	**31.1**	**39.5**	**--**
Native Grasslike Species									
Carex filifolia	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Sub-Total	**0.2**	**0.5**	**0.6**	**--**	**--**	**10**	**2.7**	**3.2**	**--**
Native Perennial Forbs									
Antennaria microphylla	0.1	0.2	0.4	0	2	5	1.4	1.6	11
Phlox hoodii	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Sub-Total	**0.3**	**0.7**	**0.7**	**--**	**--**	**15**	**4.1**	**4.8**	**--**
Native Full Shrubs									
Artemisia tridentata	33.1	79.2	9.9	16	54	100	27.0	106.4	1
Chrysothamnus viscidiflorus	2.3	5.5	2.6	0	8	50	13.5	19.0	2
Ericameria nauseosa	1.7	4.1	2.1	0	6	50	13.5	17.6	3
Sub-Total	**37.1**	**88.8**	**11.0**	**--**	**--**	**200**	**54.1**	**143.0**	**--**
Native Half &Sub-Shrubs									
Gutierrezia sarothrae	0.4	1.0	1.4	0	6	10	2.7	3.7	7
Sub-Total	**0.4**	**1.0**	**1.4**	**--**	**--**	**10**	**2.7**	**3.7**	**--**
Native Succulents									
Opuntia polyacantha	0.2	0.5	0.6	0	2	10	2.7	3.2	8
Sub-Total	**0.2**	**0.5**	**0.6**	**--**	**--**	**10**	**2.7**	**3.2**	**--**

Table 3.6-4 (Cont.) Cover Parameters of the Lowland Big Sagebrush Shrubland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Cryptograms									
Moss	0.0	0.0	0.0	0	0	0	0.0	0.0	12
Lichen	0.1	0.2	0.4	0	2	10	2.7	2.7	9
Algae	0.0	0.0	0.0	0	0	0	0.0	0.0	12
Fungi	0.0	0.0	0.0	0	0	0	0.0	0.0	12
Sub-Total	**0.1**	**0.2**	**0.4**	**--**	**--**	**10**	**2.7**	**2.7**	**--**

Totals	Mean	Std. Dev.
Total Vegetation	41.7	9.9
Total Vegetation w/Cryptograms	41.8	9.8
Litter	37.5	9.6
Rock	0.0	0.0
Total Ground Cover	79.3	8.9
Bare Soil	20.7	8.9

† Based on data from twenty 50-meter point intercept transects sampled June 2013
I.V. stands for Importance Value

Table 3.6-5 Native Full, Half, and Sub-Shrub Densities of the Lowland Big Sagebrush Shrubland

Species	Mean (Number/Plot)	Relative Density	Std. Dev. n-1 (Number/Plot)	Mean (Number/ sq. m.)	Mean (Number/Acre)
Native Full Shrubs					
Artemisia tridentata	242.6	83.6	223.2	2.4	9,816
Chrysothamnus viscidiflorus	29.2	10.1	25.8	0.3	1,180
Ericameria nauseosa	9.1	3.1	8.5	0.1	368
Total Native Full Shrubs	**280.8**	**96.8**	**206.5**	**2.8**	**11,364**
Native Half & Sub-Shrubs					
Gutierrezia sarothrae	9.1	3.1	21.9	0.1	366
Linanthus pungens	0.2	0.1	0.7	<0.1	8
Total Native Half &Sub-Shrubs	**9.3**	**3.2**	**21.8**	**0.1**	**374**
Total	**290.1**	**100**	**220.9**	**2.9**	**11,738**

Table 3.6-6 Cover Parameters of the Mixed Grass/Mat Cushion Grassland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Native Cool Season Perennial Grasses									
Elymus lanceolatus	0.8	4.2	1.8	0	6	21	3.9	8.9	9
Elymus smithii	0.1	0.7	0.5	0	2	7	1.3	2.1	15
Elymus spicatus	0.5	2.4	2.0	0	10	7	1.3	4.2	11
Hesperostipa comata	0.3	1.7	0.9	0	4	14	2.6	4.7	10
Koeleria macrantha	1.2	6.3	2.2	0	8	28	5.2	11.5	7
Poa secunda	1.7	8.4	2.2	0	10	55	10.3	20.4	3
Sub-Total	**4.7**	**23.8**	**3.3**	**--**	**--**	**131**	**24.5**	**51.8**	**--**
Native Perennial Forbs									
Antennaria microphylla	0.3	1.4	1.5	0	8	3	0.7	2.4	14
Eremogone hookeri	0.2	1.0	0.8	0	4	7	1.3	2.5	13
Eriogonum flavum	0.3	1.4	0.9	0	4	10	1.9	3.6	12
Ivesia gordonii	0.1	0.3	0.4	0	2	3	0.7	1.0	16
Phlox hoodii	3.3	16.9	2.4	0	10	86	16.0	36.4	1
Phlox muscoides	0.8	3.9	1.5	0	4	24	4.5	9.2	8
Stenotus acaulis	1.7	8.4	2.2	0	8	48	9.0	19.0	4
Tetraneuris acaulis	0.1	0.3	0.4	0	2	3	0.7	1.0	16
Sub-Total	**6.6**	**33.7**	**3.3**	**--**	**--**	**186**	**34.9**	**75.2**	**--**
Native Full Shrubs									
Artemisia tridentata	3.2	16.5	3.6	0	12	66	12.3	32.0	2
Chrysothamnus viscidiflorus	0.1	0.3	0.4	0	2	3	0.7	1.0	16
Ericameria nauseosa	0.3	1.7	0.9	0	4	14	2.6	4.7	10
Sub-Total	**3.7**	**18.6**	**3.7**	**--**	**--**	**83**	**15.5**	**37.7**	**--**

Table 3.6-6 (Cont.) Cover Parameters of the Mixed Grass/Mat Cushion Grassland †

Species	Cover					Frequency			
	Mean Absolute	Relative (%)	Std. Dev. (n-1)	Lowest Value (%)	Highest Value (%)	Absolute	Relative (%)	I.V*	Rank
Native Half &Sub-Shrubs									
Krascheninnikovia lanata	1.4	7.0	2.5	0	10	31	5.8	14.2	6
Linanthus pungens	0.1	0.3	0.4	0	2	3	0.7	1.0	16
Sub-Total	**1.4**	**7.3**	**2.5**	**--**	**--**	**34**	**6.5**	**15.2**	**--**
Native Succulents									
Opuntia polyacantha	0.1	0.7	0.5	0	2	7	1.3	2.1	15
Sub-Total	**0.1**	**0.7**	**0.5**	**--**	**--**	**7**	**1.3**	**2.1**	**--**
Cryptograms									
Moss	0.0	0.0	0.0	0	0	0	0.0	0.0	17
Lichen	3.2	16.5	5.2	0	16	90	16.8	16.8	5
Algae	0.0	0.0	0.00	0	0	0	0.0	0.0	17
Fungi	0.0	0.0	0.00	0	0	0	0.0	0.0	17
Sub-Total	**3.2**	**16.5**	**5.2**	**--**	**--**	**90**	**16.8**	**16.8**	**--**

Totals	**Mean**	**Std. Dev.**
Total Vegetation	16.4	3.4
Total Vegetation w/Cryptograms	19.7	5.3
Litter	15.2	6.7
Rock	1.0	2.0
Total Ground Cover	35.9	9.3
Bare Soil	64.1	9.3

† Based on data from twenty-nine 50-meter point intercept transects sampled June 2013

I.V. stands for Importance Value

Table 3.6-7 Full, Half, and Sub-Shrub Densities of the Mix Grass/Mat Cushion Grassland

Species	Mean (Number/Plot)	Relative Density	Std. Dev. n-1 (Number/Plot)	Mean (Number/ sq. m.)	Mean (Number/Acre)
Native Full Shrubs					
Artemisia tridentata	46.7	77.6	48.08	0.5	1,888
Chrysothamnus viscidiflorus	0.7	1.1	1.78	<0.1	27
Ericameria nauseosa	7.8	13.0	9.80	0.1	317
Total Native Full Shrubs	**55.1**	**91.7**	**47.05**	**0.6**	**2,232**
Native Half & Sub-Shrubs					
Artemisia frigida	<0.1	0.1	0.2	<0.1	1
Krascheninnikovia lanata	0.7	1.2	2.4	<0.1	29
Linanthus pungens	4.2	7.1	16.0	<0.1	172
Total Native Half &Sub-Shrubs	**5.0**	**8.3**	**16.1**	**0.1**	**202**
Total	**60.1**	**100**	**49.3**	**0.6**	**2,434**

Table 3.6-8 List of Vegetation Species Observed at Lost Creek East

Acronym	Current Nomenclature	Common Name	Vegetation Community		
			UBSS	LBSS	MGMC
Introduced Annual Grasses					
BROTEC	*Bromus tectorum*	Cheatgrass	X	X	
Native Cool Season Perennial Grasses					
ACHHYM	*Achnatherum hymenoides*	Indian ricegrass	X	X	X
ELYCIN	*Elymus cinereus*	Basin wildrye		X	
ELYELY	*Elymus elymoides*	Bottlebrush squirreltail	X		
ELYLAN	*Elymus lanceolatus*	Thickspike wheatgrass	X	X	X
ELYSMI	*Elymus smithii*	Western wheatgrass	X	X	X
ELYSPI	*Elymus spicatus*	Bluebunch wheatgrass	X	X	X
FESIDA	*Festuca idahoensis*	Idaho fescue	X	X	
HESCOM	*Hesperostipa comata*	Needleandthread	X	X	X
KOEMAC	*Koeleria macrantha*	Prairie junegrass	X	X	X
NASVIR	*Nassella viridula*	Green needlegrass		X	
POASEC	*Poa secunda*	Sandberg bluegrass	X	X	X
Native Grasslike Species					
CARFIL	*Carex filifolia*	Threadleaf sedge		X	X
Native Annual Forbs					
DESPIN	*Descurainia pinnata*	Western tansymustard		X	
ERISTR	*Erigeron strigosus*	Rough fleabane			X
LAPRED	*Lappula redowskii*	Bluebur stickseed		X	
LUPPUS	*Lupinus pusillus*	Rusty lupine		X	
Introduced Annual Forbs					
DESSOP	*Descurainia sophia*	Flixweed		X	
Native Biennial Forbs					
ERIGLA	*Erigeron glabellus*	Streamside fleabane			X
Native Perennial Forbs					
ANTMIC	*Antennaria microphylla*	Littleleaf pussytoes		X	X
ASTSPA	*Astragalus spatulatus*	Spoonleaf milkvetch		X	
CIRUND	*Cirsium undulatum*	Wavyleaf thistle			X
EREHOO	*Eremogone hookeri*	Hooker sandwort	X		X
ERIFLA	*Eriogonum flavum*	Alpine golden			X
ERIOVA	*Eriogonum ovalifolium*	Cushion wild	X		
ERIUMB	*Eriogonum umbellatum*	Sulfur wild buckwheat	X	X	
IVEGOR	*Ivesia gordonii*	Gordon's ivesia			X
MACTAN	*Machaeranthera*	Tansyleaf tansy aster			X
PHLHOO	*Phlox hoodii*	Hoods phlox	X	X	X
PHLMUS	*Phlox muscoides*	Musk phlox	X		X
PHYSPP	*Physaria* species	Twinpod	X		
STEACA	*Stenotus acaulis*	Stemless goldenweed	X	X	X

Table 3.6-8 (Cont.) List of Vegetation Species Observed at Lost Creek East

Acronym	Current Nomenclature	Common Name	Vegetation Community		
			UBSS	LBSS	MGMC
Native Perennial Forbs (Cont.)					
TETACA	*Tetraneuris acaulis*	Stemless four-nerve			X
THERHO	*Thermopsis rhombifolia*	Golden banner		X	
Native Full Shrubs					
ARTTRI	*Artemisia tridentata*	Big sagebrush	X	X	X
CHRVIS	*Chrysothamnus*	Sticky-leaved	X	X	X
ERINAU	*Ericameria nauseosa*	Rubber rabbitbrush	X	X	X
Native Half &Sub-Shrubs					
ARTFRI	*Artemisia frigida*	Fringed sagewort			X
GUTSAR	*Gutierrezia sarothrae*	Broom snakeweed	X	X	
KRALAN	*Krascheninnikovia lanata*	Winterfat	X	X	X
LINPUN	*Linanthus pungens*	Granite pricklygila	X	X	X
Native Succulents					
OPUPOL	*Opuntia polyacantha*	Plains pricklypear	X	X	X
Total in each Vegetation Community			**24**	**29**	**27**
Total number of species=42					
X	Species observed and/or sampled				

Table 3.6-9 Designated Noxious and Declared Weeds Surveyed for at Lost Creek East

State of Wyoming Designated Noxious Weeds	
Scientific Name	**Common Name**
Convolvulus arvensis	Field bindweed
Cirsium arvense	Canada thistle
Euphorbia esula	Leafy spurge
Sonchus arvensis	Perennial saothistle
Cardaria draba	Hoary cress
Lepidium latifolium	Perennial pepperweed
Chrysanthemum leucanthemum	Ox-eye daisy
Franseria discolor	Skeletonleaf bursage
Centaurea repens	Russian knapweed
Linaria vulgaris	Yellow toadflax
Linaria dalmatica	Dalmatian toadflax
Onopordum acanthium	Scotch thistle
Carduus nutans	Musk thistle
Arctium minus	Common burdock
Carduus acanthoides	Plumeless thistle
Isatais tinctoria	Dyers woad
Cynoglossum officinale	Houndstongue
Centaurea maculosa	Spotted knapweed
Centaurea diffusa	Diffuse knapweed
Lythrum salicaria	Purple lustrife
Tamarix spp.	Saltcedar
Hypericum perforatum	Common St. Johnswort
Tanacetum vulgare	Common tansy
Elaeagnus angustifolia	Russian olive
Sweetwater County Declared Weeds	
Scientific Name	**Common Name**
Hyoscyamus niger	Black henbane
Hordeum jubatum	Foxtail barley
Galium verum	Lady's bedstraw
Thermopsis montana	Mountain thermopsis
Glycyrrhiza lepidota	Wild licorice

Table 3.6-10 Evaluation of Sample Adequacy

Transect #	Upland Big Sagebrush		Lowland Big Sagebrush		Mixed Grass/Mat Cushion	
	Vegetation Cover %	Ground Cover %	Vegetation Cover %	Ground Cover %	Vegetation Cover %	Ground Cover %
1	13	28	19	33	9	15
2	10	26	20	38	7	12
3	12	28	28	47	14	23
4	13	22	19	39	9	25
5	14	24	31	42	9	16
6	21	27	17	43	9	17
7	11	31	23	40	15	20
8	13	27	28	38	8	13
9	14	23	19	42	7	18
10	18	33	20	43	7	16
11	17	25	18	37	11	20
12	14	23	14	34	9	15
13	20	25	20	34	8	19
14	13	24	21	44	15	26
15	18	28	21	43	7	12
16	17	32	22	39	12	21
17	17	40	22	46	7	7
18	21	30	11	30	11	22
19	15	22	17	42	13	20
20	14	24	28	39	12	19
21	--	--	--	--	14	21
22	--	--	--	--	6	14
23	--	--	--	--	9	17
24	--	--	--	--	10	19
25	--	--	--	--	6	9
26	--	--	--	--	12	19
27	--	--	--	--	11	18
28	--	--	--	--	8	23
29	--	--	--	--	10	25

Vegetation Community	Mean	Standard Deviation	Actual Sample #	Computed Adequate Sample Size	Computed Z-Value
Upland Big Sagebrush					
Total Vegetation Cover	30.5	6.4	20	15	N/A
Total Ground Cover	54.2	8.9	20	9	N/A
Lowland Big Sagebrush					
Total Vegetation Cover	41.8	9.8	20	19	N/A
Total Ground Cover	79.3	8.9	20	5	N/A
Mixed Grass/Mat Cushion					
Total Vegetation Cover	19.7	5.3	29	24	N/A
Total Ground Cover	35.9	9.3	29	22	N/A

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 1 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
BIRDS				
Pied-billed Grebe	*Podilymbus podiceps*	Fairly Common		
Eared Grebe	*Podiceps nigricollis*	Uncommon		
American White Pelican	*Pelecanus erythrorhynchos*	Fairly Common	NSS3	
Great Blue Heron	*Ardea herodias*	Uncommon	NSS4	
Snowy Egret	*Egretta thula*	Rare	NSS3	
Black-crowned Night-Heron	*Nycticorax nycticorax*	Uncommon		
Canada Goose	*Branta canadensis*	Uncommon		
Green-winged Teal	*Anas crecca*	Uncommon		
Mallard	*Anas platyrhynchos*	Fairly Common		
Northern Pintail	*Anas acuta*	Uncommon	NSS3	
Gadwall	*Ana strepera*	Uncommon		
Blue-winged Teal	*Anas discors*	Fairly Common		
Cinnamon Teal	*Anas cyanoptera*	Fairly Common		
Northern Shoveler	*Anas clypeata*	Uncommon		
American Wigeon	*Anas americana*	Uncommon		
Canvasback	*Aythya valisineria*	Rare	NSS3	
Redhead	*Aythya americana*	Rare	NSS3	
Common Goldeneye	*Bucephala clangula*	Uncommon		
Bufflehead	*Bucephala albeola*	Uncommon		
Hooded Merganser	*Lophodytes cucullatus*	Uncommon		
Common Merganser	*Mergus merganser*	Fairly Common		
Ruddy Duck	*Oxyura jamaicensis*	Uncommon		
Turkey Vulture	*Cathartes aura*	Common		x
Osprey	*Pandion haliaetus*	Rare		
Bald Eagle	*Haliaeetus leucocephalus*	Unknown	MBHFI, FT, NSS2	
Northern Harrier	*Circus cyaneus*	Common		x
Sharp-shinned Hawk	*Accipiter striatus*	Uncommon		x
Cooper's Hawk	*Accipiter cooperii*	Uncommon		
Northern Goshawk	*Accipiter gentilis*	Uncommon	SSS, NSS4	
Swainson's Hawk	*Buteo swainsoni*	Common	BCC, MBHFI, NSS4	x
Red-tailed Hawk	*Buteo jamaicensis*	Common		x
Ferruginous Hawk	*Buteo regalis*	Common	BCC, MBHFI, SSS, NSS3	x
Rough-legged Hawk	*Buteo lagopus*	Common		x
Golden Eagle	*Aquila chrysaetos*	Common	BCC	x
American Kestrel	*Falco sparverius*	Common		x
Merlin	*Falco columbarius*	Unknown	MBHFI, NSS3	
Prairie Falcon	*Falco mexicanus*	Uncommon	BCC	x
Peregrine Falcon	*Falco peregrinus*	Unknown	BCC, MBHFI, SSS, NSS3	
Sage Grouse	*Centrocercus urophasianus*	Common	MBHFI, SSS, NSS2	x
Sora	*Porzana carolina*	Uncommon		
American Coot	*Fulica americana*	Uncommon		
Sandhill Crane	*Grus canadensis*	Rare	NSS3	
Killdeer	*Charadrius vociferus*	Common		x
Mountain Plover	*Charadrius montanus*	Unknown	BCC, MBHFI, SSS, NSS4	
American Avocet	*Recurvirostra americana*	Uncommon		
Greater Yellowlegs	*Tringa melanoleuca*	Uncommon		
Lesser Yellowlegs	*Tringa flavipes*	Uncommon		
Spotted Sandpiper	*Actitis macularia*	Fairly Common		

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 2 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Upland Sandpiper	*Bartramia longicauda*	Rare	BCC, MBHFI, NSS4	
Long-billed Curlew	*Numenius americanus*	Uncommon	BCC, MBHFI, SSS, NSS3	
Marbled Godwit	*Limosa fedoa*	Rare	BCC	
Wilson's Snipe	*Gallinago delicata*	Fairly Common		
Wilson's Phalarope	*Phalaropus tricolor*	Uncommon	BCC	
Franklin's Gull	*Larus pipixcan*	Uncommon		
Ring-billed Gull	*Larus delawarensis*	Uncommon		
California Gull	*Larus californicus*	Uncommon		
Rock Dove	*Columba livia*	Common		
Band-tailed Pigeon	*Columba fasciata*	Unknown		
Mourning Dove	*Zenaida macroura*	Abundant		x
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Rare	MBHFI	
Great Horned Owl	*Bubo virginianus*	Fairly Common		x
Snowy Owl	*Nyctea scandiaca*	Unknown		
Western Burrowing Owl	*Athene cunicularia*	Uncommon	MBHFI, SSS, NSS4	
Long-eared Owl	*Asio otus*	Uncommon		
Short-eared Owl	*Asio flammeus*	Uncommon	MBHFI, NSS4	x
Common Nighthawk	*Chordeiles minor*	Common		x
Common Poorwill	*Phalaenoptilus nuttallii*	Uncommon		
White-throated Swift	*Aeronautes saxatalis*	Uncommon		
Broad-tailed Hummingbird	*Selasphorus platycercus*	Rare		
Rufous Hummingbird	*Selasphorus rufus*	Rare		
Downy Woodpecker	*Picoides pubescens*	Uncommon		
Hairy Woodpecker	*Picoides villosus*	Rare		
Northern Flicker	*Colaptes auratus*	Uncommon		
Western Wood-Pewee	*Contopus sordidulus*	Fairly Common		
Empidonax Species	*Empidonax spp.*	Common		
Willow Flycatcher	*Empidonax traillii*	Fairly Common	NSS3	
Hammond's Flycatcher	*Empidonax hammondii*	Uncommon		
Gray Flycatcher	*Empidonax wrightii*	Common		
Dusky Flycatcher	*Empidonax oberholseri*	Common		
Say's Phoebe	*Sayornis saya*	Common		
Cassin's Kingbird	*Tyrannus vociferans*	Uncommon	MBHFI	
Western Kingbird	*Tyrannus verticalis*	Common		
Eastern Kingbird	*Tyrannus tyrannus*	Fairly Common		
Horned Lark	*Eremophila alpestris*	Abundant		x
Tree Swallow	*Tachycineta bicolor*	Fairly Common		
Violet-green Swallow	*Tachycineta thalassina*	Fairly Common		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Fairly Common		
Bank Swallow	*Riparia riparia*	Common		
Cliff Swallow	*Petrochelidon pyrrhonota*	Common		
Barn Swallow	*Hirundo rustica*	Fairly Common		
Steller's Jay	*Cyanocitta stelleri*	Uncommon		
Pinyon Jay	*Gymnorhinus cyanocephalus*	Rare		
Clark's Nutcracker	*Nucifraga columbiana*	Fairly Common		
Black-billed Magpie	*Pica pica*	Abundant		
American Crow	*Corvus brachyrhynchos*	Fairly Common		x
Common Raven	*Corvus corax*	Abundant		x
Black-capped Chickadee	*Poecile atricapillus*	Uncommon		
Mountain Chickadee	*Poecile gambeli*	Uncommon		
Red-breasted Nuthatch	*Sitta canadensis*	Fairly Common		

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 3 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
White-breasted Nuthatch	*Sitta carolinensis*	Rare		
Brown Creeper	*Certhia americana*	Uncommon		
Rock Wren	*Salpinctes obsoletus*	Common		
House Wren	*Troglodytes aedon*	Uncommon		
Western Bluebird	*Sialia mexicana*	Rare		
Mountain Bluebird	*Sialia currucoides*	Common		x
Townsend's Solitaire	*Myadestes townsendi*	Uncommon		
Veery	*Catharus fuscescens*	Uncommon		
Swainson's Thrush	*Catharus ustulatus*	Uncommon		
Hermit Thrush	*Catharus guttatus*	Uncommon		
American Robin	*Turdus migratorius*	Common		x
Gray Catbird	*Dumetella carolinensis*	Uncommon		
Northern Mockingbird	*Mimus polyglottos*	Uncommon		
Sage Thrasher	*Oreoscoptes montanus*	Common	MBHFI, SSS, NSS4	x
European Starling	*Sturnus vulgaris*	Fairly Common		
Bohemian Waxwing	*Bombycilla garrulus*	Uncommon		
Cedar Waxwing	*Bombycilla cedrorum*	Uncommon		
Northern Shrike	*Lanius excubitor*	Uncommon		
Loggerhead Shrike	*Lanius ludovicianus*	Common	BCC, MBHFI, SSS	x
Warbling Vireo	*Vireo gilvus*	Uncommon		
Yellow Warbler	*Dendroica petechia*	Fairly Common		
Yellow-rumped Warbler	*Dendroica coronata*	Fairly Common		
American Redstart	*Setophaga ruticilla*	Uncommon		
Northern Waterthrush	*Seiurus noveboracensis*	Rare		
MacGillivray's Warbler	*Oporornis tolmiei*	Uncommon		
Common Yellowthroat	*Geothlypis trichas*	Uncommon		
Yellow-breasted Chat	*Icteria virens*	Uncommon		
Western Tanager	*Piranga ludoviciana*	Uncommon		
Black-headed Grosbeak	*Pheucticus melanocephalus*	Rare		
Blue Grosbeak	*Guiraca caerulea*	Rare		
Lazuli Bunting	*Passerina amoena*	Uncommon		
Indigo Bunting	*Passerina cyanea*	Unknown		
Green-tailed Towhee	*Pipilo chlorurus*	Common		
Spotted Towhee	*Pipilo maculatus*	Fairly Common		
American Tree Sparrow	*Spizella arborea*	Uncommon		x
Chipping Sparrow	*Spizella passerina*	Uncommon		x
Clay-colored Sparrow	*Spizella pallida*	Rare		x
Brewer's Sparrow	*Spizella breweri*	Common	BCC, MBHFI, SSS, NSS4	x
Vesper Sparrow	*Pooecetes gram ineus*	Common	MBHFI	x
Lark Sparrow	*Chondestes grammacus*	Common	MBHFI	
Sage Sparrow	*Amphispiza belli*	Fairly Common	MBHFI, SSS, NSS4	x
Lark Bunting	*Calamospiza melanocorys*	Common	MBHFI, NSS4	
Savannah Sparrow	*Passerculus sandwichensis*	Uncommon		
Grasshopper Sparrow	*Ammodramus savannarum*	Uncommon	MBHFI, NSS4	
Song Sparrow	*Melospiza melodia*	Uncommon		
White-crowned Sparrow	*Zonotrichia leucophrys*	Uncommon		
Dark-eyed Junco	*Junco hyemalis*	Common		
McCown's Longspur	*Calcarius mccownii*	Uncommon	BCC, MBHFI, NSS4	
Chestnut-collared Longspur	*Calcarius ornatus*	Unknown	MBHFI, NSS4	x
Snow Bunting	*Plectrophenax nivalis*	Unknown		

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 4 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Bobolink	*Dolichonyx oryzivorus*	Rare	MBHFI, NSS4	
Red-winged Blackbird	*Agelaius phoeniceus*	Abundant		
Western Meadowlark	*Sturnella neglecta*	Abundant		x
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Rare		
Brewer's Blackbird	*Euphagus cyanocephalus*	Abundant		
Common Grackle	*Quiscalus quiscula*	Fairly Common		
Brown-headed Cowbird	*Molothrus ater*	Fairly Common		
Bullock's Oriole	*Icterus bullockii*	Rare		
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	Fairly Common		
Cassin's Finch	*Carpodacus cassinii*	Uncommon		
House Finch	*Carpodacus mexicanus*	Uncommon		
Red Crossbill	*Loxia curvirostra*	Uncommon		
Pine Siskin	*Carduelis pinus*	Uncommon		
American Goldfinch	*Carduelis tristis*	Fairly Common		
House Sparrow	*Passer domesticus*	Uncommon		

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 5 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
MAMMALS				
Masked Shrew	*Sorex cinereus*	Fairly Common		
Pygmy Shrew	*Sorex hoyi*	Rare		
Dusky Shrew	*Sorex monticolus*	Fairly Common		
Dwarf Shrew	*Sorex nanus*	Rare	NSS3	
Vagrant Shrew	*Sorex vagrans*	Rare	NSS3	
Western Small-footed Myotis	*Myotis ciliolabrum*	Uncommon	NSS3	
Long-eared Myotis	*Myotis evotis*	Uncommon	SSS	
Little Brown Myotis	*Myotis lucifugus*	Fairly Common	NSS3	
Long-legged Myotis	*Myotis volans*	Unknown	NSS2	
Hoary Bat	*Lasiurus cinereus*	Rare	NSS4	
Silver-haired Bat	*Lasionycteris noctivagans*	Uncommon	NSS4	
Big Brown Bat	*Eptesicus fuscus*	Fairly Common	NSS3	
Townsend's Big-eared Bat	*Plecotus townsendii*	Rare	SSS, NSS2	
Pallid Bat	*Antrozous pallidus*	Rare	NSS2	
Pygmy Rabbit	*Brachylagus idahoensis*	Common	SSS, NSS3	x
Desert Cottontail	*Sylvilagus audubonii*	Common		x
Mountain Cottontail	*Sylvilagus nuttallii*	Fairly Common		
White-tailed Jackrabbit	*Lepus townsendii*	Common		x
Least Chipmunk	*Tamias minimus*	Common		x
Wyoming Ground Squirrel	*Spermophilus elegans*	Common		x
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*	Common		x
White-tailed Prairie Dog	*Cynomys leucurus*	Uncommon	SSS, NSS4	
Wyoming Pocket Gopher	*Thomomys clusius*	Uncommon	SSL, NSS4	x
Northern Pocket Gopher	*Thomomys talpoides*	Common		x
American Beaver	*Castor canadensis*	Common		
Olive-backed Pocket Mouse	*Perognathus fasciatus*	Common	NSS3	
Ord's Kangaroo Rat	*Dipodomys ordii*	Common		x
Western Harvest Mouse	*Reithrodontomys megalotis*	Uncommon		
Deer Mouse	*Peromyscus maniculatus*	Abundant		x
Northern Grasshopper Mouse	*Onychomys leucogaster*	Fairly Common		x
Bushy-tailed Woodrat	*Neotoma cinerea*	Fairly Common		
House Mouse	*Mus musculus*	Uncommon		
Long-tailed Vole	*Microtus longicaudus*	Fairly Common		
Montane Vole	*Microtus montanus*	Common		
Prairie Vole	*Microtus ochrogaster*	Fairly Common	NSS3	
Sagebrush Vole	*Lemmiscus curtatus*	Fairly Common		
Western Jumping Mouse	*Zapus princeps*	Uncommon		
Common Porcupine	*Erethizon dorsatum*	Uncommon		
Coyote	*Canis latrans*	Abundant		x
Red Fox	*Vulpes vulpes*	Common		x
Raccoon	*Procyon lotor*	Rare		x
Long-tailed Weasel	*Mustela frenata*	Fairly Common		x
Black-footed Ferret	*Mustela nigripes*	Unknown	FE/NSS1	
American Badger	*Taxidea taxus*	Common		x
Western Spotted Skunk	*Spilogale gracilis*	Unknown		
Striped Skunk	*Mephitis mephitis*	Common		x
Mountain Lion	*Felis concolor*	Uncommon		
Bobcat	*Lynx rufus*	Fairly Common		x
American Elk	*Cervus elaphus*	Common		x
Mule Deer	*Odocoileus hemionus*	Abundant		x
Pronghorn	*Antilocapra americana*	Common		x
Feral Horse	*Equus caballus*	Common		x

Table 3.6-11 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 6 of 6)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
AMPHIBIANS				
Tiger Salamander	*Ambystoma tigrinum*	Fairly Common		
Great Basin Spadefoot Toad	*Spea intermontana*	Unknown	SSS	
Western Chorus Frog	*Pseudacris triseriata*	Unknown		
Northern Leopard Frog	*Rana pipiens*	Rare	SSS	
REPTILES				
Northern Sagebrush Lizard	*Sceloporus graciosus*	Common		
Greater Short-horned Lizard	*Phrynosoma hernandesi*	Common		x
Great Basin Gopher Snake	*Pituophis catenifer*	Rare		
Western Terrestrial Garter Snake	*Thamnophis elegans*	Fairly Common		x
Prairie Rattlesnake	*Crotalus viridis*	Uncommon		x

Notes:

Abundance Code

Abundant - A species that inhabits much of the preferred habitat within its range. The species or its sign is typically encountered while using survey techniques that could be expected to indicate its presence.

Common - A species that inhabits much of the preferred habitat within its range. The species or its sign is usually encountered while using survey techniques that could be expected to indicate its presence.

Uncommon - A species that is common only in limited areas within its range or is found throughout its range in relatively low densities. Intensive surveying is usually required to locate the species or its sign.

Rare - A species that occupies only a small percentage of the preferred habitat within its range or is found throughout its range in extremely low densities. The species or its sign is seldom encountered while using survey techniques that could be expected to indicate its presence.

Unknown - Insufficient information is available to determine abundance. Species is difficult to observe without specialized survey techniques.

Status

Federal – Endangered Species Act

FT - Federally listed threatened species

Federal – Migratory Bird Treaty Act

BCC - Birds of Conservation Concern species identified by the USFWS as those migratory non-game birds that without additional conservation actions are likely to become candidates for listing under the Endangered Species Act.

Federal – Migratory Birds of High Federal Interest in Wyoming

MBHFI - Listed utilized by the USFWS, Wyoming Field Office for reviews concerning existing or proposed coal mine leased land.

BLM – Special Status Species

SSS - BLM Special Status Species are species protected under the Endangered Species Act and those designated by the State Director as Sensitive. Sensitive species are those under status review by the FWS/National Marine and Fisheries Service (NMFS), or whose numbers are declining so rapidly that Federal listing may become necessary, or with typically small or widely dispersed populations, or those inhabiting ecological refugia or other specialized or unique habitats. The minimum level of policy protection for these designated sensitive species will be the same as policy for candidate

SSL - Warranting special attention on BLM lands.

State – Native Species Status

NSS1 - Native Species Status 1 - Populations are greatly restricted or declining, extirpation appears possible and on-going significant loss of habitat.

NSS2 - Native Species Status 2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.

NSS3 - Native Species Status 3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.

NSS4 - Native Species Status 4 - Populations are greatly restricted or declining, extirpation appears possible; habitat is stable and not restricted.

Table 3.6-12. Relative Abundance of Big Game Observations

Month	Species	Habitat Type	
		Upland Sagebrush	Lowland Sagebrush
January	Pronghorn	High	High
January	Elk	Low	Low
April	Pronghorn	High	High
June	Pronghorn	Medium	Medium
August	Elk	Low	--
August	Pronghorn	Medium	Medium

Table 3.6-13. Sage-grouse lek count data summary for 2012 and 2013 in project SG Monitoring Areas

Lek Name/ Complex Count	DATE ♂-♀-U TIME							
	Count 1	Count 2	Count 3	Count 4	Count 5	Count 6	Count 7	Peak Males
2012								
Arapahoe	4/15 18-10-0 0650	4/17 28-6-0 0615	4/26 24-0-0 0600					28
Bare Ring Butte	4/10 46-10-0 0630	4/18 26-6-0 0620	4/25 43-1-0 0555					46
Bull Springs	4/6 20-3-0 0637	4/12 23-1-0 0616	4/17 25-0-0 0730	4/24 23-0-0 0713				25
Chain Lakes Rim	3/26 3-0-0 0852	3/27 13-12-0 0759	4/5 19-9-0 0609	4/13 20-7-0 0619	4/21 17-7-0 0615			20
Chicken Springs	4/6 88-23-0 0718	4/12 84-4-0 0653	4/17 90-1-0 0707	4/24 83-1-0 0645	4/25 79-1-0 0624			90
Crooked Well	4/3 0-0-0 0720	4/12 0-0-0 0715	4/26 0-0-0 0710					0
Cyclone Rim	4/11 48-10-0 0640	4/17 24-4-0 0705	4/23 43-3-0 0639	4/26 48-0-1 0630				48
Discover	3/29 2-0-0 0655	4/3 6-2-0 0650	4/12 4-2-0 0645	4/13 6-2-0 0640	4/20 6-1-0 0610	4/24 1-0-0 0638		6
Discover East	4/3 0-0-0 0730	4/12 0-0-0 0730	4/13 0-0-0 0650	4/20 1-0-0 0618	4/24 0-0-0 0710			1
Discover South	3/29 12-1-0 0720	4/3 10-3-0 0715	4/12 6-0-0 0710	4/13 22-3-3 0610	4/20 20-2-0 0638	4/24 15-0-0 0655		22
Eagles Nest	4/5 4-0-0 0620	4/17 1-0-0 0640	4/24 0-0-0 0615	4/30 1-0-0 0511				1
Eagles Nest Draw	4/4 40-6-0 0635	4/12 34-6-0 0650	4/18 64-6-0 0625					64
Eagles Nest Fence	3/23 23-16-3 0710	3/30 39-4-2 0700	4/6 29-0-0 0705	4/17 25-0-0 0650				39
Eagles Nest Reservoir	4/4 0-0-0 0715	4/24 0-0-0 0705	5/3 0-0-0 0715					0
East Alkali	4/11 16-0-0 0645	4/18 15-0-0 0625	5/3 13-0-0 0605					16
East Antelope	4/12 32-6-0 0625	4/18 33-6-2 0705	4/24 32-0-0 0630					33
Frenchman*	4/3 4-0-0 0845	4/11 10-2-0 0620	4/19 7-2-0 0620	4/25 0-0-0 0615				10
Green Ridge	4/3 55-12-0 0705	4/6 8-0-0 0815	4/7 5-0-0 0737	4/12 44-0-0 0630	4/12 0-0-0 0742	4/17 55-9-0 0625	4/25 42-2-0 0605	55

	DATE ♂-♀-U TIME							
Lek Name/ Complex Count	**Count 1**	**Count 2**	**Count 3**	**Count 4**	**Count 5**	**Count 6**	**Count 7**	**Peak Males**
Hadsell Crossing	4/5 22-7-0 0720	4/17 21-3-0 0630	4/23 25-1-0 0614	4/26 18-0-0 0615				25
Hadsell Road	3/25 1-0-1 0625	4/6 0-0-0 0620	4/18 0-0-0 0745	5/7 0-0-0 0620				1
Harrier	4/4 50-8-0 0725	4/11 54-16-0 0642	4/12 2-0-0 0805	4/19 60-16-0 0659	4/25 36-3-0 0645			60
Larsen North Well	4/7 0-0-0 0700	4/6 3-0-0 0742	4/12 0-0-0 0716	4/13 0-0-0 0639	4/17 18-0-0 0635	4/24 15-0-0 0618	4/25 3-0-0 0646	18
Little Osborne	4/5 0-0-0 0635	4/17 0-0-0 0605	4/26 0-0-0 0545					0
Lost Alkali	4/11 0-0-0 0655	4/18 0-0-0 0625	5/3 0-0-0 0615					0
Lost Arapahoe	4/11 16-0-0 0710	4/18 22-0-0 0610	5/3 19-0-0 0630					22
Lost Creek	4/11 0-0-0 0650	4/18 0-0-0 0645	5/3 0-0-0 0610					0
Lost Creek Basin	4/11 50-2-0 0630	4/18 46-2-0 0700	5/3 33-2-0 0550					50
Minex West	3/29 4-0-0 0630	4/3 5-0-0 0630	4/12 4-2-0 0625	4/18 0-0-0 0605				5
Monument Lake	3/26 0-0-0 0824	3/27 0-0-0 0747	4/5 4-2-0 0643	4/13 3-1-0 0645	4/22 3-0-0 0545			4
Mud Lake	4/21 0-0-0 0630	5/1 0-0-0 0600	5/8 0-0-0 0630					0
Mud Lake North	4/17 12-0-0 0800	4/21 21-0-0 0620	5/1 6-0-0 0550	5/8 0-0-0 0520				21
Mud Springs	4/6 18-4-0 0630							18
Osborne Draw	4/4 0-0- 0725	4/18 0-0-0 0715	4/24 0-0-0 0650					0
Prospects	4/4 34-8-0 0640	4/12 9-0-0 0650	4/17 39-8-0 0642					39
Prospects South	4/4 0-0-0 0650	4/12 0-0-0 0700	4/17 0-0-0 0658					0
Red Creek Well	4/5 21-6-0 0645	4/17 25-3-0 0600	4/20 29-0-0 0721	4/24 14-0-0 0555				29
Ruby Knolls North	4/4 0-0-0 0725	4/12 0-0-0 0750	4/18 0-0-0 0700	4/25 0-0-0 0655				0

Lek Name/ Complex Count	DATE ♂-♀-U TIME Count 1	Count 2	Count 3	Count 4	Count 5	Count 6	Count 7	Peak Males
Rubby Knolls South	3/21 40-32-0 0804	3/29 39-9-0 0735	4/7 45-2-0 0650	4/14 0-0-0 0645	4/21 38-3-0 0645			45
Ruby Knolls West	3/27 11-0-0 0728	4/3 18-3-0 0724	4/10 16-2-0 0700	4/18 20-1-0 0630	4/25 23-2-0 0618			23
Sand Gully	4/4 0-0-0 0645	4/12 0-0-0 0715	4/18 1-0-0 0640					1
SK Well	4/5 0-0-0 0620	4/17 0-0-0 0655	4/24 0-0-0 0620					0
Smiley Springs	4/11 44-7-0 0700	4/17 41-5-0 0715	4/23 41-1-0 0703	4/26 34-0-0 0600				44
Sooner	4/3 11-6-0 0630	4/12 1-0-0 0610	4/13 0-0-0 0708	4/17 19-5-0 0610	4/25 1-0-0 0550			19
Sooner Oil	4/3 0-0-0 0645	4/11 0-0-0 0616	4/12 0-0-0 0615	4/25 0-0-0 0555				0
Sourdough Mine	3/26 10-1-0 0833	4/7 0-0-0 0640	4/24 6-0-0 0615					10
Southland Well	4/6 26-3-0 0757	4/7 4-0-0 0714	4/12 0-0-0 0726	4/13 0-0-0 0650	4/17 32-2-0 0613	4/24 32-3-0 0553		32
Stewart Creek	4/6 32-4-0 0658	4/7 37-10-0 0642	4/12 31-0-0 0637	4/13 34-1-0 0609	4/17 43-1-0 0648	4/25 31-0-0 0545		43
Stinking Springs	4/10 17-0-0 0630	4/18 33-3-0 0610	5/2 27-1-0 0550	5/4 16-5-0 0610				33
Stinking Springs North	4/10 0-0-0 0645	4/18 0-0-0 0630	5/2 0-0-0 0540	5/4 0-0-0 0600				0
Stratton	4/17 0-0-0 0826	4/19 21-0-0 0630	4/26 18-0-0 0610	5/3 15-0-0 0545				21
Stratton Camp	3/27 9-13-0 0818							9
Stratton Lake	4/11 0-0-0 0715	4/17 0-0-0 0730	4/26 0-0-0 0615					0
Texas Oil	3/23 0-0-0 0805	3/30 0-0-0 0635	4/6 0-0-0 0750	4/18 0-0-0 0625	5/7 0-0-0 0720			0
Upper Osborne	4/4 8-0-0 0715	4/11 29-6-0 0630	4/12 0-0-0 0751	4/19 49-12-0 0638	4/28 29-4-0 0620			49
White Water	4/6 0-0-0 0650	4/18 0-0-0 0640	5/3 0-0-0 0555					0
White Water East*	4/6 7-2-0 0655	4/19 6-0-0 0645	5/3 4-0-0 0550					7
2013								

Lek Name/ Complex Count	Count 1	Count 2	Count 3	Count 4	Count 5	Count 6	Count 7	Peak Males
	DATE ♂-♀-U TIME							
Arapahoe	4/3 14-10-0 0705	4/4 17-0-0 0705 (F)	4/24 1-0-0 0615	4/25 1-0-0 0625	4/26 8-0-0 0540			17
Bare Ring Butte	4/4 38-12-0 0635	4/22 48-6-0 0725	4/27 40-6-0 0603	4/30 60-2-0 0705				60
Bull Springs	4/5 20-4-0 0646	4/13 0-0-0 0735	4/14 6-0-0 0621	4/22 20-1-0 0610	4/25 6-0-0 0717			20
Chain Lakes Rim	4/2 18-0-0 0615	4/12 19-9-0 0633	4/24 16-0-0 0621	4/30 18-1-0 0711				19
Chicken Springs	4/5 59-14-0 0723	4/13 43-4-0 0700	4/14 42-0-0 0703	4/22 6-0-0 0652	4/24 70-0-0 0637	4/25 52-3-0 0635		70
Connors	4/30 9-0-0 0500	5/3 6-0-0 0450						9
Crooked Well	4/5 0-0-0 0645 (F)	4/25 0-0-0 0700	5/4 0-0-0 0635					0
Cyclone Rim	4/12 18-6-0 0615	4/20 21-4-0 0605	5/2 29-1-0 0610					29
Discover	4/1 0-0-0 0650	4/11 0-0-0 0635	4/12 2-0-0 0635	4/24 2-0-0 0600				2
Discover East	4/1 0-0-0 0735	4/11 0-0-0 0705	4/12 0-0-0 0640	4/24 0-0-0 0605				0
Discover South	4/1 6-15-0 0715	4/11 0-0-0 0650	4/12 8-5-0 0625	4/24 8-0-1 0550	5/3 7-4-0 0540			8
Eagles Nest	4/5 0-0-0 0645	4/12 0-0-0 0725	4/23 0-0-0 0625					0
Eagles Nest Draw	4/1 0-0-0 0735	4/11 29-4-0 0735	4/25 18-1-0 0600					29
Eagles Nest Fence	3/20 17-0-3 0715	3/29 1-0-1 0900	4/3 15-3-0 0735	4/14 12-1-0 0615	5/7 0-0-0 0600			17
Eagles Nest Reservoir	4/3 0-0-0 0750	4/26 0-0-0 0650	5/3 0-0-0 0650					0
East Alkali	4/13 9-0-0 0640	4/22 12-0-0 0620	4/30 14-0-0 0605					14
East Antelope	4/4 19-6-0 0700	4/22 20-3-0 0705	4/30 2-0-0 0645					20
Frenchman	4/2 0-0-0 0720	4/19 0-0-0 0635	4/25 8-1-0 0545	4/28 10-0-0 0605				10
Green Ridge	4/2 4-0-0 0705	4/11 32-20-0 0635	4/25 31-0-0 0555	5/4 27-0-0 0550				32

	DATE ♂-♀-U TIME							
Lek Name/ Complex Count	**Count 1**	**Count 2**	**Count 3**	**Count 4**	**Count 5**	**Count 6**	**Count 7**	**Peak Males**
Hadsell Crossing	4/3 10-8-0 0640	4/24 8-0-0 0600	4/26 0-0-0 0610	5/2 7-1-0 0800	5/3 0-0-0 0620			10
Hadsell Road	3/29 0-0-0 0810	4/5 0-0-0 0650	4/19 0-0-0 0655	5/6 0-0-0 0655				0
Harrier	4/2 0-0-0 0745	4/4 25-31-0 0730	4/24 20-1-0 0640	4/26 21-4-0 0545				25
Larsen North Well	4/5 7-0-0 0745	4/6 12-6-0 0700	4/13 11-0-0 0645	4/14 0-0-0 0727	4/22 0-0-0 0708	4/24 0-0-0 0656	4/25 0-0-0 0621	12
Little Osborne	4/3 0-0-0 0720 (F)	4/24 0-0-0 0705	5/3 0-0-0 0630					0
Lost Alkali	4/13 0-0-0 0630	4/22 0-0-0 0630	4/30 0-0-0 0615					0
Lost Arapahoe	4/5 16-0-0 0735	4/13 17-0-0 0615	4/22 16-0-0 0645	4/30 16-0-0 0630				17
Lost Creek	4/13 0-0-0 0645	4/22 0-0-0 0625	4/30 0-0-0 0610					0
Lost Creek Basin	4/13 25-7-0 0700	4/22 5-0-0 0610	4/30 0-0-0 0545					25
Minex West	4/1 1-0-0 0635	4/11 1-0-0 0615	4/24 0-0-0 0645					1
Monument Lake	4/7 1-0-0 0712	4/12 1-0-0 0720	4/24 0-0-0 0550	4/26 0-0-0 0704	4/30 0-0-0 0642			1
Mud Lake	3/15 0-0-0 0815	4/1 1-0-4 0755	4/3 14-42-0 0630	4/8 0-0-0 0655	4/22 0-0-0 0605	4/29 16-0-0 0630		16
Mud Lake North	3/15 15-1-0 0735	4/1 0-0-0 0840	4/8 17-6-1 0630	4/23 18-0-0 0700	4/25 0-0-0 0741			18
Mud Springs	4/18 74-49-0 0640							74
Osborne Draw	4/3 0-0-0 0735	4/4 0-0-0 0745 (F)	4/24 0-0-0 0700	5/3 18-0-0 0635				18
Prospects	4/11 14-5-0 0705	4/19 22-2-0 0600	4/25 16-0-0 0630	4/28 29-2-1 0540				29
Prospects South	4/11 0-0-0 0715	4/19 0-0-0 0615	4/25 0-0-0 0640					0
Red Creek Well	4/5 16-5-0 0630	4/12 8-0-0 0740	4/23 13-0-0 0605					16
Ruby Knolls North	3/26 0-0-0 0635	4/2 0-0-0 0755	4/12 0-0-0 0715	4/23 0-0-0 0643				0

	DATE ♂-♀-U TIME							
Lek Name/ Complex Count	**Count 1**	**Count 2**	**Count 3**	**Count 4**	**Count 5**	**Count 6**	**Count 7**	**Peak Males**
Rubby Knolls South	4/26 17-4-0 0638	5/6 2-6-0 0618	5/13 16-0-0 0620					17
Ruby Knolls West	3/26 11-1-0 0717	4/2 10-2-0 0716	4/10 9-0-0 0708	4/23 7-0-0 0613	4/24 9-0-0 ----			11
Sand Gully	4/1 1-1-0 0745	4/11 0-0-0 0725	4/25 0-0-0 0605					1
SK Well	4/5 0-0-0 0650	4/12 0-0-0 0710	4/23 0-0-0 0630					0
Smiley Springs	4/12 13-3-0 0635	4/20 32-0-0 0635	5/1 21-0-0 0550	5/2 12-0-0 0625				32
Sooner	4/2 3-5-0 0640	4/11 3-7-0 0625	4/25 2-0-0 0540	5/4 4-0-0 0540				4
Sooner Oil	4/2 0-0-0 0645	4/11 0-0-0 0625	4/25 0-0-0 0545	5/4 0-0-0 0545				0
Sourdough Mine	3/15 7-1-0 0750	4/3 8-0-1 0740	4/12 8-0-0 0625	4/24 9-0-0 0555	4/26 4-0-0 0710	4/30 4-0-0 0652		9
Southland Well	4/5 0-0-0 0759	4/6 18-32-0 0635	4/13 20-6-0 0617	4/14 17-0-0 0739	4/22 3-0-0 0720	4/24 0-0-0 0702	4/25 12-0-0 0601	20
Stewart Creek	4/5 30-11-0 0704	4/13 20-0-0 0720	4/14 28-2-0 0644	4/22 23-0-0 0631	4/24 24-0-0 0621	4/25 9-0-0 0655		30
Stinking Springs	4/14 19-3-0 0720	4/21 17-5-0 0615	4/29 16-2-0 0550					19
Stinking Springs North	4/14 0-0-0 0655	4/21 0-0-0 0600	4/29 0-0-0 0605					0
Stratton	3/15 0-0-0 0900	4/1 15-5-0 0705	4/8 18-2-0 0735	4/23 19-0-0 0635				19
Stratton Camp	4/5 7-0-0 0720	4/23 2-0-0 0710	5/2 13-1-0 0550					13
Stratton Lake	4/12 0-0-0 0700	4/20 0-0-0 0650	5/2 0-0-0 0645					0
Texas Oil	3/29 0-0-0 0845	4/3 0-0-0 0805	4/12 0-0-0 0740	4/24 0-0-0 0745				0
Upper Osborne	4/2 2-0-0 0735	4/19 32-2-0 0645	4/25 43-2-0 0602	4/28 42-1-0 0612				43
White Water	4/6 0-0-0 0730	4/26 0-0-0 0550	4/30 0-0-0 0550	5/3 0-0-0 0605				0
White Water East	4/6 0-0-0 0730	4/26 11-0-0 0555	4/30 11-1-0 0540	5/3 12-0-0 0550				12

*New Leks Found in 2012

Table 3.6-14. Lost Creek sage-grouse brood survey results (2012 and 2013).

Date	Transect ID	Start Time	End Time	Males	Females	Young of Year	Unknown
7/19/2012	A&M #1	0600	0625	0	5	3	
7/19/2012	A&M #2	0630	0655	0	0	0	
7/18/2012	Crooks #1	0655	0720	0	12	11	
7/18/2012	Crooks #2 [1]	0600	0630	0	0	0	
7/17/2012	Lost Creek #1 [2]	0640	0710	0	0	0	
7/17/2012	Lost Creek #2 [3]	0550	0615	0	0	0	
7/20/2012	Stewart Creek #1	0640	0715	1	5	2	
7/20/2012	Stewart Creek #2 [4]	0610	0635	0	4	3	
8/3/2012	A&M #1	0655	0720	0	4	14	
8/3/2012	A&M #2	0615	0640	0	0	0	
8/2/2012	Crooks #1	0610	0635	0	1	1	
8/2/2012	Crooks #2 [5]	0710	0735	0	0	0	
8/1/2012	Lost Creek #1	0605	0630	0	0	0	
8/1/2012	Lost Creek #2	0705	0725	0	0	0	
8/4/2012	Stewart Creek #1	0635	0700	0	1	2	
8/4/2012	Stewart Creek #2 [6]	0605	0630	0	0	0	
8/7/2013	A&M #1 [7]	0605	0625	0	0	0	
8/7/2013	A&M #2	0640	0705	0	2	0	
8/8/2013	Crooks #1	0710	0735	0	1	1	
8/8/2013	Crooks #2 [8]	0605	0635	0	3	2	
8/9/2013	Lost Creek #1 [9]	0650	0715	0	1	0	
8/9/2013	Lost Creek #2 [10]	0600	0625	0	0	0	
8/6/2013	Stewart Creek #1 [11]	0605	0635	0	1	0	
8/6/2013	Stewart Creek #2	0640	0710	0	1	1	
8/14/2013	A&M #1 [12]	0640	0705	0	0	0	
8/14/2013	A&M #2 [13]	0600	0625	9	1	0	
8/15/2013	Crooks #1	0610	0635	0	1	2	
8/15/2013	Crooks #2	0710	0735	0	6	2	

Date	Transect ID	Start Time	End Time	Males	Females	Young of Year	Unknown
8/16/2013	Lost Creek #1	0615	0640	0	0	0	
8/16/2013	Lost Creek #2 [14]	0715	0735	0	0	0	
8/13/2013	Stewart Creek #1 [15]	0645	0715	0	0	0	
8/13/2013	Stewart Creek #2	0610	0640	0	0	0	

1 10 females and 2 young of the year were observed 100 meters north of the north end of transect. 6 females flew over transect 200 meters to the north of the north end.

2 2 golden eagles in area of transect. 12 males observed 200 meters west of central part of transect

3 1 female on road near transect

4 2 badgers in transect area

5 Golden eagle in transect area. Observed 5 young of the year 100 meters north of north end of transect on evening of 8/1/2012.

6 Coyotes in transect area.

7 No cattle in area of both transects this season.

8 Walked 1 mile upstream along Stewart creek and observed 4 groups of 2-3 birds, all female except for 1 male. Very few grouse tracks in sand along creek bottom. Water in channel found 100-150 meters up stream from area usually observed in previous years.

9 No water in channel along entire transect reach. In past years some pockets of water were observed.

10 20 female and young-of-year observed south of transect along main BLM road. Water in creek along entire reach of transect.

11 No cattle in area of both transects this season. Coyote establishing den near central portion of Transect #1.

12 Walked entire perimeter of A&M Reservoir beyond transect end and did not flush a single grouse.

13 15 males observed in transect area at 0755 (not flushed on initial transect pass at 0610).

14 Several cattle in area. Walked 1 mile upstream of transect and flushed no birds.

15 Several small groups (2-10 birds)of grouse heard moving to south east from creek area at 0530.

Table 3.6-15 Raptor Nest Locations, 2013.

Nest ID #	Species	PLSS Location	UTM Location	2013 Nest Status	Nest Substrate	2013 Nest Fate	Notes
AFH25921004	Ferruginous Hawk	T25N R92W NWSE Sec. 10	0268595E 4670503N	Active	Artificial Nest Structure	2 fledged	Within 1-mile buffer
FH25921601	Ferruginous Hawk	T25N R92W SESW Sec. 16	0266480E 4668397N	Inactive, Dilapidated	Sagebrush	---	Old stick nest, in Permit Area
FH25922801	Ferruginous Hawk	T25N R92W SENE Sec. 28	0267066E 4665882N	Active/ unsuccessful	Artificial Nest Structure	1 fledged	Just outside 1-mile buffer, active in early June (1 chick observed) but no birds fledged
FH25923201	Ferruginous Hawk	T25N R92W SWNW Sec. 32	0264483E 4664481N	Active/ unsuccessful	Artificial Nest Structure	No fledged	Just outside 1-mile buffer, adults seen at nest in early June, new nest materials
AFH25923502	Ferruginous Hawk	T25N R92W SWNW Sec. 35	0270343E 4664395N	Active/unsuc cessful	Artificial Nest Structure	0 fledged	Just outside 1-mile buffer, adjacent to Sooner Res.
FH25932502	Ferruginous Hawk	T25N, R93W SWNW Sec. 25	0260949E 466620N	Inactive, Nest gone	T-Line Post (no platform)	0 fledged	Established by pair of ravens early spring 2011, taken over by hawks. Nest is no longer present.

Table 3.6-16. MBHFI June, 2012 transect results, Lost Creek East Permit Area.

Species Observed	Species Status[1]	Lowland SB Transect #1 # Birds	Lowland SB Transect #2 # Birds	Upland SB Transect #1 # Birds	Upland SB Transect #2 No. Birds	Total No. Birds
Brewer's Sparrow (*Spizella breweri*)	MBHFI, BLM, BCC	3	4	1	1	9
Sage Sparrow (*Amphispiza belli*)	MBHFI, BLM	4	4	3	0	11
Vesper Sparrow (*Pooecetes gramineus*)	MBHFI	2	1	2	0	5
Sage Thrasher (*Oreoscoptes montanus*)	MBHFI. BLM	1	3	0	0	4
Horned Lark (*Eremophila alpestris*)	-	9	12	9	10	40
Total # Birds	-	**19**	**24**	**15**	**11**	**69**

[1]MBHFI- Migratory Bird of High Federal Interest; BLM-BLM Sensitive Species; BCC - Birds of Conservation Concern species identified by the USFWS as those migratory non-game birds that without additional conservation actions are likely to become candidates for listing under the Endangered Species Act.

Table 3.6-17. Lagomorph spotlight survey results summary (Lost Creek East Permit Area, 2012).

Transect	Date	Results and Comments
#1	6/12	0
#2	6/12	0
#3	6/12	1 jackrabbit observed
#4	6/12	0
#1	9/12	0
#2	9/12	1 jackrabbit
#3	9/12	2 jackrabbit
#4	9/12	0

Table 3.6-18. Pygmy rabbit transect results summary (Lost Creek East Permit Area, August 2, 2012).

Transect No.	UTM Easting	UTM Northing	Status[1]	Comment
1	0268932	4671558		START
	0269196	4671764	B+OP	1 cottontail rabbit observed
	0269199	4671766	B	
	0269296	4671828	Poss	
	0269644	4671824	OP	
	0269691	4671859		END
2	0267648	4668267		START
	0267658	4668298	B+OP	
	0267660	4668311	B+OP	
	0267683	4668337	B+OP	
	0267683	4668344	B+FP	
	0267708	4668376	B	
	0267723	4668381	B+FP	
	0267724	4668391		old badger hole
	0267737	4668405	POSS	
	0267959	4668523	B	1 cottontail observed
	0268076	4668692		END
3	0265874	4667294		START
	0265826	4667222	B	
	0265820	4667204	UB+FP	
	0265829	4667062	Col	
	0265848	4667003	B	
	0265851	4666986	B	
	0265852	4666970	B	
	0265865	4666896	B	
	0265872	4666831	B+OP	
	0262838	4666671	B+OP	
	0265836	4666619	B	
	0265817	4666577		END
4	0267193	4666701		START
	0267182	4666656		2 large (coyote?) burrows
	0267167	4666633	B+OP	
	0267140	4666504	B+FP	sagebrush knocked down by cattle
	0267134	4666430	B+OP	
	0267128	4666425	B	
	0267126	4666364	B+FP	
	0267128	4666356	B	
	0267129	4666353	B+FP	
	0267137	4336322	B	
	0267131	4666302	B	
	0267081	4666236	B	
	0267050	4666200	Col	
	0267045	4666196	B	
	0267019	4666005	B	END

[1] B=burrowB; FP=fresh pellets only; E=burrow enlarged by predator; OP= old pellets; UB=unused burrow; COL=collapsed burrow; POSS=possible burrow; t=clean trail; ts=tracks in snow; deb=debris filled; b=at base of bush; dig=fresh digginG

Table 3.6-19. Location, burrow diameter, and trapping results for 2013 Lost Creek East Wyoming Pocket Gopher mound complexes (THCL = Wyoming Pocket Gopher (*Thomomys clusius*), THTA = Northern Pocket Gopher
(*Ttalpoidies*).

Complex ID	Easting	Northing	Burrow Diameter (mm)	Species Assumed	Species Trapped
1	269270	4671638	50-55	THCL	
2	270215	4671162	60-65	?	THTA
3	270288	4671198	40-45	THCL	
4	269548	4669749	40-45	THCL	
5	269291	4669661	50-60	THCL	
6	269391	4669686	50-55	THCL	
7	269827	4669823	50-55	THCL	
8	269857	4669775	50-55	THCL	
9	269330	4669018	50-55	THCL	
10	269055	4669110	50-55	THCL	THCL
11	267997	4668475	50-55	THCL	
12	266677	4666346	70-75	?	THTA
13	266824	4666329	55-60	?	THCL
14	266721	4666408	50-55	THCL	
15	266938	4666682	50-55	THCL	
16	266405	4667137	50-55	THCL	
17	264407	4667318	65-70	> 6 months old, no recent activity ?	
18	264412	4667908	50-55	THCL	
19	264197	4667994	50-55	THCL	
20	264328	4667896	50-55	THCL	
21	264297	4667699	50-55	THCL	
22	264429	4667828	50-55	TCHL	
23	264545	4667347	50-55	THCL	
24	264875	4667418	50-55	THCL	
25	264900	4667118	50-55	THCL	
26	264981	4667696	50-55	THCL	
27	265030	4667910	50-55	THCL	
28	265424	4667699	50-55	THCL	
29	265921	4667437	55-60	?	THCL
30	265980	4667625	50-55	THCL	
31	265996	4667544	50-55	THCL	
32	266626	4667282	50-55	THCL	
33	266739	4667654	50-55	THCL	
34	266985	4667872	50-55	THCL	
35	266702	4667990	50-70	?	THCL
36	267569	4667944	50-55	THCL	
37	267879	4667994	50-55	THCL	
38	266891	4668127	45-50	TCHL	

Table 3.6-20. T&E Wildlife Species Potentially Occurring in the Permit Area (USFWS 2013).

Common Name	**Scientific Name**	**Status***	**Potential Habitat in Project Area**
Black-footed ferret	*Mustela nigripes*	E	No: prairie dog colonies present in Permit Area. Species unlikely to be present
Canada lynx	*Lynx canadensis*	T	No: montane forest not present in Permit Area
Yellow-Billed Cuckoo	*Coccyzus* americanus	C	No: Cuckoos breed in large blocks of riparian habitats, particularly woodlands with cottonwoods (*Populus fremontii*) and willows (*Salix sp*.). No cottonwood/willow riparian habitat present in Permit Area
Greater Sage-grouse	*Centrocercus urophasianus*	C	Yes: species occurs in Permit Area, Permit Area is within WGFD designated Core Area

*E= Federally listed as Endangered
T= Federally listed as Threatened
C= Candidate for Federal listing

Table 3.6-21. Lost Creek East Project: Wildlife Species of Special Concern Potentially Occurring in the Permit Area.

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area, Comments
Mammals			
Long-eared Myotis	*Myotis evotis*	BLM Sensitive Species, NSS2	Possible
Little Brown Myotis	*Myotis lucifugus*	NSS3	Possible
Long-legged Myotis	*Myotis volans*	NSS2	Possible
Hoary Bat	*Laiurus cinerus*	NSS4	Unlikely
Silver-haired Bat	*Lasionycterius noctivagans*	NSS4	Unlikely
Big Brown Bat	*Eptesicus fuscus*	NSS3	Possible
Townsend's Big-eared Bat	*Plecotus townsendii*	BLM Sensitive Species, NSS2	Possible
Pallid Bat	*Antrozous pallidus*	NSS2	Possible
Pygmy Rabbit	*Brachylagus idahoensis*	BLM Sensitive Species, NSS3	Yes
White-tailed Prairie Dog	*Cynomys leucurus*	BLM Sensitive Species, NSS3	No prairie dog colonies present
Wyoming Pocket Gopher	*Thomomys idahoensis*	BLM Sensitive Species, NSS3	Yes
Black-footed Ferret	*Mustela nigripes*	Endangered, NSS1	No, no prairie dog colonies present.
Olive-backed Pocket Mouse	*Perognathus fasciatus*	NSS3	Possible
Prairie Vole	*Microtus ochrogaster*	NSS3	Possible
Birds			

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area, Comments
American White Pelican	*Pelecanus erythrorhynchos*	NSS3	Unlikely
Great Blue Heron	*Ardea herodias*	NSS4	Possible
Snowy Egret	*Egratta Thula*	NSS3	Possible
White-faced Ibis	*Plegadis chihi*	BLM Sensitive Species, NSS3	Possible
Sandhill Crane	*Grus canadensis*	NSS3	Possible
Northern Pintail	*Anas acuta*	NSS3	Unlikely
Redhead	*Aythya americana*	NSS3	Unlikely
Canvasback	*Aythya valisineria*	NSS3	Unlikely
Trumpeter Swan	*Cygnus buccinator*	BLM Sensitive Species, NSS2	Unlikely
Bald Eagle	*Haliaeetus leucocephalus*	BLM Sensitive Species, NSS2	Potential winter use, no known nests
Northern Goshawk	*Accipter gentilis*	BLM Sensitive Species, NSS4	No, forested areas not present
Swainson's Hawk	*Buteo swainsoni*	NSS4	Yes
Ferruginous Hawk	*Buteo regalis*	BLM Sensitive Species, NSS3	Yes
Merlin	*Falco columbaris*	NSS3	Possible
Peregrine Falcon	*Falco peregrinus*	BLM Sensitive Species, NSS3	No nesting habitat
Short-eared Owl	*Asio flammeus*	NSS4	Yes

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area, Comments
Burrowing Owl	*Athene cunicularia*	BLM Sensitive Species, NSS4	Potential habitat present
Greater Sage Grouse	*Centrocercus urophasianus*	BLM Sensitive Species, Candidate	Yes
Upland Sandpiper	*Bartramia longicauda*	NSS4	Possible
Long-billed Curlew	*Numenius americanus*	BLM Sensitive Species, NSS3	Possible
Mountain Plover	*Charadrius montanus*	BLM Sensitive Species, NSS4	Thick sagebrush poor potential habitat
Willow Flycatcher	*Empidonax traillii*	NSS3	Unlikely
Loggerhead Shrike	*Lanius ludovicianus*	BLM Sensitive Species	Yes
Lark Bunting	*Calamospiza melanocorys*	NSS4	Possible
Grasshopper Sparrow	*Ammodramum savannarum*	NSS4	Yes
Sage Thrasher	*Oreoscoptes montanus*	BLM Sensitive Species, NSS4	Yes
Brewer's Sparrow	*Spizella breweri*	BLM Sensitive Species, NSS4	Yes
Sage Sparrow	*Amphispiza belli*	BLM Sensitive Species, NSS4	Yes
Chestnut-collared Longspur	*Calcarius ornatus*	NSS4	Yes
McCown's Longspur	*Calcarius ornatus*	NSS4	Possible
Bobolink	*Dolichonyx oryzivorus*	NSS4	Possible
Amphibians			
Northern Leopard Frog	*Rana pipiens*	BLM Sensitive Species, NSS4	No potential habitat
Great Basin Spadefoot	*Spea intermontana*	BLM Sensitive Species, NSS4	Very limited potential habitat

[1] Sensitive Species = BLM Sensitive Species List

Endangered, Threatened, Candidate = Status under the Endangered Species Act

NSS1 = State of Wyoming Native Species Status 1; Populations are greatly restricted or declining, extirpation appears possible OR on-going significant loss off habitat.

NSS2 = State of Wyoming Native Species Status 2; Populations are declining, extirpation appears possible; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. *~OR~* Populations are declining or restricted in numbers and (or) distribution, extirpation is not imminent; ongoing significant loss of habitat.

NSS3 = State of Wyoming Native Species Status 3; Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable, but no loss; species is not sensitive to human disturbance. *~OR~* Populations are declining or restricted in numbers and (or) distribution, extirpation is not imminent; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. *~OR~* Species is widely distributed; population status or trends are unknown, but are suspected to be stable; ongoing significant loss of habitat.

NSS4 = State of Wyoming Native Species Status 4; restricted. *~OR~* Populations are declining or restricted in numbers and (or) distribution, extirpation is not imminent; habitat is not restricted, vulnerable, but no loss; species is not sensitive to human disturbance. *~OR~* Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. *~OR~* NSS4 - Populations are stable or increasing and not restricted in numbers and (or) distribution; ongoing significant loss of habitat.

ATTACHMENT 3.6-1

Scope of Work

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Matt Mead, Governor

Todd Parfitt, Director

June 4, 2013

Ms. Dawn Gardner
BKS Environmental Associates
P. O. Box 3467
Gillette, WY 82717

RE: Acceptance of proposed vegetation sampling methodology for Lost Creek East Project, DN416

Dear Ms. Gardner:

The above-referenced proposed vegetation sampling methodology was reviewed by LQD's Craig Smith (via e-mail correspondence, attached) on May 30, 2013. The three comments cited by Mr. Smith's review were addressed by you in the form of a revised methodology. That revised methodology was reviewed and approved by Mr. Smith on June 3, 2013. The signed certification of LQD's acceptance of the proposed methodology is enclosed. Please do not hesitate to contact me regarding this correspondence at (307) 332-3047.

Sincerely,

Melissa L. Bautz, P.G.
District 2, Natural Resources Analyst
Land Quality Division

Enclosures: Electronic Mail correspondence (2 pages)
LQD-Certified Vegetation Sampling Methodology for Lost Creek East Project (9 pages)

cc John Cash, NFU Wyoming 5880 Enterprise Drive, Suite 200Casper, WY 82609
LQD Cheyenne→ DN416 File (w/encl)
LQD Lander, Mark Moxley/Craig Smith → DN416 File (w/encl)
Chron (Craig Smith, w/encl)

E:\MELISSA_WDEQ_WORK_FOLDER\MLB Work Files\My WorkStuff\Mines\Fremont_County_Sites\NFU-Wyoming\416DN (LCreek-East)\LC_East_Soil_Smplg_Appr_Ltr_6_4_2013.docx

Wyoming

Craig Smith <craig.smith@wyo.gov>

RE: NFU Wyoming LLC Lost Creek East Veg. Sampling

1 message

Dawn Gardner <dgardner@bksenvironmental.com> Thu, May 30, 2013 at 3:19 PM
To: Craig Smith <craig.smith@wyo.gov>
Cc: John Cash <john.cash@ur-energy.com>, Paul Hildenbrand <PRH@lidstone.com>, Chris Lidstone <CDL@lidstone.com>

Craig,

Please find attached the revised Lost Creek East vegetation sampling methodology (Lost_Creek_Vegetation_WDEQ_Methodology_05302013) which addresses the comments received on Thursday, May 30, 2013. The date on the file name and date on the report has been revised as an indication of version. The following outlines how each comment was addressed in the text; no additional changes were made to the previously reviewed document (Lost_Creek_Vegetation_WDEQ_Methodology_05132013).

1) WDEQ Comment: Vegetation community classification and mapping section (p.2): Please add "Mixed Grass/Mat Cushion Grassland" to the list of communities.

BKS response: Added Mixed Grass/Mat Cushion Grassland to list of communities on page 2.

2) WDEQ Comment: Shrub Density Section (p.4): You state "it is assumed that this area is not part of any wildlife critical winter range; thus, shrub density is not necessary". It is not clear if this is a safe assumption. The area is part of the Sage Grouse Core area and there are Pronghorn crucial ranges in that area. Shrub density measurements would be important to know in this area especially in light of the increased interest in Sage grouse and their habitat.

BKS response: Removed "It is assumed that this area is not part of any wildlife critical winter range; thus, shrub density information is not necessary."

3) Other Data Collected Section (p.5): Please add listed noxious weeds and selenium indicator species to the list of other data collected. These should be noted in text and located on the vegetation map if they are found. If none are found just note in the text.

BKS response: (p.5) Changed/Added Text "All state designated noxious weed and county declared weeds will be noted, discussed in the text, and identified on the baseline vegetation map. Selenium indicator plant species listed in Appendix III of WDEQ-LQD Guideline 2 will be noted, discussed in the text, and identified on the baseline vegetation map. The text will indicate if state designated noxious weeds, county declared weeds, and/or selenium indicator plant species are not found within the project area."

Baseline Vegetation Survey Report Section III (p.6) Added as bullet four "Identify state designated noxious weeds, county declared weeds, and selenium indicator plant species, if present."

Baseline Vegetation Survey Report Section VII (p.8) changed to Present Other Data Collected and included the following three bullets:

- Text briefly describing special status plant species presence or absence.

- Text briefly describing state designated noxious weeds and county declared weeds presence or absence.
- Text briefly describing selenium indicator plant species presence or absence.

Previous change required renumbering of following sections.

Please let me know if you have any questions or comments regarding the responses to the May 30, 2013 comments.

Thank you for your time and help with this project,

Dawn Gardner

BKS Environmental Associates, Inc.

307.686.0800

From: Craig Smith [mailto:craig.smith@wyo.gov]
Sent: Thursday, May 30, 2013 10:21 AM
To: Dawn Gardner
Cc: Melissa Bautz
Subject: NFU Wyoming LLC Lost Creek East Veg. Sampling

Dawn,

Melissa forward me your proposed vegetation sampling protocols for review. I had just a few comments that should be quick and easy to change. Overall it looked good. Below please see the suggested changes/revisions.

1) Vegetation community classification and mapping section (p.2): Please add "Mixed Grass/Mat Cushion Grassland" to the list of communities.

2) Shrub Density Section (p.4): You state "it is assumed that this area is not part of any wildlife critical winter range; thus, shrub density is not necessary". It is not clear if this is a safe assumption. The area is part of the Sage Grouse Core area and there are Pronghorn crucial ranges in that area. Shrub density measurements would be important to know in this area especially in light of the increased interest in Sage grouse and their habitat.

3) Other Data Collected Section (p.5): Please add listed noxious weeds and selenium indicator species to the list of other data collected. These should be noted in text and located on the vegetation map if they are found. If none are found just note in the text.

Thank you,

Craig Smith
Vegetation Ecologist
Wyoming DEQ/LQD - District II
(307) 332-3047
craig.smith@wyo.gov

E-Mail to and from me, in connection with the transaction of public business, is subject to the Wyoming Public Records Act and may be disclosed to third parties.

Sampling Methods for Vegetation Baseline Study
NFU Wyoming, LLC
Lost Creek East Project Area
May 30, 2013

Land Quality Division Review & Acceptance Certification

The Land Quality Division has reviewed the following vegetation baseline permit plan and hereby certifies that it satisfactorily addresses the requirements of Land Quality Division Non-Coal Permitting regulations. Vegetation baseline permit field work conducted and reported in accordance with this plan will satisfy Wyoming regulatory and guideline requirements.

Accepted By: Wyoming Department of Environmental Quality – Land Quality Division

Name (printed): Craig Smith

Title: Environmental Scientist

Signature: Craig Smith

Date: 6/3/13

Accepted by: NFU Wyoming, LLC

Name (printed): John Cash

Title: V.P. Regulatory Affairs, Exploration and Geology

Date: 30 May 2013

Prepared by: BKS Environmental Associates, Inc

Name (printed): Cindy Adams

Title: Vegetation Ecologist

Signature: C.A. Adams

Date: 30 May 2013

Sampling Methods for Vegetation Baseline Study
NFU Wyoming, LLC
Lost Creek East Project Area
May 30, 2013

INTRODUCTION

A vegetation baseline study will be performed in Sweetwater County approximately 50 miles north of Rawlins, Wyoming. The vegetation baseline study will occur within the proposed NFU Wyoming, LLC Lost Creek East project area. The proposed Lost Creek East project area is located in all or portions of:

- Sections 1, 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 27, 28, and 29, T25N, R92W

The proposed Lost Creek East project area encompasses approximately 5,724 acres. Vegetation communities located within the proposed Lost Creek East project area were classified and mapped on 8 October 2012. Refer to Table 2 for a list of vegetation communities and acreages within the proposed Lost Creek East project area.

Baseline vegetation sampling will be conducted no later than 15 July 2013. Sampling will be completed within a three-week period. If sampling within a three week period is not possible, BKS will notify Wyoming Department of Environmental Quality (WDEQ)-Land Quality Division (LQD) immediately.

The procedures described in this document follow the WDEQ-LQD Guideline 2 - Vegetation for Non-Coal Operations. Vegetation baseline sampling will be conducted using the procedures described in this document. Vegetation parameter sampling will be conducted by vegetation community as specified in Table 1. Disturbed areas and the ½ mile buffer will be excluded from all vegetation parameter sampling.

Table 1: Vegetation Baseline Sampling – Measured Parameters.

Parameter	Upland Big Sagebrush Shrubland	Lowland Big Sagebrush Shrubland	Mixed Grass/Mat Cushion Grassland
% Absolute Total Ground Cover	Yes	Yes	Yes
First Hit % Absolute Total Vegetation Cover	Yes	Yes	Yes
Multiple Hit Vegetation	Yes	Yes	Yes
Production	No	No	No
Shrub/Sub-shrub Density	Yes (Not Required)	Yes (Not Required)	Yes (Not Required)
Tree Count and Distribution	No	No	No

Wetlands may occur within the proposed project area, but such features are limited in extent and distribution. Wetlands will not be sampled as part of the baseline study, but will be included under U.S. Army Corps of Engineers delineation requirements.

VEGETATION COMMUNITY CLASSIFICATION & MAPPING

Vegetation communities within the proposed Lost Creek East project area were classified and mapped using 2011 true color ortho aerial imagery and verified through field survey conducted on 8 October 2013. Classification of vegetation communities followed Lost Creek naming conventions.

Vegetation mapping and classification identified the presence of the following three native vegetation communities within the proposed Lost Creek East project area:

- Upland Big Sagebrush Shrubland
- Lowland Big Sagebrush Shrubland
- Mixed Grass/Mat Cushion Grassland

Disturbed areas and water present within the proposed Lost Creek East project area were identified and mapped, based on the scale of the available mapping. Table 2 presents a tabular summary of vegetation community acreages within the proposed Lost Creek East project area.

Table 2: Vegetation Map Units and Associated Acreages.

Vegetation Map Units	Permit Area Acreage
Upland Big Sagebrush Shrubland	5,369.64
Lowland Big Sagebrush Shrubland	325.10
Mixed Grass/Mat Cushion Grassland	27.04
Disturbed	2.32
Water	0.26
TOTAL	**5,724.36**

All areas within ½ mile of the proposed project area will be mapped, based on a review of 2011 true color ortho aerial imagery and known expression of 2011 true color ortho aerial imagery within the proposed project area, based on October 2012 field surveys. No vegetation sampling will be conducted within this area.

TRANSECT ORIGIN SELECTION

A computerized systematic grid (through ArcGIS) will be used to randomly locate sample points within the Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities. These computer generated random numbers will be uploaded to a hand-held GPS unit for actual location in the field. Sample points will be sampled in numerical order until the minimum sample size is attained and then until either sample adequacy is met or the required maximum number of samples has been collected.

LINE TRANSECT LAYOUT

Within the Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities, 50-meter line transect will be used. Each 50-meter line transect will begin at its specified random origin point and extend in a randomly generated compass direction.

Transects that exceed the boundaries of the vegetation community being sampled will be redirected back into its vegetation community at a 90 degree angle from the original transect direction at the point of intercept. In instances where a 90 degree angle of reflection does not place the transect within the sampled vegetation community, a 45 degree angle of reflection will be used.

GROUND COVER

Line-transect point-intercept methods will be used to collect percent absolute cover data from the Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion vegetation communities within the proposed project area.

Each 50-meter transect will represent a single sample point. Percent cover measurements will be taken from point-intercepts at 1-meter intervals along a 50-meter transect using a laser point device. Should a transect run out of the vegetation community boundary or a non-vegetated feature, it will be redirected as described above. Each point-intercept will represent 2% towards the cover measurements.

Percent cover measurements will record first-hit point-intercepts by live foliar vegetation species, litter, rock, or bare ground. Litter will include all non-living organic material. Manure will be included with bare ground. Rock fragments will be recorded when they are equal to or greater than one centimeter in size (i.e., sheet flow, minimum non-erodible particle size). First-hit data will be recorded and tabulated to evaluate total ground cover and total vegetation cover. Multiple hits on vegetation will be recorded, but used only for the purpose of constructing a plant species list for each vegetation community. Total ground cover is the sum of cover values for percent vegetation, percent litter, and percent rock.

Total Vegetation Cover

Vegetation cover data will be recorded by species using first-hit data. All point intercepts of living vegetation and growth produced during the current growing season will be counted toward total vegetation cover. Total vegetation cover measurements will be expressed in absolute percentages for each sample point. Relative cover values for percent species cover will be provided. Percent vegetation cover is the vertical projection of the general outline of plants to the ground surface. Total vegetation cover will include lichen and moss.

Total Ground Cover

Total ground cover data will be recorded by live vegetation, litter, rock, or bare ground. Litter will include all dead organic matter that is recognizable. Total ground cover measurements will be expressed in absolute percentages for each sample point. Total ground cover will include lichen and moss.

SPECIES DIVERSITY

Species diversity will be determined by noting all plant species observed or sampled within 1-meter on either side of the 50-meter cover transect (100-square meter belt transect). The number of belt transects will equal the number of cover transects for a given vegetation community. Species diversity will be summarized by lifeform. Species diversity calculations will not include Species Lacking Credible Value (SLCV): halogeton (*Halogeton glomeratus*), Japanese brome (*Bromus japonicus*), cheatgrass (*Bromus tectorum*), summer cypress (*Bassia sieversiana*), Russian thistle (*Salsola tragus*), State Designated Noxious Weeds, and County Declared Weeds.

PRODUCTION

No production sampling will be necessary for the 2013 baseline vegetation assessment.

SHRUB DENSITY

Although shrub density sampling is not required for non-coal sites, this data will be taken at the time of cover sampling to ensure adequate use of field time and data collection and to ensure that adequate species diversity and density information has been acquired. Summarization of that data, however, may not be included in the report submittal for the permit. Shrub density can also be used to determine degree of suitable wildlife habitat present. Also, shrub density is a tool that can be used in the recommendations for reclamation planning and seeding for shrubland communities.

Shrub density data will be collected in conjunction with randomly selected cover transects. All shrubs, full or sub, will be counted within 1-meter on either side of the 50-meter cover transect (100-square meter belt transect). Sample adequacy will not be calculated on shrub density transects; however, shrub density data will be qualitatively evaluated. The number of belt transects will equal the number of cover transects for a given vegetation community. No shrub height measurements will be statistically summarized. General approximations of shrub heights will be recorded.

TREE DENSITY

It is anticipated that trees will not be found within the proposed project areas. No tree density sampling will be carried out; however, if trees are observed within the proposed project area, they will be noted and qualitatively summarized within the report text.

SAMPLE ADEQUACY

A minimum of 20 cover transects per vegetation community will be sampled in the Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities. Sample adequacy will be calculated and an incremental number of cover transects will be sampled up to the maximum of 50.

The sample adequacy formula outlined in WDEQ-LQD Guideline 2 will be utilized to determine the minimum required size of the sample population. The sampled vegetation communities are anticipated to be both "grassland" and "shrubland". Using Table 1 in WDEQ-LQD Guideline 2, the constant values to be used in statistical test are (for both grassland and shrubland total vegetation cover and total cover): "z"=1.28 and "d" = 0.1. All sampled vegetation will be included in the sample adequacy test (i.e., "Species Lacking Creditable Value" will not be eliminated from the equation).

Table 3: Vegetation Monitoring Minimum/Maximum Sample Population Requirements for the Proposed Lost Creek East Project Area.

Vegetation Community	Parameter	Minimum Sample Size	Maximum Sample Size
Upland Big Sagebrush Shrubland	Ground Cover	20	50
	Vegetation Cover		
Lowland Big Sagebrush Shrubland	Ground Cover	20	50
	Vegetation Cover		
Mixed Grass/Mat Cushion Grassland	Ground Cover	20	50
	Vegetation Cover		
Total		**60**	**150**

PLANT SPECIES LISTS

A plant species list by scientific name, common name, and lifeform will be developed individually for the Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities. This list will be compiled from species noted during all vegetation monitoring activities including point-intercept line transect cover measurements, species diversity belt transect measurements, and other opportunistic observations of the sampling area.

OTHER DATA COLLECTED

Habitat and species surveys for any United States Fish and Wildlife Service or Bureau of Land Management threatened, endangered, sensitive, or candidate species or any state species of special concern listed in the Wyoming Natural Heritage database will be conducted during the appropriate period based on phenology. Identified individuals, populations, or suitable habitat will be identified on the baseline vegetation map.

All state designated noxious weed and county declared weeds will be noted, discussed in the text, and identified on the baseline vegetation map. Selenium indicator plant species listed in Appendix III of WDEQ-LQD Guideline 2 will be noted, discussed in the text, and identified on the baseline vegetation map. The text will indicate if state designated noxious weeds, county declared weeds, and/or selenium indicator plant species are not found within the project area.

Photographs will be taken of each of the vegetation communities. Photographic locations will be documented and illustrated on the baseline vegetation map.

EXTENDED REFERENCE AREA MAPPING & JUSTIFICATION

Although the initial permit used the Comparison Area concept for determining vegetation reclamation success, LQD now favors the Extended Reference Area (EXREFA) concept. As noted in the Vegetation Community Classification & Mapping section, all lands within the proposed project area were mapped as one of three native vegetation communities, disturbed lands, or water. All Upland Big Sagebrush Shrubland, Lowland Big Sagebrush Shrubland, and Mixed Grass/Mat Cushion Grassland vegetation communities, within the project area, unaffected by the mining operation will serve as the EXREFA. Lands within the ½ mile buffer will not be included as part of the EXREFA. For the purposes of this permit amendment EXREFA means a native land unit which will be used to evaluate revegetation success for each of the same native vegetation communities which were affected by the mining operation. The EXREFA will be a subset of the mapped native vegetation communities and will be included as potential sample points for the cover sampling program. The EXREFA will remain unaffected over the course of the mining operation and will be as large as practical, at least two acres, considering land ownership patterns and land management history. The amendment application Appendix D-8 will show the EXREFA on the vegetation map and will include text justifying the choice of the EXREFA.

BASELINE VEGETATION SURVEY REPORT

A summary of all field data collected and will include the following major headings and content:

I. Table of Contents

II. Approved mapping and sampling methods

- Text that briefly lists the title and date for the approved methods and includes a reference to the location of the approved methods in Appendix D-8.
- Text making a clear statement that all sampling methods were executed as approved.
- Text noting the time periods when field sampling occurred.

III. Map of the vegetation communities within the proposed project area. The EXREFA and ½ mile buffer will also be included on this map.

- Map with appropriate legend information for all entries.
- Identify photo locations.
- Identify sample points in each vegetation community.
- Identify state designated noxious weeds, county declared weeds, and selenium indicator plant species, if present.
- Identify projected affected area and tabulate acreage.
- Tabulate acreage of each map unit.

IV. Present and discuss sample numbers.

- Tabular presentation

Plant Community	Total Vegetation Cover (%)	Actual Sample Size	Computed Adequate Sample Size	Computed Z-Value	Confidence Level Achieved
Upland Big Sagebrush Shrubland					
Lowland Big Sagebrush Shrubland					
Mixed Grass/Mat Cushion Grassland					

Plant Community	Total Ground Cover (%)	Actual Sample Size	Computed Adequate Sample Size	Computed Z-Value	Confidence Level Achieved
Upland Big Sagebrush Shrubland					
Lowland Big Sagebrush Shrubland					
Mixed Grass/Mat Cushion Grassland					

- Text briefly discussing numbers in relation to the approved methods

V. Present sample data

- Tabular presentation.

Vegetation Parameter	Vegetation Community		
	Upland Big Sagebrush Shrubland	Lowland Big Sagebrush Shrubland	Mixed Grass/Mat Cushion Grassland
Absolute Vegetation Cover (%)			
Absolute Total Ground Cover (%)			

- Text which describes the major vegetation and topographic characteristics of each community; integrate soil type(s) as useful.

- Tabulate and discuss relative cover values by life form.

Life Form	Upland Big Sagebrush Shrubland		Lowland Big Sagebrush Shrubland		Mixed Grass/Mat Cushion Grassland	
	Absolute %	Relative %	Absolute %	Relative %	Absolute %	Relative %
Native Annual Grasses						
Introduced Annual Grasses						
Native Cool Season Perennial Grasses						
Native Warm Season Perennial Grasses						
Introduced Perennial Grasses						
Native Annual Forbs						
Introduced Annual Forbs						
Native Perennial Forbs						
Introduced Perennial Forbs						
Half and Sub-Shrubs						
Full Shrubs						
Succulents						

- Present and discuss photographs.

VI. Present species lists by vegetation community.

- Text briefly discussing lists.
- Text noting the presence or absence of federally listed threatened and endangered species, state designated noxious weeds, and county declared weeds.

VII. Present Other Data Collected

- Text briefly describing special status plant species presence or absence.
- Text briefly describing state designated noxious weeds and county declared weeds presence or absence.
- Text briefly describing selenium indicator plant species presence or absence.

VIII. Present Extended Reference Area

- Text briefly describing reference units in baseline map.
- Text discussing and justifying representative nature of the EXREFA.

IX. References

- Includes citations for plant identification, etc.

X. Photographs

- Each caption is complete and descriptive.

XI. Raw Cover Data

- Includes tables for raw cover and density data.

ATTACHMENT 3.6-2

Raw Data

Attachment 3.6-2 **Raw Data**

Table Number	Content
Attachment D8-1.2 Table 1	Cover Data for the Upland Big Sagebrush Shrubland
Attachment D8-1.2 Table 2	Density Data for the Upland Big Sagebrush Shrubland
Attachment D8-1.2 Table 3	Cover Data for the Lowland Big Sagebrush Shrubland
Attachment D8-1.2 Table 4	Density Data for the Lowland Big Sagebrush Shrubland
Attachment D8-1.2 Table 5	Cover Data for Mixed Grass/Mat Cushion Plant Community
Attachment D8-1.2 Table 6	Density Data for Mixed Grass/Mat Cushion Plant Community

Attachment 3.6-2 Table 1: Cover Data for the Upland Big Sagebrush Shrubland

Species	Cover																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Achnatherum hymenoides	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	1	0	0	0
Elymus lanceolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0
Elymus smithii	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elymus spicatus	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesperostipa comata	0	0	0	0	0	1	0	0	0	0	0	1	2	1	1	4	2	1	0	0
Koeleria macrantha	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0
Poa secunda	0	0	0	3	2	2	0	1	4	5	0	0	2	0	1	0	0	0	0	1
Total Native Cool Season Perennial Grasses	**0**	**0**	**1**	**5**	**5**	**5**	**2**	**2**	**4**	**5**	**2**	**1**	**7**	**1**	**4**	**4**	**3**	**2**	**1**	**1**
Eremogone hookeri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Phlox hoodii	0	2	0	1	0	1	1	1	1	1	2	2	1	0	3	1	1	4	0	3
Stenotus acaulis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Total Native Perennial Forbs	**0**	**2**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**0**	**4**	**1**	**1**	**4**	**0**	**6**
Artemisia tridentata	13	8	7	5	8	10	8	10	9	9	9	10	11	12	7	7	12	14	12	7
Chrysothamnus viscidiflorus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Total Native Full Shrubs	**13**	**8**	**7**	**5**	**9**	**10**	**8**	**10**	**9**	**9**	**9**	**10**	**11**	**12**	**7**	**9**	**12**	**14**	**12**	**7**
Krascheninnikovia lanata	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0
Total Native Half &Sub-Shrubs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**
Opuntia polyacantha	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Total Native Succulents	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lichen	0	0	4	2	0	5	0	0	0	3	2	0	1	0	3	2	1	1	1	0
Fungi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment 3.6-2 Table 1 (Cont.): Cover Data for the Upland Big Sagebrush Shrubland

Species	Cover																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cryptograms	**0**	**0**	**4**	**2**	**0**	**5**	**0**	**0**	**0**	**3**	**2**	**0**	**1**	**0**	**3**	**2**	**1**	**1**	**1**	**0**
Bare Ground	22	24	22	28	26	23	19	23	27	17	25	27	25	26	22	18	10	20	28	26
Litter	15	16	16	8	6	6	20	14	4	12	8	9	5	11	10	13	23	9	7	10
Rock	0	0	0	1	4	0	0	0	5	3	0	0	0	0	0	2	0	0	0	0
Total Vegetation Cover	13	10	8	11	14	16	11	13	14	15	15	14	19	13	15	15	16	20	14	14
Total Vegetation w/Cryptograms	**13**	**10**	**12**	**13**	**14**	**21**	**11**	**13**	**14**	**18**	**17**	**14**	**20**	**13**	**18**	**17**	**17**	**21**	**15**	**14**
Total Ground Cover	28	26	28	22	24	27	31	27	23	33	25	23	25	24	28	32	40	30	22	24
No. of Species Sampled excluding SLCV	1	2	2	4	4	5	3	4	3	3	4	4	5	2	6	5	4	4	3	4
No.of Species Observed excluding SLCV	6	1	4	4	3	3	2	3	7	4	1	4	5	5	2	5	5	7	0	2
Total No. of Species excluding SLCV	7	3	6	8	7	8	5	7	10	7	5	8	10	7	8	10	9	11	3	6
Total No. of SLCV	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment 3.6-2 Table 2: Density Data for the Upland Big Sagebrush Shrubland

Species	Density																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Artemisia tridentata	201	204	488	238	338	269	168	310	323	202	286	263	380	130	351	273	150	507	371	235
Chrysothamnus viscidiflorus	2	0	0	2	9	83	5	0	2	1	0	0	9	2	0	25	4	3	0	0
Total Native Full Shrubs	**203**	**204**	**488**	**240**	**347**	**352**	**173**	**310**	**325**	**203**	**286**	**263**	**389**	**132**	**351**	**298**	**154**	**510**	**371**	**235**
Gutierrezia sarothrae	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Krascheninnikovia lanata	0	2	0	0	2	0	0	0	1	0	0	0	0	0	0	38	4	2	25	0
Linanthus pungens	0	0	0	0	0	2	0	0	1	0	0	0	6	0	0	45	0	2	0	0
Total Native Half &Sub-Shrubs	**0**	**2**	**0**	**1**	**2**	**2**	**0**	**2**	**2**	**0**	**0**	**0**	**6**	**0**	**0**	**83**	**4**	**4**	**25**	**0**
Total Density	**203**	**206**	**488**	**241**	**349**	**354**	**173**	**312**	**327**	**203**	**286**	**263**	**395**	**132**	**351**	**381**	**158**	**514**	**396**	**235**

Attachment 3.6-2 **Table 3: Cover Data for the Lowland Big Sagebrush Shrubland**

Species	**Cover**																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Achnatherum hymenoides	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Elymus lanceolatus	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Elymus smithii	0	1	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0
Festuca idahoensis	0	0	2	0	0	0	0	0	0	3	0	0	0	0	2	0	2	0	0	0
Hesperostipa comata	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Koeleria macrantha	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Poa secunda	3	0	0	3	1	2	2	1	0	0	0	0	0	0	0	0	0	1	0	0
Total Native Cool Season Perennial Grasses	**4**	**1**	**3**	**4**	**1**	**2**	**2**	**5**	**0**	**3**	**2**	**1**	**0**	**1**	**2**	**1**	**2**	**1**	**0**	**0**
Carex filifolia	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Total Native Grasslike Species	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Antennaria microphylla	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phlox hoodii	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Total Native Perennial Forbs	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Artemisia tridentata	11	17	22	9	27	15	19	22	17	14	15	11	19	18	16	16	20	8	12	23
Chrysothamnus viscidiflorus	1	2	3	0	0	0	2	0	2	2	0	0	0	0	2	2	0	0	4	3
Ericameria nauseosa	2	0	0	0	3	0	0	0	0	1	1	0	1	2	0	3	0	1	1	2
Total Native Full Shrubs	**14**	**19**	**25**	**9**	**30**	**15**	**21**	**22**	**19**	**17**	**16**	**11**	**20**	**20**	**18**	**21**	**20**	**9**	**17**	**28**
Gutierrezia sarothrae	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Total Native Half &Sub-Shrubs	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Opuntia polyacantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Total Native Succulents	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**

Attachment 3.6-2 Table 3 (Cont.): Cover Data for the Lowland Big Sagebrush Shrubland

Species	Cover																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Lichen	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fungi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cryptograms	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bare Ground	17	12	3	11	8	7	10	12	8	7	13	16	16	6	7	11	4	20	8	11
Litter	14	18	19	20	11	26	17	10	23	23	19	20	14	23	22	17	24	19	25	11
Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation Cover	19	20	28	18	31	17	23	28	19	20	18	14	20	21	21	22	22	11	17	28
Total Vegetation w/Cryptograms	19	20	28	19	31	17	23	28	19	20	18	14	20	21	21	22	22	11	17	28
Total Ground Cover	33	38	47	39	42	43	40	38	42	43	37	34	34	44	43	39	46	30	42	39
No. of Species Sampled excluding SLCV	6	3	4	6	3	2	3	6	2	4	4	4	2	3	4	4	2	4	3	3
No.of Species Observed excluding SLCV	3	1	2	2	5	4	4	2	3	0	8	2	6	4	2	4	1	2	2	5
Total No. of Species excluding SLCV	9	4	6	8	8	6	7	8	5	4	12	6	8	7	6	8	3	6	5	8

Attachment 3.6-2 Table 4: Density Data for the Lowland Big Sagebrush Shrubland

Species	Density																			
	Transect Number																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Artemisia tridentata	163	266	176	443	89	738	129	633	109	131	49	777	160	91	117	127	190	276	98	89
Chrysothamnus viscidiflorus	66	34	30	0	9	0	67	0	52	35	3	0	26	53	49	24	28	0	83	24
Ericameria nauseosa	3	2	0	23	19	5	16	0	0	2	27	0	15	13	7	13	0	17	10	10
Total Native Full Shrubs	**232**	**302**	**206**	**466**	**117**	**743**	**212**	**633**	**161**	**168**	**79**	**777**	**201**	**157**	**173**	**164**	**218**	**293**	**191**	**123**
Gutierrezia sarothrae	0	0	0	71	0	14	0	0	0	0	1	70	0	0	0	0	0	25	0	0
Linanthus pungens	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1
Total Native Half &Sub-Shrubs	**0**	**0**	**0**	**71**	**0**	**14**	**0**	**0**	**0**	**0**	**1**	**70**	**0**	**3**	**0**	**0**	**0**	**25**	**0**	**1**
Total Density	**232**	**302**	**206**	**537**	**117**	**757**	**212**	**633**	**161**	**168**	**80**	**847**	**201**	**160**	**173**	**164**	**218**	**318**	**191**	**124**

Attachment 3.6-2 Table 5: Cover Data for the Mixed Grass/Mat-Cushion Plant Community

Species	Cover																												
	Transect Number																												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Elymus lanceolatus	1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	3	3	2	0	0	0	0	0	0	0	0	0
Elymus smithii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Elymus spicatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	5	0	0
Hesperostipa comata	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2
Koeleria macrantha	3	2	0	0	1	0	0	2	1	4	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Poa secunda	0	0	1	0	0	1	1	0	1	1	0	0	0	1	1	1	0	0	1	1	3	5	2	1	0	1	2	0	0
Total Native Cool Season Perennial Grasses	**4**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**5**	**0**	**0**	**0**	**3**	**1**	**3**	**1**	**4**	**4**	**3**	**3**	**5**	**2**	**2**	**2**	**2**	**7**	**1**	**2**
Antennaria microphylla	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremogone hookeri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
Eriogonum flavum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0
Ivesia gordonii	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phlox hoodii	2	2	3	1	1	0	2	0	1	1	1	2	1	3	1	2	1	1	3	1	3	0	3	3	0	5	1	1	3
Phlox muscoides	0	2	0	0	2	0	0	0	0	1	0	1	2	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Stenotus acaulis	0	0	0	0	3	0	1	4	1	0	0	1	1	0	2	0	1	0	0	1	0	0	1	2	0	2	3	1	0
Tetraneuris acaulis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Total Native Perennial Forbs	**2**	**4**	**3**	**1**	**6**	**0**	**3**	**4**	**3**	**2**	**1**	**4**	**4**	**3**	**4**	**2**	**6**	**1**	**3**	**2**	**3**	**0**	**4**	**5**	**3**	**7**	**4**	**4**	**4**
Artemisia tridentata	4	1	0	1	0	6	2	2	0	0	1	1	3	1	2	3	0	6	4	4	1	0	0	1	0	0	0	1	3
Chrysothamnus viscidiflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ericameria nauseosa	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Total Native Full Shrubs	**6**	**1**	**0**	**1**	**1**	**6**	**2**	**2**	**0**	**0**	**1**	**2**	**3**	**1**	**2**	**3**	**0**	**6**	**4**	**4**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**2**	**3**
Krascheninnikovia lanata	0	0	0	5	0	1	3	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0
Linanthus pungens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Native Half &Sub-Shrubs	**0**	**0**	**0**	**5**	**0**	**1**	**3**	**0**	**1**	**0**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**2**	**0**	**0**	**1**

Attachment 3.6-2 Table 5: Cover Data for the Mixed Grass/Mat Cushion Plant Community

Species	Cover																												
	Transect Number																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Opuntia polyacantha	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Total Native Succulents	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lichen	0	0	8	0	1	1	6	0	0	0	5	0	0	8	0	4	0	0	2	2	7	1	1	0	0	1	0	0	0
Fungi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cryptograms	0	0	8	0	1	1	6	0	0	0	5	0	0	8	0	4	0	0	2	2	7	1	1	0	0	1	0	0	0
Bare Ground	35	38	27	25	34	33	30	37	32	34	30	35	31	24	38	29	43	28	30	31	29	36	33	31	41	31	32	27	25
Litter	6	5	8	14	7	8	5	5	11	9	9	5	11	7	5	9	0	8	6	6	7	8	8	9	3	7	5	15	15
Rock	0	0	1	2	0	0	0	0	0	0	0	1	0	4	0	0	0	3	1	1	0	0	0	0	0	0	2	0	0
Total Vegetation Cover	9	7	6	9	8	8	9	8	7	7	6	9	8	7	7	8	7	11	11	10	7	5	8	10	6	11	11	8	10
Total Vegetation w/Cryptograms	9	7	14	9	9	9	15	8	7	7	11	9	8	15	7	12	7	11	13	12	14	6	9	10	6	12	11	8	10
Total Ground Cover	15	12	23	25	16	17	20	13	18	16	20	15	19	26	12	21	7	22	20	19	21	14	17	19	9	19	18	23	25
No. of Species Sampled excluding SLCV	5	4	4	4	5	3	5	3	7	4	3	6	5	4	5	4	5	4	4	6	3	1	4	6	4	5	4	8	5
No.of Species Observed excluding SLCV	3	4	1	2	4	2	2	5	5	5	4	2	3	0	6	5	5	4	4	2	0	2	2	1	2	1	8	6	9
Total No. of Species excluding SLCV	8	8	5	6	9	5	7	8	12	9	7	8	8	4	11	9	10	8	8	8	3	3	6	7	6	6	12	14	14
Total No. of SLCV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A[illegible]ment 3.6-2 **Table 6: Density Data for the Mixed Grass/M[illegible]ushion Plant Community**

Species	Density																												
	Transect Number																												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Artemisia tridentata	88	66	8	18	11	49	39	26	52	23	149	7	80	26	29	102	30	76	208	112	23	3	20	17	2	12	0	37	40
Chrysothamnus viscidiflorus	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	1	0	1	0	0	0	0	0	0	0	0	9
Ericameria nauseosa	13	12	0	0	33	0	0	7	11	11	1	16	27	0	14	0	18	0	0	0	0	0	2	1	31	0	11	9	10
Total Native Full Shrubs	**103**	**79**	**8**	**18**	**44**	**49**	**39**	**33**	**65**	**34**	**150**	**23**	**107**	**26**	**43**	**105**	**48**	**77**	**208**	**113**	**23**	**3**	**22**	**18**	**33**	**12**	**11**	**46**	**59**
Artemisia frigida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Krascheninnikovia lanata	0	0	0	5	0	12	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Linanthus pungens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	72
Total Native Half &Sub-Shrubs	**0**	**0**	**0**	**5**	**0**	**12**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**51**	**72**
Total Density	**103**	**79**	**8**	**23**	**44**	**61**	**40**	**33**	**65**	**34**	**150**	**23**	**107**	**26**	**44**	**105**	**49**	**77**	**208**	**113**	**23**	**4**	**22**	**18**	**33**	**12**	**12**	**97**	**131**

ATTACHMENT 3.6-3

Threatened, Endangered, and Sensitive Species Survey Summary

Attachment 3.6-3 Threatened, Endangered, and Sensitive Species Survey Summary

Threatened and Endangered Habitat and Species Surveys

Habitat suitability for Ute ladies'-tresses (*Spiranthes diluvialis*), within the proposed amendment area, was evaluated based on the presence of the following characteristics: late season perennial water source, associated vegetation species, sandy or loamy textured soils, gradual transitions between uplands and water bodies or drainages, vegetation density between 75% and 90%, vegetation height less than 18 inches, and non-alkaline soils. Based on 2013 field evaluations conducted during the appropriate timeframe, late season perennial water sources were not present within the proposed amendment area. No individuals or populations of Ute ladies'-tresses were found during 2013 field surveys, and based on the lack of suitable habitat characteristics, local habitat was confirmed unsuitable for Ute ladies'-tresses.

Habitat suitability for blowout penstemon (*Penstemon haydenii*), within the proposed amendment area, was evaluated based on the presence of the following characteristics: eolian sand deposits or sand deposits greater than three feet in depth, fine sandy textured soils absent of rocks and coarse fragments, wind or gravity erosion versus water erosion, slopes greater than 25%, slope elevation changes of 60 to 120 feet, vegetation cover of less than 40%, and associated plant species. Based on Natural Resource Conservation (NRCS) soil data and baseline soil sampling, soils derived from eolian sources were not present within the proposed permit area. No individuals or populations of blowout penstemon were found during field surveys, and based on the lack of suitable habitat characteristics; local habitat was confirmed unsuitable for blowout penstemon.

Habitat suitability for desert yellowhead (*Yermo xanthocephalus*) within the proposed amendment area was evaluated based on the presence of surface outcrops of Miocene ash deposits. It's only known population occurs in the Beaver Rim Area of southern Fremont County, Wyoming. No individuals or populations of desert yellowhead were found during field surveys, and based on the lack of suitable habitat characteristics; local habitat was confirmed unsuitable for desert yellowhead.

Plant Species of Local Concern

Bureau of Land Management Sensitive plant species for the Rawlins Field Office are summarized in Table 1. Wyoming Natural Diversity Database (WYNDD) reports no BLM sensitive or special status plant species with the proposed permit area (WYNDD 2013). No individuals were observed during 2013 field surveys.

References

U.S. Department of the Interior, Bureau of Land Management 2011. Plant Conservation Program. Sensitive Species Which May Occur in the Rawlins Field Office.

Wyoming Natural Diversity Database. 2013. Data compilation for C. Wood of BKS Environmental Associates Inc., completed May 1, 2013. Unpublished report. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming

Attachment 3.6-3 Table 1: BLM Rawlins Field Office Sensitive Species List*

Scientific Name	Common Name	Local Distribution	Heritage [1]/ State Rank [2]
Aquilegia laramiensis	Laramie columbine	Albany and Converse counties	G2/S2, FSR2
Astragalus diversifolius	Meadow milkvetch	Sweetwater and Sublette counties	G2/S1, FSR4
Cirsium aridum	Cedar Rim thistle	Sublette, Fremont, Carbon, and Sweetwater counties	G2Q/S2
Penstemon gibbensii	Gibbens' beardtongue	Carbon and Sweetwater counties	G1G2/S1
Pinus flexilis	Limber pine	Campbell, Converse, Fremont, Natrona and Sweetwater	G4/S5
Rorippa calycina	Persistent sepal yellowcress	Albany, Big Horn, Carbon, Fremont, Park, Sweetwater, and	G3/S3
Sphaeromeria simplex	Laramie false sagebrush	Albany, Carbon, Converse, and Natrona counties	G2G3/S2

* (BLM 2011)

[1] **Heritage Rank Codes:**

G1: Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction (Critically endangered throughout its range).

G2: Imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. (Endangered throughout its range).

G3: Very rare or local throughout its range or found locally in a restricted range (21 to 100 occurrences. (Threatened throughout its range).

G4: Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery.

G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

T1: The variety is critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction (Critically endangered throughout its range).

Q: Indicates uncertainty about taxonomic status.

[2] **State Rank Codes:**

S1: Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state).

S2: Imperiled in state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state (Endangered or threatened in state).

S3: Rare in state (21 to 100 occurrences)

SH: Of historical occurrence, not documented in Wyoming since 1920.

ATTACHMENT 3.6-4

WGFD Wildlife Observations System Data

Attachment D3.6-4 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
3607900000406	LRO[1]	36079	4/2/1992	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	261604	4669009	NAD-83	ADMIN	ADMIN	4/2/1992	
2618900000106	LRO	26189	3/26/1988	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262288	4669653	NAD-83	ADMIN	ADMIN	3/26/1988	
2618900000406	LRO	26189	3/26/1988	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Courtship	OIL AND GAS SITES	NONE	Ground Trend Counts	9	0	13	262404	4668204	NAD-83	ADMIN	ADMIN	3/26/1988	
2473900000506	LRO	24739	3/30/1987	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	267199	4668044	NAD-83	ADMIN	ADMIN	3/30/1987	
2473900000406	LRO	24739	3/30/1987	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	266800	4668502	NAD-83	ADMIN	ADMIN	3/30/1987	
3417000000806	LRO	34170	4/19/1986	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261578	4668232	NAD-83	ADMIN	ADMIN	4/19/1986	
3109800000606	LRO	31098	12/1/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261976	4667774	NAD-83	ADMIN	ADMIN	12/1/1982	
3109600000606	LRO	31096	11/30/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261232	4670244	NAD-83	ADMIN	ADMIN	11/30/1982	
3109600000806	LRO	31096	11/30/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	1	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261067	4665358	NAD-83	ADMIN	ADMIN	11/30/1982	
3077700000306	LRO	30777	9/3/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261976	4667774	NAD-83	ADMIN	ADMIN	9/3/1982	
3397500000806	LRO	33975	10/30/1975	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Feeding	UNKNOWN	NONE	Casual observation	0	18	13	261405	4668015	NAD-83	ADMIN	ADMIN	10/30/1975	1
3397500000706	LRO	33975	10/30/1975	FALCON, PRAIRIE	*FALCO MEXICANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Casual observation	0	18	13	266679	4664837	NAD-83	ADMIN	ADMIN	10/30/1975	
4858600000306	LRO	48586	7/30/2003	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				1	0	5	0				0	0	0	0				Unknown	UNKNOWN	NONE	Unknow/ Undetermined	0	0	13	264803	4665716	NAD-83	BROWN	ffaulk	7/30/2003	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
4846700000506	LRO	48467	3/22/2003	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267114	4669153	NAD-83	HIATT, GREG	emeyer	3/22/2003	
4766800000606	LRO	47668	4/6/2002	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	1	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267689	4668303	NAD-83	HIATT, GREG	emeyer	4/6/2002	
4766800000706	LRO	47668	4/6/2002	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267114	4669153	NAD-83	HIATT, GREG	emeyer	4/6/2002	
4625100000406	LRO	46251	3/23/2000	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	9	0	13	266412	4669293	NAD-83	HIATT, GREG	emeyer	3/23/2000	
4625100000806	LRO	46251	3/23/2000	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Sign: tracks, scat, etc.	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	HIATT, GREG	emeyer	3/23/2000	
4372400001606	LRO	43724	4/6/1998	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/6/1998	
3736600000206	LRO	37366	4/5/1993	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	5	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	Cause Undetermined	Unknow/ Undetermined	9	0	13	265999	4669307	NAD-83	ADMIN	ADMIN	4/5/1993	
3608000000406	LRO	36080	4/2/1992	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	6	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/2/1992	
3604400000706	LRO	36044	3/21/1992	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	1	0	0	0				0	0	0	0				0	0	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/21/1992	
2978500000506	LRO	29785	3/9/1991	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	6	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/9/1991	
2854600000506	LRO	28546	3/20/1990	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	13	0	0	0				0	0	0	0				0	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/20/1990	
2746300000506	LRO	27463	4/13/1989	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	25	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/13/1989	
2618700000706	LRO	26187	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	10	0	0	0				2	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/26/1988	
2618900000206	LRO	26189	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	SAGEBRUSH-GRASSLAND	Predation	Unknown/ Undetermined	9	0	13	262032	4669439	NAD-83	ADMIN	ADMIN	3/26/1988	

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
2618900000304	LRO	26189	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	SAGEBRUSH-GRASSLAND	Predation	Unknown/ Undetermined	9	0	13	260049	4669506	NAD-83	ADMIN	ADMIN	3/26/1988	
2473900000306	LRO	24739	3/30/1987	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	17	0	0	0				4	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/30/1987	
3417100000206	LRO	34171	4/19/1986	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	30	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/19/1986	1
3417100000106	LRO	34171	4/19/1986	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				1	0	0	0				0	0	0	0				Escape: direct flight	SAGEBRUSH-GRASSLAND	NONE	Casual observation	9	0	13	263975	4668151	NAD-83	ADMIN	ADMIN	4/19/1986	1
3397600000206	LRO	33976	10/30/1975	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	30				Unknown	UNKNOWN	NONE	Casual observation	9	0	13	261965	4667440	NAD-83	ADMIN	ADMIN	10/30/1975	
3397600000106	LRO	33976	10/30/1975	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	Golden Eagle	Casual observation	9	0	13	261405	4668015	NAD-83	ADMIN	ADMIN	10/30/1975	
3417100000406	LRO	34171	4/19/1986	HARRIER, NORTHERN	*CIRCUS CYANEUS*	1	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	265108	4664889	NAD-83	ADMIN	ADMIN	4/19/1986	
3416600000706	LRO	34166	4/18/1986	HARRIER, NORTHERN	*CIRCUS CYANEUS*	1	0	0	0				0	0	0	0				0	0	0	0				Flying	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/18/1986	
4846700000406	LRO	48467	3/22/2003	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Reproduction	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	266459	4668383	NAD-83	HIATT, GREG	emeyer	3/22/2003	
4625400000806	LRO	46254	3/25/2000	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				2	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262032	4669439	NAD-83	HIATT, GREG	emeyer	3/25/2000	
3736500000406	LRO	37365	4/5/1993	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262472	4670203	NAD-83	ADMIN	ADMIN	4/5/1993	
3417000000106	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	262296	4664983	NAD-83	ADMIN	ADMIN	4/19/1986	
3417000000206	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Live Trapping Operation - Animal	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/19/1986	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
3417000000406	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261232	4670244	NAD-83	ADMIN	ADMIN	4/19/1986	
3416600000806	LRO	34166	4/18/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261067	4665358	NAD-83	ADMIN	ADMIN	4/18/1986	
3416700000106	LRO	34167	4/18/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261867	4664553	NAD-83	ADMIN	ADMIN	4/18/1986	
2854700000206	LRO	28547	3/20/1990	HAWK, ROUGH-LEGGED	*BUTEO LAGOPUS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	261179	4668690	NAD-83	ADMIN	ADMIN	3/20/1990	
4766700001206	LRO	47667	5/19/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	0	18	13	267801	4666246	NAD-83	ADMIN	ADMIN	5/19/1993	
3766700000206	LRO	37667	5/19/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	0	18	13	267801	4666246	NAD-83	ADMIN	ADMIN	5/19/1993	
3774000000506	LRO	37740	5/11/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				7	0	0	0				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	0	18	13	262923	4666408	NAD-83	ADMIN	ADMIN	5/11/1993	
3736600000106	LRO	37366	4/5/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	6				Feeding	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	266427	4669737	NAD-83	ADMIN	ADMIN	4/5/1993	
3604400000806	LRO	36044	3/21/1992	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	Cause Undetermined	Unknown/ Undetermined	0	18	13	266255	4669520	NAD-83	ADMIN	ADMIN	3/21/1992	
2618700000806	LRO	26187	3/26/1988	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				10	0	0	0				Escape: direct flight	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	267024	4670273	NAD-83	ADMIN	ADMIN	3/26/1988	
3416600000606	LRO	34166	4/18/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	1	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/18/1986	
3416600000406	LRO	34166	4/18/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				2	0	0	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	260206	4669279	NAD-83	ADMIN	ADMIN	4/18/1986	
3415600000806	LRO	34156	4/11/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				3	0	0	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261405	4668015	NAD-83	ADMIN	ADMIN	4/11/1986	
3255400000506	LRO	32554	6/11/1984	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	263694	4664714	NAD-83	ADMIN	ADMIN	6/11/1984	
3255400000306	LRO	32554	6/11/1984	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	General Census	0	0	13	265373	4667882	NAD-83	ADMIN	ADMIN	6/11/1984	
4920400000306	LRO	49204	8/8/2004	PRONGHORN	*ANTILOCAPRA AMERICANA*	2	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	265842	4669659	NAD-83	BROWN	emeyer	8/8/2004	
884395200000406	LRO	9E+06	8/10/1998	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	261751	4666002	NAD-83	ADMIN	ADMIN	8/10/1998	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
884395200000306	LRO	9E+06	8/10/1998	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	261803	4667557	NAD-83	ADMIN	ADMIN	8/10/1998	
4205700001706	LRO	42057	8/16/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	8/16/1996	
4197000000306	LRO	41970	5/20/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				43	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	266653	4669063	NAD-83		ADMIN	4/28/2005	
4196200000406	LRO	41962	5/14/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				9	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	266653	4669063	NAD-83		ADMIN	4/28/2005	
4765700001106	LRO	47657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	261859	4669223	NAD-83	ADMIN	ADMIN	5/19/1993	
4765700001206	LRO	47657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	260206	4669279	NAD-83	ADMIN	ADMIN	5/19/1993	
3765700000106	LRO	37657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	261859	4669223	NAD-83	ADMIN	ADMIN	5/19/1993	
3765700000206	LRO	37657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	260206	4669279	NAD-83	ADMIN	ADMIN	5/19/1993	
4765600001106	LRO	47656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/19/1993	
3765600000106	LRO	37656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/19/1993	
3765600000206	LRO	37656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	6				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266547	4665842	NAD-83	ADMIN	ADMIN	5/19/1993	
4765600001206	LRO	47656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	6				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266547	4665842	NAD-83	ADMIN	ADMIN	5/19/1993	
3765500000306	LRO	37655	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/19/1993	
4765500001306	LRO	47655	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/19/1993	
3774000000406	LRO	37740	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	18	13	260040	4664393	NAD-83	ADMIN	ADMIN	5/11/1993	
3773900000406	LRO	37739	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	General Census	61	0	13	263322	4665950	NAD-83	ADMIN	ADMIN	5/11/1993	
3773900000306	LRO	37739	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	3				Unknown	UNKNOWN	NONE	General Census	61	0	13	263374	4667504	NAD-83	ADMIN	ADMIN	5/11/1993	
3513900000506	LRO	35139	8/14/1991	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	1	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	8/14/1991	
2566200000406	LRO	25662	9/5/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266969	4668607	NAD-83	ADMIN	ADMIN	9/5/1987	
2566200000506	LRO	25662	9/5/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266229	4668743	NAD-83	ADMIN	ADMIN	9/5/1987	

Attachment 3.6-4 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
2489500000206	LRO	24895	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000506	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266602	4667508	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000406	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				3	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265031	4667560	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000606	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268172	4667456	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000106	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				5	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268223	4669011	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000206	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				2	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000306	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				2	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	5/31/1987	
3254700000306	LRO	32547	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266093	4664634	NAD-83	ADMIN	ADMIN	6/11/1984	
3254500000706	LRO	32545	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				3	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266280	4670298	NAD-83	ADMIN	ADMIN	6/11/1984	
3254700000206	LRO	32547	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				8	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	6/11/1984	
3254900000806	LRO	32549	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	262096	4666435	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000206	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	267799	4668691	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000506	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				5	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266602	4667508	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000306	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266229	4668743	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000406	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265402	4668771	NAD-83	ADMIN	ADMIN	6/11/1984	
3165600000206	LRO	31656	9/3/1983	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	9/3/1983	1
3109800000806	LRO	31098	12/1/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	28	0	0	0				27	0	0	0				0	0	15	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Marked Animal	61	0	13	260777	4669037	NAD-83	ADMIN	ADMIN	12/1/1982	1
3109800000706	LRO	31098	12/1/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	28	0	0	0				27	0	0	0				0	0	15	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	260777	4669037	NAD-83	ADMIN	ADMIN	12/1/1982	1
3077700000206	LRO	30777	9/3/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				1	0	0	0				0	0	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	261123	4667024	NAD-83	ADMIN	ADMIN	9/3/1982	
3077700000106	LRO	30777	9/3/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				3	0	0	0				0	0	2	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	260736	4665370	NAD-83	ADMIN	ADMIN	9/3/1982	

Attachment 3.6-4 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
1944800000606	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	261457	4669570	NAD-83	ADMIN	ADMIN	5/15/1981	
1944800000206	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	267103	4670159	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000706	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	4				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	264681	4669462	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000306	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263002	4666294	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000206	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	265348	4664659	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000106	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	266920	4664607	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000606	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263828	4668712	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000506	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	4				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263772	4667046	NAD-83	ADMIN	ADMIN	5/15/1981	

Attachment 3.6-4 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
1944800000506	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	3				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	262201	4667099	NAD-83	ADMIN	ADMIN	5/15/1981	
61700001804	GRRO[2]	617	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	1	0	0				3	0	0	0				0	0	2	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	
61900001804	GRRO	619	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				5	0	0	0				0	0	4	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	
61800001804	GRRO	618	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				3	0	0	0				0	0	4	0				Unknown	GRASSLANDS	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	

[1] LRO = Lander Regional Office
[2] GRRO = Green River Regional Office

Attachment 3.6-5 Work Plan for Wildlife

Scope of Work for:

BASELINE WILDLIFE STUDIES AT THE LOST CREEK EAST SITE

Prepared for:

UR Energy
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Casper Wyoming, 82609

Prepared by:

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June 2012

LWR

Table of Contents

1.0 Introduction

This document outlines the proposed scope of work for wildlife studies to be conducted at the Lost East Creek site for UR Energy, Inc. (UR). The proposed work is designed to address requirements laid out in the Wyoming Department of Environmental Quality, Land Quality Division Guideline No. 5 for Wildlife Studies, NRC Technical Report Section 2.8.3 (Wildlife), and to support BLM NEPA Permitting requirements. The proposed Scope of Work **is based on the scope** that was used for the wildlife studies and monitoring for the Lost Creek project (BLM 2011, UR 2007a,b,c).

The Lost Creek East site is shown in Attachment A, Figure 1. The site is located near the center of the Great Divide Basin and occurs at an elevation of approximately 7,000 feet above mean sea level. Overall annual precipitation is ten inches. Most of the site consists of flat upland areas and gentle south facing slopes that are dissected by southerly-flowing ephemeral washes. There are no perennial streams on the site. The vegetation is dominated by big sagebrush (*Artemisia tridentata*) which occurs throughout both upland and lowland environmental settings. Big sagebrush is well adapted to the cold winter temperatures and limited precipitation that characterize the site. Two vegetation types have been identified and mapped on the adjoining Lost Creek Lost Creek East site: Upland Big Sagebrush Shrublands and Lowland Big Sagebrush Shrublands.

Baseline wildlife studies have occurred on the adjacent Lost Creek site since 2006. Many of these studies overlap onto the Lost Creek East site. Baseline studies for sage-grouse and raptors being completed for Lost Creek overlap the Lost Creek East project area. To save time and effort LWR will combine monitoring and survey tasks for Lost Creek and Lost Creek East where it is practicable.

2.0 Work Tasks

2.1 Agency Consultations, Review of Work Plan

When approved by UR both the WDEQ and BLM will be consulted to ensure proposed work will meet agency requirements. A wildlife work plan will be prepared and submitted to agencies for review or comment. At this time it is assumed that the Scope of Work presented here will serve as the wildlife work plan. Field work may begin before agency review and approval of the work plan, as needed by UR.

All baseline monitoring and survey methods are designed to be consistent with standard protocol used by the WGFD (WGFD 2007), and to also follow monitoring requirements and recommendations from WDEQ-LQD (WDEQ 1994).

LWR will gather additional GIS data from WGFD and the BLM to supplement existing data that has already been collected for the Lost Creek project. NOTE: No agency consultations or data requests will be completed until authorized by UR. Field work can be completed without agency notification (with the exception of small mammal trapping).

2.2 Big Game

2.2.1 Seasonal Distribution and Habitat Affinity

Based on current WGFD GIS mapping, the Lost Creek East site is mapped as winter/yearlong range for pronghorn. The Lost Creek East site is out of mapped range for mule deer, elk and moose. Both elk and mule deer have been observed on the site during baseline studies. The survey area for big game will include the Lost Creek East site and surrounding 2-mile buffer.

One aerial survey and one ground survey will be completed between January 1 and mid- March each year to determine winter habitat use. Aerial surveys will be completed on a clear day when snow cover is near 100 percent. Transects will be flown at approximately 0.5 mile intervals (with one observer). The ground survey will be completed as soon as possible after the aerial survey. If appropriate snow conditions have not developed by March 1st, the aerial survey will be conducted when snow cover is either less than 20 percent or between 80 to 100 percent. If these snow conditions are not present the aerial survey will be cancelled for the year and only the ground survey would be completed.

To determine spring and summer habitat use, one ground survey of the Lost Creek East site will be completed in April, early June, and August. This survey will be completed while driving a standard route within the Lost Creek East site.

During each survey the number of pronghorn (and other big game species) will be counted, and the general location will be recorded by GPS. Data on breeding status (e.g., doe with fawn), age (e.g., adult, yearling, young-of-year), sex, and general activity (e.g., feeding, resting, etc.) will additionally be collected. The dominant vegetation/habitat type that is being used will be noted.

2.2.2 Climate Information

Climate data from the nearest NOAA weather station or the on-site weather station will be summarized year around.

2.2.3 Range Conversion

The entire Lost Creek East site is within winter/yearlong pronghorn range; no other mapped big game ranges are present. The acreage of this range impacted will be detailed in the report (the total for the project life and the incremental area impacted per year will be summarized).

2.2.4 Mortality and Concentration Buildups

An annual record of all big game mortality due to fence entanglements, vehicle collisions, and other factors will be completed. Winter mortalities will be estimated each spring from observations taken during wildlife surveys and other mine activities. The data to be recorded include: species, date, probable cause of mortality, and location. A table summarizing big game mortality will be submitted in the annual report.

If concentrations of pronghorn appear suddenly or if apparent migration blocks (fences, snow drifts along roads or other blocks) are observed they will be reported immediately to the local WGFD personnel. Any big game concentrations or migration blocks will be reported in the report.

2.3 Sage Grouse/Upland Birds

Sage-grouse are the only upland birds on the Lost Creek East site. The majority of the Lost Creek East site is within the Lost Creek Small Sage-Grouse Study Area, the entire Lost Creek East site is within the Lost Creek Large Study Area. Lek counts, lek searches (searches for new leks), and radio-collared hens have included both the Lost Creek and Lost Creek East study areas.

At this time no new sage-grouse studies are planned for Lost Creek East. The ongoing sage-grouse monitoring being completed for Lost Creek will overlap the Lost Creek East study area.

LWR will make note of any new leks in or around the Lost Creek East site, and all leks within the Lost Creek Large and Small sage-grouse study areas will continue to be monitored on a annual basis following the approved Lost Creek Wildlife Monitoring Plan (UR 2007b, BLM 2012).

Because activities on Lost Creek East may result in increased disturbance of sage brush habitats, and Lost Creek East is located within the South Pass Sage-Grouse Core Area, UR will need to update the Density/Disturbance Calculation Tool (DDCT) to ensure compliance with Maximum Disturbance Process.

The potential for increased regional impacts to sage-grouse from construction and operation of Lost Creek East in addition to Lost Creek could result in agency requirements for additional sage-grouse monitoring or mitigation for both projects.

2.4 Raptors

2.4.1 Nest Status and Production Success

Annual monitoring of known raptor nests will be completed each spring between April and July to determine nest status. At the same time a survey for new/unknown nests will be completed. Nest surveys can be completed by air or from the ground.

A ground or aerial survey of the Lost Creek East site and surrounding one-mile radius will be completed during the first two weeks of February each year for signs of golden eagle and great-horned owl nesting and or courtship.

Three thorough surveys for nesting raptors will be completed for the Lost Creek East site and surrounding one-mile perimeter through the spring. One survey will be completed during March to locate great-horned owl and golden eagle nests. A second survey will be completed in April to locate most of the nests of other species. Reporting will indicate whether nesting territory is: not occupied (inactive); occupied by one raptor (active); or occupied by a pair (active).

One survey will be completed from mid-May to mid-June to locate new raptor nests (nests that have become established since the April survey) and to check the status (activity, number of young birds) of all nests. Follow-up visits to previously identified nests will be timed to facilitate documentation of nesting activity, according to the biology of the species present and variations in breeding chronology, including: nest building; reproductive attempts and success; and fledging success. The status and productivity of all nests will be reported annually (by location, nest type and characteristics, species, and number of fledged birds.

Nest surveys will be completed either from the air or the ground. Nest checks will be brief and conducted to avoid flushing incubating raptors.

2.4.2 Measures of Disturbance

The linear distance of each nest site (active and inactive) from the nearest known regular human or equipment activity will be determined each breeding season. The presence of visual barriers (does a direct line of site exists between the disturbance and the nest) will be noted. It will be determined if the activity/disturbance is unrelated or related to ISR activities. This information will be shown on a raptor monitoring map in the report.

2.4.3 Prey Abundance

2.4.3.1 Lagomorphs

Lagomorphs present include desert cottontails and white-tailed jackrabbits. Pygmy rabbits are also present in lowland sagebrush habitat. Desert cottontail and white-tailed jackrabbit populations will be evaluated using spotlight surveys through native habitat in the Lost Creek East site. Surveys will be completed on a night as close to the full moon as possible. One survey will be completed in June and another survey will be completed in August of each year. Transects will be established along approximately 1.5 mile of road within the Lost Creek East site. Once reclaimed/restored areas are established, a transect will be established in these areas. All transect locations will be presented on a map in the Report.

Based on current wildlife inventories for the Lost Creek site, pygmy rabbits are restricted to lowland sagebrush habitat areas within the Lost Creek East site. Pygmy rabbits will be surveyed using techniques described in Ulmschneider et al. (2004). Four transects will be established in pygmy rabbit occupied lowland sagebrush swales within the Lost Creek East site. Lowland sagebrush occurs in narrow swales and drainages on the site. Transect length (from start and stop point) will be 0.5 miles. Transects will not be linear but will meander through the habitat area. Meandering transects will start and end at the same points each year. Data will be recorded on standard data forms using the recommended data recording methods (Ulmschneider et al., 2004). Annual transect tracts will be recorded and presented on a map in the Report.

2.3.3.2 Small Mammals

Surveys for other small mammals are not proposed at this time. Wyoming pocket gopher trapping was completed at the Lost Creek site (LWR 2010). Wyoming pocket gophers were identified throughout the impact area of Lost Creek. It is assumed that Wyoming pocket gophers are present in suitable habitat throughout the Lost Creek East site. LWR will note and map potential Wyoming pocket gopher burrow complexes while completing other wildlife surveys at Lost Creek East. The BLM could request that additional Wyoming pocket gopher trapping be completed at Lost Creek East.

2.5 Migratory Birds of High Federal Interest (MBHFI)

Nesting non-game bird surveys will be conducted in representative vegetation/habitat types within the Lost Creek East site. These surveys will be used to document breeding MBHFI that are present in the area.

Surveys will follow techniques recommended by the WDEQ (WDEQ-LQD, 1994). Two transects will be established in each vegetation type of the Lost Creek East site (four total transects). Transects will be 1,000 meters in length (2,000 meters per habitat type). The two vegetation types in the Lost Creek East site are Upland Big Sagebrush and Lowland Big Sagebrush. In the both vegetation types, belt transects (100 meters) wide will be walked. All birds (including non-game and non-MBHFI birds) observed or heard will be recorded. Transect start and stop points will be located by GPS. Transect locations will be shown on a 1:24,000 scale quad map.

Based on already completed baseline breeding bird surveys, the Lowland Big Sagebrush habitat provides the most important nesting habitat to MBHFI on the site.

Surveys will be completed during the peak of the nesting season during the 1st week of June. Surveys will be completed from 0.5 hours before sunrise to 9:30 am.

2.6 Federally Listed Threatened and Endangered Species

Any observation of a federally listed (threatened or endangered) species will be recorded and promptly reported. Any mortality of a listed species will be reported to the USFWS within one day of discovery.

If new species (that are present in the Lost Creek East site) are listed as threatened or endangered during the period of mine operation, the USFWS will be consulted to develop specific mitigation and monitoring measures.

2.7 Non-Game Mammals

Specific monitoring surveys of non-game mammals are not proposed. Incidental observations of non-game mammals will be made while completing other wildlife surveys. These incidental observations will be summarized in a table in the Annual Report.

Wyoming pocket gopher trapping was completed at the Lost Creek site (LWR 2010). Wyoming pocket gophers were identified throughout the impact area of Lost Creek. Based on input from the BLM Wyoming Pocket Gopher trapping was completed for the Lost Creek East project (Cline 2013). The purpose of the Wyoming pocket gopher (*Thomomys clusius*) surveys is to determine if the species occupies areas of potential future disturbance for the Lost Creek East Project. The information will be provided to the Bureau of Land Management (BLM), Wyoming Natural Diversity Database (WNDD), and Wyoming Department of Environmental Quality. All trapping efforts will be coordinated with the BLM.

The general protocol would follow the same methods recommended by the BLM and WNDD (WNDD 2009, 2010, BLM 2010).

1. Complete meandering transects (approximately 150 meters apart) within areas of potential ground disturbance (see Attached Site Map for general Lost Creek East project area). Locate, map and characterize any pocket gopher burrow/mound complexes found while walking transects. Complete WNDD Mound Survey Data Sheets. Complete tunnel measurements at each active burrow complex. Tunnels less than 55mm are most likely Wyoming Pocket Gophers, tunnels over 80mm are most likely Northern Pocket Gophers (WNDD 2010).

2. Trap active burrows with a tunnel diameter that is greater than 55mm and less than 80mm that were located in the transect survey. **All burrow complexes with burrow diameters of less than 55mm will be assumed to be occupied by Wyoming pocket gophers, burrows greater than 80mm will be assumed to be occupied by Northern pocket gophers.** In addition, LWR will pick 2-4 burrow complexes with burrows less than 55mm to trap for trapping. This trapping will serve to confirm Wyoming pocket gopher presence and gain additional animal data. Sherman live traps would be set at active burrow/mound locations. The number of

traps set at each site would depend on the amount of recent activity (likely 3-5 traps). Traps are set in the evening and checked at sunrise. Traps are covered with black plastic and buried with at least 6-inches of dirt. If temperatures are warm traps are closed during the day or LWR will check the traps every 2-3 hours. Traps baited with cilantro and carrots. Polyester bedding material inserted into each trap.

LWR will trap each active burrow area for at least 3-4 nights (using professional Judgment and increase the number of nights if there is lots of activity but nothing is caught).

3. If a Wyoming pocket gopher is caught data collected includes: Photograph gopher, get GPS, characterize vegetation cover at site (using standard veg. cover methods, only characterize veg. if Wyoming pocket gopher is caught). Standard WNDD Trapping Data Sheets will be completed.

All small mammals caught will be released. If there is any mortality the individual Wyoming pocket gophers will be bagged and frozen and sent to the WNDD. However, by checking traps in the early morning (before the heat of the day) and insulating traps with at least 6-inches of dirt mortality can be minimized. If needed, LWR will check traps every 2-3 hours to help avoid any mortality.

LWR will also record any other species (small mammals, reptiles) that are inadvertently captured during the effort. All animals captured will be released unharmed.

By collection tunnel diameter data, and concentrating trapping on burrows of greater than 55mm and less than 80mm in diameter trapping efforts can be streamlined while still gathering important occurrence data. We are assuming that burrow complexes with tunnels of less than 55mm that are not trapped can be assumed to be occupied by Wyoming Pocket Gophers.

Trapping is planned for September and October 2013. Summary reports will be provided to the BLM and WNDD. LWR holds an appropriate Section 33 permit from the Wyoming Game and Fish Department for the trapping. Trapping efforts will be summarized in a Report for submittal to the BLM and WNDD.

2.8 Non-Game Birds

Specific surveys for non-game birds are not proposed. However, as noted in Section 2.4, during the surveys for MBHFI, all birds observed or heard will be recorded. In addition, incidental observations of non-game birds will be made while completing other wildlife surveys. These incidental observations will be summarized in a table in the reports.

2.9 Reptiles and Amphibians

Specific surveys for reptiles and amphibians are not proposed. Incidental observations of reptiles and amphibians will be made while completing other wildlife surveys. These incidental observations will be summarized in a table in the Annual Report.

2.10 Reports

Data collected will be summarized in 1 Wildlife Report:

- Appendix D9 Wildlife for the Lost Creek East Project WDEQ-LQD Permit to Mine Application

The report will include data summary tables; figures showing vegetation types, locations of any sensitive plant, and sampling locations. The format for the Wildlife Report (including Figures, Tables) will follow the Lost Creek Appendix D9 Wildlife Report (UR Energy 2007a). Existing reports will be followed to streamline the Lost Creek East reporting effort.

The Wildlife Reports will be used to support the BLM NEPA process for any future Lost Creek East expansion.

4.0 Literature Cited

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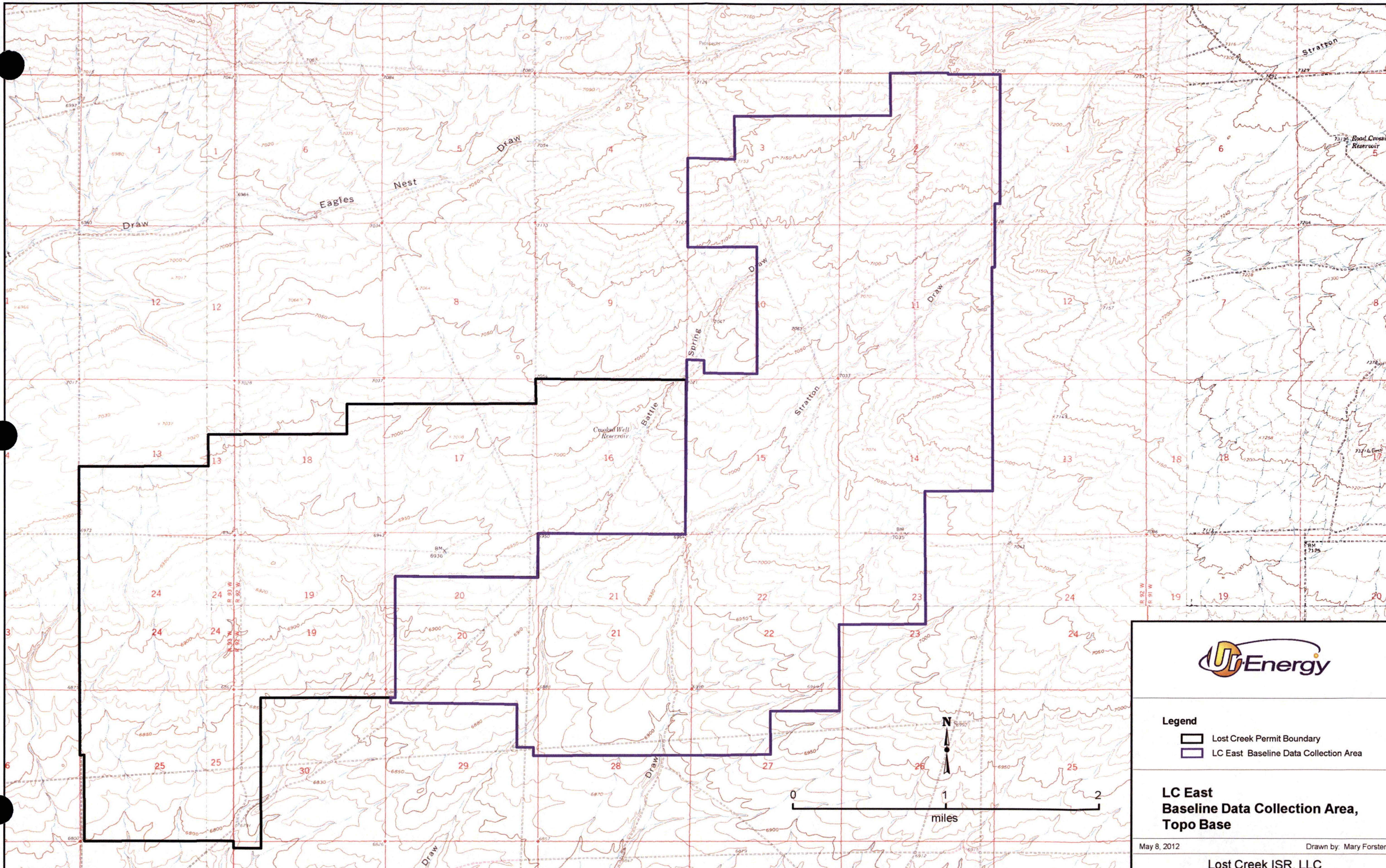
Wyoming Natural Diversity Database. 2009. POCKET GOPHER SURVEYS IN SOUTHWESTERN WYOMING DRAFT PROJECT REPORT. Prepared by: Hannah Griscom, Zoologist, Doug Keinath, Senior Zoologist, Mark Andersen, GIS Specialist. University of Wyoming, Laramie, Wyoming 82071

Wyoming Natural Diversity Database 2010. POCKET GOPHER SURVEYS IN SOUTHWESTERN WYOMING DRAFT PROJECT REPORT. Prepared by: Hannah Griscom, Zoologist; Doug Keinath, Senior Zoologist; Mark Andersen, GIS Specialist. Wyoming Natural Diversity Database University of Wyoming, Laramie, Wyoming 82071

ATTACHMENT A- Lost Creek East Site Map



Ur-Energy
Legend
Lost Creek Permit Boundary
LC East Baseline Data Collection Area
LC East
Baseline Data Collection Area,
Topo Base
May 8, 2012
Drawn by: Mary Forster
Lost Creek ISR, LLC
0
1
2
miles
N
Eagles
Nest
Draw
Spring
Draw
Stratton
Battle
Crooked Well Reservoir
Road Crossing Reservoir
Stratton
R 93 W
R 92 W
R 91 W

Attachment 3.6-6 Agency Correspondence

Cline, H. 2013. Wildlife Biologist, BLM Rawlins Field Office. Personal Communication with E. Berg, LWR Consultants, Inc. May-July 2013.

Gamo, S. 2012. Habitat Biologist, Wyoming Game and Fish Department. Personal Communication with E. Berg. LWR Consultants, Inc. September 2012.

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Hiatt, G. 2012-2013. District Wildlife Biologist, Wyoming Game and Fish Department. Personal Communication with E. Berg, LWR Consultants, Inc. March –July 2012-2013.

Morton, C. 2012- 2013. Wildlife Biologist, BLM Rawlins Field Office. Personal Communication with E. Berg, LWR Consultants, Inc. March-May 2012-13.

ATTACHMENT 3.6-7

MBHFI in Wyoming

Because attachment is comprehensive, it may be used for both coal and non-coal projects (WDEQ Guideline 5).

Migratory Bird of High Federal Interest in Wyoming
COAL MINE LIST

Based on Wyoming Bird Conservation Plan, 1 May 2000 (Cerovski et al. 2000)

May 2, 2002

U.S. Fish and Wildlife Service, Wyoming Field Office,
4000 Airport Parkway, Cheyenne, Wyoming 82001

The Wyoming Field Office of the U.S. Fish and Wildlife Service (Service) has compiled the following list from the ongoing work among State and Federal agencies, non-governmental organizations, and the interested public that produced the Wyoming Bird Conservation Plan. This list will now serve as the Service's list of Migratory Birds of High Federal Interest (also known as the Migratory Bird Species of Management Concern in Wyoming) to be used exclusively for reviews concerning existing or proposed coal mine leased land. The Wyoming Bird Conservation Plan identified "priority species" based on a number of criteria (see below) using the best information available for these generally un-studied species. In many cases, this list reflects identified threats to habitat because no information is available on the species population trends. In some cases it reflects identified population declines though no causal factors have been identified.

Partners in Flight (PIF) is the name given to the coalition of groups that produced the Wyoming Bird Conservation Plan. PIF developed a scoring system to rank species in order of conservation priority. A species' PIF score is the sum of seven sub scores rating the following biological criteria: relative abundance (RA), breeding distribution (BD), non-breeding distribution (ND), threats on breeding grounds (TB), threats on non-breeding grounds (TN), population trends (PT), and area of importance (AI). These criteria are more fully described the end of this document. AI, PT and total PIF scores are listed for each species in Tables 1 and 2. Species with a PIF score of 18 or above, an AI score of 3 or above, and/or PT score of 3 or above were identified as the highest priority species. For more information on the listing process, refer to the Wyoming Bird Conservation Plan, available from the U.S. Fish and Wildlife Service, 4000 Airport Parkway, Cheyenne, Wyoming 82001; or Wyoming Game and Fish Department, Nongame Branch, 260 Buena Vista, Lander, Wyoming 82520.

Table 1. **Level I Species (Conservation Action)**. Species clearly needs conservation action. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, and the need for additional knowledge through monitoring and research into basic natural history, distribution, etc.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Mountain Plover[d]	28	4	3	Shortgrass Prairie, Shrub-steppe
Sage Grouse	26	5	3	Shrub-steppe
McCown's Longspur	26	3	2	Shortgrass Prairie, Shrub-steppe
Baird's Sparrow	26	2	3	Shortgrass Prairie
Ferruginous Hawk	23	4	3	Shrub-steppe, Shortgrass Prairie
Brewer's Sparrow	23	5	5	Shrub-steppe, Mountain-foothills Shrub
Sage Sparrow	22	5	2	Shrub-steppe, Mountain-foothills Shrub
Swainson's Hawk	21	3	3	Plains/Basin Riparian
Long-billed Curlew	21	2	3	Shortgrass Prairie
Short-eared Owl	20	3	3	Shortgrass Prairie
Peregrine Falcon	19	3	3	Specialized (cliffs)
Burrowing Owl	19	3	4	Shortgrass Prairie
Bald Eagle	18	3	3	Montane Riparian, Plains/Basin Riparian
Upland Sandpiper	18	2	2	Shortgrass Prairie

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database, Carter et al. 1997).
[c] PT = Population Trend (from the PIF Priority Database, Carter et al. 1997).
[d] Species previously appeared on the Service's 1995 list.

Table 2. **Level II Species (Monitoring)**. The action and focus for the species is monitoring. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, species whose population trend is unknown, species that are peripheral for breeding in the habitat or state, or species for which additional knowledge is needed.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Cassin's Kingbird	22	3	3	Juniper Woodland, Plains/Basin Riparian
Lark Bunting	22	4	4	Shortgrass Prairie, Shrub-steppe
Dickcissel	21	3	3	Shortgrass Prairie
Chestnut-collared Longspur	21	2	3	Shortgrass Prairie
Black-chinned Hummingbird	20	2	3	Plains/Basin Riparian, Shrub-steppe
Pygmy Nuthatch	20	3	3	Low Elevation Conifer
Marsh Wren	20	3	4	Wetlands
Western Bluebird	19	3	3	Juniper Woodland, Low Elevation Conifer
Sage Thrasher	19	5	2	Shrub-steppe
Grasshopper Sparrow	19	3	5	Shortgrass Prairie, Shrub-steppe
Bobolink	19	2	3	Shortgrass Prairie, Shrub-steppe
Common Loon	18	3	3	Wetlands
Black-billed Cuckoo	18	2	3	Plains/Basin Riparian
Red-headed Woodpecker	18	2	3	Plains/Basin Riparian, Low Elevation Conifer
Yellow-billed Cuckoo	18	3	3	Plains/Basin Riparian
Eastern Screech-Owl	18	3	3	Plains/Basin Riparian
Western Screech-Owl	18	3	3	Plains/Basin Riparian
Western Scrub-Jay [d]	18	3	3	Juniper Woodland
Loggerhead Shrike	18	3	3	Shrub-steppe
Vesper Sparrow	18	5	4	Shrub-steppe
Lark Sparrow	18	3	4	Shrub-steppe
Ash-throated Flycatcher [d]	16	2	3	Juniper Woodland
Bushtit [d]	16	3	3	Juniper Woodland
Merlin	15	3	3	Low Elevation Conifer
Sprague's Pipit	n/a	n/a	n/a	Grassland, Plains/Basin Riparian, Shortgrass Prairie
Barn Owl	n/a	n/a	n/a	Shortgrass Prairie, Urban

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database).
[c] PT = Population Trend (from the PIF Priority Database).
[d] Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

Wyoming Partners In Flight Process for Prioritizing Species

Wyoming Partners In Flight participants developed the current list of priority species based on a combination of the seven criteria in the national Partners In Flight Priority Database (Carter et al. 1997). This database serves as a defensible method of prioritizing both species and habitats in need of conservation. The criteria include Wyoming-dependent and Wyoming-independent factors. The Wyoming-independent criteria are constant over a species' range and do not vary for each species. The Wyoming-dependent criteria were the key components used to prioritize species and their conservation action needs. In the absence of any more rigorous statewide surveys, Breeding Bird Survey data dating back to 1968 were used to determine population trends in Wyoming.

Criteria

Within each criterion below, a species was given a rank score ranging from 1 to 5, with 1 being the least critical rank and 5 the most critical. Each ranked species could potentially receive a low score of 7 and a high score of 35. However, setting conservation goals based only on total score could be misleading; therefore, each total score was reviewed in conjunction with its component parts. In Wyoming, species were initially ranked using total score, area importance, and population trend.

1. Relative Abundance (RA) - The abundance of a bird, in appropriate habitat within its entire range, relative to other bird species. This criterion gives an indication of a species' vulnerability to withstand cataclysmic environmental changes. A low score would indicate a higher relative abundance, therefore reducing the risk of complete extirpation from losses in one or more regions. Higher scores indicate a lower relative abundance, thus more vulnerability to drastic losses or population changes.

2. Breeding Distribution (BD) - A relative measure of breeding range size as a proportion of North America [defined as the main body of the continent, excluding Greenland, through Panama and the islands of the Caribbean, comprising an area of 22,059,680 km^2 (National Geographic Society 1993)], and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized breeding, thus a higher likelihood of serious decline from drastic environmental changes. Low scores indicate wide breeding distribution, therefore less likelihood of extirpation. Used for breeding birds only.

3. Non-breeding Distribution (ND) - A relative measure of non-breeding, or winter, range size as a proportion of North America, and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized distribution on the non-breeding grounds. Low scores indicate wide distribution on the non-breeding grounds, therefore less likelihood of extirpation. Used for wintering birds only.

4. Threats on Breeding Grounds (TB) - The ability of a habitat in an area to support populations of a species in that area. Two factors are considered here: 1) each species' demographic and ecological vulnerability (the potential inability of a species to recover from population loss by normal reproductive effort due to low reproductive rate, high juvenile mortality, or both; and the level of ecological specialization of a species and, hence, its potential inability to withstand environmental change), and 2) habitat loss or disruption (a combination of the amount of habitat or conditions necessary for survival and reproductive success that has been lost since 1945, and the amount that is anticipated to be lost in the future). High scores indicate either a large loss of habitat or a species that is an extreme ecological specialist. Low scores indicate a stable or increasing habitat or a species that is an ecological generalist. Used for both breeding and wintering birds.

5. Threats on Non-breeding Grounds (TN) – Range-wide threats on non-breeding, or winter, grounds. This is scored using the same criteria as threats on breeding grounds but reflects non-breeding issues, including migratory habitat. Used for wintering birds only.

6. Population Trend (PT) - The overall population trend of each species assigned independently for each state, province, or physiographic area. This criterion must meet two thresholds, reliability and magnitude, to warrant either a very high or very low score. When possible, a score was assigned using BBS data, which incorporated a population trend uncertainty score based on the statistical validity of the BBS data (i.e. a species must be detected on a minimum of 14 BBS routes per state for population trends to have statistical significance). This criterion was chosen to alert managers to species with modest, but certain, population declines.

7. Area Importance (AI) - The abundance of a species within a state, province, or physiographic area relative to its abundance throughout its range. This criterion helps direct conservation efforts toward areas that are most important to a species' survival. Area Importance is scored locally; therefore, high scores indicate that a large proportion of the species' breeding or winter range occurs in Wyoming, or a species is using a habitat that is only available in Wyoming. Low scores indicate that a small proportion of the species' range occurs in Wyoming, or the preferred habitat is widespread across its range. Used for both breeding and wintering birds.

Priority Species

Priority bird species in Wyoming were identified from the PIF Priority Database (Carter et al. 1997) and by qualitative, informed decisions. Those species with a total score of 18 or above, Area Importance (AI) of 3 or above, and/or Population Trend (PT) of 3 or above from the database, or with a total score less than 18 but of significant local interest were identified as the highest priority species. However, as more information becomes available, the highest priority species for Wyoming may change, as this is a dynamic database that allows for updated information to be periodically inserted and reviewed. The primary habitat type or types required for breeding were identified for each species to determine the highest priority habitat types for the state.

Literature Cited

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Section 3.7

Meteorology and Air Quality

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FIGURES

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3.7 Meteorology, Climatology and Air Quality

This section describes meteorology, climatology, and air quality in the region where the Permit Area is located. Both regional (long-term) and site-specific data are discussed to characterize climatological conditions at the Permit Area. Where site-specific data are not available, data from the closest representative location are presented.

3.7.1 Meteorology and Climatology

The Permit Area is located in the intermountain semi-desert ecoregion (Wyoming State Climate Office, 2005), which has cold winters and short, hot summers (Bailey, 1995). The average annual temperatures range from 40 to 52 degrees Fahrenheit (°F) in this ecoregion. The average annual precipitation ranges from five to 14 inches (Bailey, 1995). Meteorological stations within 50 miles of the Permit Area are shown in **Figure 3.7-1**. The National Weather Service (NWS) meteorological station, closest to the Permit Area, with a long period of record is Muddy Gap, Wyoming (High Plains Regional Climate Center [HPRCC], 2007a). This station is 28 miles northeast of the Permit Area, and temperature, precipitation, snowfall and snow depth data have been collected since 1949.

A meteorological station (Lost Soldier [LS] Station) was installed at a location near Bairoil in April 2006 but was removed in 2011. The LS meteorological station was located about 12 miles northeast from the Permit Area (**Figure 3.7-1**). Another meteorological station (Lost Creek [LC] Station) was installed within the Permit Area in May 2007 to collect on-site data (**Figure 3.7-1**).

Information collected from the LS station was initially used to describe local conditions until sufficient data was collected from the LC Station. All data were measured at a height of 6.6 feet (two meters), with a recovery rate of over 90 percent. The Muddy Gap station is in the same Climate Division as the Permit Area, Climate Division 10 (CLIMAS, 2005), which means that these locations have similar climatic characteristics. At the original date of this document, only data through 2005 were available for the Muddy Gap station.

3.7.1.1 Temperature

Based on the Muddy Gap data, July is the warmest month; the average maximum monthly temperature is approximately 86°F, and the monthly average minimum temperature is approximately 54°F. January is the coldest month; the monthly average maximum temperature is around 31°F, and the average monthly minimum temperatures is approximately 14°F. The maximum temperature on record is 100°F in July, while the minimum temperature on record is -40°F in December. The average monthly temperatures at the LS Station and LC Station, collected in 2006 to 2007 and 2008 through 2015, respectively, were generally within range of the long-term averages at Muddy Gap. Temperatures from these stations are compared in **Table 3.7-1**.

Dew point temperatures were calculated for the LS Station for the months of April to December 2006. The averages ranged from 22.4 to 35.1°F for the LS Station and from 10.5 to 50.5°F for the LC Station. The highest average dew point temperature occurred in July, while the lowest average dew point temperature occurred in May and December. The maximum dew point temperatures for the LS Station range from 32.6 to 53.2°F; the minimum dew point temperatures range from -10.2 to 19.7°F. The maximum dew point temperatures for the LC Station range from 24.4 to 62.5°F; the minimum dew point temperatures range from -9.1 to 40.1°F. The lowest minimum dew point temperatures occurred in November and December, while the highest maximum dew point temperatures occurred in July and August. **Table 3.7-2** presents the dew point temperature data.

3.7.1.2 Precipitation

The Permit Area is drier than many areas in the State of Wyoming. The mean annual precipitation at the Muddy Gap station from 1949 through 2005 was 10.0 inches. The mean annual precipitation at the LC Station from 2008 through 2015 was 5.9 inches.

Figure 3.7-2 shows the total monthly precipitation in the Project region. Precipitation is distributed throughout the year; the mean monthly precipitation exceeds one inch only in April, May, and June. May is the wettest month at the Muddy Gap Station with 1.9 inches of mean precipitation. The actual annual moisture may be somewhat higher, since precipitation gages capture only a small proportion of snowfall under windy conditions. Precipitation at the LC Station somewhat follows the distribution of Muddy Gap data with the wettest month in May at just less than 1 inch.

The precipitation at the LS station from May 2006 to April 2007 showed that precipitation for this period was much lower than normal. Regional data showed the area received 50 to 70 percent less rainfall than average (HPRCC, 2007b). The nearest bodies of water within 50 miles are the Pathfinder and Seminoe Reservoirs (see **Figure 3.7-1**).

3.7.1.3 Humidity

The average relative humidity at the Permit Area (LC Station) is low in the summer, with the lowest average occurring in July-August (15.2 percent). The relative humidity is elevated during the winter, where the highest average occurred in February (89.8 percent).

The monthly maximum and minimum humidity measured at the LS and LC meteorological stations is provided in **Table 3.7-3**.

3.7.1.4 Wind

The annual average wind speed at a height of ten meters, measured at the LC Station between 2008 and 2015, was 16.4 feet per second (ft/s) (5.0 meters per second [m/s]). The wind speed is typically highest in March the highest of which was recorded in 2012 at 67.3 ft/s (20.5 m/s). The annual wind speed and wind direction summaries from 2008 to 2015 are shown as wind roses on **Figure 3.7-3**. The prevailing wind direction is from the west-southwest to west.

3.7.1.5 Evaporation

Evaporation from a Class A pan was measured from March to November at the Pathfinder Dam, 56 miles from the Permit Area. This location is in the same climatic zone as the Permit Area (Wyoming State Climate Office, 2007), so potential evaporation would be similar in both locations. Evaporation pan data were not collected during the winter months. Evaporation occurs at a slower rate in lakes than in pans, so empirical equations are generally used to estimate actual lake evaporation. The Kohler-Nordenson-Fox equation uses temperature, wind, humidity, and radiation to predict monthly and annual evaporation, and has been shown to produce reliable results in Wyoming (Pochop et al., 2007). This paper reported the annual estimated lake evaporation at the Pathfinder Dam is 42.5 inches (**Table 3.7-4**). The highest estimated evaporation rates occurred during the summer months, with a peak of 7.5 inches in July. The period of maximum evaporation is consistent with the pan evaporation measurements from the Pathfinder Dam. Evaporation rates were low in the winter, with less than one inch of evaporation predicted for December and January.

3.7.1.6 Severe Weather

Tornadoes are more prevalent in eastern Wyoming than in western Wyoming, because mountain ranges in western Wyoming are barriers to the flow of warm, moist air that causes tornadoes. In Sweetwater County, 22 tornados, none of which caused any injury or death, were reported since 1950. An individual tornado would affect only a portion of Sweetwater County; therefore, the chances are small that the Permit Area would experience a tornado. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused to man-made structures (The Tornado Project, 2003). The most destructive tornado recorded in Sweetwater County from 1950 to 2016 was an F-1 "moderate" tornado, which would be unlikely to cause extensive damage to the Project. **Figure 3.7-4** presents tornado data collected by the Storm Prediction Center from 1950 to 2016 (Storm Prediction Center, 2016).

July has the highest number of thunderstorm days, as measured over many years at select stations in Wyoming. Wind gusts during thunderstorms are often over 49 mph. The Permit Area is located in an area that has statistically shown a lower density of lightning strikes. The probability of hail is also low, with six occurrences recorded in a 24-year period (Curtis and Grimes, 2007).

3.7.1.7 Local Air Flow Patterns and Characteristics

Atmospheric stability was categorized into six classes according to Pasquill. Calculations were made using wind speed and solar radiation data collected at the Permit Area, and the results are presented in **Table 3.7-5**. The data show that low stability conditions (i.e. Class A-D), which contribute to good dispersion conditions, occur 91 percent of the time at Lost Soldier and 88 percent at Lost Creek, making atmospheric inversion conditions unlikely.

3.7.2 Air Quality

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), lead, and particulate matter small enough to move easily into the lower respiratory tract (particles less than ten micrometers in aerodynamic diameter, designated Particulate Matter [PM_{10} and $PM_{2.5}$]). The NAAQS are expressed as pollutant concentrations that are not to be exceeded in the ambient air, that is, in the outdoor air to which the general public has access (40 CFR Part 50.1(e)). Primary NAAQS are designated to protect human health; secondary NAAQS are designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) and manufactured materials. Primary and secondary NAAQS are presented in **Table 3.7-6**.

The air quality in the Project region is good. The area is sparsely populated and is not heavily developed with industrial sources of air pollution. The closest monitoring station to the Permit Area is in Rawlins, and shows that regional air quality is in compliance with the NAAQS and Wyoming Ambient Air Quality Standards (WAAQS) (BLM, 2004c).

In addition to ambient air quality standards, which represent an upper bound on allowable pollutant concentrations, there are national standards for the Prevention of Significant Deterioration (PSD) of air quality (40 CFR § 51.166). The PSD standards differ from the NAAQS in that the NAAQS provide maximum allowable concentrations of pollutants, while PSD requirements provide maximum allowable increases in concentrations of pollutants for areas already in compliance with the NAAQS. PSD standards are, therefore, expressed as allowable increments in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for four pollutants: NO_2, SO_2, $PM_{2.5}$, and PM_{10}. Increments are particularly relevant when a major proposed action (involving either a new source or a major modification to an existing source) may degrade air quality without exceeding the NAAQS, as would be the case, for example, in an area where the ambient air is very clean. One set of allowable increments exists for Class II areas, which cover most of the US; a much more stringent set of allowable increments exists for Class I areas, which are designated areas where the degradation of ambient air quality is severely restricted. Class I areas include certain national parks and monuments, wilderness areas, and other areas as described in 40 CFR § 51.166(e) and 40 CFR Part 81:400-437. Maximum allowable PSD increments for Class I and Class II areas are given in **Table 3.7-7**. Class I areas, as designated in the Rawlins RMP, include the Savage Run Wilderness and Rocky Mountain National Park. PSD Class I areas receive the highest degree of protection from air pollution; only small amounts of particulate, SO_2, and NO_2 air pollutants are allowed in these areas (BLM, 2004c).

Emission air quality data in the EPA database consist of the amount of selected air quality parameters that are released into a particular airshed. Criteria Air Pollutant parameters reported include CO, NO_X (a group of highly reactive gases that contain nitrogen and oxygen in varying amounts), SO_2, volatile organic compounds (VOCs), $PM_{2.5}$, PM_{10} and ammonia (NH_3). Near the Permit Area, reported sources of emissions include that from the Amoco CO_2 Bairoil station, the Northern Gas Bunker Hill compression station and the Sinclair Oil Bairoil station (**Table 3.7-8**). Hazardous Air Pollutants consist of 188 parameters and are also reported in the EPA database; the reported total emissions from the facilities near the Permit Area are presented in **Table 3.7-9**.

Air particulate matter in the Permit Area was sampled using two Mini-Volumetric (MiniVol) samplers with ten micron (PM_{10}) filters. Dust trapped by these filters is the size considered most detrimental to human health. Two samplers were used as a pair, with samples collected concurrently upwind and downwind of the Permit Area, at three locations: Northern (LCAIR9&10), Central (LCAIR13&14), and Southern (LCAIR11&12). The sampling duration was approximately 24 hours; the results were time-adjusted for a 24-hour period. **Figure 3.7-5** shows the sampling locations, and the results are presented in **Table 3.7-10**. Additional readings were not collected at LC East since the vegetation cover is very similar and therefore baseline conditions should also be similar.

The average PM_{10} concentration in June 2006, including both upwind and downwind sampling locations, was 8.5 micrograms per cubic meter ($\mu g/m^3$). The maximum value was 10.5 $\mu g/m^3$, and the minimum value was 5.4 $\mu g/m^3$. For comparison, the average PM_{10} in Casper Wyoming was 18.8 $\mu g/m^3$ from 1990 through 1994 (Natural Resources Defense Council, 2007). At the northern sampling location, the PM_{10} concentration in the upwind sample was more than 70 percent higher than the downwind sample. At the central and southern sampling locations, the upwind and downwind samples differed by 15 percent or less. The sample collection runs lasted between 21.5 to 28 hours. In February 2007, the PM_{10} concentration at the central sampling location was about one-half of the concentration in June 2006, possibly due to slightly damper soil conditions.

The NAAQS criteria for PM_{10} sets a limit of 150 $\mu g/m^3$ for a 24-hour period, not to be exceeded more than once per year on an average over three years. The data show that for both upwind and downwind locations, this standard was not exceeded. More information on dust and emissions from Project activities are covered in Section 4.7 of this report.

Passive radon and gamma air sampling for the Project was initiated in November 2006. Sampling locations were established at the closest full-time residence, which is in Bairoil, (URPA1 [Ur-Energy Passive Air 1]), at the western site boundary (URPA7), at the southeastern site boundary (URPA8), at the northeastern site boundary (URPA10), and at the center of the site (URPA9). An additional sampling site was added (URPA13) after the first quarter, to reflect changes to the Permit Area. **Figure 3.7-6** shows passive radiological sampling locations, which represent conditions both upwind (west) and downwind (east) of the Permit Area.

The samplers were retrieved quarterly, and the results are presented in **Table 3.7-11**. The elevated radon measurement at URPA9 during the first quarter may be due to radon retention by snow cover. When retrieved, the sensor was buried in a snow drift; thereafter, the sampler was relocated five feet away. The gamma sensor at URPA10 was missing at the end of the second quarter, but was replaced.

Monitoring of passive radon and gamma at LC East Amendment location PR-13/HV-6 (**Figure 3.7-6**), representing the eastern boundary of LC East, has been conducted on a quarterly basis since its installation in 2012. The data for that location are presented in Section 3.12 of this report. Operational monitoring of passive radon and gamma in the Permit Area has been conducted on a quarterly basis since 2013 and the data are reported to the NRC in the Semi-Annual Effluent and Environmental Monitoring Report. The operational monitoring locations at Lost Creek are shown on **Figure 3.7-6** designated as "PR" and "HV" stations.

3.7.3 References

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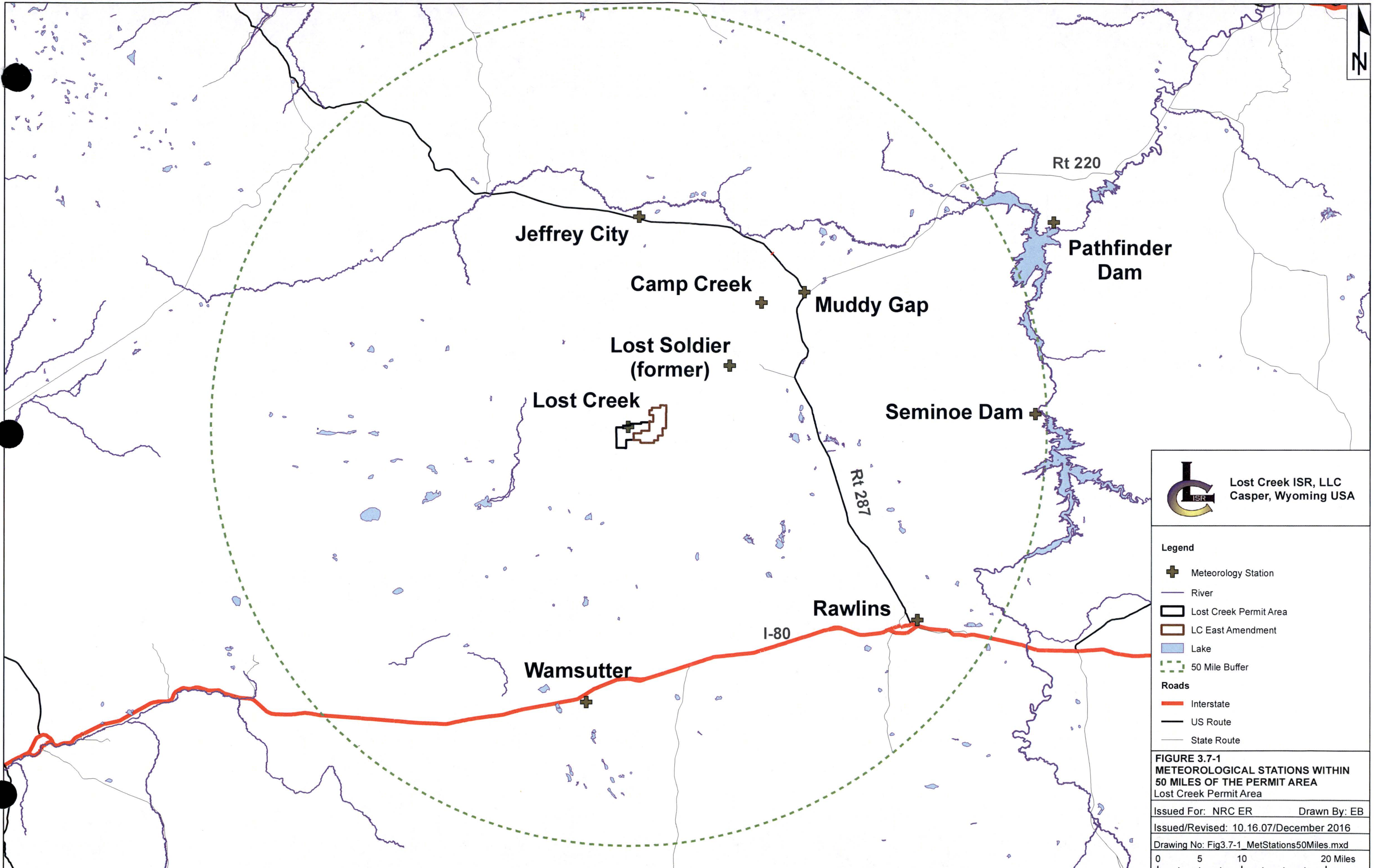

FIGURE 3.7-1
METEOROLOGICAL STATIONS WITHIN
50 MILES OF THE PERMIT AREA
Lost Creek Permit Area

Issued For: NRC ER Drawn By: EB

Issued/Revised: 10.16.07/December 2016

Drawing No: Fig3.7-1_MetStations50Miles.mxd

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Figure 3.7-2: Monthly Total Precipitation for the Lost Creek Region

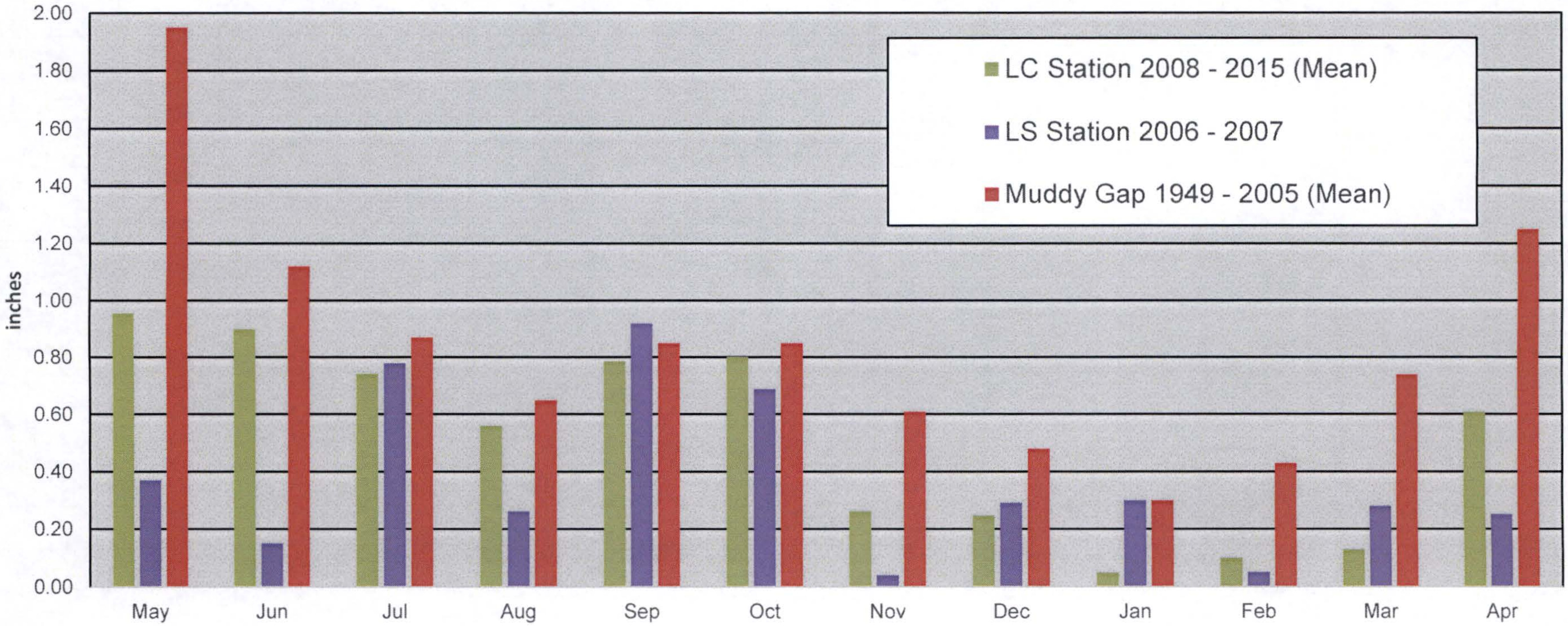


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

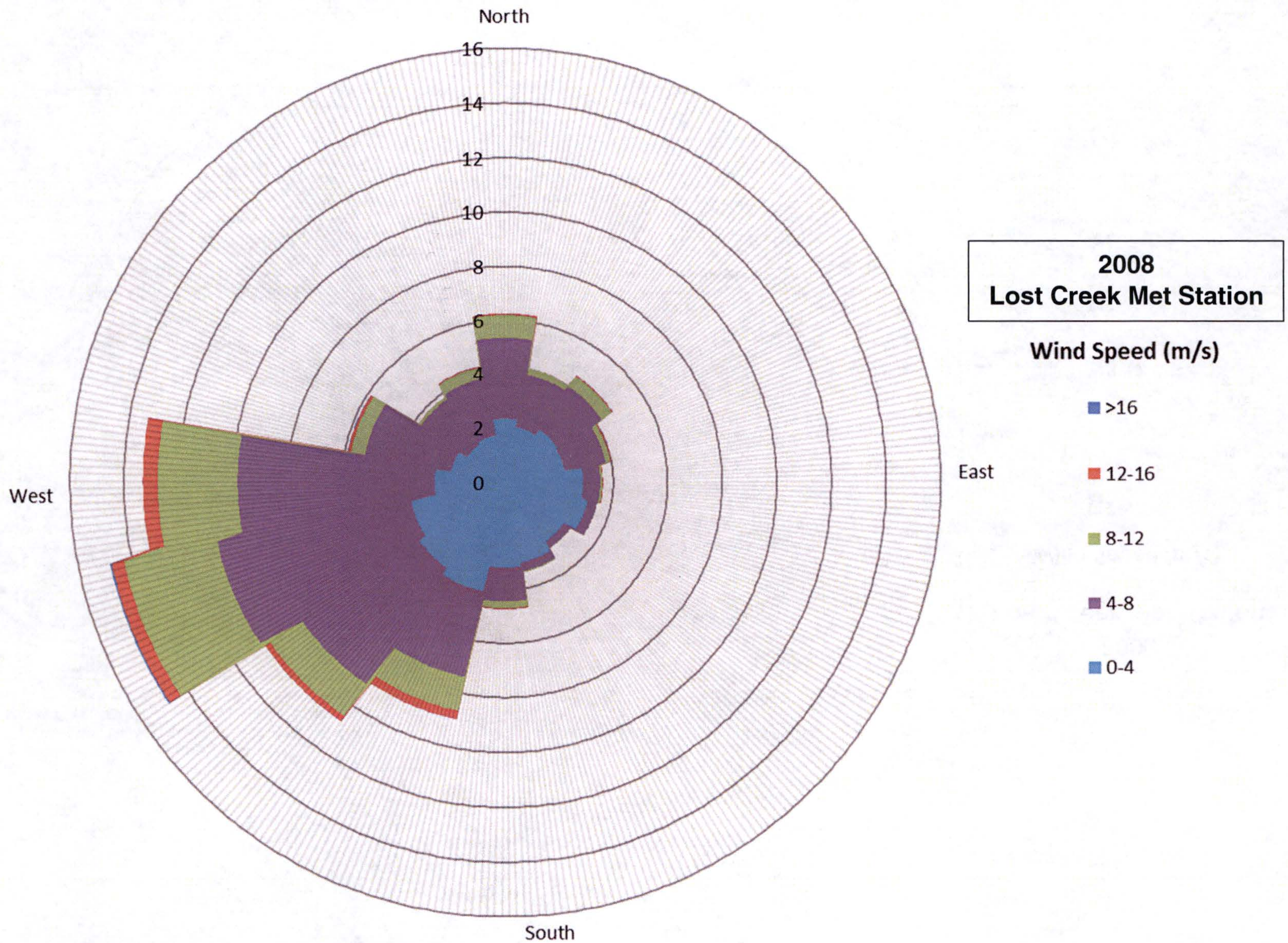


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

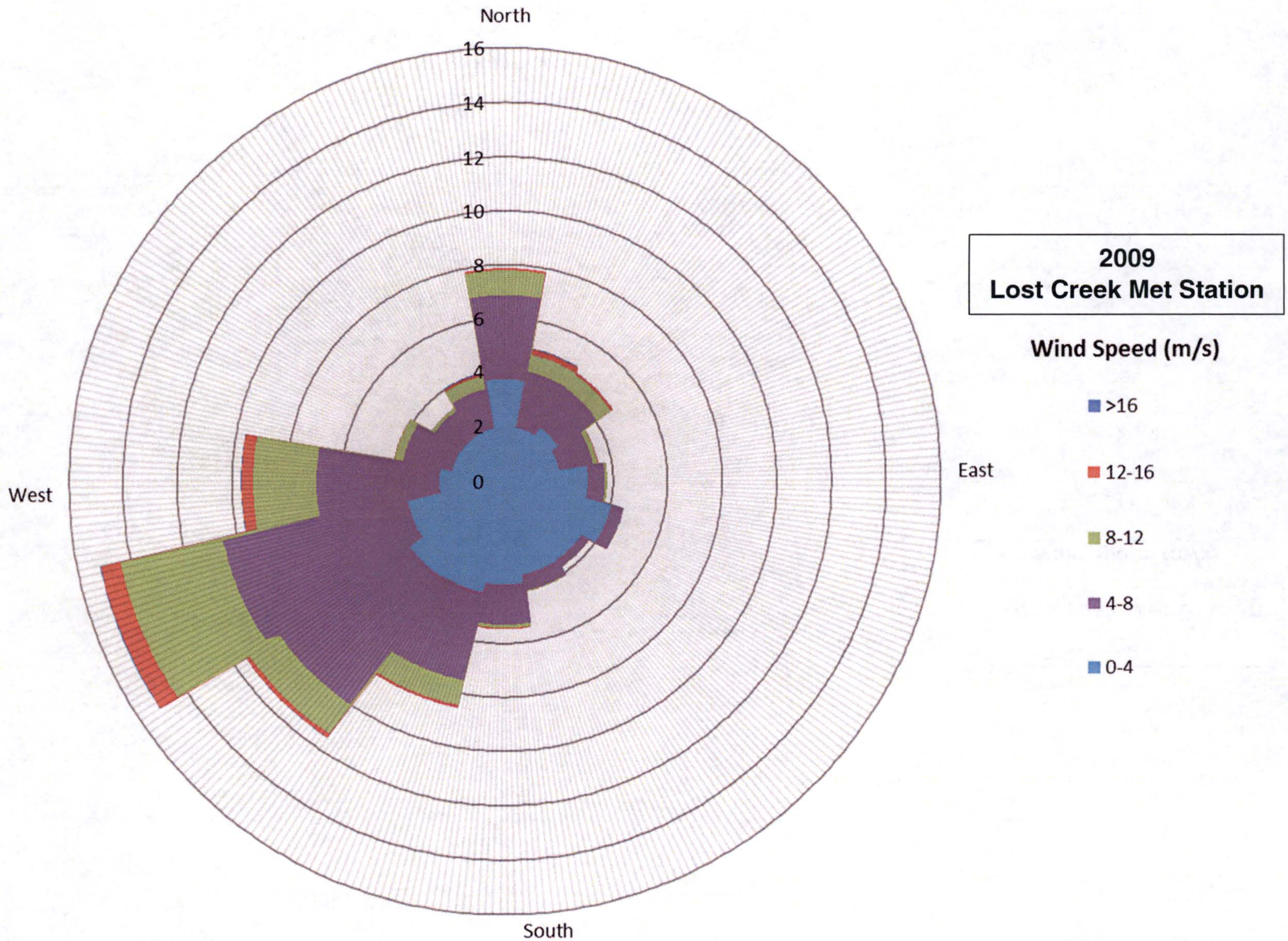


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

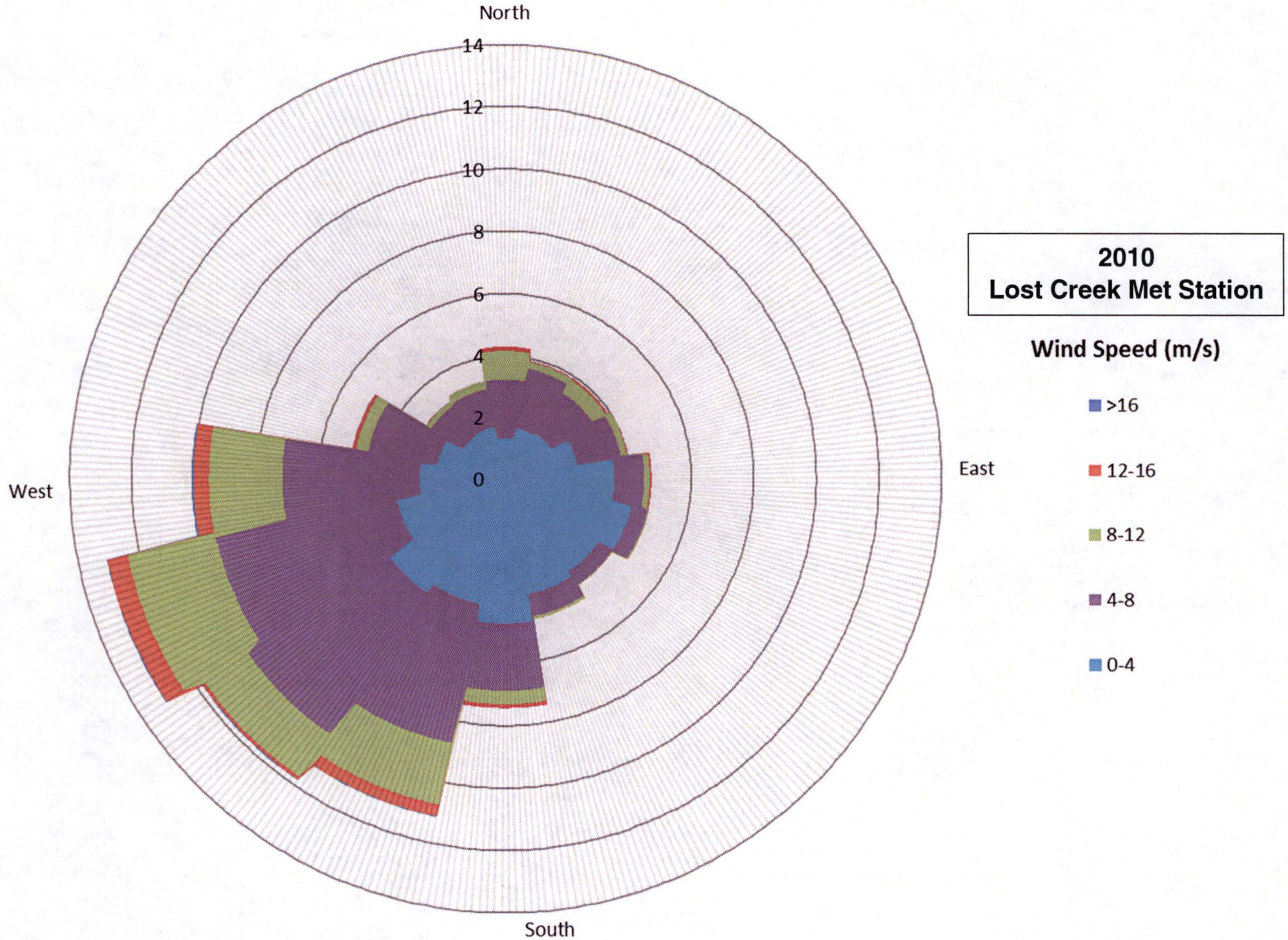
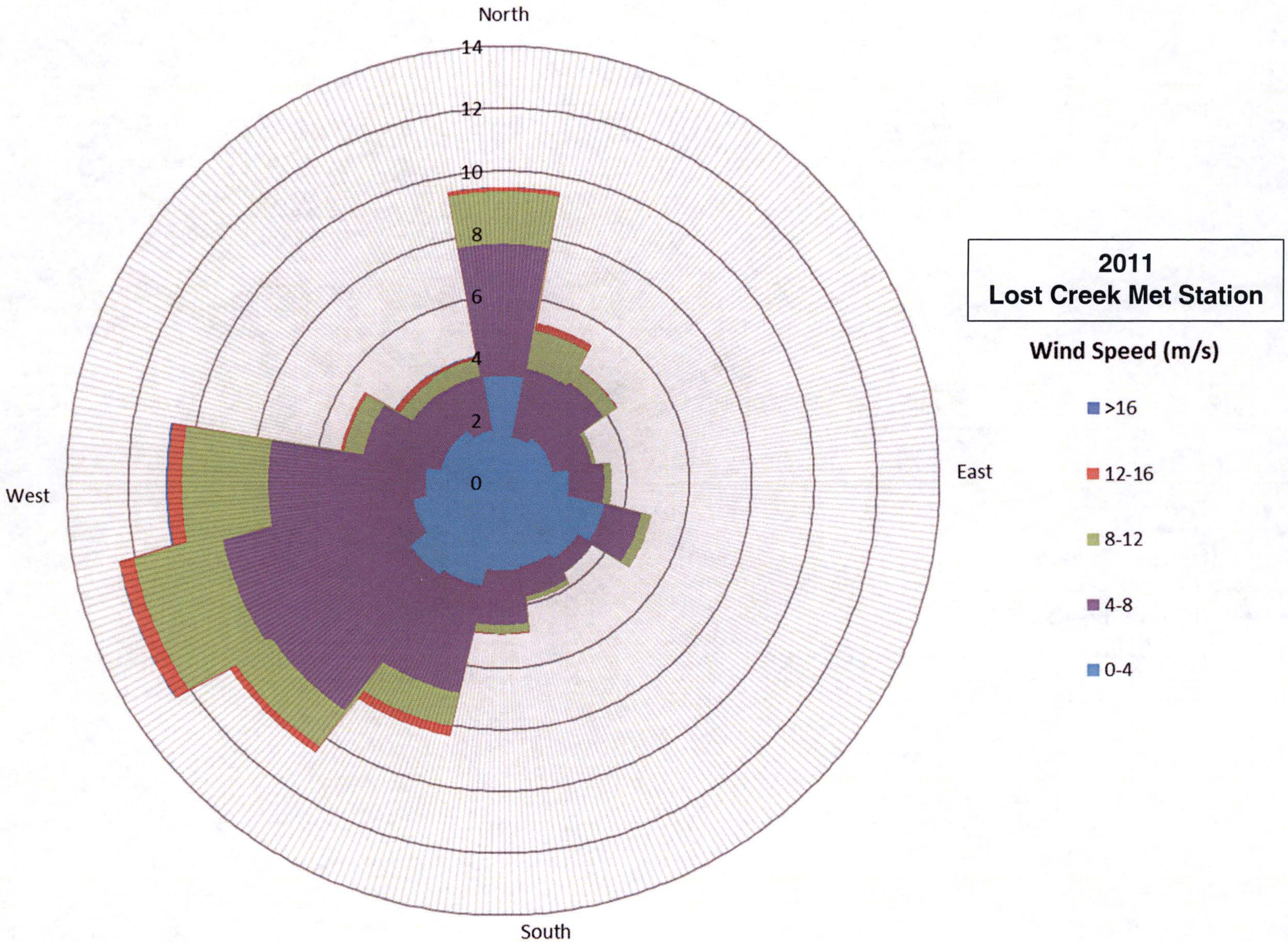


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek



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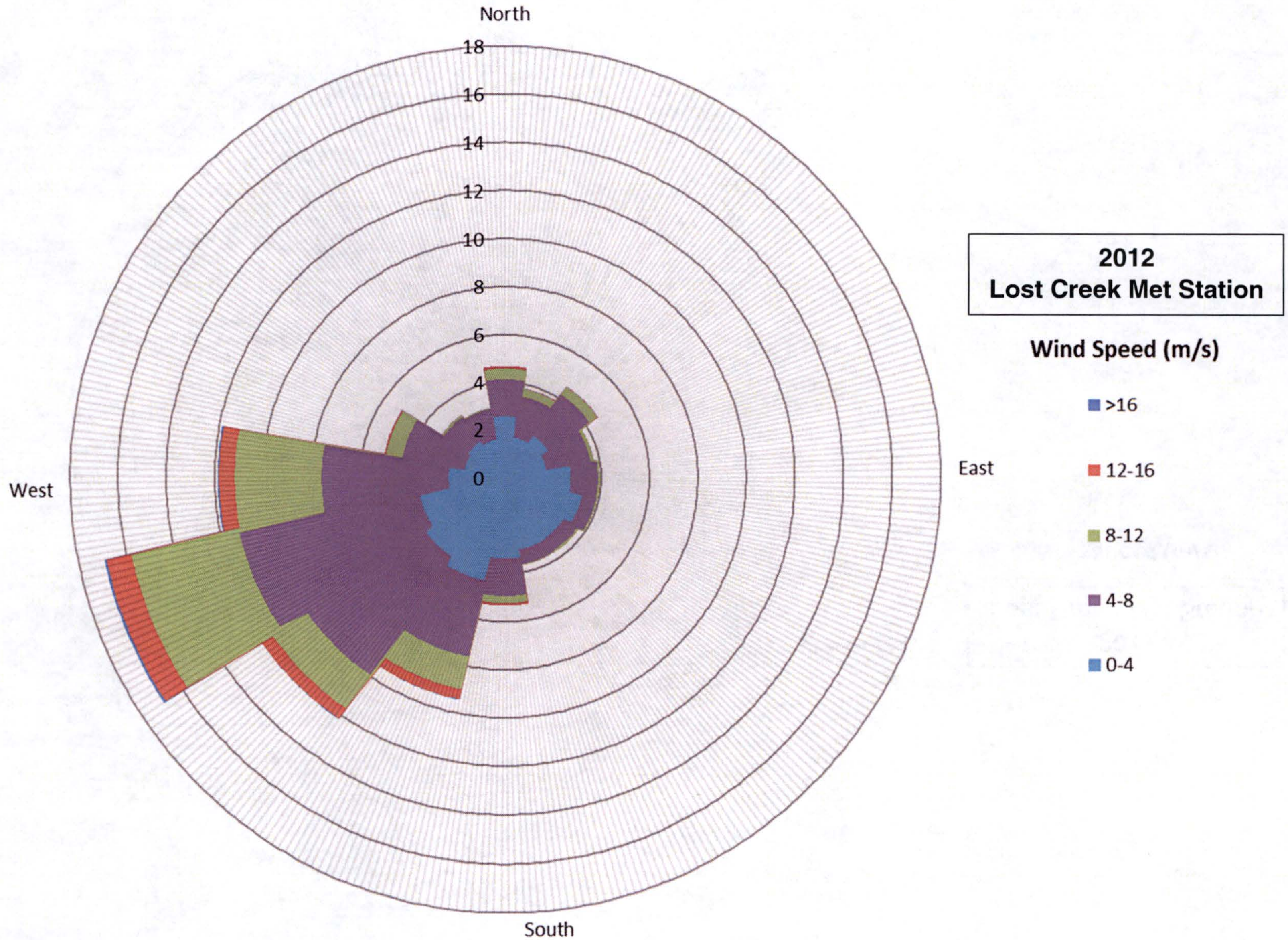


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

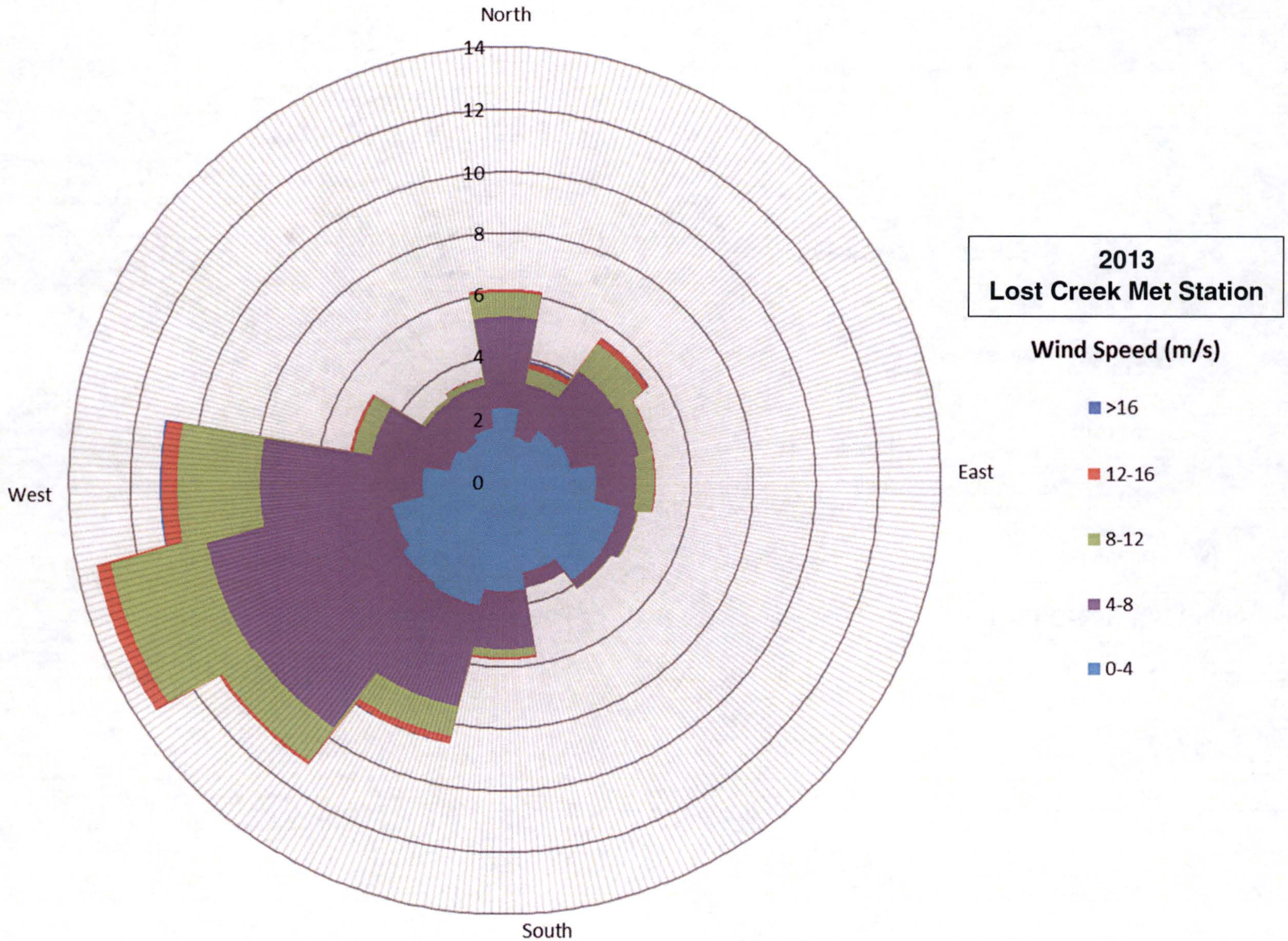


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

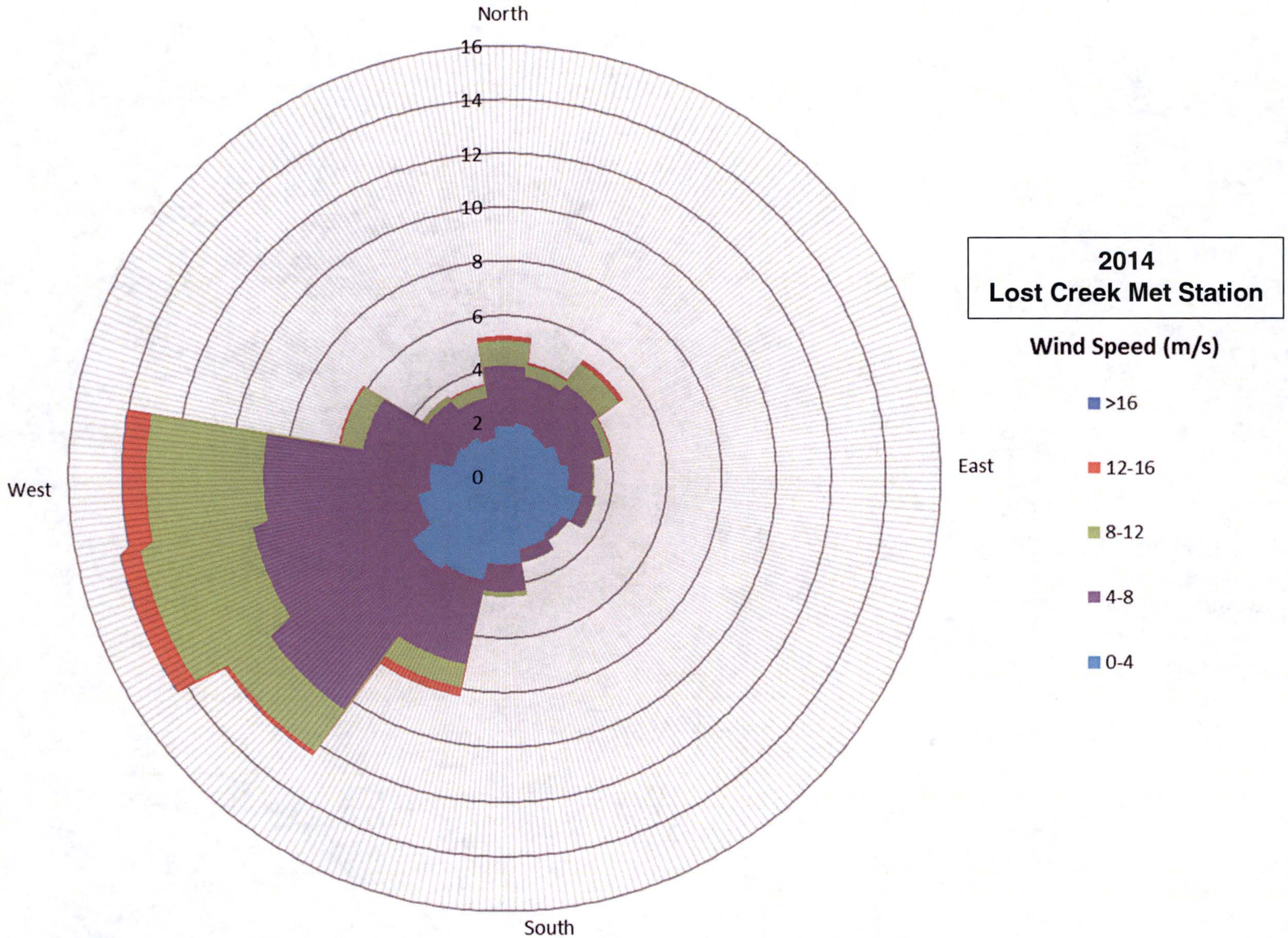


Figure 3.7-3: Wind Speed and Wind Direction at Lost Creek

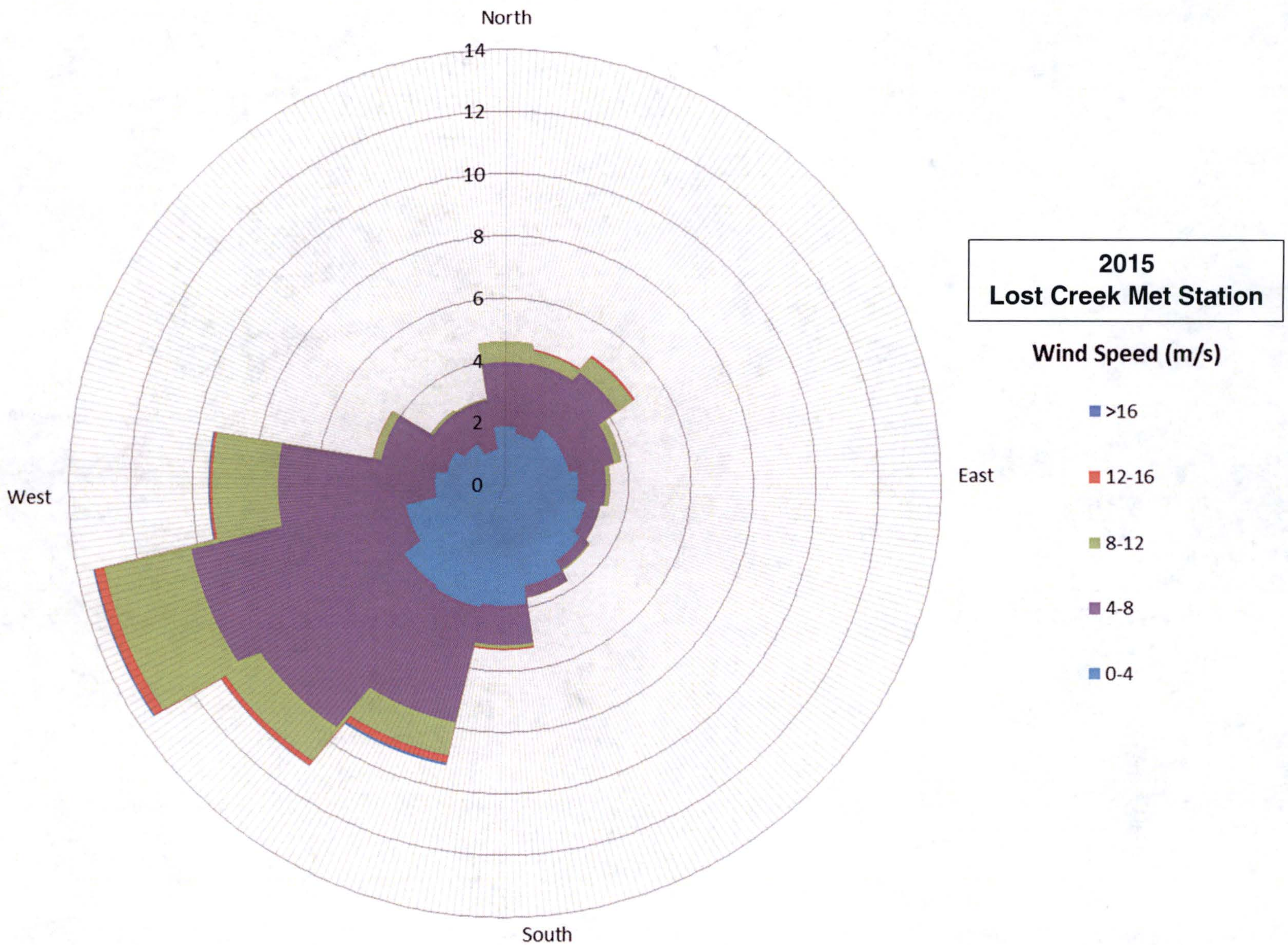
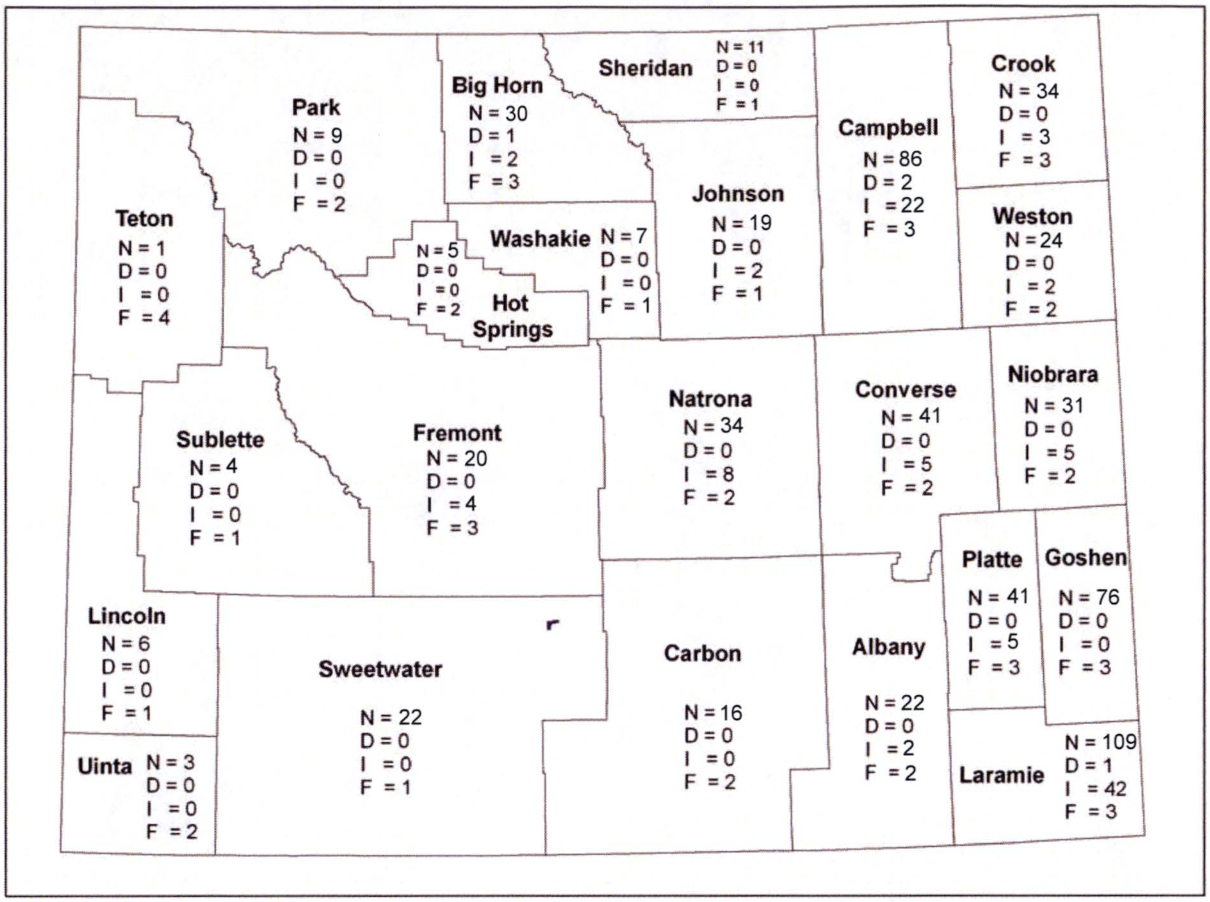


Figure 3.7-4. Tornado Statistics by County (1950–2016)



Source: Storm Prediction Center Data, 2016
Legend:
N = total number of tornadoes reported
D = deaths
I = injuries
F = Fujita scale index of most destructive storm (0 = gale tornado, 1 = moderate tornado, 2 = significant tornado, 3 = severe tornado, 4 = devastating tornado, 5 = incredible tornado, 6 = inconceivable tornado)

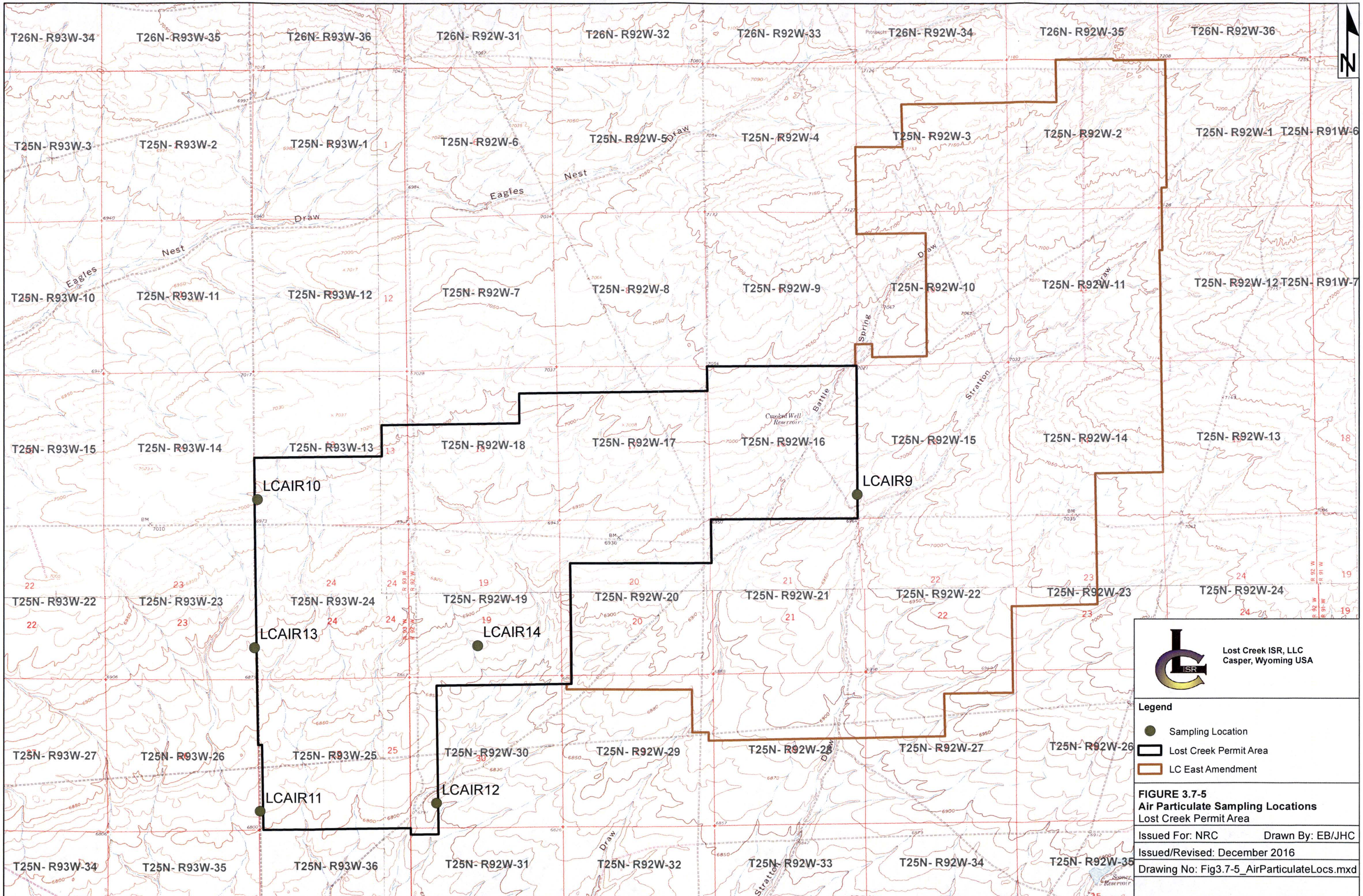


FIGURE 3.7-5
Air Particulate Sampling Locations
Lost Creek Permit Area

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Issued/Revised: December 2016
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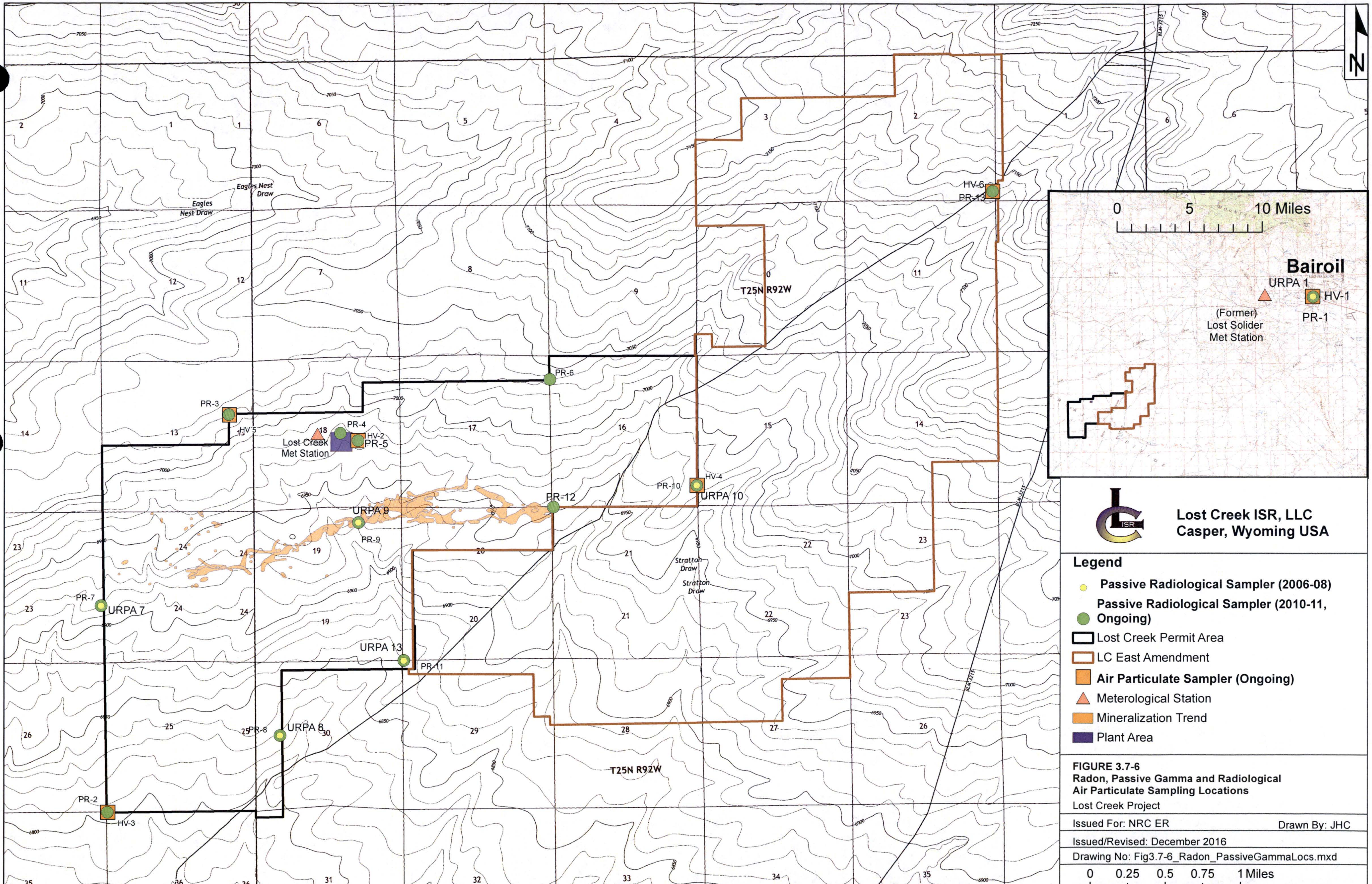

FIGURE 3.7-6
Radon, Passive Gamma and Radiological Air Particulate Sampling Locations
Lost Creek Project

Issued For: NRC ER
Drawn By: JHC
Issued/Revised: December 2016
Drawing No: Fig3.7-6_Radon_PassiveGammaLocs.mxd

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Table 3.7-1 Comparison of Temperature Data

Month	Lost Soldier Meteorological Station (2006 - 2007)			Muddy Gap (1949 - 2005)			Lost Creek Meteorological Station (2008-2015)		
	Mean Temp. (°F)	Maximum Temp. (°F)	Minimum Temp. (°F)	Mean Temp. (°F)	Mean Maximum Temp. (°F)	Mean Minimum Temp. (°F)	Mean Temp. (°F)	Mean Maximum Temp. (°F)	Mean Minimum Temp. (°F)
May	51.8	64.0	39.5	52.0	66.0	37.9	47.0	60.3	33.4
June	64.2	77.6	50.2	62.5	78.0	46.9	59.1	74.2	42.4
July	70.0	82.0	57.3	69.6	85.5	53.6	67.4	82.7	50.9
August	65.1	78.4	52.2	68.3	83.9	52.7	65.0	80.7	48.8
September	51.3	61.9	40.7	58.3	73.0	43.6	56.0	71.6	40.4
October	39.0	49.6	29.8	46.9	60.0	33.7	41.0	54.6	28.2
November	32.0	40.6	23.3	32.3	41.8	22.8	29.6	42.3	17.7
December	21.9	34.3	49.9	23.8	32.7	14.9	17.6	28.3	5.7
January	12.6	18.7	4.0	22.7	31.4	14.0	17.9	30.1	5.1
February	23.7	31.6	16.6	26.2	35.5	16.8	20.6	31.7	7.8
March	34.8	45.8	26.4	34.6	45.5	23.7	30.1	42.3	17.7
April	35.1	45.9	23.8	42.6	55.5	29.6	37.2	49.8	24.4

Table 3.7-2 Dew Point Temperature Data (°F)

Month	Lost Creek Meteorological Station 2008 - 2015			Lost Soldier Meteorological Station 2006		
	Mean Minimum	Mean Maximum	Average	Minimum	Maximum	Average
January	-3.6	28.5	10.8	---	---	---
February	-2.2	27.2	13.9	---	---	---
March	5.7	34.3	20.6	---	---	---
April	8.6	43.4	26.6	19.7	36.4	27.9
May	18.3	49.4	35.0	-7.8	43.2	22.4
June	27.4	56.9	42.7	6.1	49.0	26.8
July	40.1	62.5	50.5	3.7	51.5	35.1
August	36.8	58.2	47.3	9.1	53.2	33.3
September	23.4	53.2	39.4	8.1	47.6	29.6
October	13.7	45.1	29.6	10.9	47.8	29.7
November	-2.0	36.8	20.4	-10.2	36.6	25.2
December	-9.1	24.4	10.5	11.2	32.6	25.5

Table 3.7-3 Humidity Data by Month

Lost Creek Met Station 2008-2015	Mean Max Humidity (percent)	Mean Min Humidity (percent)
January	88.6	52.3
February	89.8	52.0
March	87.4	37.1
April	84.9	28.5
May	81.9	24.8
June	72.5	17.0
July	71.5	15.2
August	69.9	15.2
September	71.9	19.6
October	83.4	31.7
November	86.3	38.0
December	88.6	55.4

Lost Soldier Met Station 2006-2007	Max Humidity (percent)	Min Humidity (percent)
April 2006	98.6	9.4
May 2006	97.5	6.8
June 2006	87.3	5.8
July 2006	98.5	8.1
August 2006	94.7	6.3
September 2006	98.8	8.9
October 2006	98.8	11.7
November 2006	98.5	13.3
December 2006	97.4	28.9
January 2007	97.6	37.7
February 2007	99.2	31.0
March 2007	98.8	15.9
April 2007	98.4	12.6

Table 3.7-4 Annual Estimated Lake Evaporation at the Pathfinder Dam

1948 to 1991	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	9-month total
PATHFINDER DAM (inches)	---	---	3.2	5.07	6.78	8.78	10.53	9.75	7.17	4.95	2.81	---	59.04

Table 3.7-5 Air Stability Data

Pasquill Stability Class	Percent Frequency Distribution (SRDT) Lost Creek Station Jul 2007 – Jun 2015*	Percent Frequency Distribution (SRDT) Lost Soldier Station Apr 2006 – Apr 2007
A	1.0	0.1
B	6.0	5.0
C	12.0	8.0
D	69.0	77.8
E	4.0	3.1
F	8.0	6.0
	100.0	*100.0*

Pasquill Stability Classes:
- A = very unstable
- B = unstable
- C = slightly unstable
- D = neutral
- E = slightly stable
- F = stable

SRDT = Solar Radiation Delta Temperature

*Source: IML Air Science, *On-Site Meteorological Data and Off-Site Long Term Representativeness - Lost Creek Uranium In-Situ Recovery Project*, 2015

Table 3.7-6 Primary and Secondary Limits for National Ambient Air Quality Standards (NAAQS) and the state of Wyoming

Pollutant	National Ambient Air Quality Standards (NAAQS)*		Wyoming Ambient Air Quality Standards (WAAQS)**	
	Average Time	Maximum Allowed	Average Time	Maximum Allowed
Particulate Matter $PM_{2.5}$	24 Hour Annual Mean (Primary) Annual Mean (Secondary)	35 ug/m^3 12 ug/m^3 15 ug/m^3	24 Hour Annual Mean (Primary) Annual Mean (Secondary)	35 ug/m^3 12 ug/m^3 15 ug/m^3
Particulate Matter PM_{10}	24 Hour	150 ug/m^3	24 Hour Annual Mean	150 ug/m^3 50 ug/m^3
Nitrogen Dioxide	1 Hour Annual Mean	100 ppb 53 ppb	1 Hour Annual Mean	100 ppb 53 ppb
Ozone O_3	8 Hour	70 ppb	8 Hour	75 ppb
Sulfur Dioxide SO_2	1 Hour (Primary) 3 Hour (Secondary)	75 ppb 0.5 ppm	1 Hour	75 ppb
Carbon Monoxide	1 Hour 8 Hour	35 ppm 9 ppm	1 Hour 8 Hour	35 ppm 9 ppm

*U.S. EPA National Ambient Air Quality Standards (NAAQS)

** Wyoming Air Quality Standards and Regulations (WAQSR), Chapter 2, Ambient Standards. [Last Updated October 13, 2015]

Table 3.7-7 Allowable Increments for Prevention of Significant Deterioration of Air Quality

Pollutant	Averaging Time	Prevention of Significant Deterioration Increment					
		Class I			Class II		
		μg/m³	ppm	ppb	μg/m³	ppm	ppb
Nitrogen Dioxide NO_2	Annual	2.5	0.0013	1.3	25	0.013	13
Sulfur Dioxide SO_2	3-hour	25	0.0096	9.6	512	0.1956	196
	24-hour	5	0.0019	1.9	91	0.0348	35
	Annual	2	0.0008	0.8	20	0.0076	8
Particulate Matter $PM_{2.5}$	24-hour	2	---	---	9	---	---
	Annual	1	---	---	4	---	---
Particulate Matter PM_{10}	24-hour	8	---	---	30	---	---
	Annual	4	---	---	17	---	---

Table 3.7-8 Reported Sources of Emissions near the Permit Area

Source	Year	CO	NO_x	VOC	SO_2	$PM_{2.5}$	PM_{10}	Total Emission (tons/year)
AMOCO BAIROIL CO_2	1996	24.28	51.53	7.04	28.13	1.48	1.72	112.70
NORTHERN GAS - BUNKER HILL	1996	5.99	26.34	18.14				50.47
COMPRESSION STATION	1999	35.42	15.14	10.43				60.99
SINCLAIR OIL - BAIROIL STATION	1996			87.33				87.33
	1999			102.66				102.66

Table 3.7-9 Reported Total Emissions near the Permit Area *

Name	Facility ID	Pollutant	Emission (lbs/year)
COLORADO INTERSTATE GAS - MUDDY GAP COMPRESSION STATION	NTIWY2595	Formaldehyde	3,244
SINCLAIR OIL-BAIROIL STATION	NTIWY2593	Ethylbenzene	154
		Hexane	3,143
		Naphthalene	21
		Toluene	281
		Xylenes (Mixed Isomers)	523
		Total	**4,122**
AMOCO BAIROIL CO_2	NTIWY20140	Acetaldehyde	0.0535
		Arsenic Compounds (Inorganic Including Arsine)	0.0009
		Benzene (Including Benzene From Gasoline)	0.184
		Beryllium Compounds	0.0006
		Cadmium Compounds	0.0006
		Chromium Compounds	0.0006
		Formaldehyde	0.0212
		Lead Compounds	0.0018
		Manganese Compounds	0.0013
		Mercury Compounds	0.0006
		Polycyclic Organic Matter as 7-PAH	0.0854
		Total	**0.351**
NORTHERN GAS - BUNKER HILL COMPRESSION STATION	NTIWY0071269	Acetaldehyde	11
		Acrolein	10
		Benzene (Including Benzene From Gasoline)	0.0081
		Ethylbenzene	522
		Formaldehyde	285
		Hexane	111
		Methanol	57
		Naphthalene	1
		Polycyclic Organic Matter as 7-PAH	0.0005
		Toluene	1,118
		Xylenes (Mixed Isomers)	8,173
		Total	**10,288**

Table 3.7-10 PM_{10} Concentrations at Lost Creek

Location	Date	Wind Speed (mi/hr)	Upwind Sample	Concentration ($\mu g/m^3$)	Downwind Sample	Concentration ($\mu g/m^3$)
Northern	6/24/2006	10.1	LCAIR10	9.3	LCAIR9	5.4
Central	6/26/2006	10.3	LCAIR13	10.5	LCAIR14	9.1
Southern	6/25/2006	n/a	LCAIR11	8.0	LCAIR12	8.9
Central	2/7/2007	7.2	LCAIR16	4.7	LCAIR15	3.7

Table 3.7-11 Analytical Results for Passive Radon and Gamma Sampling

Location	2007 Period	Radon pCi/l-days	Gamma millirems	Gamma millirems/ day
URPA1 (Bairoil)	Q1	50.30	11.30	0.12
	Q2	22.50	16.90	0.20
	Q3	90.50	18.60	0.19
URPA7 (West Boundary of LC)	Q1	147.60	33.00	0.34
	Q2	56.30	23.20	0.28
	Q3	153.70	41.70	0.43
URPA8 (Southeast Boundary of LC)	Q1	258.40	13.60	0.14
	Q2	108.10	23.40	0.28
	Q3	203.10	38.20	0.39
URPA9 (North-Central LC)	Q1	370.60	23.70	0.24
	Q2	67.50	18.00	0.21
	Q3	148.80	42.10	0.43
URPA10 (Northeast boundary of LC)	Q1	201.70	24.40	0.25
	Q2	100.70	NA [1]	NA
	Q3	173.20	50.40	0.52
URPA13 (South-Central near boundary of LC)	Q1	#	#	#
	Q2	167.20	25.60	0.30
	Q3	146.80	24.80	0.26

No data available for first quarter due to later sampler installation.
[1] NA = sensor missing; a new undamaged sensor was installed for the next quarter.

Section 3.8

Noise

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3.8 Noise

Background noise in the Permit Area is representative of a quiet rural area. In the afternoon of June 13, 2007, field measurements of noise in the Lost Creek Permit Area were below the instrument detection limit of 40 decibels. Thirty to 35 decibels is considered the normal range for background noise in a quiet rural area, according to a government study (Federal Interagency Committee on Urban Noise, 1980).

A background noise survey of the LC East Amendment area was conducted during the afternoon of December 6, 2016 using a Metrosonic Model #db-4000EZ factory calibrated dosimeter. Readings were integrated over ten minutes on the main access road with no traffic present; this is approximately the center of the amendment area. The wind was calm during the reading. The results, consistent with readings at Lost Creek, were below the instrument detection limit of 40 decibels.

There are no sensitive receptors near the Permit Area. The closest residence is in Bairoil, about 15 miles northeast from the Permit Area.

Section 3.9

Historical and Cultural Resources

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3.9 Existing Historic and Cultural Resources

Requesting NRC confidentiality. Cultural Resources Report submitted separately to NRC and BLM.

Section 3.10

Visual and Scenic Resources

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3.10 Visual/Scenic Resources

Visual resources consist of landforms, vegetation, rock and water features and cultural modifications that create the visual character and sensitivity of landscapes. Important visual resources are areas that have landscape qualities of unusual or intrinsic scenic value and areas of human and cultural use that are valued for their visual settings. Factors considered in evaluating the importance of visual resources include the following (BLM, 1984).

"Visual quality" is defined as the overall visual impression or attractiveness of an area, considering the variety, vividness, coherence, harmony or pattern of landscape features. Visual quality is defined according to three levels: distinctive resources that are unique or exemplary in quality; representative resources that are typical of the physiographic region and commonly encountered; and indistinctive resources that are landscape or cultural areas that either lack visual resource amenities or have been degraded.

"Visual sensitivity" is defined as a measure of an area's potential sensitivity to visual change, considering types of viewers and viewer exposure. Visual sensitivity considers viewer types and numbers, as well as viewing distance zones. Areas and associated viewer types considered to be potentially sensitive to visual changes include: park, recreation and wilderness study areas, major travel routes, and residential areas.

Distance zones also influence the potential impact of scenery changes on receptors. Potentially sensitive view areas are discussed with respect to three distance zones: foreground (within 0.5 mile), middle-ground (0.5 to 2.0 miles) and background (beyond 2.0 miles).

The BLM Visual Resource Inventory process consists of a scenic quality evaluation, a sensitivity level analysis, and a delineation of distance zones. Together, these evaluations are used to group areas into Visual Resource Management (VRM) classes, which provide guidance for management decisions. Areas are classified on a four-level scale, with Class I being the most protective of visual and scenic resources, and Class IV being the least restrictive (BLM, 1984).

The objectives of each class are:

- Class I: to preserve the existing character of the landscape. The class provides for natural ecological changes. The level of change to the characteristic landscape should be very low and must not attract attention.
- Class II: to retain the existing character of the landscape. The level of visual change should be low. Management activities may be seen, but should not attract the attention of the casual observer.

- Class III: to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer.
- Class IV: to provide for management activities that require major modification to the existing character of the landscape. The level of change to the characteristic landscape can be high.

3.10.1 Visual/Scenic Quality

The study area for visual resources includes the Permit Area (including LC East), access roads, and a two-mile buffer area outside of the Permit Area. Beyond this distance, any changes to the landscape would be in the background distance zone, and either unobtrusive or imperceptible to viewers.

The Permit Area is characterized by low-relief, sagebrush-dominated plains, dissected by small ephemeral drainage networks. The scenery is characteristic of surrounding areas in the Great Divide Basin, though less visually appealing than many other locations. Few intermittent meandering streams, creeks and associated riparian vegetation cross the open steppe, providing localized visual diversity to the otherwise homogeneous landscapes. More rugged mountainous landscapes can be seen in the background. Previous modifications to the natural environment of the Permit Area include fencing, power lines, and four-wheel drive roads. Drilling rigs can currently be seen in the Permit Area; and these impacts are temporary. The site scenery at LC East is characterized by **Figures 3.10-1 thru 8**), which are photographs taken on a December afternoon in 2016 from the north of the main access road (42° 8' 17.02" by 107° 49' 14.57") and south of the main access road (42° 7' 38.75" by 107° 50' 1.20") facing four compass directions. The scenic quality field inventory score according to BLM methodology was seven out of a possible 32 (Landform=1, Vegetation=3, Water=0, Color=2, Influence of adjacent scenery=0, Scarcity=1, cultural modifications=0). The associated scenic quality classification based on a score of 7 was "C", the lowest possible.

3.10.2 Visual/Scenic Sensitivity

Visually sensitive areas include: parks, recreation and natural areas; major travel routes; and residential areas within two miles of the Permit Area. Potentially sensitive areas located two miles or more from the Permit Area are not considered in this study since beyond this distance the Project changes would be indistinct compared to the existing conditions. The viewer groups and use areas described below are considered to be moderately or highly sensitive to visual impacts when in the foreground or middle-ground distance.

No developed parks or recreation areas are located within the visual resources study area. Travel routes in the visual resources study area include CR 63, CR 23N, and BLM 3215. Portions of the LC East area will be visible from Sooner Rd with a minimum spacing between the wellfields and the public road of about 1 mile. The only buildings to be installed within the LC East area will consist of relatively small header houses which will be painted to blend in with the background. There are no residences within the visual resources study area since the nearest residence is in Bairoil about 15 miles to the northeast.

The Project is approximately 28 miles from the Ferris Mountain Wilderness Study Area, but no Wilderness Areas or Areas of Critical Environmental Concern are located within the visual resources study area. The Permit Area is within proximity of recreation areas, but these activities, such as hiking, sight-seeing, antler collecting, OHV use, hunting, and wild horse viewing are dispersed.

The Permit Area is not visually pristine or of special visual interest. The sole visually sensitive receptors within the visual resources study area are a small number of dispersed recreationists. The Permit Area has been designated VRM Class III by the BLM (BLM, 2004c; Rau, P. Recreation Specialist, BLM Rawlins Field Office. Personal communication. 2007), and the Project would be compatible with this use.

3.10.3 References

Bureau of Land Management (US). 1984. Visual resource inventory [Internet]. Manual No. H-8410-1. Available from: http://www.blm.gov/nstc/VRM/8410.html#Anchor-23240

Figure 3.10-1 North site looking East

Figure 3.10-2 North site looking North

Figure 3.10-3 North site looking West

Figure 3.10-4 North site looking South

Figure 3.10-5 South site looking East

Figure 3.10-6 South site looking North

Figure 3.10-7 South site looking West

Figure 3.10-8 South site looking South

Section 3.11
Socioeconomic Conditions

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3.11 Socioeconomic Conditions

This section provides a description of the existing population and economy of the Permit Area, including LC East, and nearby regions within 50 miles (80 kilometers [km]) of the Permit Area, which includes the potentially affected communities of Rawlins, Sinclair, Bairoil, and other outlying towns in Carbon and Sweetwater Counties, Wyoming.

3.11.1 Demographics

Table 3.11-1 presents the demographic information for Sweetwater and Carbon Counties and **Figure 3.11-1** shows the population centers within a 50-mile (80-km) radius from the center of the Permit Area. The information for Jeffrey City is from the 2000 census. As seen in the figure, the Project is located in a remote area in the Great Divide Basin, with Bairoil being the closest town to the Permit Area. There are no population centers within two miles of the Permit Area.

Table 3.11-2 shows the population distribution by race for the environmental justice analysis. Minority populations within the study area, will not be disproportionately affected as the nearest resident to the mine is about 15 miles away.

3.11.1.1 Sweetwater County

As shown in **Table 3.11-1**, the Sweetwater County population in 2010 was 43,806 people, up (16.5 percent) from 37,613 in 2000. According to US Census Bureau estimates, the population of Sweetwater County increased slightly (1.9 percent) between the 2010 census and 2015 (Census Bureau, 2010).

According to the 2010 census, Sweetwater County had a population density of 4.2 people per square mile. According to the 2000 census, 89.1 percent (33,512 people) of the population lived in urban clusters. Of the 4,101 rural residents, only 416 (10.1 percent of rural residents, 1.1 percent of county residents) resided on farms. Bairoil is the community in Sweetwater County nearest to the Permit Area.

For Bairoil, including incorporated and unincorporated areas, the population was 106 in the 2010 census with 2.16 persons per household. Bairoil is an example of an oil and gas boom-and-bust town. The population of Bairoil was 228 people in the 1990 and then fell to 97 in the 2000 census. Subsequently, with the rise and fall of oil and gas prices and the sale of oil properties to Merit Energy Company and then in July 2014 to Memorial Production Partners, many people have moved from Bairoil. Amoco Production Company once required all employees who worked in Bairoil to live in the town.

3.11.1.2 Carbon County

As shown in **Table 3.11-1**, the Carbon County population increased by 1.6 percent between 2000 and 2010. The Carbon County population declined by 6.1 percent between 1990 and 2000. The Wyoming census population estimates for 2020 show that Carbon County will continue to increase in population. However, a recent downturn in oil and gas prices may result in diminished economic growth which could impact the population trend.

Rawlins and Sinclair are the Carbon County communities that are most likely to be affected by the Project. As summarized in **Table 3.11-1**, growth in Rawlins is on the upswing. The population of Rawlins has increased by 8.4 percent from 2000 to 2010 to a population estimate of 9,259 people. The estimated 2010 population in Sinclair was 433 people. Population forecasts for Sweetwater and Carbon Counties are shown in **Table 3.11-1**.

3.11.2 Economic Trends and Characteristics

The economy in Carbon and Sweetwater Counties has historically depended on industrialized activities, including mining, oil and gas development, power generation, related services, and agricultural activity, including grazing and farmland. Recently, the service and trade sectors have become increasingly important in providing services to the growing population. Many of the service sector jobs are directly and indirectly associated with oil and gas development. In the recent past, oil, gas, and coal prices have significantly declined resulting in higher unemployment and reduced severance and ad valorem taxes. This trend has placed a burden on counties and the state with all levels of government reducing their budgets and associated services.

3.11.2.1 Employment Sectors and Industry Income

In 2003, the mining sector employment (including oil and gas) was not disclosed for Sweetwater County, but represented 1.9 percent of the 9,580-person workforce in Carbon County. Besides retail trade, other important sectors in Sweetwater County included services (21 percent) and government (17 percent). In Carbon County, services represented 28 percent, retail represented 12 percent and government represented 23 percent of the total employment. Many of the employment sectors have shown growth during the 13-year period between 1990 and 2003 for the counties included within the study area. Much of the increase in employment in the mining and service sectors has been filled by workers who have moved into the area either from other parts of Wyoming or from outside of the State of Wyoming. For every direct mining sector job created, additional service jobs are also created. Jobs in the mining and related gas service sectors are competing for workers in the lower paying jobs. Many government, retail, and other service workers are leaving the lower paying jobs to work in the mining sector. All cities and towns are having a hard time finding minimum-wage workers or workers for the lower paying jobs, including police, sheriff, and public works departments (Allen, D. Business Development Specialist, City of Rawlins. Personal communication. March, 2006).

Wyoming's mining and minerals sector contributes more to Gross State Product (GSP) than any other sector of the economy (State of Wyoming Dept. of Administration and Information, 2010). Minerals (including oil and gas) accounted for 33.2 percent of Wyoming's Gross State Product (GSP), or over $11.7 billion in 2008, and supported approximately 35,627 full-time wage earners, or 8.8 percent of Wyoming's employment base economy (State of Wyoming Dept. of Administration and Information, 2010). In 2008, government-led industry income provided 12.7 percent of income, followed by real estate and rental leasing (7.1 percent), construction (6.1 percent), and transportation and warehousing (6.0 percent). Based on statistics available (State of Wyoming Dept. of Administration and Information, 2010), farm earnings declined from $99,558 million in 2002 to $81,814 thousand in 2008. Mining experienced a boom during the same time period with earnings of $1,415,656 thousand in 2002 growing to $3,098,339 thousand in 2008. Economic data covering the recent decline in oil and gas, coal, and uranium prices wasn't available.

In 2008, Sweetwater County's personal income generated by the mining sector led other industries by generating $637 million which represents approximately 32% of the county's personal income. Government jobs provided $238 million, construction jobs provided $206 million and transportation and warehousing provided $142 million of personal income respectively (State of Wyoming Dept. of Administration and Information, 2010).

In 2008, Carbon County's income generated by the government sector, $115 million, led other industries (17 percent of the total). Total mineral extractions provided six percent of the industry income; $41 million. Transportation and warehousing (seven percent) and construction (fifteen percent) were also important sectors in income generation (State of Wyoming Dept. of Administration and Information, 2010).

Both labor force and employment have increased in Sweetwater and Carbon Counties from 2000 to 2016, as seen in **Table 3.11-3**. Labor force statistics reflect employment by residence, unlike employment by sector statistics, which reflect employment by work location.

The labor force in Sweetwater County increased from 20,714 to 22,149 laborers, a seven percent increase, from 2000 to 2016. In recent years, the unemployment rate throughout the region may have fluctuated due to seasonal employment. The months with highest unemployment are typically December through March. The average annual unemployment rate in 2000 in Sweetwater County was 4.0 percent, compared to 6.6 percent in 2010 and 4.6 percent in 2015. The high and low monthly unemployment rate between 1991 and 2015 ranged from 1.9 % in December 2007 and 8.7% in January 2010 (Homefacts, 2016). The unemployment rate in October 2016 was 5.3%.

The labor force in Carbon County increased from 8,094 in 2000 to 8,530 in October 2016 (**Table 3.11-3**). The average annual unemployment rate in 2000 in Carbon County was 4.3 percent, compared to 6.7 percent in 2010 and 3.6 percent in 2015. The high and low monthly unemployment rate between 1991 and 2015 ranged from 2.4% in October 2007 and 8.4% in January 2010 (Homefacts, 2016). The unemployment rate in October 2016 was 4.0%.

Income levels throughout the study area are diverse. The most recent estimate of per capita personal income for major industries was $42,772 in Carbon County and $50,015 in Sweetwater County in 2008 (State of Wyoming Dept. of Administration and Information, 2010). These numbers are fairly consistent with the economic base of the area, which is mineral resource and agriculturally driven. The most recent poverty status estimates were made by the U.S. Census Bureau in 2014 show a poverty rate of 9.8 percent in both Carbon and Sweetwater counties (Census Bureau, 2010). Since the economic base of the study area is largely rural-agriculture and resource-extraction based, low income areas are dispersed within the study area.

3.11.3 Other Resources

3.11.3.1 Housing

The existing housing situation is difficult to characterize quantitatively with any degree of certainty since the status of the housing market and availability is changing constantly. The effect on housing demand from the oil and gas industry has had a significant impact on the availability and price of both owner-occupied and rental units. Recent declines in oil and gas, coal and uranium prices has resulted in slightly higher unemployment which in turn has increased the availability of housing. Because some of the LC ISR, LLC employees may reside in Casper, discussion of housing in Natrona County is included.

According to the Wyoming Housing Database Authority, Carbon county had 2,399 housing units in 2014 of which 219 or 9.1 percent were for rent and 187 or 7.8 percent were for sale. Sweetwater County had 2,103 housing units in 2013 pf which 509 or 24.2

percent were for rent and 128, or 6.1%, were for sale (WCDA, 2016). The average rents are shown in **Table 3.11-4** for Carbon, Sweetwater, and Natrona Counties for 2005 and 2010 (WCDA, 2016). The average single-family sale price in 2015 was lowest in Carbon County ($187,001) and highest in Sweetwater County ($245,919). The average sales price in Natrona County was $230,430 (WCDA, 2016).

The expansion of the project to incorporate LC East and the KM Horizon at Lost Creek will not require a significant number of new employees since the flow rate will not change appreciably. The introduction of product for toll milling may require an additional dryer operator in order to keep up with processing. Since the total number of employees is expected to remain about the same, there is no reason to expect an impact on local housing.

3.11.3.2 Public Facilities and Services

Bairoil and Wamsutter are the two nearest towns in Sweetwater County to the Permit Area. Sweetwater County provides the typical county government services, including county assessor, county attorney, county commissioners, treasurer, road and bridge, engineering, planning, landfill, emergency management, health and human services, sheriff, search and rescue, parks and recreation, museum, libraries, and community arts center. Bairoil and Wamsutter provide similar municipal services, including administration, public works, police, fire, and parks and recreation services. The landfill is located in Wamsutter.

In Carbon County, the communities of Rawlins, Sinclair, and other outlying areas would potentially be affected by the Project. Carbon County provides the typical county government services, including county assessor, county attorney, county commissioners, treasurer, road and bridge, planning, emergency management, public health, and sheriff.

Law Enforcement and Fire Protection

The Carbon County Sheriff has an office and 74 jail beds in Rawlins, a substation in Medicine Bow, a deputy in Baggs, and a part-time deputy in Saratoga. The sheriff's office has 17 patrol officers, 23 detention deputies, seven full-time and three part-time dispatchers, and 11 other employees. The sheriff covers a service area of 8,000 square miles. The sheriff's department is adequately staffed and will possibly add a patrol officer this year to handle the slight increase in calls caused by the increases in oil and gas activity in the area (Colson, J. Sheriff, Carbon County Sheriff's Office. Personal communication. March, 2007; Morris, M. Deputy Sheriff, Carbon County Sheriff's Office. Personal communication. March, 2007). Rawlins has a police department with one chief, two detectives, 12 patrol officers, and 19 additional staff employees. All law enforcement offices have 911 emergency telephone services. Fire protection is provided by Rawlins Fire Department, which has eight paid staff and 15 volunteers in the area. The fire department has two fire stations, a training center, five engines, a wildland engine, and a rescue truck.

Law enforcement near the Project Area is primarily provided by the Bairoil Police Department, which consists of one police officer. The department provides law enforcement for Bairoil and the surrounding unincorporated area of the Sweetwater County Sheriff's Department. This area is 165 square miles and extends 20 miles west and 15 miles south of Bairoil. Fire protection is provided by the Bairoil Volunteer Fire Department, with a station in Bairoil.

Law enforcement in Wamsutter area is currently provided by the Sweetwater County Sheriff's Department; a deputy patrols the town daily. Two Wyoming Highway Patrol officers also live in Wamsutter. Wamsutter has positions for two part-time police officers, but the positions are currently vacant; and the town has not been able to hire officers for the positions (BLM, 2006). Emergency response services are provided by 15 volunteer emergency medical technicians (EMTs) operating one ambulance and ten volunteer firefighters operating two fire trucks.

The volunteer fire and ambulance services provide coverage to surrounding oil and gas operations, and both services may have difficulty responding to more than one emergency at the same time.

Health Services

Medical services within Carbon County are provided by the Memorial Hospital in Rawlins, a 35-bed acute care facility served by a 24-hour ambulance service. The hospital has five physicians and 105 full-time equivalent employees. Rawlins also has a Public Health Department, Senior Citizens Center, the South Central Wyoming Health Care and Rehabilitation, Senior Citizens apartment complex, and various private health care providers. No routine medical care is available in either Bairoil, however, a doctor visits the town once per week. Sweetwater County is served primarily by the Memorial Hospital of Sweetwater County in Rock Springs, which has 99 beds. The study area is served by Memorial Hospital in Rawlins.

Education

Sweetwater School District Number One serves Wamsutter. Wamsutter has one school with an enrollment of 41 students in K-6 in 2016. Carbon County School District Number One provides educational services to the Rawlins and Bairoil area. The total enrollment in the district is about 3,500 according the districts website. The district has five elementary schools, two middles schools and two high schools. Bairoil and Sinclair have elementary schools. Bairoil has one elementary school with five students. Rawlins has the Carbon County Higher Education Center, which provides continued and extended education courses on-line. Some school capacities are being met, and additional school capacity may be required if economic activity in the area brings in more families.

Utilities

Rawlins provides water, sewer, landfill, and recycling services for its residents and businesses. Rocky Mountain Power provides electric service to all areas, and Black Hills Energy provides natural gas to the community. The infrastructure in Rawlins has a capacity for increased population, as well as commercial and industrial growth. Bairoil provides water service for residents and businesses. The landfill is located in Wamsutter, but has a transfer station in Bairoil.

Qwest is the provider of telephone services. Wireless communications are provided by Verizon, Union Wireless and T-Mobile. Digital switching and fiber-optic systems are available. Local internet access is provided by Charter and Centrylink.

Other

Other services in Carbon County include a public library, senior services, daycares, and recreation facilities, and services including a recreation center in Rawlins, golf courses, parks, ball fields, bike trails, and an airport. Other community services in Wamsutter consist of a town attorney and engineer, library, recreation center, and city park. Although the transient drilling and field development population in Wamsutter can be substantial from time to time, their demands on local government facilities and services have generally been minor (Wyoming Business Council et al., 2002).

Transportation infrastructure is discussed in **Section 3.2** of this report.

3.11.3.3 Taxes and Revenues

Financial resources of the study area refer to government revenue sources from local and state taxes on the production of natural resources in Carbon and Sweetwater Counties. These statistics are useful in helping to determine the financial impacts of industrial development on the counties potentially affected. Both counties will directly benefit from the increased tax base provided by the Project. Both counties also could be financially impacted by secondary growth from residential development, increased retail sales, and increased demands on public services and facilities.

The minerals industry accounts for a substantial share of revenues to the state and to local governments in Wyoming. Produced minerals are classified as personal property, and mineral producers pay two types of taxes: 1) the county property (ad valorem-gross products) tax on production and 2) the state severance tax. Producers pay county property (ad valorem) taxes on plants, refineries, mining and well head equipment, pipelines, and other facilities used in the mineral production and transportation operations. A severance tax is an excise tax imposed on the present and continued privilege of removing, extracting, severing, or producing any mineral in Wyoming. Severance taxes are distributed according to Wyoming Statute (WS) 39-14-801. The Permanent Wyoming Mineral Trust Fund (PWMTF) is a fund that holds 25 percent of all severance taxes currently received by the State of Wyoming, functioning like a savings account.

Local and state government fiscal conditions that would be affected by development of the Project include: ad valorem property tax revenues of Sweetwater and Carbon Counties, Sweetwater County School District Number One, and certain special districts; sales and use tax revenues of the state, county, and municipalities; state severance taxes; and state gross products tax.

As of June 2016, the State Treasurer's office currently manages $7.3 billion in the Permanent Wyoming Mineral Trust Fund, $3.7 billion in the Permanent Land Funds, $566.8 million in the Hathaway Scholarship Endowment Fund, $116.9 million in the Excellence in Higher Education Endowment Fund, and $1.9 billion in the Worker's Compensation Fund and $5.9 billion in the State Agency Pool (Wyoming State Treasurer's Office, 2016). The corpus of the Permanent Wyoming Mineral Trust Fund only grew by $227 million in fiscal year 2016 compared to $346.5 million the previous fiscal year. This is a direct reflection on the depressed marker for several of Wyoming's important minerals including oil and gas, coal, and uranium.

Carbon County's tax valuation for 2016 is $591.5 million (Carbon County Assessor, 2016). Sweetwater County's tax valuation for 2016 is $2.3 billion (Sweetwater County Assessor, 2016) of which $19.5 million was for uranium. The severance tax rate for uranium, established by the state, is 4% of the spot market price (Wyoming Statute Title 39). Uranium mining companies must also pay ad valorem taxes at a rate of 4% adjusted by an industry factor established by the state (0.311% in 2016).

The 2016 Wyoming Department of Revenue Annual Report indicates that in 2016, coal production contributed the greatest proportion of taxable value to the state ($3.7 billion), followed by oil ($3.3 billion), natural gas ($2.9 billion), and trona ($483 million). The valuation for uranium was $65 million. The total statewide valuation was $12.1 billion in 2016.

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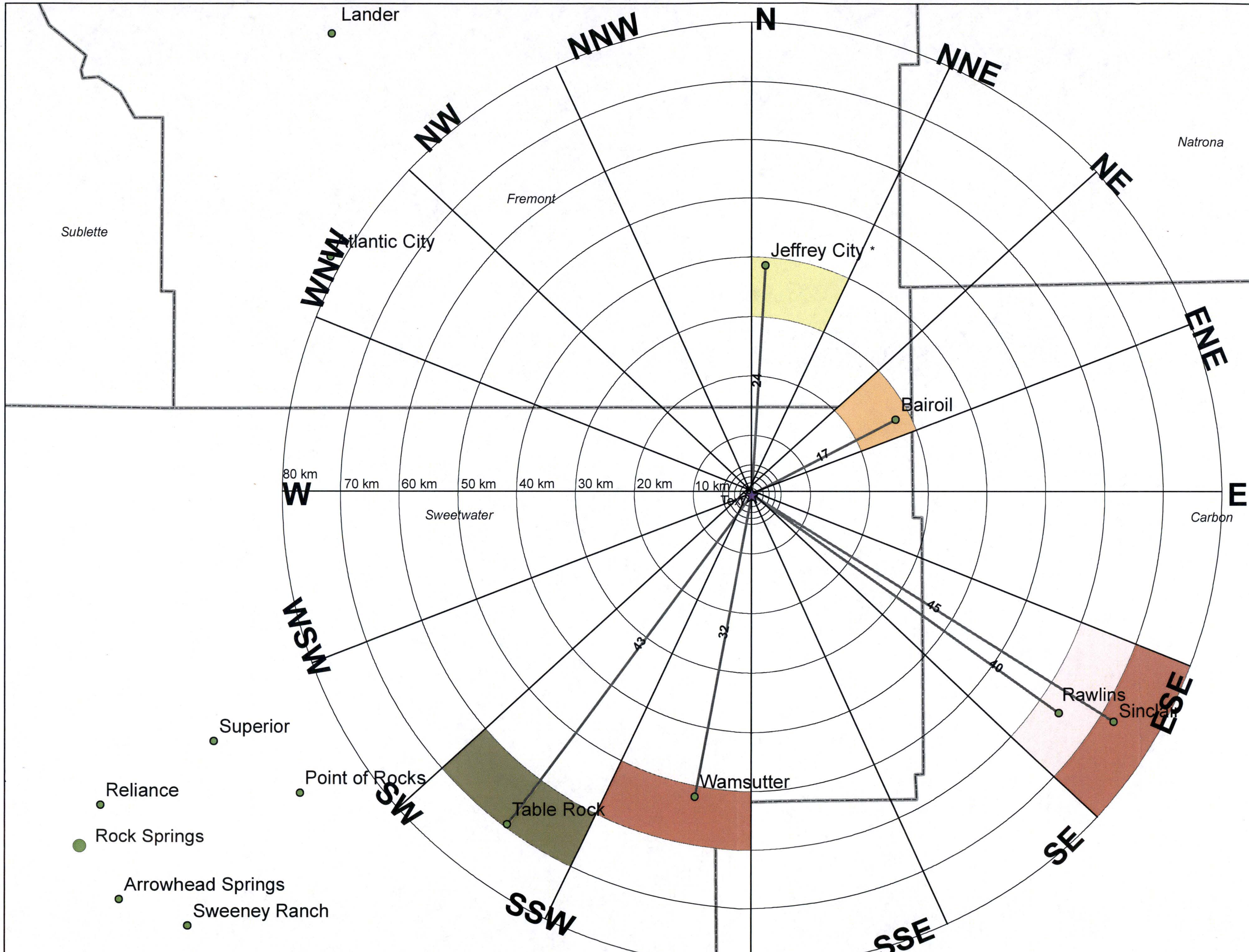

Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

Legend

Lost Creek Permit Area

County Border

Population Density (persons / square mile)

12

13 - 62

63 - 125

126 - 250

251 - 1500

POPULATION

0 - 10000

10001 - 25000

25001 - 50008

FIGURE 3.11-1
SIGNIFICANT POPULATION CENTERS WITHIN 80 KILOMETERS
Lost Creek Permit Area

Issued For: NRC ER Drawn By: EB

Issued/Revised: 10.16.07

Drawing No: NRC-ER-3.11-1-10.16.07-EJS

0 3 6 12 Miles

*Population density for unincorporated Jeffrey City is approximate because the area is undefined

Table 3.11-1 Demographic Information

Location	Population			Change in Population (Percent)		Projected Population		
	1990 [1,2]	2000 [2]	2010	1990 to 2000	2000 to 2010	2020	2025	2030
US (thousands)	248,709	281,421	308,746[3]	13.2	9.7	334,503[5]	347,335[5]	359,402[5]
Wyoming	453,588	493,782	563,626[4]	8.9	14.1	616,140[4]	642,870[4]	665,670[4]
Sweetwater County	38,823	37,613	43,806[4]	- 3.1	16.5	47,630[4]	49,300[4]	50,510[4]
Bairoil	228	97	106[4]	- 57.5	9.3	115[4]	119[4]	122[4]
Wamsutter	NA	261	451[4]	NA	72.8	490[4]	508[4]	520[4]
Carbon County	16,659	15,639	15,885[4]	- 6.1	1.6	16,210[4]	16,390[4]	16,340[4]
Rawlins	9,380	8,538	9,259[4]	- 9.0	8.4	9,448[4]	9,553[4]	9,524[4]
Sinclair	500	423	433[4]	- 15.4	2.4	442[4]	4474	445[4]
Other								
Casper	46,765	49,644	55,316[4]	6.2	11.4	69,480[4]	72,486[4]	74,9864

[1] Source: WDAI (2000).
[2] Source: WDAI (2001a).
[3] U.S. Census Bureau website accessed on 12/15/16, Annual Estimate of the Population of the U.S. Regions, and States: April 1, 2010to July 1, 2015, http://eadiv.state.wy.us/pop/st-15est.htm
[4] WY Dept. of Administration and Information Economic Analysis Division website accessed on 12/5/16, Population Forecasts for Wyoming, Counties, and Towns for 2015-20140, http://eadiv.state.wy.us/pop/wyc&sc40.htm
[5] U.S. Census Bureau website accessed on 12/5/16, 2014 National Population Projections, http://www.census.gov/population/projections/data/national/2014/summarytables.html

Table 3.11-2 Population Distribution *

Percent of Population	Carbon County	Sweetwater County
Persons Below Poverty Level (2014) (1)	Estimated 1,913	Estimated 4,373
Percent Below Poverty (2014) (1)	12.3 percent	9.8 percent
White (2010) (2)	80.0 percent	81.0 percent
Black (2010) (2)	0.7 percent	1.00 percent
American Indian (2010) (2)	0.8 percent	0.7 percent
Asian (2010) (2)	0.7 percent	0.7 percent
Native Hawaiian or Pacific Islander (2010) (2)	0.1 percent	0.1 percent
Hispanic Origin (of any race) (2010) (2)	16.8 percent	15.3 percent

(1) U.S. Census QuickFacts website accessed on 12/5/16 at http://www.census.gov/quickfacts/table/PST045215/56007,00 and http://www.census.gov/quickfacts/table/PST045215/56037,56007,00

(2) Wyoming Department of Administration and Information Economic Analysis Division website accessed on 12/5/16, Table 10. Distribution of the Resident Population by Race and Hispanic Origin for the U.S., Wyoming and Counties: April 1, 2010 Census, http://eadiv.state.wy.us/pop/CO_RO_Alone15.htm

Table 3.11-3 Labor Force Statistics

Location/Year	Labor Force	Employment	Unemployment	Unemployment Rate
Carbon County				
1990 (1)	8,825	8,366	459	5.2
2000 (1)	8,094	7,757	337	4.2
October 2016 (2)	8,530	8,188	342	4.0
Sweetwater County				
1990 (1)	20,354	19,281	1,073	5.3
2000 (1)	20,714	19,890	824	4.0
October 2016 (2)	22,149	20,983	1,166	5.3

(1) Wyoming Department of Employment, Research and Planning (2006).

(2) Wyoming Department of Employment website accessed on 12/5/16 at http://doe.state.wy.us/lmi/news.htm

Table 3.11-4 Average Rental Rates*

County	Apartments [1]			Mobile Home Lot [2]			House [3]			Mobile Home [4]		
	2005	4th Qtr. 2010	Percent Change	2005	4th Qtr. 2010	Percent Change	2005	4th Qtr. 2010	Percent Change	2005	4th Qtr. 2010	Percent Change
Carbon	$507	$671	24.4	$128	$278	54.0	$546	$792	31.1	$396	$733	46.0
Sweetwater	$512	$688	25.6	$214	$319	32.9	$673	$932	27.8	$594	$801	25.8
Natrona	$441	$676	34.8	$189	$314	39.8	$719	$1,035	30.5	$527	$598	11.9
Statewide Average	$504	$651	22.6	$203	$281	27.8	$693	$928	25.3	$505	$619	18.4

* Wyoming Housing Database Partnership

[1] Two-bedroom, unfurnished, excluding gas and electric.

[2] Single-wide, including water.

[3] Two or three-bedroom, single family, excluding gas and electric.

[4] This price reflects total monthly rental expense, including lot rent.

Section 3.12

Background Radiation

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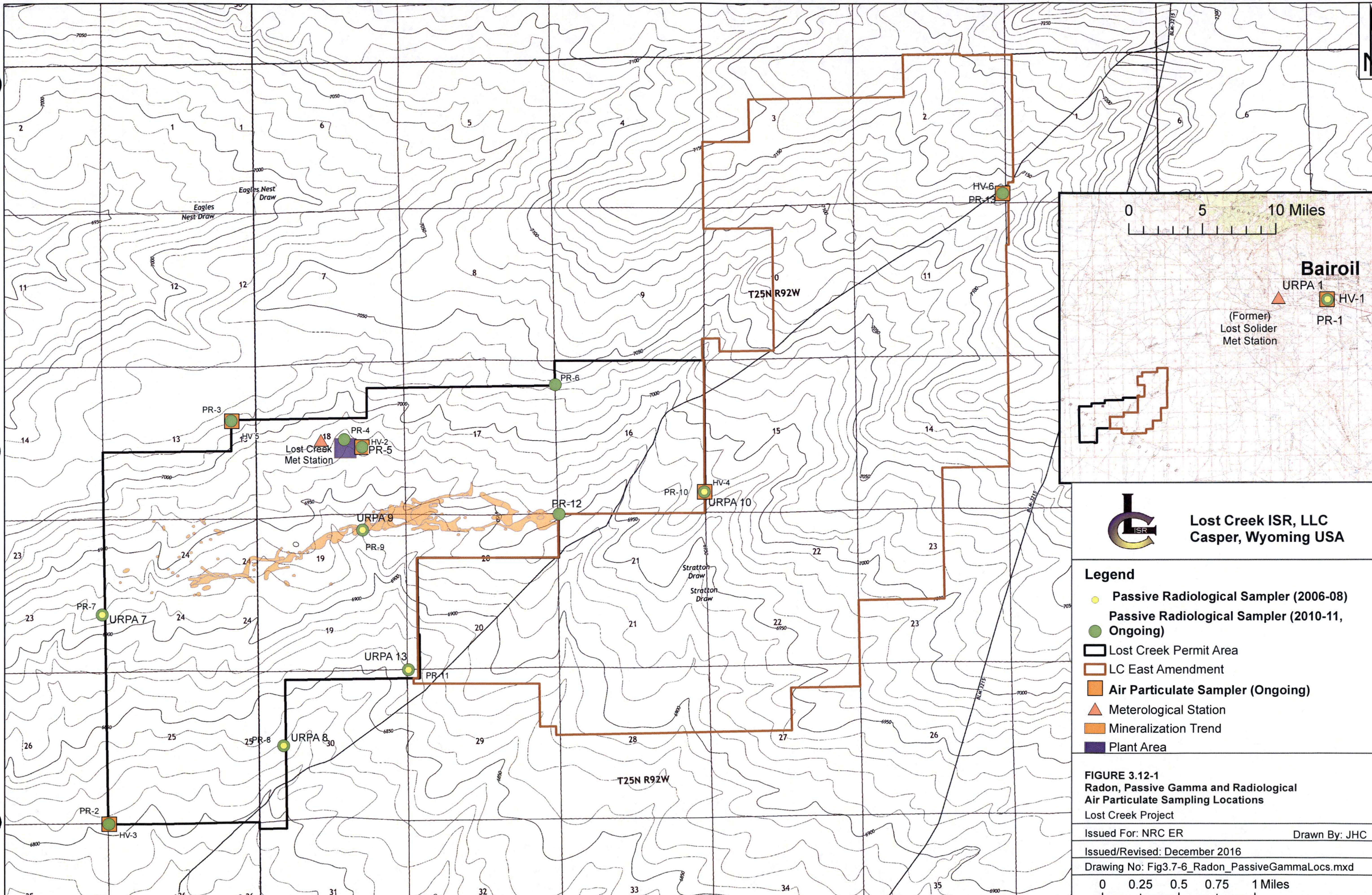
3.12 Background Radiological Characteristics

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 3.12-1**). Radiological analysis was completed on quarterly groundwater and stormwater samples, and the results are presented in **Section 3.5**. The results of natural gamma readings collected from OSLs, airborne radionuclides sampled by a high volume air station, Rn-222 readings from track etch cups and soil radionuclide chemistry are presented in **Tables 3.12-1, 3.12-2, 3.12-3 and 3.12-4** respectively. Additional soil radionuclide chemistry can be found in **Attachment 3.12-1**. Figure **3.12-1** provides the location of the sampling points. The revised MILDOS model is included as **Attachment 3.12-2**.

The results of the radiologic sampling program at LC East are consistent with the findings at Lost Creek. Because there is no perennial surface water in the Permit Area, sediment sampling was not conducted.



Document Path: S:\GIS\LC_East\Figure3.12-1_Radon_PassiveGammaLocs\v104\Fig3.12-1_Radon_PassiveGammaLocs.mxd

Table 3.12-1 Direct Gamma Using OSL Badges

Location	Year	Quarter	Gross Gamma (mrems)	Net Gamma (mrems)
HV6	2012	12Q4	49.2	26.20
	2013	13Q1	49.90	22.4
	2013	13Q2	59.80	29.5
	2013	13Q3	56.70	26.0
	2013	13Q4	63.90	24.4
	2014	14Q1	41.30	15.2

Table 3.12-2 High Volume Air Sampling Results

Year	Qtr.	Location	Start Date	End Date	Volume (mL)	U-nat (uCi/mL)	U-nat MDC	Th-230 (uCi/mL)	Th-230 MDC	Ra-226 (uCi/mL)	Ra-226 MDC	Pb-210 (uCi/mL)	Pb-210 MDC
2012	4	HV6	10/3/12	12/26/12	3.47E+09	1.57E-16	N/A	1.42E-16	7.60E-17	1.98E-16	8.21E-17	2.39E-14	2.40E-15
2013	1	HV6	12/26/12	3/28/13	3.79E+09	1.00E-16	N/A	1.68E-16	1.59E-16	5.63E-17	1.29E-16	2.34E-14	1.59E-15
2013	2	HV6	3/28/13	7/3/13	3.85E+09	1.00E-16	N/A	7.92E-17	5.56E-17	6.37E-17	7.71E-17	1.51E-14	1.46E-15
2013	3	HV6	7/3/13	9/23/13	3.51E+09	1.00E-16	N/A	2.5E-16	5.0E-17	4.6E-17	1.4E-16	1.8E-14	1.7E-15
2013	4	HV6	9/23/13	12/26/13	4.26E+09	1.00E-16	N/A	8.8E-17	4.0E-17	6.4E-18	9.5E-17	1.8E-14	1.3E-15
2014	1	HV6	12/26/13	3/31/14	2.11E+09	9.50E-17	N/A	1.50E-16	1.00E-16	1.20E-16	6.00E-17	6.10E-15	4.00E-15

Table 3.12-3 Radon Track Etch Cup Results

Location	Year	Quarter	Radon-222 Concentration (pCi/l)	Concentration Error	Radon-222 Exposure (pCi/l-days)	Exposure Error
PR-13	2012	12Q4	0.3	0.03	30.0	---
PR-13	2013	13Q1	2.0	0.14	155.1	10.90
PR-13	2013	13Q2	1.1	0.08	103.9	8.10
PR-13	2013	13Q3	1.2	0.09	118.6	8.60
PR-13	2013	13Q4	1.7	0.11	165.1	10.50
PR-13	2014	14Q1	0.6	0.06	43.0	4.07

Table 3.12-4 Soil Chemistry at Sample Point HV-6

Date	Moisture (wt %)	Uranium (mg/kg-dry)	Pb-210 (pCi/g-dry)	Ra-226 (pCi/g-dry)	Th-230 (pCi/g-dry)
6/22/2015	0.5	1.9	0.7	1.3	0.6
5/12/2016	7.4	1	0.8	1.3	0.7

Baseline Radiological Survey Report

Lost Creek East In-Situ Uranium Mine
Sweetwater County, Wyoming

Prepared for:

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Tetra Tech Project No. 114-182274

September 6, 2013

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ACRONYMNS

Acronym	Definition
AEA	asset exchange agreement
DQO	data quality objectives
GPS	Global positioning system
HASP	health and safety plan
HPIC	high-pressure ionization chamber
ISR	*in-situ* recovery
LCRA	Lower Colorado River Authority
MARRSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NRC	U.S. Nuclear Regulatory Commission
NUREG	U.S. Nuclear Regulatory Commission Regulation
QA/QC	Quality Assurance / Quality Control
μR/hr	micro-Roentgen per hour
UTVs	utility-terrain vehicles
WDEQ	Wyoming Department of Environmental Quality

1.0 INTRODUCTION

Tetra Tech prepared this report on behalf of Lost Creek ISR, LLC to support their radioactive materials license and permit applications with the U.S. Nuclear Regulatory Commission (NRC) and the Wyoming Department of Environmental Quality / Land Quality Division (WDEQ/LQD) for the Lost Creek East *in-situ* recovery (ISR) project. This report is intended to be an addendum to the permit application.

Lost Creek ISR submitted an application to the NRC for a new source material license for the Lost Creek ISR Project via a letter dated March 31, 2008. In 2012, the Lost Creek property area expanded by way of an asset exchange agreement (AEA). This AEA provided the transfer of specific federal mining claims and State of Wyoming mineral leases located in the immediate vicinity of Lost Creek Project including the Lost Creek East Project which is the subject of this report.

An NRC source and byproduct materials license is required to recover uranium via ISR extraction techniques under the provisions of Title 10 U.S. Code of Federal Regulations, Part 40 (10 CFR Part 40), "Domestic Licensing of Source Material." Guidance for radiological surveys at uranium recovery sites can be found in NRC Regulatory Guide 4.14 (NRC, 1980). While not specific to ISR facilities, the NRC and the WDEQ/LQD recommend using this guidance during baseline surveys of ISR sites (NRC, 1982). Tetra Tech staff conducted the Lost Creek East site surveys in accordance with this guidance. Some aspects of Regulatory Guide 4.14 guidance were modified to apply technology improvements developed since the guide was drafted in the 1970s.

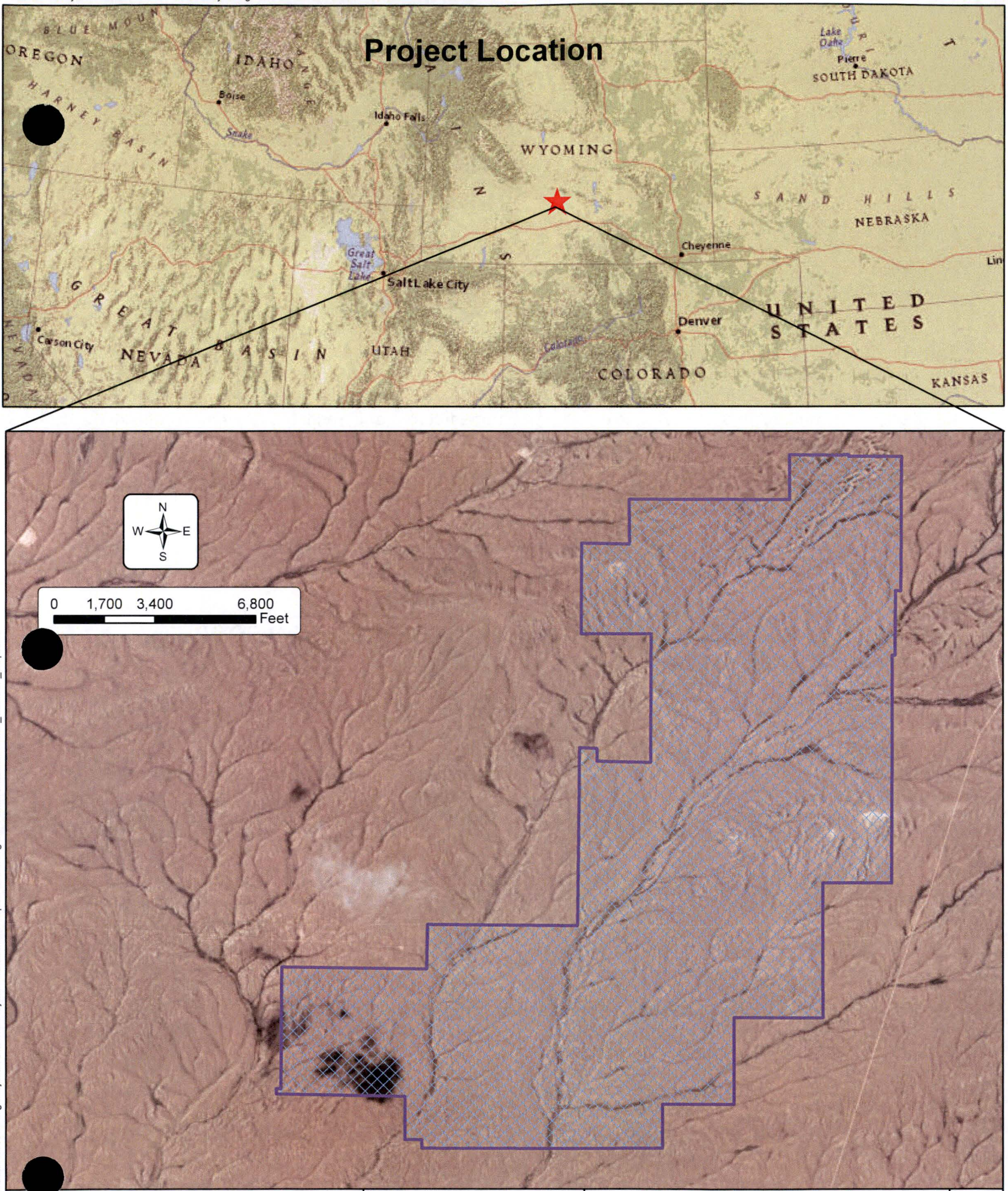
Consistent with ISR permit application guidelines described in Regulatory Guide 3.46 (NRC, 1982) and U.S. Nuclear Regulatory Commission Regulation (NUREG) 1569 (NRC, 2003), as well as the method outlined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, 2000), Tetra Tech employed scanning technology capable of providing relatively high density gamma measurements across large areas. This scanning system can be mounted in various configurations, including backpacks and utility-terrain vehicles (UTVs), and has been used in the United States and abroad for site characterization applications.

Previous baseline radiological and environmental studies in support of permitting the currently operating Lost Creek project were conducted in 2006. Baseline studies for an additional 5,700 acres, located to the east of current operations, were conducted in September and October of 2012. The following sections of this report describe survey methods, activities, and results of the additional acreage.

2.0 SITE DESCRIPTION

The Lost Creek East ISR Project is located in the northeast portion of Sweetwater County, in south-central Wyoming. The area studied is located in the Great Divide Basin, approximately 40 miles north of Rawlins, Wyoming and covers approximately 5,700 acres. Figure 1 shows the project location and vicinity. The Site is approximately 21 miles from the nearest major highway (Highway 73), with a transportation network within the Site consisting of rough, two-track roads. Topography on the Site is characterized by low relief and rolling landscapes. Vegetation is dominated by sagebrush with no forested areas present on the Site. There are no perennial surface waters present; however, the Site is dissected by a small ephemeral drainage network.

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



Legend:

★ Site Location

Lost Creek East Permit Boundary

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(970) 223-9600 (970) 223-7171 fax

Lost Creek East ISR
Permit Boundary Map

2
Revision

Project: Lost Creek East	Project no.: 114-182274	Figure 1
Location: Sweetwater County, Wyoming	August 2013	

Path: X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 1 Lost Creek East Site_Location_Map.mxd

3.0 PREVIOUS SITE INVESTIGATIONS

Baseline environmental studies at the Lost Creek area began in January 2006. As part of the studies, Tetra Tech (formerly MFG, Inc.) performed a radiological baseline survey of naturally occurring gamma exposure rates and soil radionuclide concentrations beginning in August 2006. The information collected during the 2006 survey was presented in the report titled "Baseline Gamma Survey and Radiological Soil Sampling Results for the Lost Creek Claim Area" submitted to the client on June 30, 2007 (Tetra Tech, 2007a).

The methods and procedures utilized during the 2006 gamma exposure rate survey were similar to those used in the 2012 survey; although, updated vehicle mounting hardware used in 2012 produced a modified radiation detector orientation as compared to 2006. Because modifying detector orientation can cause changes in shielding and detector efficiency characteristics, and because radon daughter product gamma radiation intensity can vary over time as a result of environmental factors including soil moisture, temperature, and recent barometric pressure history, a comparison study plot was scanned to compare 2006 and 2012 instrument readings. The results of this comparison study are included in Section 5.0 and were used to develop a correction ratio between the two sets of results, allowing them to be plotted and analyzed together.

The study area for the 2006 survey comprised 4,400 acres. The study results indicated significant variability in gamma exposure rates, with localized trends of higher gamma activity evident on the site.

4.0 BASELINE RADIOLOGICAL CHARACTERIZATION SCOPE OF ACTIVITIES

4.1 Data Collection Objectives

Developing spatial characterization of radionuclide concentrations in surface soils is useful prior to performing site work that might modify soil radiation characteristics. Without such data, post-operational investigation might be unable to distinguish between pre-existing natural radionuclide distributions versus contamination caused by operations. The data could inform later discussions as to the need for costly remedial actions.

The sampling methods during the survey are presented in Section 4.2. To decide whether data collection objectives have been met, a Quality Assurance and Quality Control (QA/QC) program was enforced, as discussed in Section 4.3. A data uncertainty and usability assessment was performed to evaluate the overall precision, accuracy, representativeness, comparability, and completeness of the developed data set.

4.2 Baseline Radiological Characterization Survey Methods

4.2.1 Gamma Radiation Survey Methods

In general, the gamma radiation survey methods used during this characterization study were consistent with guidelines outlined in MARSSIM (NRC, 2000). The methods exceed the requirements of the NRC Regulatory Guide 4.14. The radiation survey systems employed UTVs to traverse the site. The UTVs were specially configured to minimize terrain damage.

The UTVs carried Ludlum 44-10 2-inch sodium iodide (NaI) gamma radiation detectors linked to 2350-1 dataloggers and paired global positioning system (GPS) receivers. The permanently paired radiation detector systems are factory calibrated to a cesium-137 (Cs-137) source by Ludlum and report gamma exposure rates in micro-Roentgen per hour (μR/hour), converted via calibration factors from detector count rates. Simultaneous GPS and gamma radiation exposure rate data are transmitted approximately once every second. Data are recorded on laptop computers using proprietary software (ComReader©, Tetra Tech, 2007b). Each detector is positioned approximately 3.5 feet above the ground surface during scanning.

Based on Tetra Tech's previous experience using similar system configurations, each detector has an estimated "field of view" approximately 10 feet in diameter at the ground surface. This does not imply a system detector can discriminate gamma radiation from a small point source five feet away, but does suggest that photons from larger, above-background source areas are distinguishable at that distance. Vehicle scanning speeds generally ranged between two and five miles per hour.

The survey design was based on the data quality objectives (DQOs) developed for pre-license facilities where Tetra Tech has performed similar work. A spacing of 100 meters between scanning tracks was the goal for gamma surveying. Practical considerations, such as steep terrain and natural obstructions, often influenced actual courses maintained by the vehicles. In areas where ore deposits were known to exist or areas where elevated radiation was observed, 50-meter spacing was substituted to provide increased data detail. All field work was performed in accordance with a health and safety plan (HASP) prepared by Tetra Tech prior to the work.

4.2.2 Field Cross-Correlation of NaI Detectors

Sodium-iodide-based detectors are energy dependent. True gamma exposure rates are best measured using an energy-independent system, such as a high-pressure ionization chamber (HPIC), but such systems typically develop data at a rate too slow for efficient field use. The GPS-based NaI systems are useful for ISR mining sites because they can time-efficiently demonstrate differences between pre-mining and post-mining gamma exposure rate conditions, over large areas. In-field cross-correlation of energy-independent detectors versus the energy-independent NaI detectors provides a data set more useful for future site measurements, perhaps taken with different detector systems.

A NaI/HPIC cross-correlation was performed as part of the 2006 baseline radiation survey performed by Tetra Tech. The methods for the cross correlation are outlined in Tetra Tech (2007a). Since, similar NaI instruments and methods were employed during the 2012 survey, no additional NaI/HPIC cross-correlation was determined to be necessary. The result of applying the 2006 cross-correlation equations to the 2012 gamma exposure rate data is presented in Section 6.1.2. Equation 1, below, is a linear regression representing the correlation between NaI and HPIC detectors. It can be used to convert readings collected using a NaI detector, to the equivalent energy independent exposure rates. Figure 2 displays the plotted correlation data used in developing the linear regression. Equation 1 presents the relationship between the mean HPIC reading and the mean NaI readings.

Equation 1: *Mean HPIC Reading (μR/hr) = 0.57*(Mean NaI reading (μR/hr))+6.97*

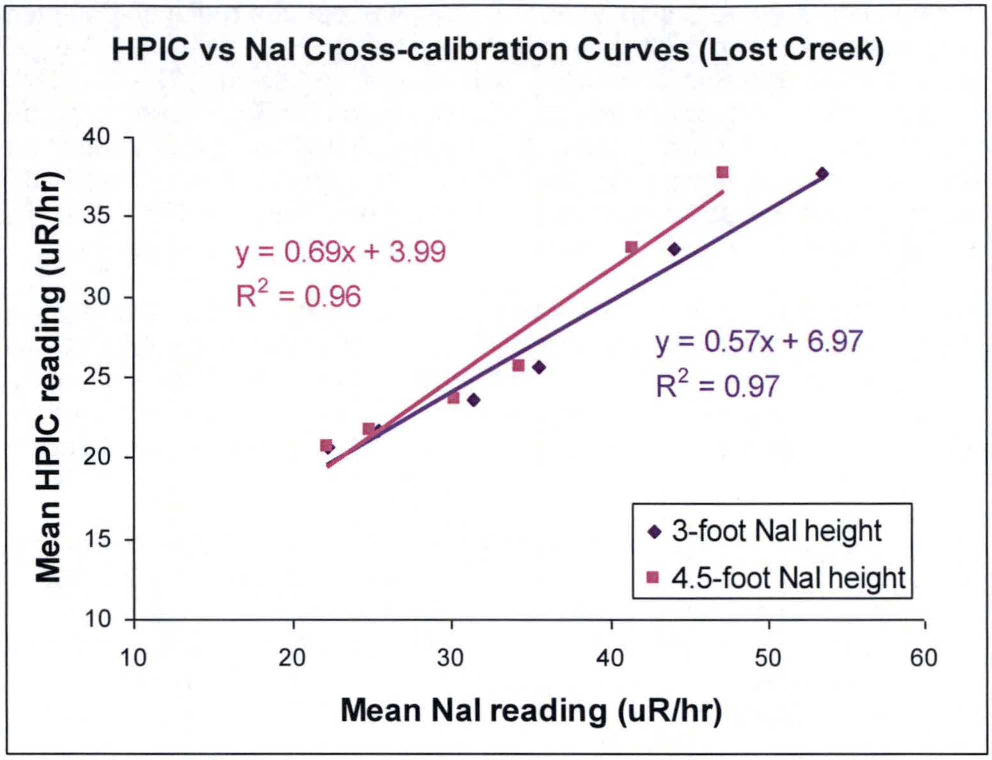


Figure 2. HPIC versus NaI Cross-Correlation Data from Tetra Tech 2007

4.2.3 Correlation of NaI Detectors to Soil Radium-226 Activity

In addition, a correlation was developed between soil Radium-226 (Ra-226) concentrations and gamma exposure rates during the 2006 survey (Tetra Tech, 2007a). Soil sampling and laboratory analysis methods used to develop the Ra-226 concentration information are discussed in that report. The 2006 data are assumed here to be applicable to the 2012 study. The earlier correlation can then be used to infer approximate Ra-226 concentrations across the Site, based on the gamma survey results. Equation 2, below, provides the relationship between Ra-226 and mean gamma exposure rate measured using the energy dependent NaI detection systems. Figure 3 displays the correlation between soil Ra-226 concentrations and gamma exposure rate.

Equation 2: *Mean Ra-226 Conc. (pCi/g) = 0.37*Mean NaI Gamma Exposure Rate (μR/hr)-4.37*

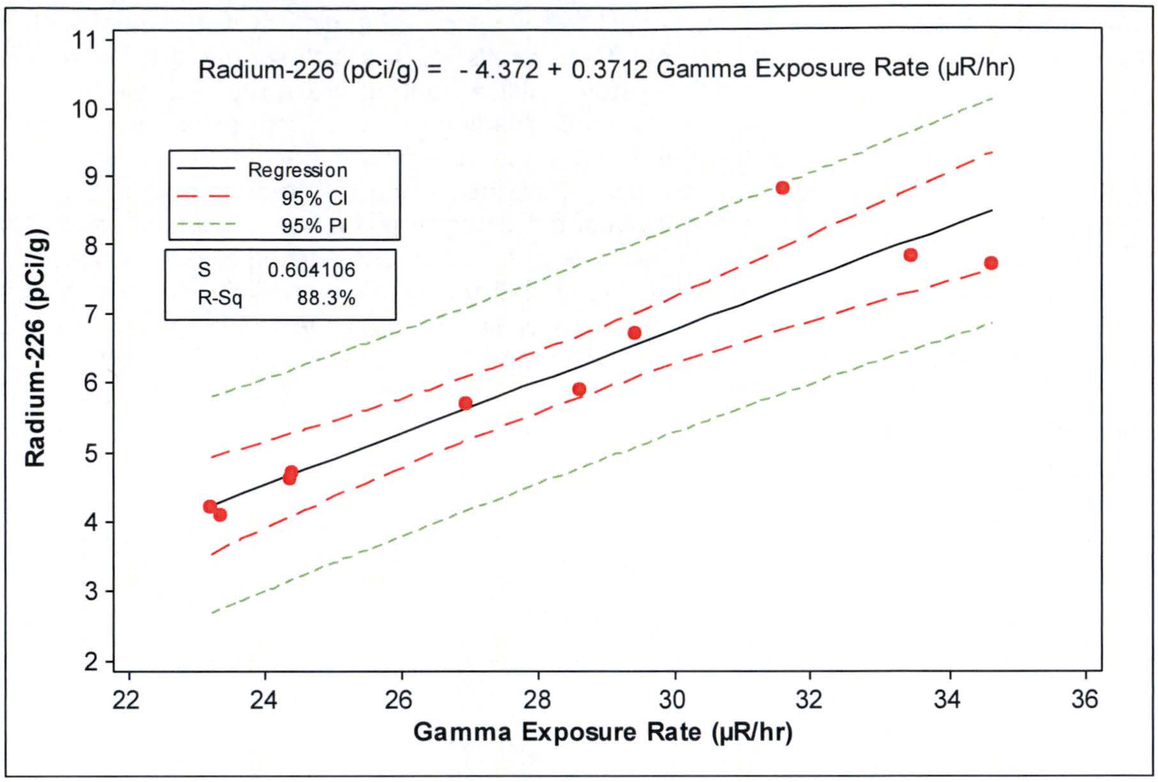


Figure 3. Soil Radium-226 versus NaI Gamma Exposure Rate

4.3 Data Quality Assurance / Quality Control

4.3.1 Methods and Results

Radiological characterization projects conducted by Tetra Tech incorporate specific data QA/QC protocols. In general, QA includes qualitative factors that provide confidence in results, while QC involves quantitative, field evidence that support results validity. The factory calibration sheets for the radiation detectors used during the 2012 survey are in Appendix A.

Prior to commencement (pre-survey) of the gamma radiation survey, QC measurements were performed at an indoor location for each NaI detector that would potentially be used during the survey. The same QC procedure was performed again after completion (post-survey) of the field work, but only on the instruments used during the survey. The purpose of this assessment was to quantify the consistency of detector readings under controlled conditions before and after the gamma radiation survey. The instrument QC measurements included a static background reading and a radioactive source check (Cs-137) reading.

Individual radiation detector systems generally display slightly different gamma exposure rates under the same field conditions due to variations within each system. By identifying systems with the most similar readings, field engineers may select specific sets of instruments to be used during a study, reducing variability in the final data set. Note that there can be large distance/angular response differences in NaI counting efficiency for a Cs-137 point source, especially when the source is placed in close proximity to the detector (Ogundare et al., 2008).

The QC data collected as noted above should follow a normal statistical distribution related to common instrument measurement errors. The results of the pre-survey and post-survey measurements indicate that the detector systems utilized during the survey followed a normal distribution for both background and source check readings and for both pre-survey and post-survey measurements. The applicable frequency histograms for each detector system are shown in Figure 4 and Figure 5. The top rows show the pre-survey frequency histograms and the bottom row shows the post-survey frequency histograms for the detectors used in the survey; summary statistics are shown to the right of the frequency histograms for both figures. The results of the pre-survey and post-survey instrument QC analysis indicate that the instruments used in the survey met the objectives of Tetra Tech's QA/QC program. Therefore, the field data collected should be considered valid, and the data are qualified to be included in the final project database. An analysis of the results of pre-survey and post-survey QC measurements is provided in Appendix B.

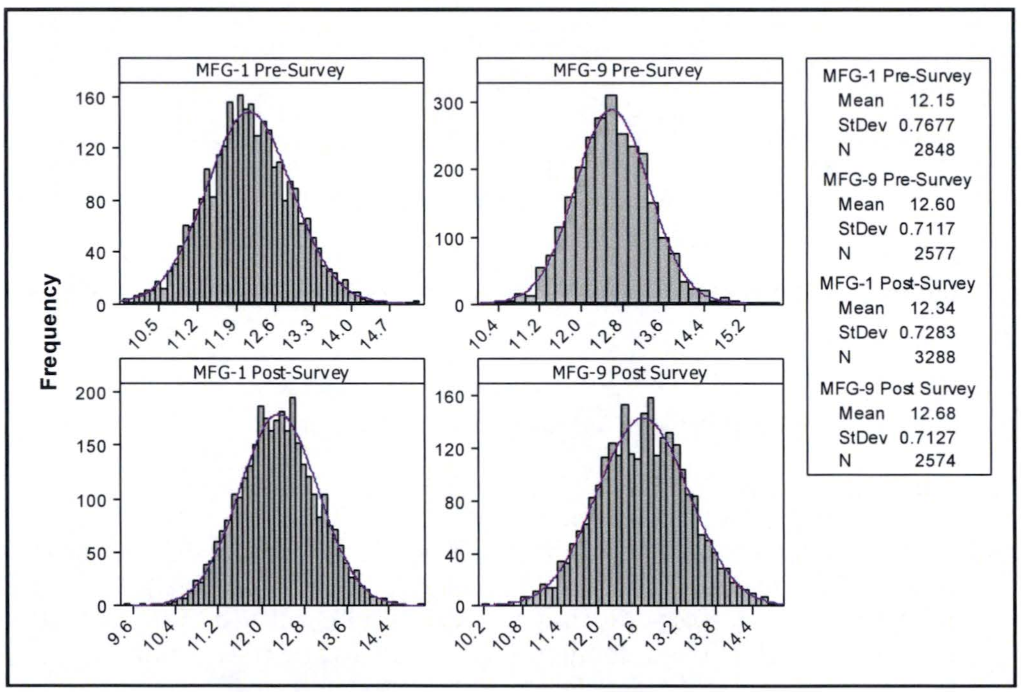


Figure 4. Frequency Histograms for Controlled Indoor Background Radiation Pre-Survey and Post-Survey QC Measurements

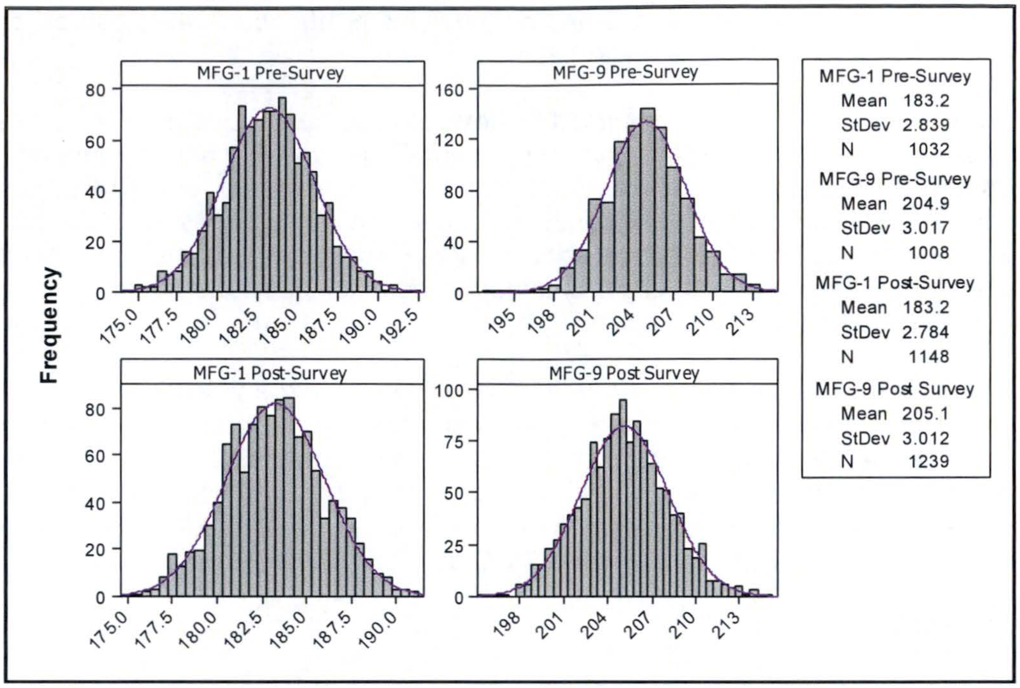


Figure 5. Frequency Histograms for Controlled Indoor Cs-137 Source Radiation Pre-Survey and Post-Survey QC Measurements

In addition to the controlled pre-survey and post-survey QC measurements discussed above, sets of individual, background, and field strip QC measurements were collected at a designated location in the field before and after each day of scanning. Under the QA program, factory-calibrated instruments must meet on-site field test criteria. Data developed using any of the field-qualified instruments are then interchangeable, allowing instrument substitution if needed.

Field check requirements are as follows:

- For normally distributed data, 99 percent of all measurements are expected to fall within ±3 standard deviations of the mean. Background, field strip and check source standard deviation values are recalculated twice daily throughout the project. Any instrument with a QC measurement result falling outside ±3 standard deviations from the mean of all QC measurements on the field check control chart requires investigation. A detector that exceeds control limits on any QC check (background, field strip, or source check) is replaced with a pre-qualified spare detector and sent back to the manufacturer for evaluation, repair, and calibration.

- QC measurements, including a background check, a source check, and a field strip check, are performed twice daily during the work for each scanning system in use. The daily field strip check, during which data are collected along the same 10-meter strip in the morning and evening, provides an indication of total measurement uncertainty for the system.

The Ludlum 2350-1 datalogger employs a calibration factor to internally convert detector counts per minute to a gamma exposure rate. The calculated exposure rate, directly proportional to the measured count rate, is transmitted by the data logger to the scanning system's portable computer. No record of count rate is retained by the system, but count rates can be calculated using the instrument-specific calibration factor.

Daily count rate variations may be influenced by several variables, including exact placement of detector systems during daily checks, and recent rainfall and variations in barometric pressure (affecting radon daughter concentrations in air and soil). Low detector count rates at very low radiation levels also contribute significantly to variability. Differences in detector internal characteristics, including minor NaI detector crystal issues or photomultiplier tube optical interface variations, combined with slight changes in detector positions during field work, can also affect detector readings.

Tetra Tech field personnel performed daily QA/QC checks before and after scanning activities. The systems functioned properly during the characterization work; no instruments were substituted due to failure. The results indicate that the instrument QC results were within the acceptable ranges; therefore, the field data collected during the gamma radiation survey are considered valid and have been incorporated in the final project database. Detailed presentation and analysis of the gamma radiation survey QA/QC data are included in Appendix B.

4.3.2 Data Uncertainty

In general, scan system QC measurements along field strips at the site provide an indication of total gamma measurement uncertainty, including most of the below sources of variability in gamma exposure rate readings. Based on the data in Appendix B, the total range of potential uncertainty in NaI scanning measurements at field strip locations was approximately ±2 μR/hr.

When both spatial and quantitative aspects are considered, gamma-based estimates of soil radionuclide concentrations across the site should result in considerably less overall uncertainty than soil sampling alone, given the small number of soil samples typically taken for analysis during a survey based on NRC Regulatory Guide 4.14. The gamma survey methodology produces far better density and areal coverage. Grid-based approaches rely more heavily on the assumption of spatial uniformity in soil radium concentrations. Survey data for this site, as well as for many other uranium recovery sites, demonstrate that baseline soil radionuclide concentrations can vary significantly across relatively small areas. Grid-based survey approaches have a higher probability of missing or mischaracterizing the extent of such features.

Sources of measurement uncertainty include:

- Gamma detector variability within and between detector systems.
- Variations in count data associated with the random nature of radioactive decay at low count rates.
- Small-scale spatial variability in gamma exposure rates.
- Temporal variability in gamma exposure rates associated with changes in natural shielding or soil radon retention factors, including changes in soil moisture and barometric pressure.
- Inaccuracies in wide area augmentation system-enabled GPS position readings.
- Errors associated with soil sampling technique and laboratory analyses methods.

4.4 Overview of Spatial Interpolation Methods

To provide an estimate of the baseline radiological data in areas that were not directly surveyed, a spatial interpolation technique called *kriging* was applied to the dataset. Kriging is a method of interpolation that has become an important tool in the field of geostatistics and earth sciences over the past several decades. The technique of kriging was named after Daniel G. Krige (Krige et al., 1982), a South African mining engineer who developed the tool in an attempt to more accurately predict ore reserves and mineral resources. Kriging, as applied here, is a regression technique for estimation of values based on a best unbiased estimate of a value at an un-sampled location. The kriging results are displayed on a grid or mesh and provide estimates of parameters across an entire site. Interpolation by kriging was applied to the gamma exposure rates, soil Ra-226 concentrations, and HPIC-equivalent exposure rate data.

Table 1 provides the kriging parameters and method of kriging that was applied for each data set. The kriging method that was applied used an exponential semivariogram modeling option. Raster files produced from the kriging analysis are displayed using bilinear interpolation, providing a continuous view of the radiological data estimates.

Table 1. Kriging Parameters and Modeling Applied

Kriging Parameters	
Kriging Method	Ordinary
Semivariogram Model	Exponential
Output Cell Size	100 meters
Number of Points	10
Maximum Distance	350 feet

5.0 DATA COMPARISON

To develop a correction factor to compensate for differences between the 2006 and 2012 scanning studies, the 2012 measurements were collected during this project on a 6-acre soil tract common to both studies. Statistics for the 2006 and 2012 studies are presented in Table 2.

Table 2. 2006 versus 2012 Scan Data Collected on a Plot Common to Both Studies

Summary Statistic	2006 Survey	2012 Survey
# of Measurements	1,042	143
Mean	25.1	21.9
Median	25.1	21.7
Standard Deviation	1.63	1.14
90^{th} Percentile	27.2	23.4
95^{th} Percentile	28.7	24.0

Equation 3 was used to evaluate the difference between the exposure rates:

$$\textbf{Equation 3: } \%\,Difference = \frac{|\gamma_1-\gamma_2|}{\frac{1}{2}(\gamma_1+\gamma_2)} \cdot 100 = \frac{|25.1-21.9|}{\frac{1}{2}(25.1+21.9)} \cdot 100 = 13.8\%$$

The 2006 survey plot mean gamma exposure rate averaged 13.8 percent higher than the 2012 survey plot mean gamma exposure rate. This percent difference is likely associated with the modified instrument mounting system and environmental factors affecting soil radon decay product concentrations (see Yoshioka, 1993). A correction factor of 1.138 may be applied to the 2012 Lost Creek East gamma exposure rate data to correct for the differences, and normalize the new data to the 2006 Lost Creek ISR survey results.

A comparison of the statistical distribution using a fitted normal density curve of the histograms of the 2006 survey data collected from the 2006 Lost Creek ISR study and the 2012 Lost Creek East study is shown in Figure 6. The corrected 2012 data set is re-plotted, against the 2006 data, in the graphic on the right in Figure 6. Results discussed in this report utilize this modified 2012 data set.

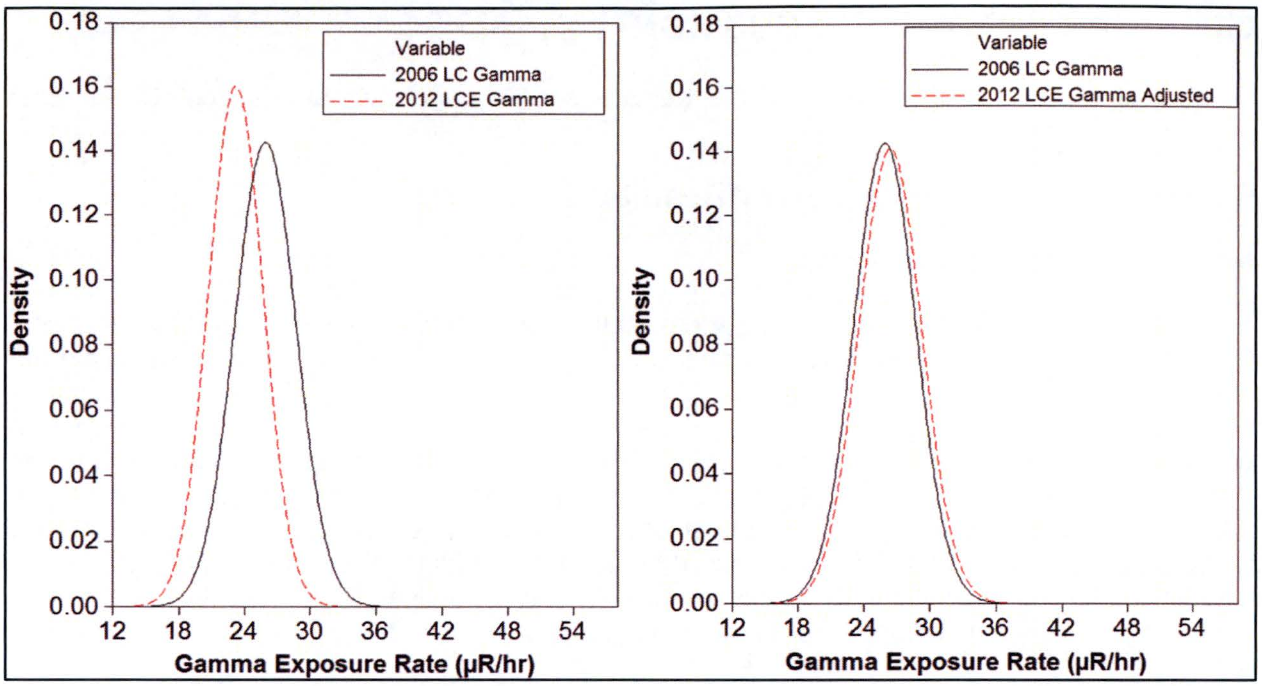


Figure 6. Frequency Histogram Comparison – 2006 versus 2012 Populations, Showing Uncorrected and Corrected 2012 Data

6.0 RESULTS AND DISCUSSION

This section presents the results of the gamma survey performed at the Lost Creek East property by Tetra Tech.

6.1 Baseline Gamma Survey Results

6.1.1 Gamma Exposure Rates

Summary: Tetra Tech field engineers performed the survey between September 23, 2012 and October 3, 2012. The survey was performed to collect exposure rate measurements within the permit boundary of the Lost Creek East Site (Figure 1). Data collection followed the methods outlined in Section 4.2.1. A data comparison analysis is presented in Section 5.0 and a correction factor was developed and applied to the exposure rate dataset to normalize it to the 2006 Lost Creek ISR baseline survey data set. The analysis in this section utilizes that normalized set of measurements. The Lost Creek East permit boundary covers approximately 5,700 acres; the scan transect width was 100 meters, but additional scanning at higher density was performed on approximately 30 percent of the total area; specifically, over ore bodies and at drainages or other locations where radiation anomalies were noted.

A total of 126,299 gamma exposure rate measurements were collected during the study, using two UTV-based scan systems, resulting in a scan density average of 22 points per acre. Table 3 presents summary statistics. The mean and median of the exposure rates were 26.4 µR/hr and 26.2 µR/hr, respectively. Measurements ranged between 18.3 µR/hr and 50.1 µR/hr.

Table 3. Summary Statistics of Lost Creek East Gamma Exposure Rates

Summary Statistic	Gamma Exposure Rate
# of Measurements	126,299
Minimum (µR/hr)	18.3
Maximum (µR/hr)	50.1
Mean (µR/hr)	26.4
Median (µR/hr)	26.2
Standard Deviation (µR/hr)	2.83
90^{th} Percentile (µR/hr)	30.0
95^{th} Percentile (µR/hr)	31.4

A distribution analysis was performed on the data. Using a combination of probability plots and goodness of fit testing, a parametric distribution was fitted to the population. A total of 14 parametric distributions were evaluated via the Anderson-Darling (AD) goodness of fit test; the best fit for the exposure rate data is a three-parameter lognormal distribution. Figure 7 and Figure 8 provide the probability plot and frequency histogram fitted to a three-parameter lognormal curve. This information may be useful if eventual remedial action is required at the Site. Figure 9 provides the exposure rate map for the study's boundary area. Figure 10 provides a kriged version of the exposure rates.

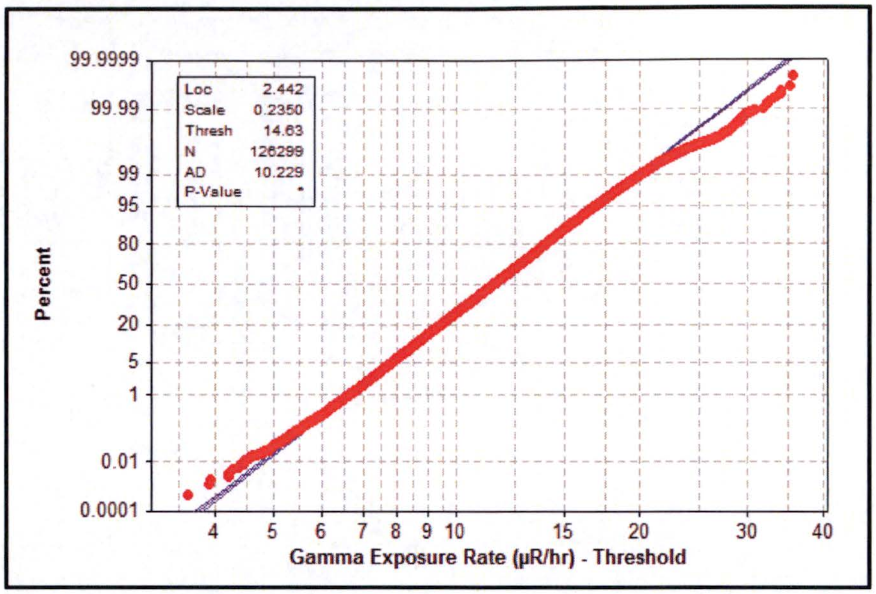


Figure 7. Three-Parameter Lognormal Probability Plot of Gamma Exposure Rate Data

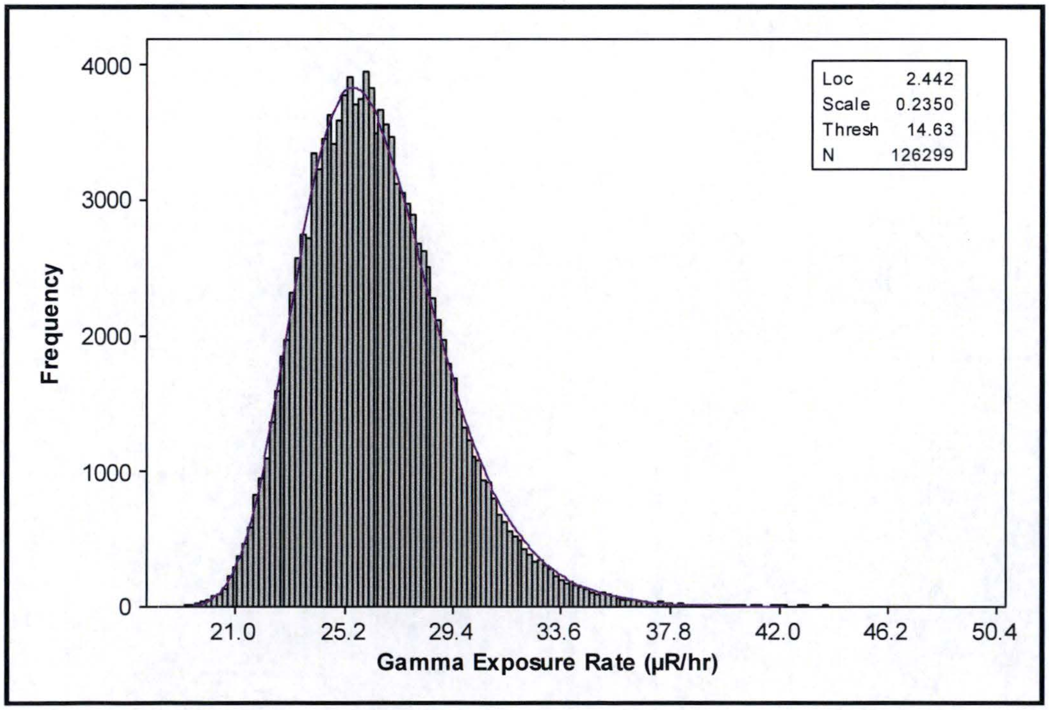
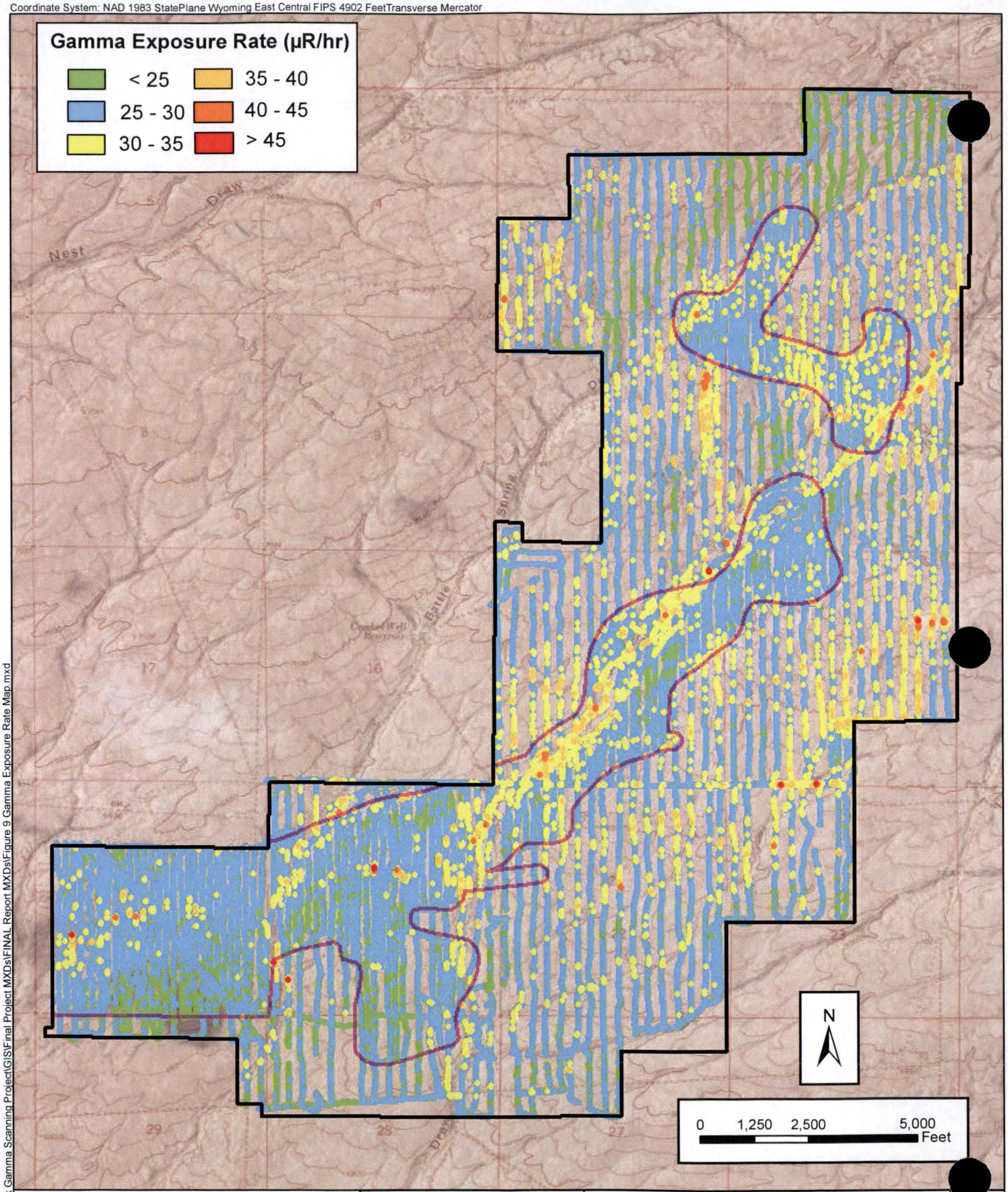


Figure 8. Three-Parameter Lognormal Frequency Histogram of Gamma Exposure Rate Data

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 9 Gamma Exposure Rate Map.mxd

Legend:

Project Boundary

Ore Body Boundary

Issued by:

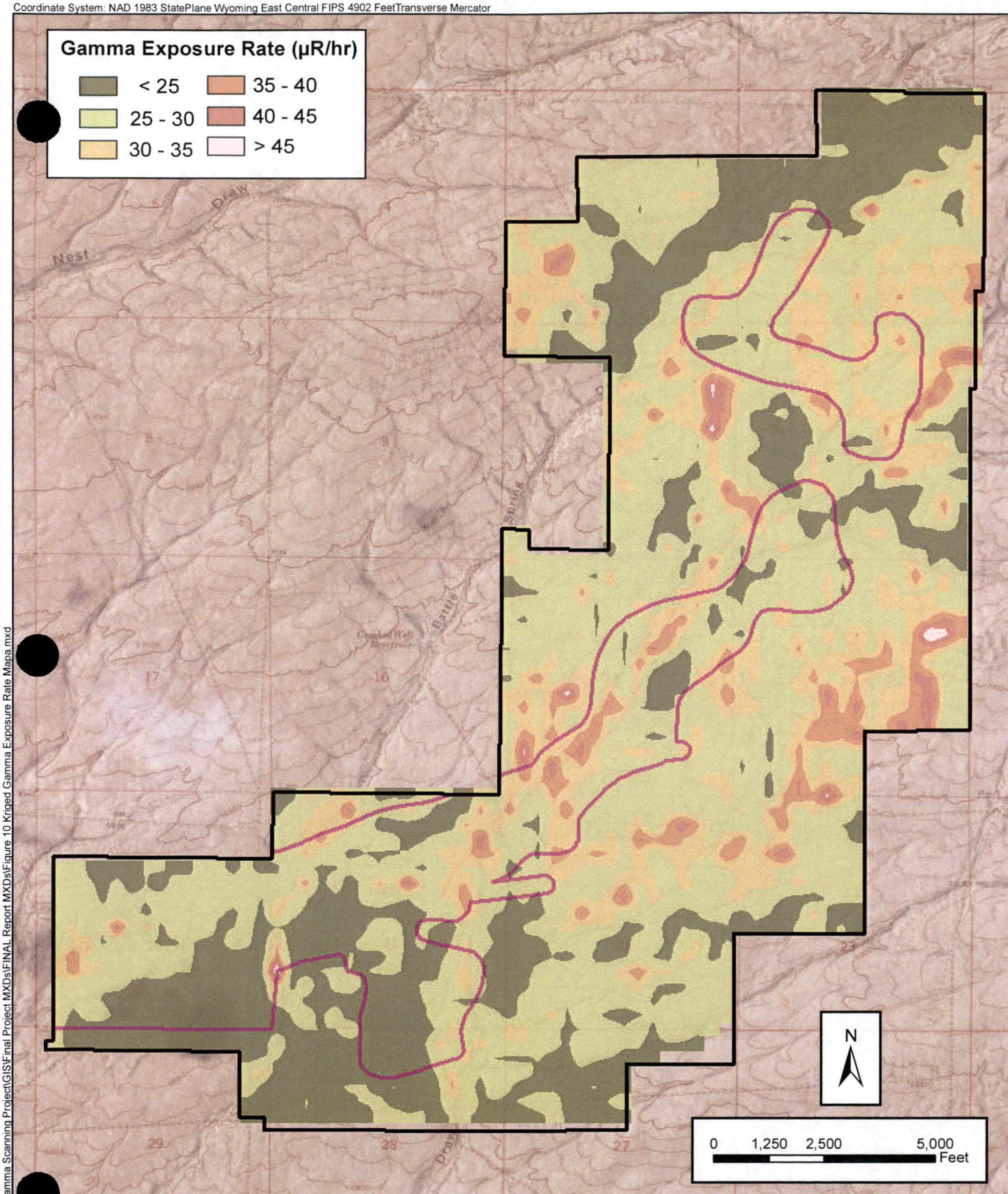
TETRA TECH
3801 Automation Way, Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

Lost Creek East
Gamma Exposure Rate Map

2
Revision

Project:	Lost Creek East	Project no.: 114-182274	Figure 9
Location:	Sweetwater County, WY	August 2013	

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 10 Kriged Gamma Exposure Rate Mapa.mxd

Legend:

Project Boundary

Ore Body Boundary

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Lost Creek East Kriged Gamma Exposure Rate Map

2
Revision

Project:	Lost Creek East	Project no.: 114-182274	Figure 10
Location:	Sweetwater County, WY	Agusut 2013	

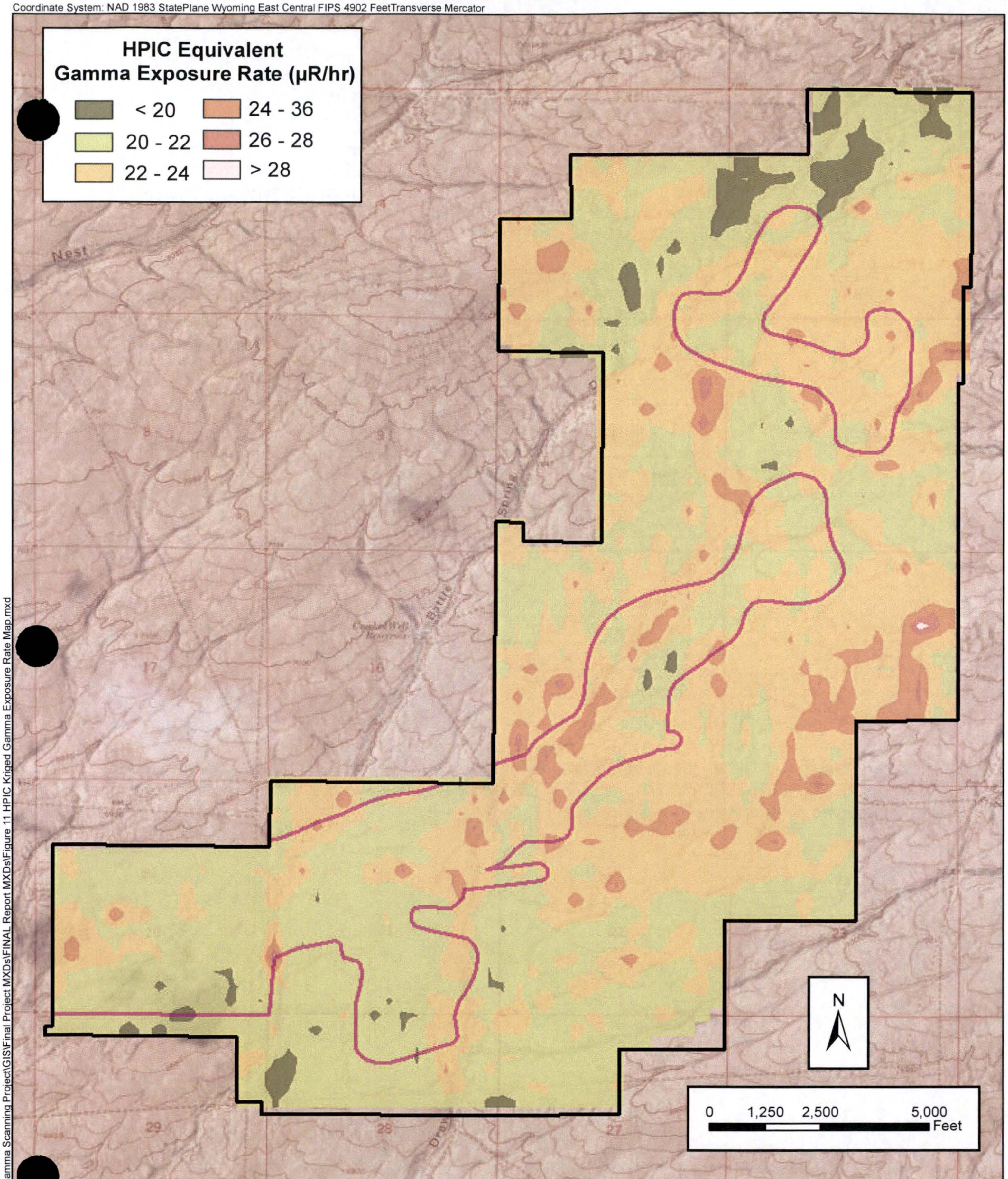
6.1.2 HPIC Equivalent Final Gamma Dose Rate Results

The 126,299 exposure rate measurements collected within the permit boundary were converted into HPIC equivalent rates using the equation presented in Section 4.2.2. Summary statistics of the HPIC data are presented in Table 4. The mean and median gamma exposure rates were 22.0 μR/hr and 21.9 μR/hr, respectively. The exposure rates ranged from 17.4 μR/hr to 35.5 μR/hr. A map showing the kriged HPIC equivalent gamma exposure rates is presented in Figure 11.

Table 4. Summary Statistics Lost Creek East HPIC-Equivalent Exposure Rates

Summary Statistic	HPIC Equivalent Gamma Exposure Rate
# of Measurements	126,299
Minimum (μR/hr)	17.4
Maximum (μR/hr)	35.5
Mean (μR/hr)	22.0
Median (μR/hr)	21.9
Standard Deviation (μR/hr)	1.62
90^{th} Percentile (μR/hr)	24.1
95^{th} Percentile (μR/hr)	24.9

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 11 HPIC Kriged Gamma Exposure Rate Map.mxd

Legend:

Project Boundary

Ore Body Boundary

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Lost Creek East
HPIC Equivalent Kriged
Gamma Exposure Rate Map

2
Revision

Project:	Lost Creek East	Project no.: 114-182274	Figure 11
Location:	Sweetwater County, WY	August 2013	

6.1.3 Soil Radium-226 Results

The 126,299 gamma exposure rate measurements collected within the Lost Creek East permit boundary were converted into estimated soil Ra-226 soil concentrations. Measured exposure rates were converted using a correction factor developed as discussed previously. The results were then converted into estimated soil Ra-226 concentrations using the linear regression model presented in Section 4.2.3.

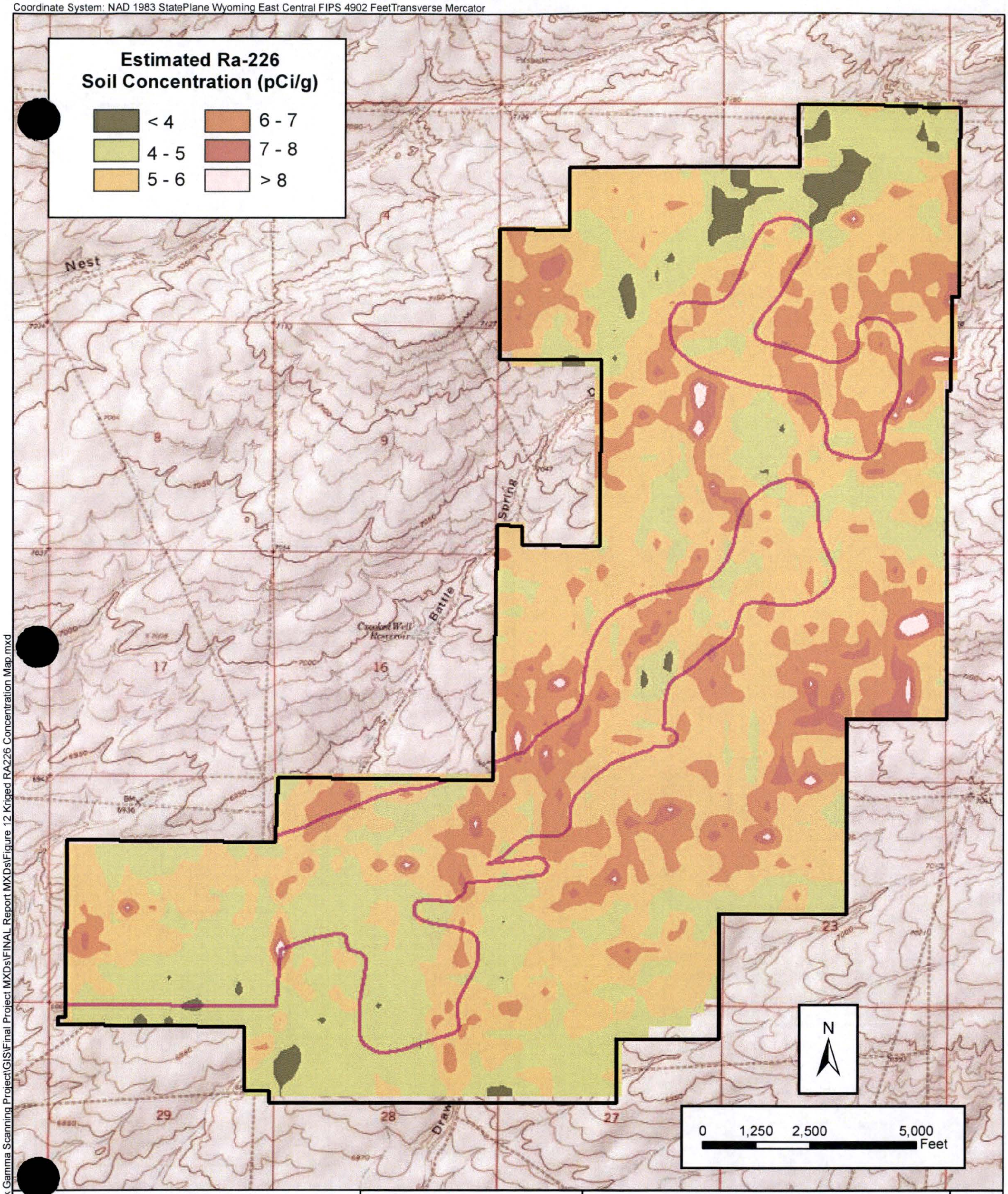
Summary statistics for the soil Ra-226 concentrations for the study area are presented in Table 5. The mean and median of the soil Ra-226 concentrations were 5.42 pCi/g and 5.31 pCi/g, respectively. Soil Ra-226 concentration estimates ranged from 2.38 pCi/g to 14.2 pCi/g.

Table 5. Summary Statistics of Estimated Lost Creek Radium-226 Soil Concentrations

Summary Statistic	Radium-226
# of Measurements	126,299
Minimum (pCi/g)	2.38
Maximum (pCi/g)	14.2
Mean (pCi/g)	5.42
Median (pCi/g)	5.31
Standard Deviation (pCi/g)	1.05
90^{th} Percentile (pCi/g)	6.75
95^{th} Percentile (pCi/g)	7.27

A kriged soil Ra-226 concentration map is presented in Figure 12. A 100-meter raster grid was used, and Figure 13 presents a map showing the estimated Ra-226 concentration, presented in binary fashion as either greater than or less than 5 pCi/g, for each 100-meter grid that covers the Site. This type of mapping can be useful when evaluating eventual remedial action alternatives, if necessary.

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 12 Kriged RA226 Concentration Map.mxd

Legend:

Project Boundary

Ore Body Boundary

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Fort Collins, Colorado 80525
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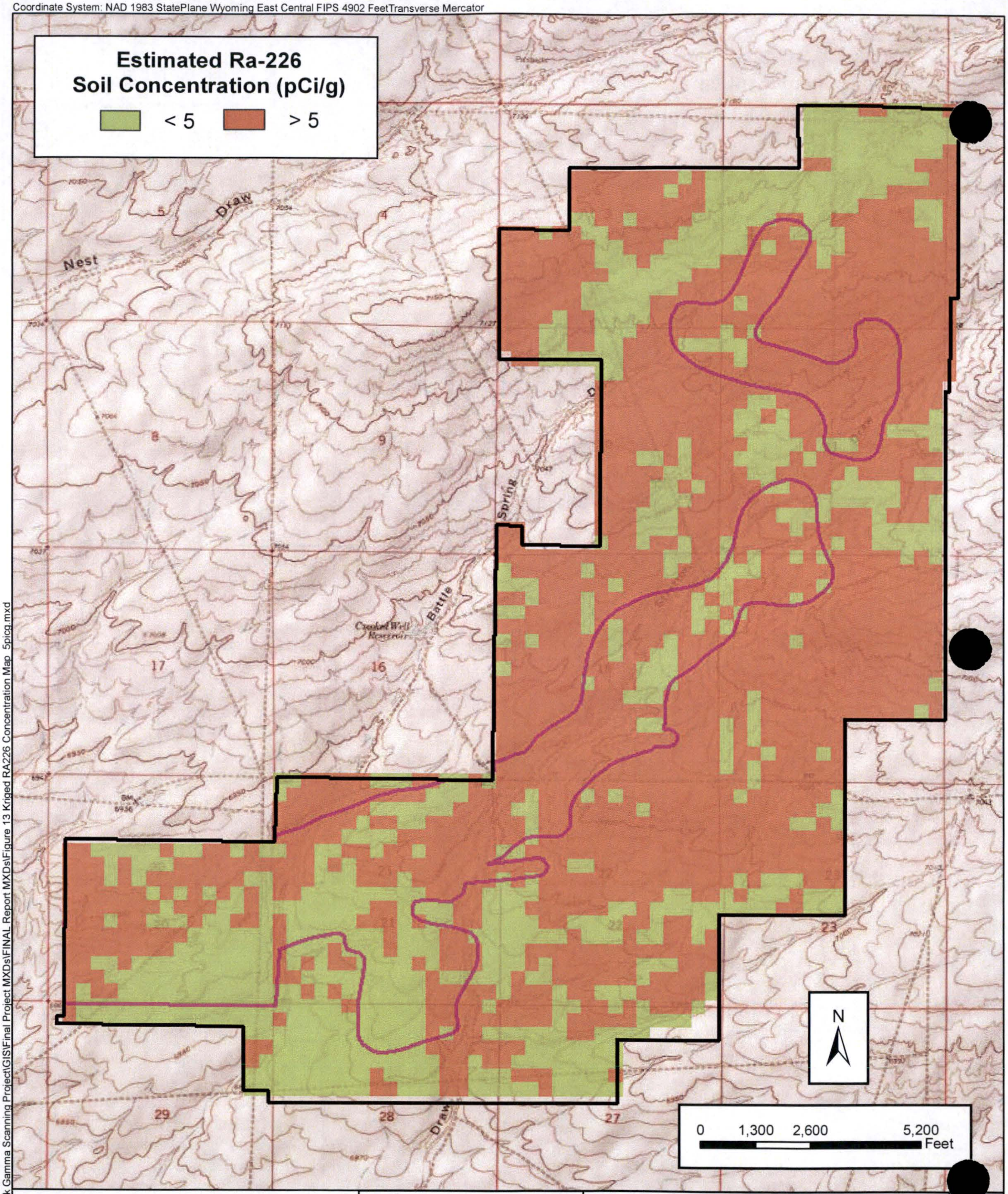
Lost Creek East Kriged Ra-226
Soil Concentration Map

2
Revision

Project:	Lost Creek East	Project no.: 114-182274	Figure 12
Location:	Sweetwater County, WY	August 2013	

Coordinate System: NAD 1983 StatePlane Wyoming East Central FIPS 4902 FeetTransverse Mercator



Legend:

Project Boundary

Ore Body Boundary

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Lost Creek East Kriged Ra-226 Soil Concentration Map (Discrete)

2
Revision

Project:	Lost Creek East	Project no.: 114-182274	Figure 13
Location:	Sweetwater County, WY	August 2013	

X:\182274 - Lost Creek Gamma Scanning Project\GIS\Final Project MXDs\FINAL Report MXDs\Figure 13 Kriged RA226 Concentration Map_5picg.mxd

7.0 CONCLUSIONS

The baseline radiation survey conducted by Tetra Tech at the Lost Creek East project in Sweetwater County, Wyoming appears to meet data collection/quality objectives appropriate for regulatory permitting. Information provided in this report exceeds certain applicable NRC Regulatory Guide 4.14 specifications, providing a detailed characterization of exposure rates within the Lost Creek East permit boundary. Using information from the 2006 site investigation on the initial Lost Creek Project Site, estimates were developed for Ra-226 concentrations in surface soils within the study area.

8.0 REFERENCES

[NRC] U.S. Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills. Regulatory Guide 4.14. April 25.

NRC. 1982. Standard Format and content of License Applications, Including Environmental Reports, For In Situ Uranium Solution Mining. Regulatory Guide 3.46.

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Ogundare FO, Oniya EO, Balogun FA. 2008 May. Dependence of Nal (T1) Detector Intrinsic Efficiency on Source-Detector Distance, Energy and Off-Axis Distance: Their Implications for Radioactivity Measurements. Pramana Journal of Physics 70: pp. 863-74.

Tetra Tech. 2006. Gamma Data Map Viewer. [Software.] Fort Collins, Colorado.

Tetra Tech. 2007a. Baseline Gamma Survey and Radiological Soil Sampling Results for the Lost Creek Claim Area. June 30.

Tetra Tech. 2007b. ComReader©. [Software.] Fort Collins, Colorado.

Yoshioka K. 1993. Study of Time Variation of Terrestrial Gamma Radiation Due to Depth Distribution of Soil Moisture Content. Shimane Prefectural Institute of Public Health and Environmental Science. Japan. Nov 26.

APPENDIX A
RADIATION INSTRUMENTS FACTORY CALIBRATION DOCUMENTATION

MFG 1

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TETRA TECH MFG, INC. ORDER NO. 20201979/379278

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 98616

Cal. Date 17-Jun-12 Cal Due Date 17-Jun-13 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 702.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check Threshold

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 2001 V

COMMENTS: *Firmware: 37122N26*
I/O Firmware: 37123n05 ; Cal'd with 39" cable ; Resolution for Cs137: 9.51%

NO 'AS FOUND' DATA
DUE TO LOSS OF MEMORY.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	44-10	PR102508	1050	100	4 / 2	1.676147E-05	5.960651E+10	✓
Detector # 2	44-10	PR102508	1050	100	7 / 1	1.676146E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	679	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39974 (0)	39977 (0)	400cpm	40 (0)	40 (0)
	40kcpm	3997	3997	40cpm	4	4
	4kcpm	399	399			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ 70897 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 190566 ☐ Ra-226 S/N Y982 ☑ Multimeter S/N 86250390

Calibrated By: [signature] Date 17-Jun-12

Reviewed By: [signature] Date 19 Jun 12

FORM C44A 10/24/2011 Page 1 of 3

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Model 2350 Bench Test Data

Customer TETRA TECH MFG, INC. Date 17-Jun-12 Order #. 20201979/379278

Model 2350-1 Serial No. 98616 Detector 44-10 Serial No. PR102508

Source Cs 137, 1.9mCi

High Voltage 1050 V As Found n/A V. Input 10.00 mV As Found n/A mV.

Cal. Constant 5.960651E+10 as found n/A

Dead Time 1.676147E-05 as found

Alarm Setting: Ratemeter 1000000000.000000 as found

Scaler 1000000.000000 as found

Integrated dose 1000000000.0000 as found

Overload ☐ On ☑ Off as found ☐ On ☐ Off Window 1000 (OFF) as found n/A

Detector Received: ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

Reference Point	"As Found" Readings: Meter Reading	After Adjustment Readings: Meter Reading
2000 µR/Hr	n/A	2.00 mR/Hr
1500		1.50
1000		0.99
500		482 µR/Hr
200		200
100		100

Other NO 'AS FOUND' DATA DUE TO LOSS OF MEMORY

Signature [signature] Date 17-JUN-12

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 231 Sam Raybum Parkway
865-270-8982
Lenoir City, TN 37771, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR102508

Customer TETRA TECH MFG, INC. Order #. 20201979/379278

Counter 2350-1 Serial No. 98616 Counter Input Sensitivity 10.00 mV

Count Time 6 sec. Distance Source to Detector Surface

Other Cal Constant = 1.000000E+00 Dead Time = 1.676146E-05

High Voltage	Background	Isotope Am241 Size ≈0.79µCi	Isotope Size	Isotope Size	Isotope Size
900	945	11939			
950	932	12135			
1000	950	12250			
1050	965	12115			
1100	909	12189			
1150	974	12075			
1200	924	12223			
1250	1008	12138			
1300	1059	12430			

Signature [signature] Date 17-Jun-12

FORM C4A 05/31/2012 Page 3 of 3

Detector Setup Checklist GENERATED: 6/17/2012 4:09:09 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 1

The following list is stored as detector setup D1 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: J.F.

Comments:

User ID	=
High Voltage	= 1050 volts
Threshold	= 100
Window	= 1000,OFF
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 6 seconds
Readout Units	= R
Readout Time Base	= hours
Readout Range Multiplier	= Auto
Detector Dead Time	= 1.676147E-05
Detector Calibration Constant	= 5.960651E+10
Detector Model Number	= 44-10
Detector Serial Number	= PR102508
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.3 volts

Detector Setup Checklist GENERATED: 6/17/2012 4:09:09 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 2

The following list is stored as detector setup D2 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: S.F.

Comments:

User ID	=
High Voltage	= 1050 volts
Threshold	= 100
Window	= 1000,OFF
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 12 seconds
Readout Units	= c
Readout Time Base	= minutes
Readout Range Multiplier	= Auto
Detector Dead Time	= 1.676146E-05
Detector Calibration Constant	= 1.000000E+00
Detector Model Number	= 44-10
Detector Serial Number	= PR102508
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.3 volts

Detector Setup Checklist.   GENERATED: 6/17/2012 4:09:09 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 3

The following list is stored as detector setup D3 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: J.F.

Comments:

User ID	=	
High Voltage	=	679 volts
Threshold	=	642
Window	=	40,ON
Overload Current	=	40.0 micro amperes
Scaler Count Time	=	6 seconds
Readout Units	=	c
Readout Time Base	=	minutes
Readout Range Multiplier	=	Auto
Detector Dead Time	=	0.000000E+00
Detector Calibration Constant	=	1.000000E+00
Detector Model Number	=	CS137PK
Detector Serial Number	=	662KEV
Ratemeter Alarm Setting	=	1.000000E+09
Scaler Alarm Setting	=	1000000
Integrated Dose Alarm Setting	=	1.000000E+09
Low Count Alarm Setting	=	0.000000E+00
Operating Batter Voltage	=	6.3 volts

Detector Setup Barcodes GENERATED: 6/17/2012 4:09:07 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 1

H1050$J
Set High Voltage: 1050

W1000$WOFF$P
Set Window: 1000,OFF

F6$H
Set Scaler Count Time: 6

SB2$.
Set Readout Time Base: hours

SL1.676147E-05$/
Set Dead Time: 1.676147E-05

SC5.960651E+10$W
Set Calibration Constant: 5.960651E+10

M44-10$K
Set High Detector Model: 44-10

NPR102508$1
Set High Detector Serial #: PR102508

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP1$7

Save Parameters as: D1

T100$Q

Set Threshold: 100

O40.0$OOFF$6

Set Overload: 40.0,OFF

SU4$F

Set Readout Units: R

SM0$3

Set Readout Range Multiplier: Auto

SVD0$P

Set Display Mode: Normal

SVD1$Q

Set Display Mode: Parameters

SVD2$R

Set Display Mode: Detector

D1$A

Set Active Detector Setup: 1

Detector Setup Barcodes GENERATED: 6/17/2012 4:09:07 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 2

H1050$J
Set High Voltage: 1050

W1000$WOFF$P
Set Window: 1000,OFF

F12$E
Set Scaler Count Time: 12

SB1$-
Set Readout Time Base: minutes

SL1.676146E-05$$
Set Dead Time: 1.676146E-05

SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00

M44-10$K
Set High Detector Model: 44-10

NPR102508$1
Set High Detector Serial #: PR102508

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP2$8

Save Parameters as: D2

T100$Q
Set Threshold: 100

O40.0$OOFF$6
Set Overload: 40.0,OFF

SU7$I
Set Readout Units: c

SM0$3
Set Readout Range Multiplier: Auto

SVD0$P
Set Display Mode: Normal

SVD1$Q
Set Display Mode: Parameters

SVD2$R
Set Display Mode: Detector

D2$B
Set Active Detector Setup: 2

Detector Setup Barcodes GENERATED: 6/17/2012 4:09:08 PM
Model 2350-1 Serial Number: 98616
Detector Setup Number: 3

H679$Z
Set High Voltage: 679

W40WONL
Set Window: 40,ON

F6$H
Set Scaler Count Time: 6

SB1$-
Set Readout Time Base: minutes

SL0.000000E+00$8
Set Dead Time: 0.000000E+00

SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00

MCS137PK$S
Set High Detector Model: CS137PK

N662KEV$C
Set High Detector Serial #: 662KEV

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP3$9

T642$.
Set Threshold: 642

O40.0$OOFF$6
Set Overload: 40.0,OFF

SU7$I
Set Readout Units: c

SM0$3
Set Readout Range Multiplier: Auto

SVD0$P
Set Display Mode: Normal

SVD1$Q
Set Display Mode: Parameters

SVD2$R
Set Display Mode: Detector

D3$C
Set Active Detector Setup: 3

MFG 1

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TETRA TECH MFG, INC. ORDER NO. 20201979/379278

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129403

Cal. Date 18-Jun-12 Cal Due Date 18-Jun-13 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 702.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2001 V

COMMENTS: *Firmware: 37122N21*
I/O Firmware: 37123n05 ; Cal'd with 39" cable ; Resolution for Cs137: 11.02%
No 'As Found' data due to loss of memory.
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	44-10	PR135858	1150	100	4 / 2	1.613346E-05	5.975914E+10	✓
Detector # 2	44-10	PR135858	1150	100	7 / 1	1.613345E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	827	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	N/A	39992 (0)	400cpm	N/A	40 (0)
	40kcpm		3999	40cpm		4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ 70897 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 190566 ☐ Ra-226 S/N Y982 ☑ Multimeter S/N 86250390

Calibrated By: [signature] Date 18-Jun-12
Reviewed By: [signature] Date 19 Jun 12

FORM C44A 10/24/2011 Page 1 of 3

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Model 2350 Bench Test Data

Customer TETRA TECH MFG, INC. Date 18-Jun-12 Order #. 20201979/379278

Model 2350-1 Serial No. 129403 Detector 44-10 Serial No. PR135858

Source Cs 137, 1.9mCi

High Voltage 1150 V As Found N/A V. Input 10.00 mV As Found N/A mV.

Cal. Constant 5.975914E+10 as found N/A

Dead Time 1.613346E-05 as found

Alarm Setting: Ratemeter 1000000000.000000 as found

Scaler 1000000.000000 as found

Integrated dose 1000000000.0000 as found

Overload ☐ On ☑ Off as found ☐ On ☐ Off Window 1000 as found N/A

Detector Received: ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

Reference Point	"As Found" Readings: Meter Reading	After Adjustment Readings: Meter Reading
2000 µR/hr	N/A	2.01 mR/hr
1500		1.50
1000		1.00
500		484 µR/hr
200		200
100		100

Other No 'AS FOUND' DATA Due To loss of Memory.

Signature [signature] Date 18-Jun-12

LUDLUM MEASUREMENTS, INC.
Designer and Manufacturer of Scientific and Industrial Instruments
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 231 Sam Rayburn Parkway
865-270-8962
Lenoir City, TN 37771, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR135858

Customer TETRA TECH MFG, INC. Order #. 20201979/379278

Counter 2350-1 Serial No. 129403 Counter Input Sensitivity 10.00 mV

Count Time 6 sec. Distance Source to Detector Surface

Other Cal Constant = 1.000000E+00 Dead Time = 1.613345E-05

High Voltage	Background	Isotope Am241 Size ≈0.79 uCi	Isotope Size	Isotope Size	Isotope Size
1000	961	11136			
1050	963	12042			
1100	970	12472			
1150	967	12558			
1200	984	12544			
1250	997	12417			
1300	1091	12558			

Signature [signature] Date 18-Jun-12

Detector Setup Checklist GENERATED: 6/18/2012 10:21:27 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 1

The following list is stored as detector setup D1 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: J.F.

Comments:

User ID	=	
High Voltage	=	1150 volts
Threshold	=	100
Window	=	1000,OFF
Overload Current	=	40.0 micro amperes
Scaler Count Time	=	12 seconds
Readout Units	=	R
Readout Time Base	=	hours
Readout Range Multiplier	=	Auto
Detector Dead Time	=	1.613346E-05
Detector Calibration Constant	=	5.975914E+10
Detector Model Number	=	44-10
Detector Serial Number	=	PR135858
Ratemeter Alarm Setting	=	1.000000E+09
Scaler Alarm Setting	=	1000000
Integrated Dose Alarm Setting	=	1.000000E+09
Low Count Alarm Setting	=	0.000000E+00
Operating Batter Voltage	=	6.4 volts

Detector Setup Checklist GENERATED: 6/18/2012 10:21:27 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 2

The following list is stored as detector setup D2 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: J.F.

Comments:

User ID	=
High Voltage	= 1150 volts
Threshold	= 100
Window	= 1000,OFF
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 6 seconds
Readout Units	= c
Readout Time Base	= minutes
Readout Range Multiplier	= Auto
Detector Dead Time	= 1.613345E-05
Detector Calibration Constant	= 1.000000E+00
Detector Model Number	= 44-10
Detector Serial Number	= PR135858
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.4 volts

Detector Setup Checklist GENERATED: 6/18/2012 11:36:27 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 3

The following list is stored as detector setup D3 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: J. F.

Comments:

User ID	=	
High Voltage	=	827 volts
Threshold	=	642
Window	=	40,ON
Overload Current	=	40.0 micro amperes
Scaler Count Time	=	6 seconds
Readout Units	=	c
Readout Time Base	=	minutes
Readout Range Multiplier	=	Auto
Detector Dead Time	=	0.000000E+00
Detector Calibration Constant	=	1.000000E+00
Detector Model Number	=	CS137PK
Detector Serial Number	=	662KEV
Ratemeter Alarm Setting	=	1.000000E+09
Scaler Alarm Setting	=	1000000
Integrated Dose Alarm Setting	=	1.000000E+09
Low Count Alarm Setting	=	0.000000E+00
Operating Batter Voltage	=	6.4 volts

Detector Setup Barcodes GENERATED: 6/18/2012 10:21:26 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 1

H1150$K
Set High Voltage: 1150

W1000$WOFF$P
Set Window: 1000,OFF

F12$E
Set Scaler Count Time: 12

SB2$.
Set Readout Time Base: hours

SL1.613346E-05$W
Set Dead Time: 1.613346E-05

SC5.975914E+10$/
Set Calibration Constant: 5.975914E+10

M44-10$K
Set High Detector Model: 44-10

NPR135858$F
Set High Detector Serial #: PR135858

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP1$7

Save Parameters as: D1

T100$Q

Set Threshold: 100

O40.0$OOFF$6

Set Overload: 40.0,OFF

SU4$F

Set Readout Units: R

SM0$3

Set Readout Range Multiplier: Auto

SVD0$P

Set Display Mode: Normal

SVD1$Q

Set Display Mode: Parameters

SVD2$R

Set Display Mode: Detector

D1$A

Set Active Detector Setup: 1

Detector Setup Barcodes GENERATED: 6/18/2012 10:21:26 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 2

H1150$K
Set High Voltage: 1150

W1000$WOFF$P
Set Window: 1000,OFF

F6$H
Set Scaler Count Time: 6

SB1$-
Set Readout Time Base: minutes

SL1.613345E-05$V
Set Dead Time: 1.613345E-05

SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00

M44-10$K
Set High Detector Model: 44-10

NPR135858$F
Set High Detector Serial #: PR135858

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP2$8

Save Parameters as: D2

T100$Q
Set Threshold: 100

O40.0$OOFF$6
Set Overload: 40.0,OFF

SU7$I
Set Readout Units: c

SM0$3
Set Readout Range Multiplier: Auto

SVD0$P
Set Display Mode: Normal

SVD1$Q
Set Display Mode: Parameters

SVD2$R
Set Display Mode: Detector

D2$B
Set Active Detector Setup: 2

Detector Setup Barcodes GENERATED: 6/18/2012 11:36:25 AM
Model 2350-1 Serial Number: 129403
Detector Setup Number: 3

H827$U
Set High Voltage: 827

W40WONL
Set Window: 40,ON

F6$H
Set Scaler Count Time: 6

SB1$-
Set Readout Time Base: minutes

SL0.000000E+00$8
Set Dead Time: 0.000000E+00

SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00

MCS137PK$S
Set High Detector Model: CS137PK

N662KEV$C
Set High Detector Serial #: 662KEV

J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09

K1000000$H
Set High Scaler Alarm: 1000000

P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09

SP3$9

T642$.

Set Threshold: 642

O40.0$OOFF$6

Set Overload: 40.0,OFF

SU7$I

Set Readout Units: c

SM0$3

Set Readout Range Multiplier: Auto

SVD0$P

Set Display Mode: Normal

SVD1$Q

Set Display Mode: Parameters

SVD2$R

Set Display Mode: Detector

D3$C

Set Active Detector Setup: 3

APPENDIX B
RADIATION INSTRUMENTS QC SUMMARY

TETRA TECH

Lost Creek East Baseline Radiation Survey
Appendix B – Radiation Instruments Quality Control Summary

1.0 PURPOSE

Before and after the gamma radiation survey, Tetra Tech performed quality control (QC) analyses for the radiation instruments that were used during the 2012 Lost Creek East baseline radiation survey. The purpose of the QC analyses is to quantify the consistency of gamma exposure readings between detectors. The QC data measurements were recorded only for the detectors that were planned to be utilized during the survey. This document summarizes the results of the QC analyses performed for those detectors.

Analysis was done by performing QC checks under a controlled indoor environment for pre-survey and post-survey checks, and by performing daily QC checks during the field work at a designated location at the Site. These daily checks included background, field strip, and Cs-137 source checks. Under these circumstances, all data from any given set of properly calibrated and correctly functioning radiation instruments should follow a normal distribution.

Two detectors, identified as MFG-1 and MFG-9, were utilized during the survey work. As part of the pre-survey and post-survey QC checks, two different conditions were measured under a controlled environment: a background reading and a Cs-137 source check reading. For the background readings, a minimum of 2,500 background level measurements were collected utilizing consistent geometry for each instrument before and after the survey field work. Similarly, for the source readings, a minimum of 1,000 measurements were collected under constant geometry for both the pre-survey and post-survey.

The pre-survey and post-survey QC measurements were performed at the Tetra Tech radiation laboratory in Fort Collins, Colorado. The pre-survey measurements were performed in September 2012 and the post-survey measurements were performed in November 2012.

2.0 AMBIENT GAMMA EXPOSURE RATE (BACKGROUND) QUALITY CONTROL RESULTS

This section summarizes the QC results for the background measurements for the pre-survey and post-survey.

Tetra Tech
3801 Automation Way, Suite 100, Fort Collins, CO 80525
Tel 970.223.9600 Fax 970.223.7171 www. tetratech.com

Table B-1. Instrument MFG-1 Pre-Survey and Post-Survey Background QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	September-12	November-12	
Detector ID:	MFG-1	MFG-1	
# of Readings	2,848	3,288	n/a
Mean	12.1	12.3	1.55%
Median	12.1	12.3	1.72%
Standard Deviation	0.77	0.73	5.26%
95th Percentile	13.4	13.6	0.93%
99th Percentile	13.9	14.0	0.72%

Table B-2. Instrument MFG-9 Pre-Survey and Post-Survey Background QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	September-12	November-12	
Detector ID:	MFG-9	MFG-9	
# of Readings	2,577	2,574	n/a
Mean	12.6	12.7	0.61%
Median	12.6	12.7	0.84%
Standard Deviation	0.71	0.71	0.14%
95th Percentile	13.8	13.8	0.36%
99th Percentile	14.3	13.8	3.64%

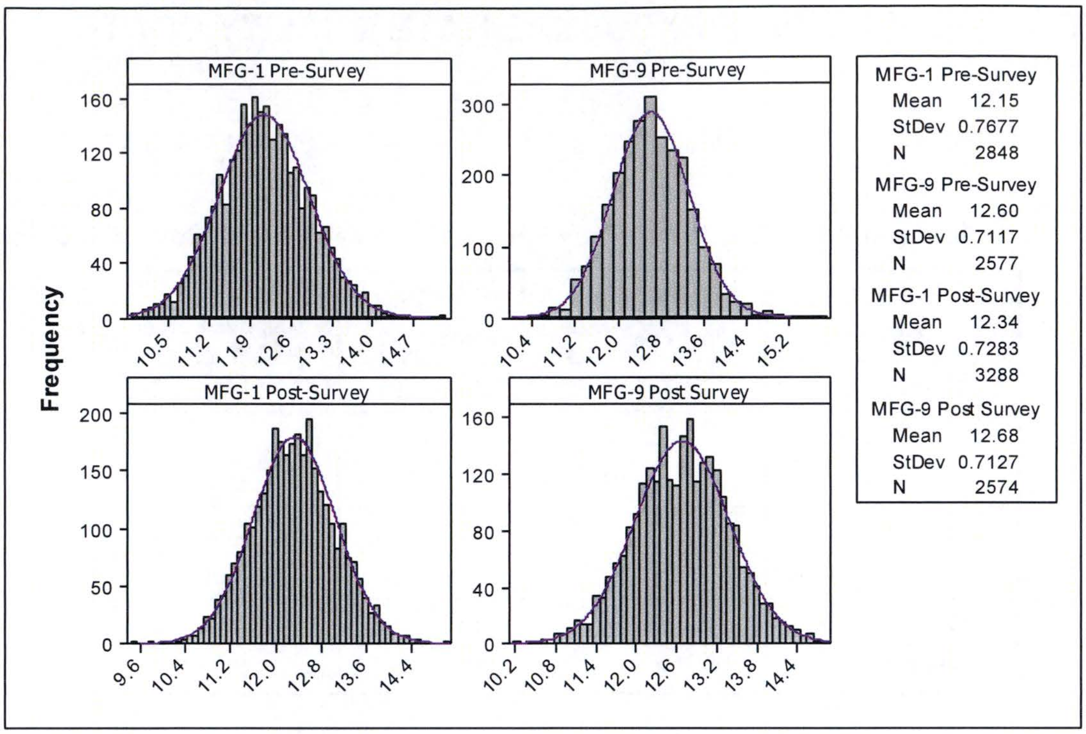

Figure B-1. Frequency Histograms for Pre-Survey and Post-Survey Background Measurements

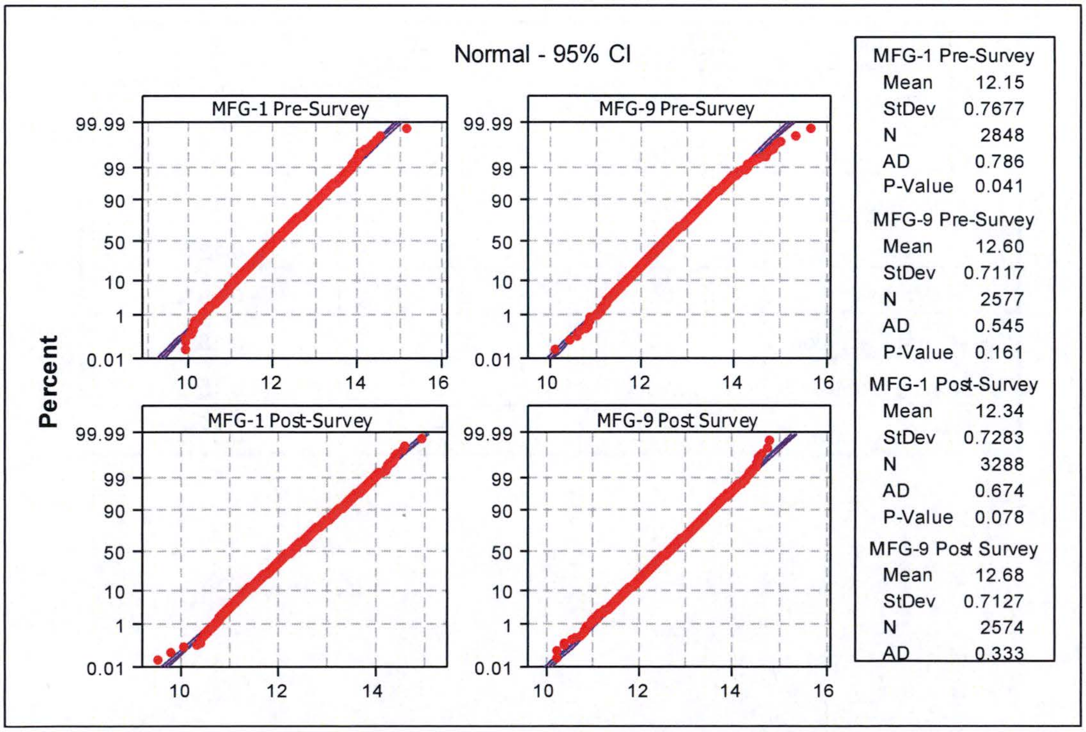

Figure B-2. Normal Probability Plots for Pre-Survey and Post-Survey Instruments Background Measurements

3.0 CESIUM-137 SOURCE EXPOSURE RATE QUALITY CONTROL RESULTS

This section summarizes the QC results for the Cs-137 source check measurements for the pre-survey and post-survey.

Table B-3. Instrument MFG-1 Pre-Survey and Post-Survey Cs-137 Source QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	September-12	November-12	
Detector ID:	MFG 1	MFG 1	
# of Readings	1,032	1,148	n/a
Mean	183	183.2	0.04%
Median	183	183.2	0.02%
Standard Deviation	2.8	2.8	1.95%
95th Percentile	188	187.8	0.02%
99th Percentile	190	189.4	0.15%

Table B-4. Instrument MFG-9 Pre-Survey and Post-Survey Cs-137 Source QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	September-12	November-12	
Detector ID:	MFG-9	MFG-9	
# of Readings	1,008	1,239	n/a
Mean	205	205	0.12%
Median	205	205	0.09%
Standard Deviation	3.02	3.01	0.18%
95th Percentile	210	210	0.15%
99th Percentile	212	212	0.08%

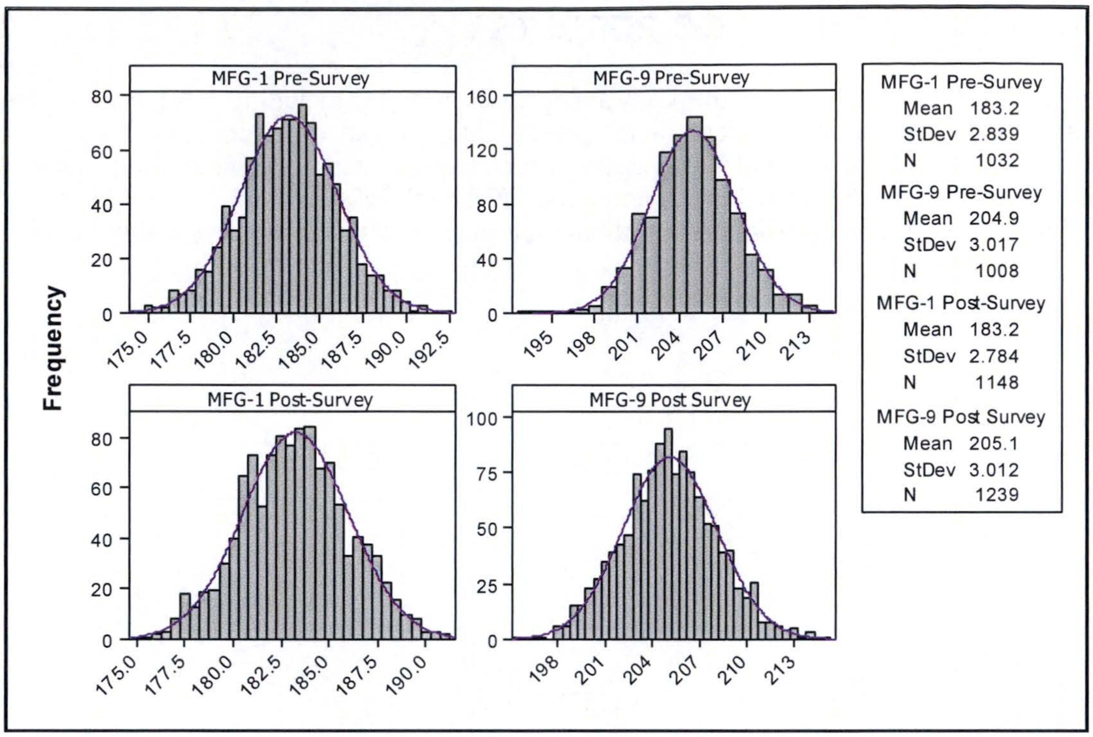

Figure B-3. Frequency Histograms for Pre-Survey and Post-Survey Background Measurements

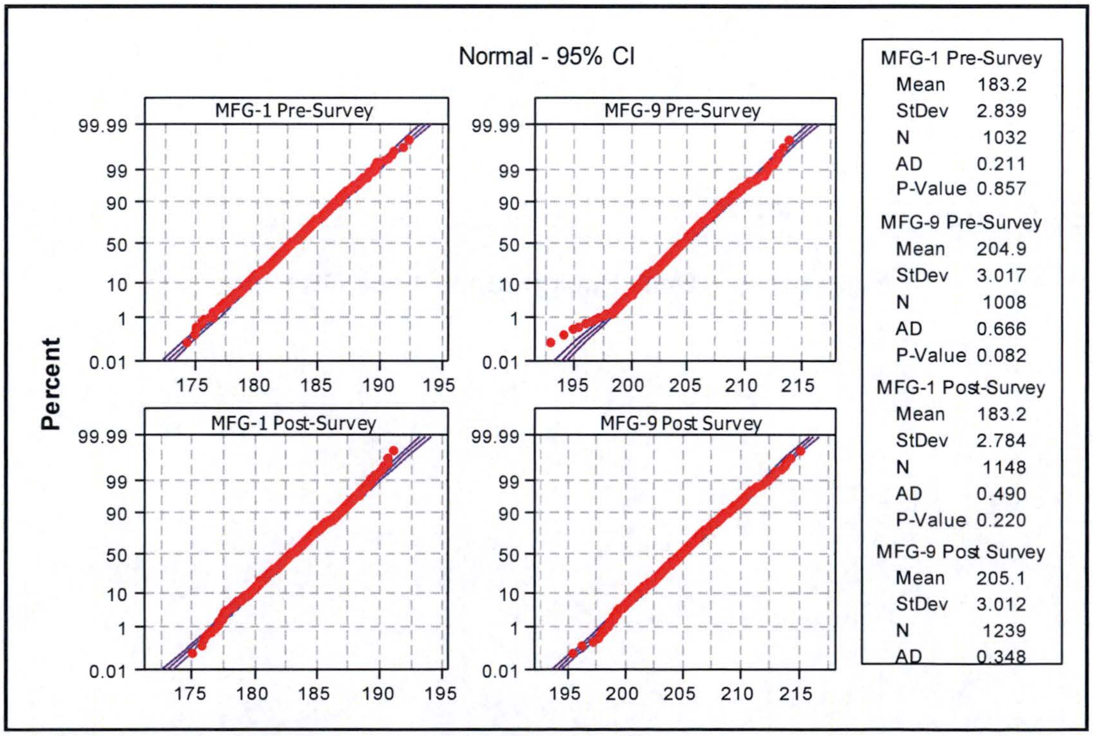

Figure B-4. Normal Probability Plots for Pre-Survey and Post-Survey Instruments Background Measurements

4.0 DAILY FIELD CHECK QC RESULTS

This section provides a summary of the daily field check results, including background checks, field strip checks, and Cs-137 source checks. These daily field checks were performed by radiation field personnel prior to going into the field and again after returning from the field on a daily frequency. Instruments are considered properly functioning if the QC check falls within 3 standard deviations of the total mean. The results below demonstrate that the instruments used all met this criterion.

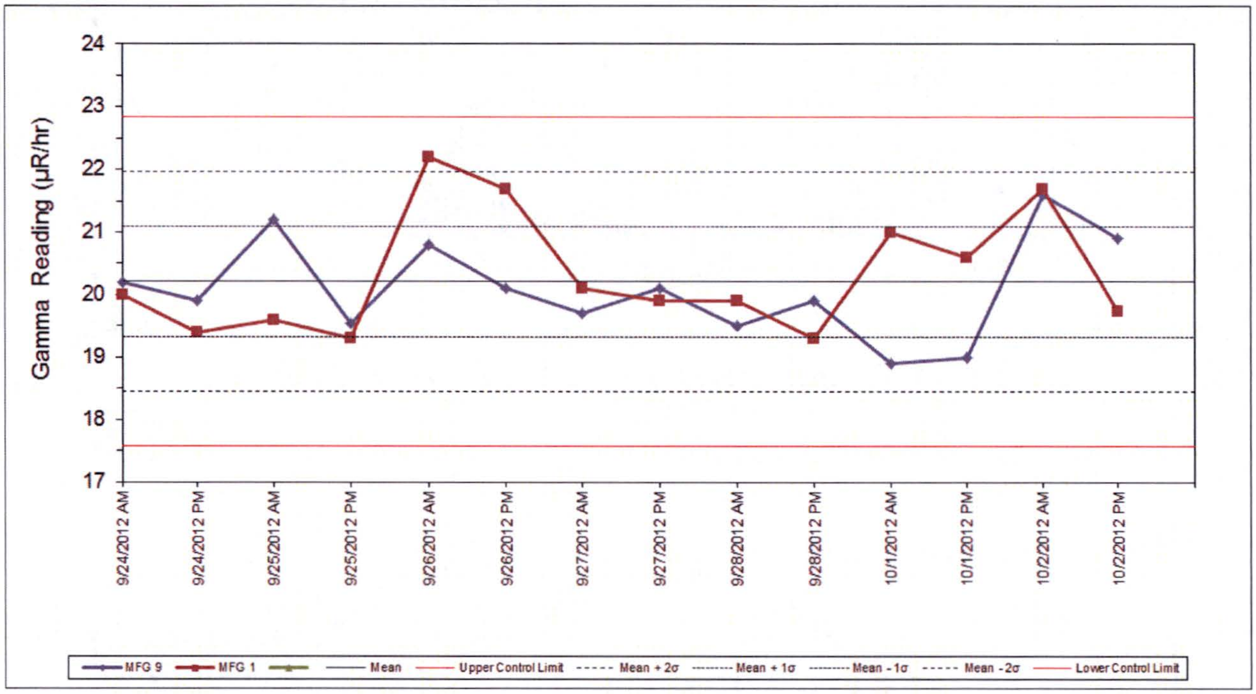

Figure B-5. Daily Background Check QC Chart

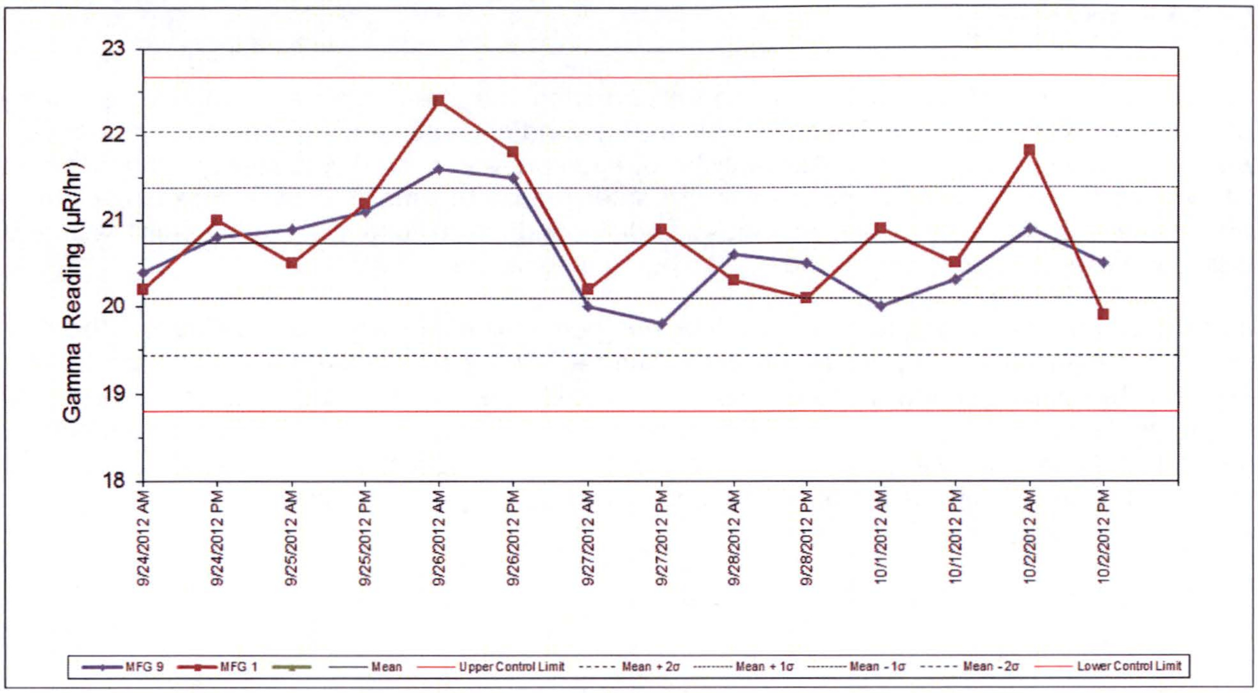

Figure B-6. Field Strip Check QC Chart

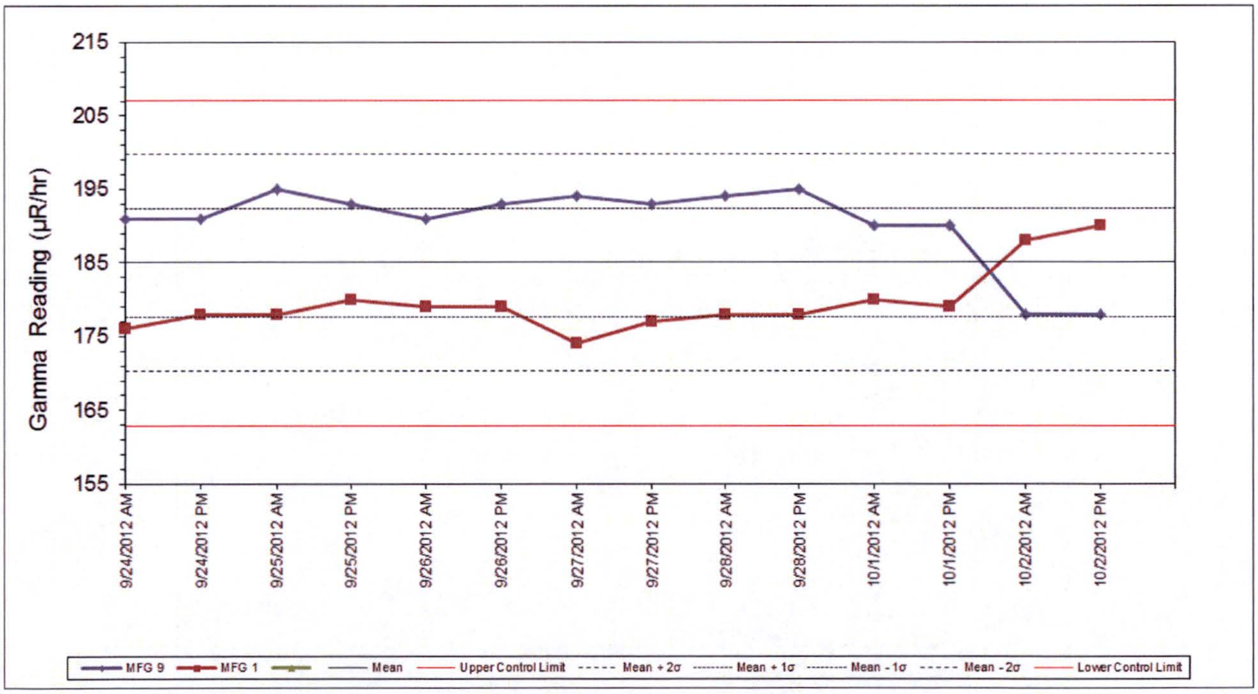

Figure B-7. Cs-137 Source Check QC Chart

5.0 CONCLUSION

The QC measurement data populations collected during the pre-survey and post-survey analysis exhibited normal (Gaussian) distribution for both background and source conditions and were evaluated by estimating the Anderson-Darling (AD) statistic for each pre-survey and post-survey distribution. All of the AD values (less than 0.75) and p-values (greater than 0.05) met the criteria to accept the null hypothesis that the data sets followed a Gaussian distribution. Additionally, all of the daily background, field strip, and source checks performed by field personnel met the criteria.

Additionally, when comparing the mean, median, and percentiles between the two surveys, the relative percent difference was minimal for all statistics. The radiation instruments used during the 2012 Lost Creek East baseline gamma radiation survey all met the pre-survey and post-survey QA/QC requirements. Based on this analysis, the data collected with both of the radiation instruments used during the Lost Creek East field work should be considered the highest quality, and the daily scan data collected during the field efforts are to be included in the final project database.

Revised Estimated Radiation Doses To Members of the Public from the Lost Creek Project including the Eastern Expansion, Sweetwater County, Wyoming

Prepared for:

Lost Creek ISR, LLC
5880 Enterprise Drive, Suite 200
Casper, WY 82609

Prepared by:

Two Lines, Inc.
896 Overview Rd.
Grand Junction, Colorado 81506
(970) 260-2810
Fax (309) 214-2569

May, 2014

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1.0 INTRODUCTION

Lost Creek ISR, LLC (a wholly owned subsidiary of Ur-Energy USA Inc.) operates an *in situ* facility for recovery of uranium at a location in south-central Wyoming (Lost Creek Project). The permit area is 38 miles northwest of Rawlins, Wyoming in the Great Divide Basin (Fig. 1). The central processing plant is situated in the NW 1/4 of the SE 1/4 of Section 18, Township 25 north, Range 92 west and is the 0,0 point for the MILDOS modeling. The region is sparsely populated with no permanent residents closer than 15 km away.

To estimate the potential radiation doses to potential and actual members of the public near the facility, radiation doses were modeled using the MILDOS-AREA code, version 3.10 as revised February 2012. The most recent version of MILDOS-AREA, 3.10, was released by the Nuclear Regulatory Commission (NRC) in February 2012.

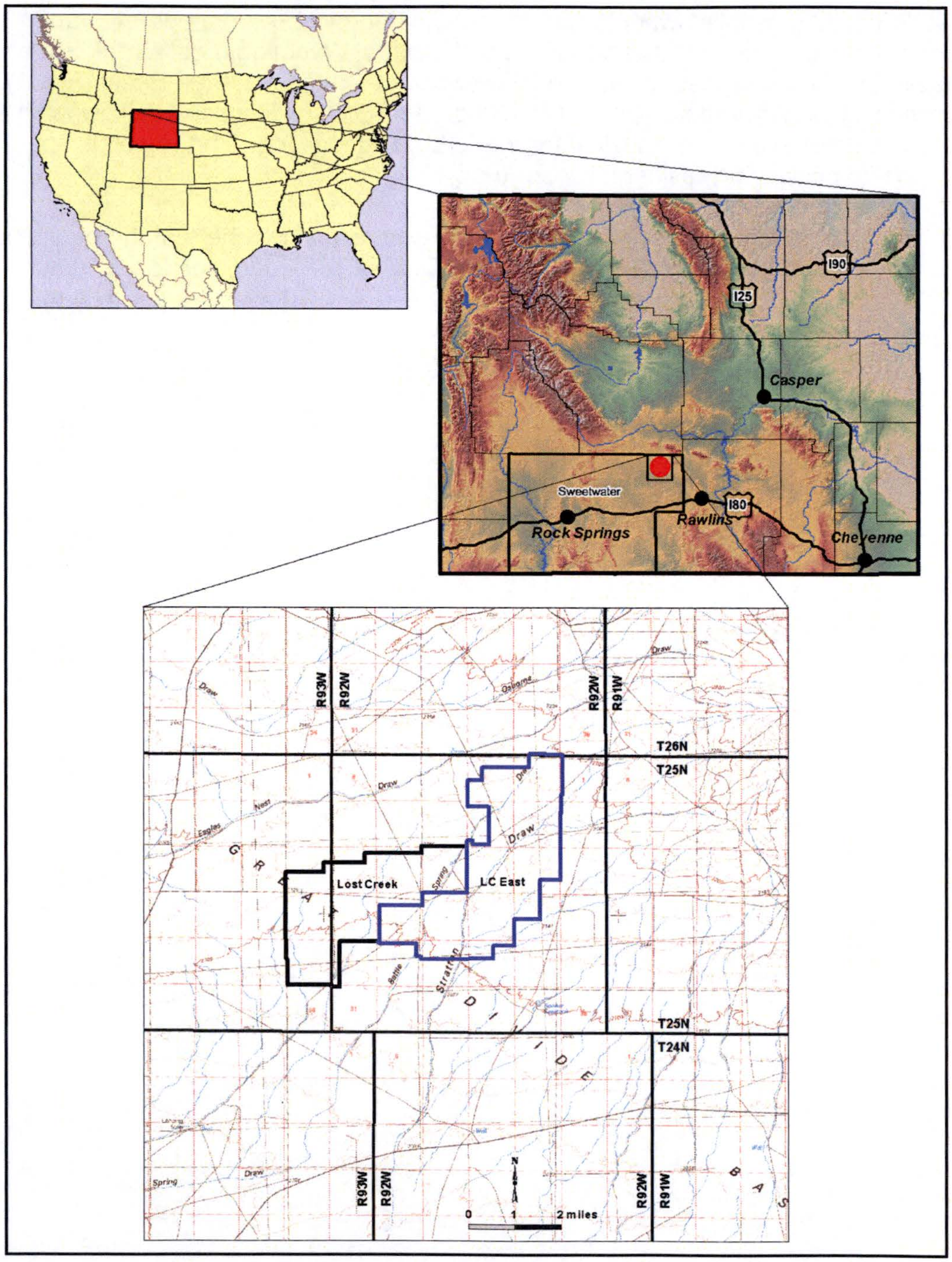

Figure 1. Map of project location.

2.0 PROJECT DESCRIPTION

The Lost Creek Project expansion, including the original production areas, will consist of eleven resource areas (RAs) that will be developed for injection and recovery of uranium leaching solutions over a nine year period. Locations of the RAs and the existing central processing plant (CPP), within the permit boundary are shown in Fig. 2. The leaching solution or lixiviant, which consists of groundwater augmented with an oxidant and source of carbonate, is pumped into the underground ore body to mobilize the uranium. Extraction wells remove the lixiviant containing uranium (termed "pregnant solution") from the ore body. The uranium is then extracted from the pregnant solution by passing through ion exchange columns.

RAs and processes are staged as shown in Fig. 3. RA-1 is currently in production. Other RAs will be added as shown and will produce through 2021. Project completion is planned for 2024. Production will begin 12-18 months after the initiation of new well installation, noted as development on Fig. 3. Restoration of RA-1 will begin in late 2015 and continue into 2017. Following RAs will be staged as shown in the figure. Resource Area 6, RA-6 shown in Fig. 2, is mineralization in the FG horizon and is not included in the original application or this application.

The Ion Exchange facility, located at the main plant, is currently operational and will continue more or less constantly through most of 2021.

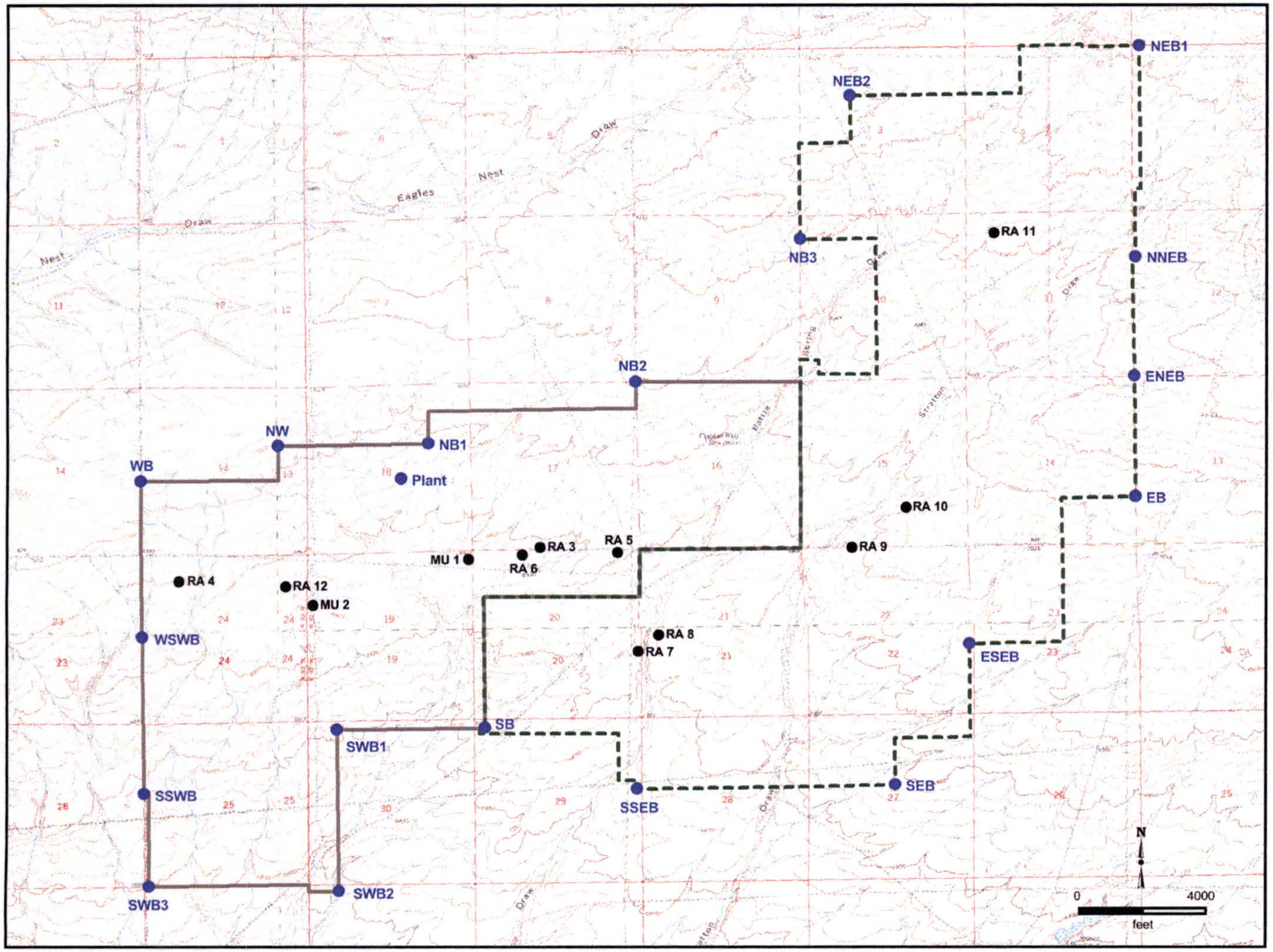

Figure 2. Boundary receptor locations, resource area centroids and processing plant.

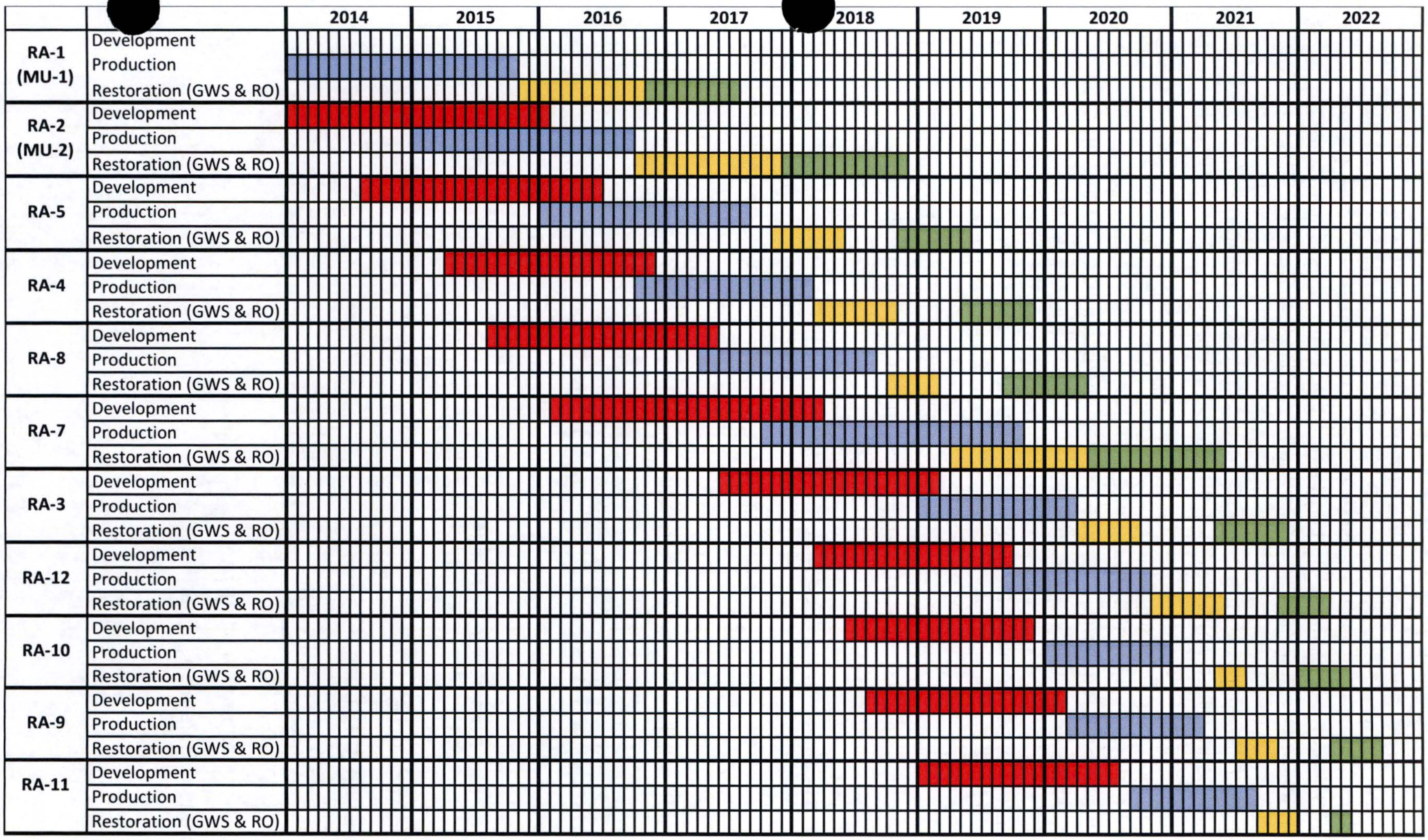

Figure 3. Staging of development, production and restoration by resource area.

3.0 POTENTIAL RADIOACTIVE EFFLUENTS

Uranium-238 (238U) in the ore body ultimately decays to radium-226 (^{226}Ra) and then radon-222 (^{222}Rn). Uranium (including ^{238}U, ^{234}U, and ^{235}U and radon are soluble in the leach solution and may be released during operations. MILDOS-AREA version 3.10 was used to estimate potential doses to members of the public. The users manual for MILDOS was published in 1989 by Argonne National Laboratory (ANL 1989) and has not been updated since that time. Doses to members of the public may arise from radioactive material released during the following operations:

- ***New wells:*** When drilling new wells into the ore body, drill cuttings, including ore, are transported to the surface in drilling mud. Cuttings are stored in mud pits where ^{222}Rn may be released to the atmosphere.
- ***Production:*** Radon dissolved in the lixiviant may be released in two ways, either from purge water or from gas venting at the wellhead.
- ***Ion Exchange columns:*** Radon gas may be released from the columns as a function of the volume of the columns, the porosity of the resin and the unloading rate of the column.
- ***Restoration activities:*** During the restoration of the mine units, water is circulated within and discharged from the wells in release rates similar to those from producing mine units.

The Lost Creek project utilizes a vacuum dryer and, therefore, no particulate materials are released from the process.

Equations used by MILDOS to estimate releases are those detailed in NUREG-1569, Appendix D as shown below.

New Well Installation

Releases from installation of new wells in a resource area are given by the following equation:

$$Rn_{new} = 10^{-12} * E * L * [Ra] * T * M * N,$$

where Rn_{new} = ^{222}Rn release rate from new mine unit (Ci/yr),

10^{-12} = Ci/pCi,

E = Rn emanation fraction (0.25),

L = ^{222}Rn decay constant (0.181/day),

[Ra] = concentration of ^{226}Ra in ore (pCi/g),

T = storage time in mudpit (d),

M = average mass of ore material in pit (g), and

N = number of mudpits generated per year.

Radon Source Term

The radon source term, S in pCi/d, can be expressed as:

$$S = 10^6 * E * L * [Ra] * A * D * \rho,$$

where $10^6 = cm^3/m^3$,

E = Rn emanation fraction (0.25),

L = ^{222}Rn decay constant (0.181/day),

$[Ra]$ = concentration of ^{226}Ra in ore (pCi/g),

A = active area of ore zone (m^3),

D = average thickness of ore zone (m), and

ρ = bulk density of ore material (g/cm^3).

Radon in Production Water

The ^{222}Rn concentration in process water at equilibrium, C_{Rn} (pCi/L), is described by:

$$C_{Rn} = (10^6 * [Ra] * A * D * \rho * E * L * f) / [(L + v) * V + F_p + F_i],$$

where $10^6 = cm^3/m^3$,

$[Ra]$ = concentration of ^{226}Ra in ore (pCi/g),

A = active area of ore zone (m^3),

D = average thickness of ore zone (m),

ρ = bulk density of ore material (g/cm^3),

E = Rn emanation fraction (0.25),

L = ^{222}Rn decay constant (0.181/day),

f = fraction of radon source carried by circulating water (unitless),

v = rate of radon venting during circulation (per day),

V = volume of water in circulation (L),

F_p = purge rate of water (L/d), and

F_i = water discharge rate from ion exchange column resin unloading (L/d).

The rate of ^{222}Rn release from purge water, Rn_w (Ci/y), is given by:

$$Rn_w = 3.65E\text{-}10 * C_{Rn} * F_{p,} ,$$

where $3.65E-10$ = day-Ci/pCi-yr,

C_{Rn} = concentration of radon in process water (pCi/L), and

F_p = purge rate of water (L/d),

Likewise, the rate of ^{222}Rn release from venting, Rn_v (Ci/y), is given by:

$$Rn_v = 3.65E\text{-}10 * v * C_{Rn} * V, ,$$

where $3.65E-10$ = day-Ci/pCi-yr,

v = rate of radon venting during circulation (per day),

C_{Rn} = concentration of radon in process water (pCi/L, and

V= volume of water in circulation (L).

Ion Exchange Columns

The water discharge rate from ion exchange column resin unloading, F_i (L/day), is calculated by:

$$F_i = N_i * V_i * P_i ,$$

where

N_i = number of ion exchange column unloadings per day

V_i = Volume of ion exchange column (L) and

P_i = porosity of resin material (unitless).

The annual ^{222}Rn discharge from unloading of ion exchange columns, Rn_x, Ci/y, is given by:

$$Rn_x = 3.65E\text{-}10 * F_i * C_{Rn} ,$$

where

$3.65E-10$ = day-Ci/pCi-yr,

F_i = water discharge rate from ion exchange column resin unloading (L/d) and

C_{Rn} = concentration of radon in process water (pCi/L).

4.0 MODELING

The computer code MILDOS-AREA was used to estimate potential radiation doses from planned Lost Creek ISR operations. MILDOS (ANL, 1989) was originally developed to estimate doses from conventional uranium milling operations, including large area releases such as ore storage pads and tailings beaches. Inputs to the dose are limited to uranium decay chain radionuclides. MILDOS was subsequently updated in 1998 to address potential impacts of uranium *in situ* leaching operations. In situ leach specific types of source terms, such as production wells and restoration wells are included in the updated version. Modeling parameters and assumptions are addressed below.

Meteorology

Meteorological conditions greatly influence dispersion of radionuclides from estimated releases during the year. The Lost Creek facility has a meteorological station that records wind speed, wind direction, and stability class simultaneously. A six-yr meteorology data set encompassing 2007-2012 was used for this modeling exercise. These data were converted to the site-specific joint frequency distribution (STAR file) required as input by MILDOS. These calculations were performed using the STARMD program which is based on the Sigma-Theta method in EPA 454/R-99-005 (EPA, 1987). STAR data represent percentages of time for each wind direction (16 compass points) in particular wind speed and stability classes. As shown in Table 1, winds from the west, west-northwest and northwest directions account for over 58% of the total.

Table 1. Percentage of wind from each direction, 2007-2012.

Direction from	Percentage of total hours	Direction from	Percentage of total hours
N	2.02	S	5.51
NNE	0.98	SSW	5.36
NE	1.12	SW	3.56
ENE	1.89	WSW	3.79
E	2.04	W	15.70
ESE	1.82	WNW	30.40
SE	3.50	NW	11.93
SSE	5.79	NNW	4.60
Total..........100.00			

Receptor Locations

There are few permanent receptors in the vicinity of the Lost Creek project. The village of Baroil is approximately 28 km to the northeast of the CPP. Other receptor locations modeled are on the boundary of the project permit area.

Table 2. Location of modeled receptors.

Receptor Designation	X (km)+	Y (km)+	Z(m) *
CPP	0	0	0
WB	(2.55)	(0.02)	16
NWB	(1.20)	0.32	15
NB1	0.26	0.34	6
NB2	2.25	0.94	25
NB3	3.84	2.33	43
NEB2	4.31	3.72	54
NEB1	7.11	4.20	74
NNEB	7.08	2.16	49
ENEB	7.07	1.00	44
EB	7.08	(0.17)	47
ESEB	5.48	(1.58)	4
SEB	4.77	(2.95)	(8)
SSEB	2.28	(2.99)	(28)
SB	0.81	(2.41)	(35)
SWB1	(0.61)	(2.41)	(35)
SWB2	(0.59)	(4.00)	(53)
SWB3	(2.45)	(3.95)	(51)
SSWB	(2.51)	(3.04)	(40)
WSWB	(2.53)	(1.52)	(13)
Baroil	26.20	10.90	(24)
+ negative numbers indicate west or south *rounded to the nearest meter			

Population Distribution

There are no towns of any size within 30 km of the proposed site. However, towns within 80 km from the proposed Lost Creek Project include Rawlins, Jeffrey City, Wamsutter and Bairoil. Directions, distances and 2010 census data are listed in Table 3.

Table 3. Population distribution surrounding the Lost Creek site.

Town	Direction	Distance (km)	Population
Rawlins	SE	75	9259
Jeffrey City	NNE	40	110
Wamsutter	S	50	451
Bairoil	ENE	28	106

Input Parameters for MILDOS Model

Parameters that apply to the entire project are shown in Table 4. Parameters specific to a resource area are listed in Table 5.

Table 4. Important Input Parameters.

All sources	Thickness of ore body	3.7 m
	Porosity of ore body	0.26
	Density of ore body	1.94 g/cm^3
New Well sources	Number of mud pits/yr	935
	Ore material added to mudpit	2.5E+05 g/y
	Duration of storage in mudpit	4 days
	% U_3O_8	0.055%
Production Mine Unit sources	Emanation fraction	0.25
	Fraction of radon in solution	0.80
	Rate of radon venting	0.01/day
	% U_3O_8	0.055%
	Volume in circulation	Varies with size of unit
	Purge rate	3.27E+05 L/d
Ion Exchange columns	Column volume	1.41E+05 L
	Column unloading rate	0.68/day
	Porosity of resin	0.4
	% U_3O_8	0.055%
Restoration Mine Unit sources	Emanation fraction	0.25
	Volume in circulation	Varies with size of unit
	Purge rate	3.27E+05 L/d
	Operating days	365/yr

Table 5. Resource Area-Specific Parameters.

Resource Area	Location of centroid (relative to CPP)			Area of active drilling (m^2)	Maximum volume in circulation (L)
	X (km)	Y (km)	Z (m)		
RA1	0.29	(0.80)	(13)	1.76E+05	1.69E+08
RA2	0.96	(0.83)	(11)	2.91E+05	2.81E+08
RA5	(0.51)	(0.83)	(11)	1.18E+05	1.14E+08
RA4	1.02	(0.55)	(6)	1.10E+05	1.07E+08
RA8	(1.27)	(1.32)	(15)	1.11E+05	1.07E+08
RA7	2.29	(1.66)	(5)	2.64E+05	2.55E+08
RA3	1.34	(0.66)	(8)	1.13E+05	1.09E+08
RA12	(1.12)	(1.04)	(11)	1.33E+05	1.28E+08
RA10	4.87	(0.28)	9	7.29E+04	7.20E+07
RA9	4.35	(0.66)	5	8.80E+04	8.65E+07
RA11	5.71	2.39	44	7.11E+04	7.05E+07

Modeling Assumptions

Sources were modeled according to the staging shown in Figure 3. New resource area development, releases from radon in purge water and from venting during both production and restoration, and Rn releases during ion exchange were modeled using the MILDOS-prescribed format and inputs for that type of source. Radon releases from production and restoration purge water was assumed to occur at the location of the central processing plant. Radon releases from venting was assumed to be at the centroid of the resource area in question.

Because the facility has a vacuum dryer, no particulates are released. So, all calculated doses come solely from radon releases.

Inhalation, direct exposure from material deposited on the surface (ground) and submersion in contaminated air (cloud) were calculated for all receptors. Food pathways were included for vegetables and cattle grown in the area. It was assumed that all cattle feed was from pasture grass, not hay or other feed. The milk pathway was turned off for all receptors because there is no commercial dairy in the vicinity. Doses were calculated for an 8760-hr year, a conservative assumption meaning that, unless otherwise noted, the receptor is present at that location 100% of the time.

Source Strength Adjustment

The QADJUST factor in MILDOS was used to adjust the timing and fraction of a year that various sources operate in keeping with the staging shown in Figure 3. The annual rate of release from a specific resource was varied depending timing of the release. For example, if a source operated for only 3/4 year, QADJUST was set at 0.75 to account for that diminished output on a yearly basis. By varying QADJUST in this way, it was possible to plot the variation in dose as the project progresses.

Model Runs

Dose modeling was conducted in several MILDOS Code runs as follows:

- New resource development was modeled in run New14-20 that encompassed all resource areas except RA-1 for which development is complete.
- Production purge was represented by runs PP14-21 and PP20-21. Use of two runs was necessary because of the number of time steps and the number of sources, both of which are limited to 10 by the MILDOS cost. Releases of radon from purge water was assumed to occur at the CPP.
- Production venting was modeled using runs PV14-21 and PV20-21 for the same reason. steps from 2009 through 2016. Releases of radon from venting were assumed to occur at the centroid of the RA.
- The IX14-21 run was used to model releases of Rn from the ion exchange columns. The Rn release rate was set at a constant throughout the project.
- Restoration purge was modeled using runs RP15-21 and RP-20-22. Again, two runs were necessary because of the number of sources (RAs) and time steps.
- Restoration venting was represented by runs RV15-21 and RV20-22.

In all cases, the modeling time step was set at one year. Hence, run PP14-21 contains 8 time steps of one year.

5.0 MODEL RESULTS

This section presents the results of the MILDOS modeling.

Radon Release Rates

Potential annual radon release rates calculated by MILDOS from input parameters during the project from the various sources are listed in Table 6. The radon release rate varies with the sources that are active during all or part of a given year.

Table 6. Maximum annual quantities released by source (Ci).

Source	2014	2015	2016	2017	2018	2019	2020	2021	2022
New well development	11	24	25	22	17	22	5		
Production venting	159	396	330	306	322	346	272	145	59
Production Purge	256	283	289	309	283	296	291	262	20
IX columns	224	224	224	224	224	224	224	224	
Restoration venting		26	225	374	404	315	325	132	74
Restoration purge		5	40	56	80	66	59	37	19
Total	650	958	1133	1292	1330	1269	1177	800	172

Dose to Individual Receptor Locations

Estimated maximum annual total effective dose equivalents (TEDE) at individual boundary receptor locations are shown below in Table 7 and Figure 4. The maximum dose of 4.04 mrem for any boundary location is estimated to occur at boundary location NB1 in 2017. Receptor NB1 is the location of the maximum dose in each year of the project, due to it's location near the CPP.

This calculated dose results exclusively from exposure to radon decay products, since there are no particulate releases from the facility. For each receptor point, dose from inhalation contributes over 99% of the total modeled dose. Doses from submersion in a plume, direct exposure to contaminated ground surface, and ingestion of vegetables and meat represent less than 1% of the dose. Further, because doses result only from releases of radon with consequent decay products, the 40 CFR 190 annual dose commitments, which are exclusive of radon exposure, are zero in all cases.

The shape of estimated doses through time reflects both the staging of different processes and their locations. It is important to note that there are no actual receptors at the boundary locations, but it is presumed that an actual receptor could reside at or near that location. In all years, the maximum calculated dose was to boundary receptor NB1 which is located nearest to the processing plant.

The actual receptors modeled for this project reside at the village of Baroil, which is approximately 28 km to the east-northeast of the plant. The maximum modeled dose at Baroil is 1.57E-02 mrem/yr.

Table 7. Maximum total effective dose equivalent (TEDE) at various receptor locations.

Lost Creek - Summary of TEDE Doses To Maximum Individual By Time, Location and Source (mrem)									
Receptor	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
WB	6.38E-02	1.39E-01	2.13E-01	2.67E-01	2.52E-01	2.05E-01	2.27E-01	1.05E-01	3.14E-02
NWB	1.64E-01	3.44E-01	5.99E-01	7.56E-01	6.97E-01	5.74E-01	7.02E-01	3.48E-01	1.08E-01
NB1	1.22E+00	2.32E+00	3.40E+00	4.04E+00	3.60E+00	3.21E+00	3.61E+00	2.16E+00	3.99E-01
NB2	1.59E-01	5.04E-01	6.22E-01	7.75E-01	8.16E-01	7.56E-01	5.66E-01	1.43E-01	3.23E-02
NB3	6.80E-02	1.92E-01	2.45E-01	3.04E-01	3.31E-01	3.18E-01	3.28E-01	1.66E-01	3.63E-02
NEB2	5.23E-02	1.42E-01	1.84E-01	2.27E-01	2.40E-01	2.27E-01	2.46E-01	1.49E-01	3.22E-02
NEB1	2.73E-02	7.48E-02	9.66E-02	1.21E-01	1.36E-01	1.40E-01	1.68E-01	1.52E-01	3.11E-02
NNEB	2.25E-02	6.40E-02	8.31E-02	1.09E-01	1.35E-01	1.69E-01	2.71E-01	4.01E-01	7.96E-02
ENEB	3.39E-02	8.81E-02	1.17E-01	1.47E-01	1.62E-01	1.70E-01	2.39E-01	2.35E-01	4.86E-02
EB	4.56E-02	1.23E-01	1.61E-01	1.97E-01	2.09E-01	1.99E-01	2.97E-01	1.86E-01	4.27E-02
ESEB	9.27E-02	2.64E-01	3.38E-01	4.30E-01	5.06E-01	5.18E-01	6.61E-01	3.57E-01	7.51E-02
SEB	1.14E-01	3.17E-01	4.06E-01	5.34E-01	6.96E-01	7.53E-01	5.71E-01	1.26E-01	2.91E-02
SSEB	1.42E-01	3.41E-01	4.48E-01	5.17E-01	4.99E-01	4.26E-01	3.94E-01	1.19E-01	3.27E-02
SB	1.14E-01	2.29E-01	3.56E-01	4.55E-01	4.35E-01	3.38E-01	3.51E-01	1.39E-01	4.53E-02
SWB1	4.99E-02	1.19E-01	1.71E-01	2.83E-01	2.95E-01	1.96E-01	2.06E-01	8.37E-02	2.55E-02
SEB2	1.69E-02	3.90E-02	5.40E-02	7.16E-02	7.35E-02	6.28E-02	6.30E-02	3.37E-02	6.69E-03
SWB3	1.32E-02	3.12E-02	4.23E-02	5.17E-02	5.14E-02	4.31E-02	4.01E-02	2.50E-02	3.99E-03
SSWB	2.05E-02	4.76E-02	6.59E-02	8.38E-02	8.28E-02	6.63E-02	6.33E-02	3.43E-02	7.03E-03
WSWB	4.07E-02	9.32E-02	1.38E-01	2.04E-01	2.04E-01	1.48E-01	1.65E-01	7.58E-02	2.18E-02
Baroil	3.35E-03	8.74E-03	1.15E-02	1.43E-02	1.57E-02	1.50E-02	1.49E-02	7.87E-03	1.55E-03

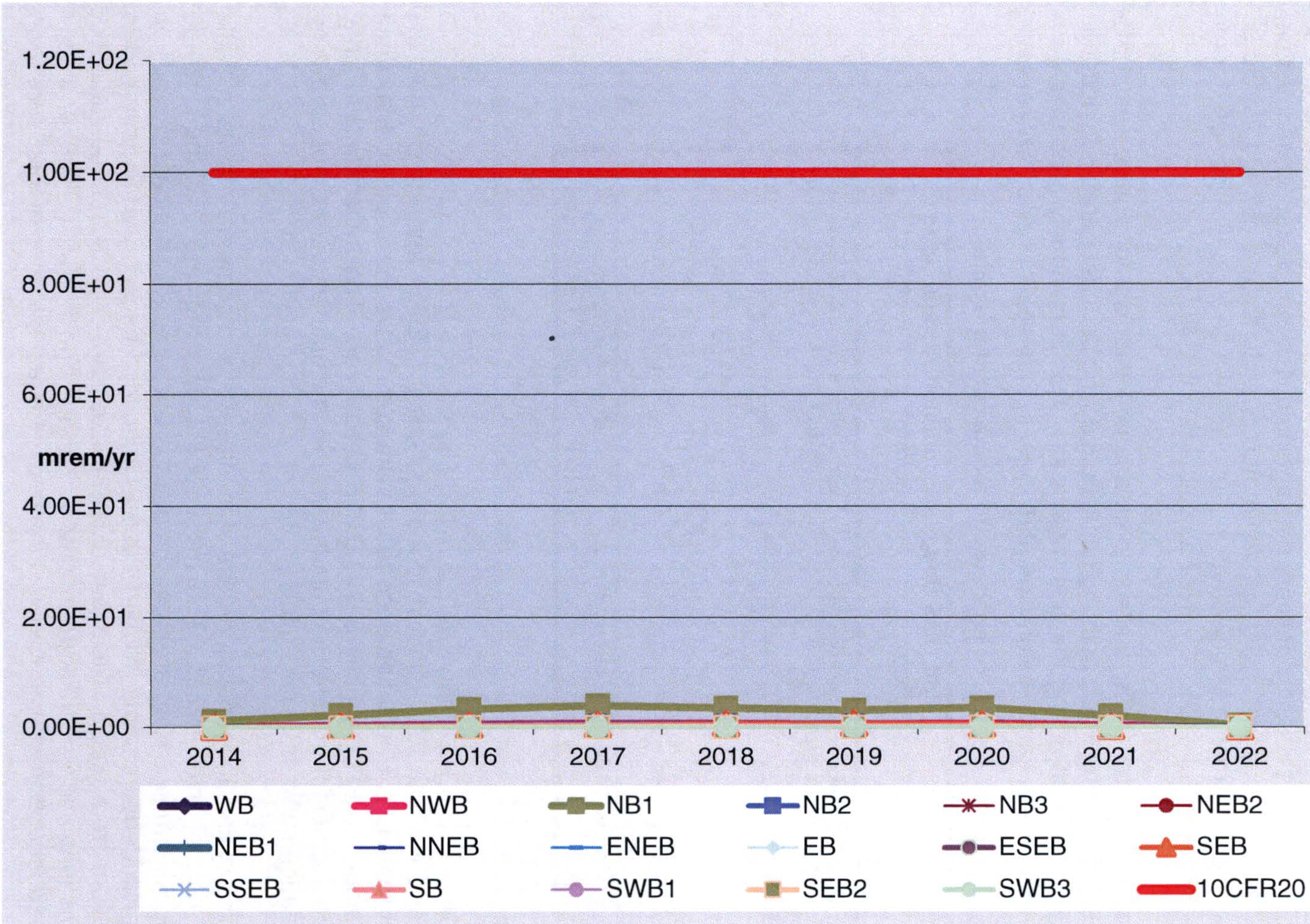

Figure 4. Maximum TEDE (mrem/yr) at each receptor, compared to dose limit.

Estimated Dose to A Transient Member of the Public

Members of the public are subject to potential doses from releases as described above. Possible categories of members of the public include a courier or delivery person, member of tour groups, a driver of a reagent truck and a nearby camper. To estimate the potential dose, visitors of various types were situated at the NB1 location which had the highest potential annual dose of 4.0 mrem. Besides the potential dose rate to members of the public, the amount of time exposed is a key variable. As mentioned above, MILDOS assumes 100% occupancy at the modeled locations, so the exposure time for members of the public must by prorated for 8760 hr/yr. Table 8 lists the exposure scenarios and calculated doses for each considered category of the public.

It is reasonable to assume that a courier or delivery person could visit the site for 30 minutes per day. Over the course of a 50-week work year, the estimated dose to such a receptor would be approximately 1.1E-02 mrem. A reagent truck driver might visit the site for half a day per month and receive a dose of approximately 2.2E-02 mrem as calculated by MILDOS.

A tour group that visited the site for ½ day during the course of a year would receive only 1.8E-03 mrem during that visit. Someone who elected to camp outside the boundary area near location NB1 would receive 7.7E-02 mrem during the one week visit. This is obviously a conservative scenario, since it is unlikely that a camper would be stationary in that location for an entire week.

Table 8. Potential classes of exposure to members of the public.

Class	Annual Hours # Exposed	MILDOS Dose Rate	Estimated Annual Dose (mrem)
UPS delivery	30 min/wk * 50 wk/yr = 25 hr/yr	4 mrem/yr	25 hr/yr * 4 mrem/yr / 8760 hr/yr = 1.1E-02 mrem
Tour group	4 hr/yr	4 mrem/yr	4 hr/yr * 4 mrem/yr / 8760 hr/yr = 1.8E-03 mrem.
Reagent truck driver	4 hr/mo * 12 mos/yr =48 hr/yr	4 mrem/yr	(48 hr/yr * 4 mrem/yr / 8760 hr/yr) = 2.2E-02 mrem/yr
Camper	1 wk/yr * 168 hrs	4 mrem/yr	168 hr/yr * 4 mrem/yr / 8760 hr/yr = 7.7E-02 mrem

Population Doses

Using the population distribution shown in Table 3, population doses (person-rem/yr) from site releases were calculated for both total effective dose equivalent (TEDE) and the dose to the bronchial epithelium of receptors. Population dose results are summarized in Table 9. Maximum population TEDE is calculated to be slightly below 0.025 person-rem. The maximum bronchial dose is estimated to be 1.2 person-rem to the population. Such small values are not surprising given the sparse population surrounding the site.

While there is no regulatory limit for population dose, it is interesting to compare results in Table 9 to exposures from natural background. The most recent data indicate that the average American receives approximately 310 mrem from "ubiquitous background" (National Council on Radiation Protection and Measurements [NCRP] 2009). Ubiquitous background is assumed to include external exposure from cosmic radiation, external exposure from terrestrial radiation, internal exposure from inhalation of background radon (^{222}Rn) and thoron (^{220}Rn) and their progeny and internal exposure from radionuclides in the body. For a population of 9926 as shown in Table 3, the total background dose exceeds 3,000 person-rem TEDE. This is over 125,000 times greater than the estimated dose to the same population from the Lost Creek East expansion.

Table 9. Collective dose to populations with 80 km surrounding the site.

Dose to Population within 80km	
	person-rem
TEDE	2.46E-02
Bronchial	1.20E+00

Uncertainties in Dose Estimates

MILDOS is not designed to calculate uncertainty associated with estimates of doses. Use of the Gaussian Plume Dispersion coefficients and the uncertainty in the dose conversion factors themselves introduce an unknown amount of uncertainty into estimated doses at receptor locations. Doses calculated by the code represent an entire year of occupancy at the specified receptor location. For any actual resident, this represents a large overestimate of the actual dose that would be received. Residents in the vicinity would leave their place of residence for work or recreation and those absences are not accounted for by the model.

6.0 SUMMARY

Potential releases from the eastward expansion of the Lost Creek Project were modeled using MILDOS-AREA, version 3.10. Releases from drilling of new resource areas were assumed to occur at the centroid of the resource area. Radon releases from the ion exchange columns and purge water during production and restoration were assumed to occur at the CPP. Venting during production and restoration was assumed to occur at the centroid of the resource area.

Results of *MILDOS* modeling indicate that no member of the public is likely to receive greater than the 10 CFR 20 limit of 100 mrem/yr TEDE. The maximum modeled dose at any boundary location is slightly above 4 mrem in the maximum modeled year.

Collective dose to the surrounding population dose, expressed in person-rem/yr, to residents surrounding the project are very small relative to natural background radiation. Because of the long distances to most of the population well less than a person-rem/yr is anticipated from the project. The average background radiation to a person in the United States is 310 mrem, which is over 100,00 times higher than the average dose to members of the public from potential releases from the Lost Creek uranium recovery facility.

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Section 4.0
Environmental Impacts and Mitigation

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4.0 ENVIRONMENTAL IMPACTS, MITIGATION, AND MONITORING

This section includes evaluations of the potential cumulative impacts of the Project (previously licensed Lost Creek plus LC East and the KM Horizon at Lost Creek) 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. The impacts of the Other Alternatives described in **Section 2** are then evaluated. Mitigation and monitoring associated with the Preferred Alternative are also included in this section.

The No Action Alternative is not discussed in detail in **Section 4** because without the expansion to LC East or the KM Horizon, there are no changes to the previously assessed and licensed Lost Creek Project. The Project does not intervene in any other on-going activities in the area. The No Action alternative is included in **Table 6.0-1**, Summary of Environmental Consequences.

The analyses of the cumulative impacts were based on publicly available information on existing and proposed projects, general knowledge of the conditions in Wyoming, and reasonably foreseeable changes to existing conditions. The primary concern in the evaluation of Cumulative Impacts is the potential for a resurgence in mining and oil and gas development. However, recent significant declines in oil and gas and uranium prices make it unlikely that there will be significant impacts in the foreseeable future. Uranium exploration in the Great Divide Basin has been terminated on all projects outside of Lost Creek and no other companies are currently seeking to permit mines in the area. In addition, for each discipline, a different scale is necessary for any substantive evaluation of impacts. For example, groundwater impacts can be evaluated within a few miles of the site because the complex hydrogeologic environment of the Great Divide Basin limits the number of projects that could affect groundwater. However, the socioeconomic impacts must be evaluated over a much larger area, e.g., 100 miles, because of the limited number of population centers, all of which are small, near the site.

For this report, it has been assumed that there will be no long-term changes within about five miles of the site, other than the possible installation of a limited number of dirt roads. Moving farther from the site, up to about 20 miles away, it has been assumed that there will be a few new drill pads for oil and gas development. However, since there are no publicly announced plans for any future uranium mines or exploration in the region, the assessment assumes there will be no other uranium development outside of Lost Creek. At greater distances, it has been assumed that relatively slow expansion of extractive industries will continue and that on-going efforts by government agencies and industries to develop the infrastructure to support the industries will continue.

4.1 Land Use

4.1.1 Land Use Impacts from Preferred Alternative

The Permit Area encompasses approximately 10,005 acres (4,254 at Lost Creek plus 5,751 at LC East). Disturbance within the five new mine units at LC East is estimated as 147 acres; disturbance from up to three additional Class I UIC drill pads at LC East is expected to be 9 acres; disturbance from the roads, header houses, pipelines, and mud pits is estimated as an additional 108 acres. When all disturbance is accounted for (Lost Creek, including the KM amendment, plus LC East), the Project is expected to disturb a total of about 642 acres, or about 6.4% of the total Permit Area.

The LC East project will consist solely of wellfields and associated infrastructure such as secondary wellfield roads, overhead power lines, trunk lines and deep wells. LC East will not have a processing plant, primary roads or holding ponds.

The KM amendment will result in mining a deeper horizon than is currently licensed. No new primary roads will be constructed. Major trunklines previously licensed at Lost Creek and largely installed will serve production from the KM Horizon. Additional feeder trunklines, generally within the approved disturbance area, will be installed to various header houses. Previously approved header houses will be utilized for KM Horizon production. However, their locations might be adjusted within the approved disturbance area in order to improve spacing. If header houses are relocated it will be necessary to extend the previously approved overhead powerlines which are located within the previously approved disturbance area. The KM amendment will not require any additional recovery plant construction, holding ponds or disposal wells beyond the five that have already been permitted at Lost Creek.

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 and small, 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

The predominant land use within the Permit Area is livestock grazing. A portion of the Stewart Creek, Cyclone Rim and Green Mountain grazing allotments (**Section 3.1**) will be impacted by the reduction in grazing land related to the Project. The entire permit area (LC and LC East) provide grazing for approximately 114 cattle. Therefore, the disturbance of 642 acres (477 acres at Lost Creek-inclusive of the KM Amendment, and 165 acres at LC East) would represent the loss of fodder necessary to support about 7 cows. This estimate is likely too high because the mine units will be constructed, developed and reclaimed in succession, and the maximum area disturbed at any time should be far less than the total disturbance for the life of the mine. Also, the calculated disturbance is exaggerated since several mine units will overlap. However, the overlap is not discounted from the total disturbance.

The loss of fodder for 7 cows represents a small fraction of the grazing in the area; therefore, the temporary loss of these AUMs is not expected to significantly impact the regional economy. If grazing rights cannot be replaced by ranchers, the temporary loss of AUMs could economically impact individual lessees. If present, these impacts will be temporary, and affect only a small number of individuals.

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

The Project will conform to the land use regulations of Sweetwater County as well as the RMP of the BLM-Rawlins Field Offices (BLM, 2008).

The following passages from the Rawlins Field Office RMP EIS demonstrate that the Project is consistent with the management goals of the BLM

- Section 4.1 "BLM manages public lands for multiple uses in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA). Land use decisions are made that protect the resources while allowing for multiple-use of those resources, such as livestock grazing, energy development, and recreation."
- Section 4.8.1 "Lands and realty management actions would result in minimal impacts because access and the establishment of the infrastructure for locatable mineral development are authorized under the provisions of the 1872 Mining Law and the 43 CFR 3809 surface management regulations. Existing withdrawals of approximately 935,530 acres would limit the land available for locatable mineral entry."

The Project is not located in lands withdrawn from mineral exploration and development. Project permitting requires review by the Rawlins BLM Field Office and Wyoming State Lands Office, which will ensure that the Project is deemed compatible with management objectives for area lands.

4.1.1.2 Short-term and Long-term Impacts

No impacts to the Permit Area can be considered permanent, since the land will ultimately be returned to its natural condition when production is complete. Surface disturbance for two weeks to six months represents a short-term impact. Mine units will be fenced prior to final construction and operation to deter access to the public and to wild horses. Each mine unit will be fenced for a period of approximately three years, which represents a medium-term impact. An estimated 71.3 acres will be disturbed for the duration of the Project for the Plant and access roads, which represents a long-term impact.

4.1.2 Land Use Impacts from Other Alternatives

The potential impact from the alternative of using portable pits is likely indistinguishable from the preferred alternative. The use of portable pits would reduce the amount of topsoil damage within the wellfield but increase the amount of topsoil damage to a similar degree wherever the cuttings are disposed of. In essence, the cuttings have to be disposed of in a pit somewhere and the degree of impact to land will likely be similar regardless of the location of burial.

4.1.3 Mitigation of Impacts for the Preferred Alternative

Land use impacts will be mitigated by minimizing the amount of fencing and the length of time fencing is in place. Also, the facility has been designed to minimize total disturbance; including by keeping disturbances close to each other instead of spreading them out. All employees are trained to stay on designated roads so new roads and associated disturbance are not created.

4.1.4 Monitoring for the Preferred Alternative

Weekly inspections are completed and documented to ensure that disturbance is minimized and reclamation occurs at the earliest practical opportunity.

4.2 Transportation

4.2.1 Preferred Alternative

Figure 1.2-1 of this report shows the existing network of on-site roads. The eastern 4.5-mile segment of the principal east-west road is the primary project access, extending from the Plant to Sooner Road (BLM 3215). The western 2.9 miles of this road is within the Permit Area. It has been upgraded to a 20-foot-wide, four-season gravel road with drainage. The other primary on-site road extends 0.4 miles south from the Plant to the mine units. Additional secondary roads will be constructed from the site access road to the header houses. Two-track roads will be established within the mine units, from the network above, to individual wells. Off-site transportation routes will use established BLM, county, state, and federal roads. The railhead in Wamsutter provides the option of utilizing rail transportation, however, this option has not been used to date and there are no plans to utilize this option in the future.

Materials shipments are subject to both federal and state regulations. All shipments to and from the Project will be under the care of properly licensed and certified commercial drivers. Materials transportation to and from the Project is classified as either: 1) shipments of construction materials, process chemicals, office supplies, and related materials from suppliers to the Plant, 2) shipments of yellowcake slurry from the Plant to an off-site drying facility or dry yellowcake from the site to a conversion facility, 3) shipments of waste material that cannot be disposed of on-site or 4) shipments of loaded resin to or from the site for processing and the return of empty resin to the originating facility. An accident scenario for each category would have different impacts, which are discussed in the following sections. The socioeconomic effects of increased traffic due to shipments and worker transportation are discussed in **Section 4.9** of this report.

Additionally, since the Lost Creek facility has been in operation for over three years, the following information is provided based on actual counts of traffic.

LC East and the KM Amendment areas will be accessed using the pre-existing primary roads established for the Lost Creek Project. The planned network of on-site primary and secondary roads is portrayed in **Plates 1.2-1a and 1.2-1b.** Secondary roads will be installed to access the proposed wellfields and deep wells.

The NRC Supplemental Environmental Impact Statement (NUREG 1910 Supplement 3) and BLM Environmental Impact Statement completed for the initial Lost Creek License, analyzed the environmental impact of the expected quantity of traffic. The actual amount of light vehicle traffic (SUVs, vans, pickups) at the site is averaging 22 vehicles per day while the predicted amount in Table 4.3-1 of the BLM EIS is 18 to 21 light vehicles per day. LC ISR LLC expects the number of light vehicles travelling to and from the site to remain about the same or decrease slightly in the future since fewer contractors will be used as the facility moves into routine operations.

The actual number of tractor trailers travelling to and from the site averages 0.61 per day. Table 4.3-1 in the BLM EIS predicted the number of tractor trailers to be 3 to 5 per week or 0.42 to 0.71 per day. LC ISR expects the average number of tractor trailers to increase to up to 1.15 per day when the facility is at maximum production (1.2 million pounds of U_3O_8 from site wellfields plus 1.0 million pounds of U_3O_8 per year delivered in the form of ion exchange resin from an off-site facility such as Shirley Basin. This analysis assumes that each load of ion exchange resin contains 6,500 pounds of U_3O_8 and each shipment of dried yellowcake contains 36,000 pounds of U_3O_8. The average number of tractor trailer daily round trips could increase to as high as two if there is no wellfield production and the amount of U_3O_8 processed from off-site resin reaches 2.2 million pounds per year.

4.2.1.1 Shipments of Supplies to the Process Facilities

Local environmental impacts could occur if a truck delivering process chemicals or analytical reagents were involved in an accident. Processing chemicals required at the Permit Area are listed in **Table 4.2-1**. The potential for a shipping accident depends on the frequency of deliveries, the distance traveled, and the accident rates described in **Section 3.2** of this report. The environmental impacts would depend on the severity of the accident, the magnitude of the release, and the unique properties of the chemical.

4.2.1.2 Shipments of Slurry from Lost Creek to an Off-Site Dryer or from an Off-Site Facility to Lost Creek

The proposed action would require the truck shipment of yellowcake slurry from the Plant to an off-site facility for drying and packaging or from another facility to Lost Creek for drying and packaging. Yellowcake slurry would be transported by truck using specially designed, DOT approved containers that contain approximately 15,000 pounds of U_3O_8. The highest risk scenario is the shipment of 2.2 million pounds of U_3O_8 in the form of slurry from an off-site facility to Lost Creek for drying. This scenario would require approximately 147 shipments per year. The shipment of yellowcake slurry, rather than loaded resin, would substantially reduce the number of shipments required.

The specific location of the off-site dryer or source of slurry has not been finalized at the time of this report, so a representative facility was analyzed to provide a realistic assessment of risk. The Uranium One Willow Creek (formerly Cogema's Christiansen Ranch) facility is the closest yellowcake dryer under consideration, and is located near

Sussex, Wyoming, approximately 190 miles northeast of the Permit Area. This is likely the most distant facility that slurry would be sent from or to so it represents the most conservative estimate. The Shirley Basin facility, which is owned by an affiliate of Lost Creek ISR, LLC, is much closer and may be a source of slurry or toll drying in the future. The proposed transportation route to this facility is shown in **Figure 4.2-1**.

Truck accidents occur at a rate of 6.4 x 10^{-7} accidents per mile on interstate highways in rural areas and 2.2 x 10^{-6} accidents per mile for interstate highways in urban areas and two-lane roads similar to those that may be used in this project (Harwood and Russell, 1990). These accident rates were multiplied by the distance traveled on each road type to calculate the risk of a truck accident for each one-way trip to the yellowcake dryer. Based on 2001 to 2005 WYDOT data, truck accidents occur at the rate of 7.8 x 10^{-7} accidents per mile on US-287 in Sweetwater County (Carpenter, T. Senior Data Analyst, WYDOT. Personal communication. March, 1997). This road is representative of the two-lane roads in both routes and the accident rate is lower than the generic accident rate used to calculate the risk per trip. The majority of both routes are two-lane roads; therefore, the risk calculation is based on conservative assumptions.

Approximately 89 percent of the route to the Uranium One facility is on two-lane roads, nine percent is on rural interstates, and three percent is on urban interstates (this does not total 100 percent due to rounding errors). The probability of a truck accident during a one-way trip to Willow Creek is 0.00039. Assuming 147 one-way trips to the dryer annually, the probability in any given year of a transportation accident, of any severity, involving a truck loaded with yellowcake slurry is approximately 57 in 1,000. In 2002 to 2005, 0.9 percent of Wyoming traffic accidents caused a fatality and 25.4 percent of accidents caused an injury (WYDOT, 2007a). Therefore, the probability in any given year of an injury-causing or fatal accident involving a loaded or unloaded Lost Creek tanker truck is about 29 in 1,000.

The yellowcake slurry will be shipped in DOT approved containers designed to withstand the impact of most accidents. In a worst-case transportation accident, the loaded tank would rupture and release some or all of the slurry. Should this scenario occur, the environmental effect would be minor compared to a similar accident involving dried yellowcake. Some portion of the slurry would pour onto the ground and thicken as the liquid infiltrated, but the yellowcake would not become airborne dust until the slurry dried (NRC, 1997). The viscosity of the yellowcake slurry would reduce the chance that a spill would travel a sufficient distance to enter a waterway before being contained by emergency personnel.

For comparison, a 1977 accident resulted in a spill of 7,000 pounds of dried yellowcake. Within three hours, the spill was covered in plastic, preventing further airborne release. The estimated atmospheric release was 53 pounds of yellowcake, which resulted in an estimated dose of 0.012 man-Sv (man-Sieverts) in an area with a population density of 2.5 people per square mile. No clinical effects or chemically toxic levels of intake were observed in rescue and clean-up personnel (NRC, 1980b). If such an accident occurred as part of the Project, the drying time for slurry would provide rescue and cleanup personnel a window of time to contain the spill. For a slurry spill of comparable size to the 1977 dried yellowcake spill, the atmospheric release would be far lower.

Sufficient statistical data are not available for a quantitative analysis of an accident involving tanker trucks carrying yellowcake slurry. Previous studies have focused on transportation of dry yellowcake in 55-gallon, 18-gauge, Class A drums. A recent analysis of transportation risk for trucks carrying dried yellowcake estimated that the 50-year dose commitments to the general public would be 0.14 to 2.0 man-Sv, depending on the fraction of yellowcake that was released (NRC, 1997). Exposures would likely be much lower in the worst-case Lost Creek scenario since: 1) little or no airborne release would occur due to the slurry form of the yellowcake; 2) the analysis considered the population densities in the eastern US, which are generally much higher than in Wyoming and the western US; 3) the modeled release time was 24 hours and an actual slurry spill would be contained much more quickly; and 4) the mathematical model for the dried yellowcake scenario was conservative by nearly a factor of six (Department of Energy [DOE], 1994).

4.2.1.3 Shipments of Material for Off-site Disposal

Disposal of all 11(e)(2) byproduct waste generated by the Project will occur at an off-site, NRC-licensed disposal facility. Most shipping would occur at the end of the Project, during facility decommissioning. LC ISR, LLC currently has an agreement in place to send 11(e)(2) waste to the Shirley Basin tailings facility. The estimated annual number of loads will be four to five, based on 80 to 100 cubic yards of waste per year transported by trucks with a capacity of 20 cubic yards each. This estimate takes into consideration the proposed increase in production rate to up to 2.2 million pounds of U_3O_8 per year. This volume is exclusive of final reclamation material. The probability of an accident while transporting 11(e)(2) waste for any given trip is the same as discussed in **Section 4.2.1.2**. However, the potential risks for exposure are lower, since the waste material is generally less radioactive than the yellowcake slurry and consists partially of solid materials that would be easily contained. Most waste is washed to remove loose radioactive material prior to disposal. Items that have easily removable contamination are typically placed inside a trash bag or super sac prior to placing in the trash bin.

4.2.1.4 Post-Reclamation Impacts

Before the on-site roads are reclaimed, BLM will be consulted and given the option to retain the Project-related roads. If BLM decides that the Project roads are beneficial to other users, such as ranchers and hunters, the roads will not be reclaimed

4.2.1.5 Cumulative Impacts from the Preferred Alternative

The Project may contribute incrementally to increased traffic loads and risk of accidents associated with continued energy resource development in the State of Wyoming. However, the volume of traffic associated with the Project is expected to be relatively small, due to the concentrated nature of the resource and the comparatively small workforce associated with ISR operations. It is believed that the tax revenue from this and other projects will help subsidize ongoing infrastructure improvements that will minimize risks and transportation impacts associated with energy resource development.

The cumulative impact of road-building will be minimized since: 1) the existing road network will be used and improved to the extent possible; 2) topsoil will be stripped where necessary for road construction and improvements; 3) all roads that are not beneficial to the approved post-operational land use will be reclaimed with topsoil and native vegetation; and 4) approval for any off-site road improvements will be sought from the BLM prior to initiating the improvements.

Oil and gas and 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 Project. The conventional Sheep Mountain Project is located just over 15 miles from the Lost Creek Plant but no plans have been announced to develop this 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 Transportation Impacts of the Other Alternative

The use of the portable pit alternative will result in increased onsite traffic since the cuttings would have to be moved from portable pits to a disposal site. We estimate that one to two small dump-truck loads of cuttings would have to be transported per drill hole/well (4 to 7 cubic yards of cuttings per well depending on depth and completion interval). The impact to transportation from the portable pit alternative would be relatively small but the increase in traffic would be discernable. A back hoe, typically used to dig a standard mud pit, would still need to be used to clean out each portable pit since it is too labor intensive to complete this task by hand.

4.2.3 Mitigation of the Preferred Alternative

The following mitigation measures will reduce the potential impact of a traffic accident.

- All delivery truck drivers are required by law to hold appropriate licenses and certifications, and submit to a mandatory drug testing program.
- All delivery trucks used to transport Project materials will carry the certifications of the relevant safety inspections.
- An active driver safety and accident avoidance program will be carried out with employees.
- On-site and local roads will be plowed, maintained, and improved as appropriate.
- An internal report will be filed in the case of a near-miss or accident, and drivers will be briefed on how to avoid similar future incidents.

4.2.4 Monitoring of the Preferred Alternative

Records of shipping, driver training, and on-site road maintenance will be kept.

4.3 Soils

4.3.1 Soil Impacts from the Preferred Alternative

ISR operations do not disturb topsoil to the extent of conventional open-pit mining, but a portion of operations within the Permit Area will affect soils. Topsoil will be removed from approximately 350 acres within the Permit Area (10,005 acres) due to the construction and excavation of the Plant (construction complete), header houses, mud pits, pipelines, primary access road (construction complete), and secondary access roads. **Table 4.3-1** shows the estimated acreage for topsoil stripping. The location of the soils with respect to Project infrastructure can be seen in **Section 3.3 Maps 1, 2** and **3** and **Plates 1.2-1a** and **b**. A portion of these effects, in addition to less significant effects, will be contained within the pattern areas of the mine units. The pattern areas encompass approximately 383 acres of the 10,005 acres.

The severity of soil impacts will depend on the number of acres disturbed, the type of disturbance and the time period of disturbance. Potential impacts include soil loss, sedimentation, compaction, salinity, loss of soil productivity, and soil contamination. Effects to soils in the Permit Area will result from the clearing of vegetation, excavating, leveling, stockpiling, compacting, and redistributing soils during construction and reclamation. While some of the disturbances related to the construction and operation of the Project are short-term in weeks or months (e.g., mud pits, pipelines, field construction laydown areas, etc.), other disturbance will be long-term, lasting for the duration of the Project (e.g., the main access roads, the Plant site).

Wind erosion is a concern at the Permit Area. Most of the soils in the Permit Area have a significant percentage of silt, which has been shown to be directly related to dust emissions from unpaved roads. Vehicular traffic on these unpaved roads and construction presents the greatest threat to soils with potential for wind erosion. Wind erosion will be controlled by removing vegetation only where it is necessary, and by techniques that may include surfacing roads with gravel, limiting traffic speeds, watering unpaved roads, spreading soil binding agents, and timely reclamation.

Water erosion is not a large concern at the Permit Area due to very low surface slopes, limited amount of precipitation and the lack of perennial and intermittent streams. However, removal of vegetation for any activity exposes soils to increased erosion. Excavation could break down soil aggregates, increasing runoff and gully formation. Soil loss will be reduced by timely reclamation, installing drainage controls, and reseeding and installing water bars across reclaimed areas.

Construction and operation activities have the potential to compact soils. While soils sensitive to compaction, such as clay loams, do not exist in the Permit Area, the intense volume and degree of constant activity could damage soil properties and cause compaction. Compaction of the soils could decrease infiltration, promoting an increase in runoff. Reduced infiltration capacity resulting from compaction could persist for many years following operations. Soils compacted during construction and operational activities will be disced and seeded as early as possible following use.

Saline soils are very susceptible to soil loss caused by development. Saline soils are not common within the Permit Area.

Facility development could displace topsoil, which could adversely affect the structure and microbial activity of the soil. Loss of vegetation would expose soils and could result in a loss of organic matter in the soil. Excavation could cause mixing of soil layers and breakdown of the soil structure. Removal and stockpiling of soils for reclamation could result in mixing of soil profiles and loss of soil structure. Compaction of the soil could decrease pore space and cause a loss of soil structure as well. This would result in a reduction of natural soil productivity.

Increased erosion and decreased soil productivity may cause a long-term declining trend in soil resources. Long-term impacts to soil productivity and stability could occur as a result of large-scale surface grading and leveling, until successful reclamation is accomplished. Reduction in soil fertility levels and reduced productivity could affect diversity of reestablished vegetative communities. Infiltration could be reduced, creating soil drought conditions. Vegetation could undergo physiological drought reactions.

Surface spillage of process materials could occur at the Permit Area. If not remediated quickly, these materials have the potential to adversely impact soil resources.

Reclamation activities to date in the vicinity of the plant and Mine Unit 1 have been successful. However, the timing of rain is critical to success.

4.3.2 Soil Impacts of the Other Alternative

Use of portable pits will result in less soil disturbance within the wellfield since standard mud pits would not have to be installed. However, the cuttings collected in the portable pit would still have to be disposed of in an on-site pit which would require disturbance of an approximately equal amount of topsoil.

4.3.3 Mitigation and Monitoring of Soil Impacts

4.3.3.1 Mitigation and Monitoring of Soil Impacts

Soil loss from erosion will be reduced by timely reclamation, the installation of drainage controls, and the reseeding and installation of water bars across reclaimed areas.

The negative effects on soil properties resulting from the high volume and degree of constant activity at the Permit Area will be minimized where possible, and soils will be loosened for reseeding during reclamation to control the effects of soil compaction. Traffic will be confined to roadways wherever possible.

The construction sites will be cleared of topsoil prior to construction. This topsoil will be stockpiled and stabilized. The stockpiled soil will be used for remediation upon site closure.

In order to minimize potential impacts from spills, the EHS Management System will include procedures for the prevention and cleanup of spills. The plan will include accidental discharge reporting procedures, spill response, and cleanup measures.

Regular inspection of erosion control installments, topsoil stockpiles, and reclamation/revegetation status will be conducted to ensure that soil impact mitigation measures are working properly.

4.4 Geology

There will be no impact on geology during site preparation and construction.

The removal of uranium from the target sandstones will result in a permanent change to the composition of these rock formations. The Project will not preclude recovering other minerals that might be discovered in economic quantities within the Permit Area in the future.

No significant matrix compression or ground subsidence is expected, as the net withdrawal of fluid (bleed) will be typically one percent or less. Once groundwater restoration is complete, groundwater levels will approximate pre-operational levels.

Theoretically, changes to the aquifer pressure may impact the transmissivity (e.g., resistance to flow) of the Lost Creek Fault. The pressure of the produced aquifer will be increased during operation and restoration activities; however, this pressure will be balanced by the production and recovery wells. It is very unlikely that the planned ISR operations will reactivate the Fault, and extremely unlikely that any earthquakes would be generated. Documented cases where fluid withdrawal or injection has impacted fault transmissivity or resulted in earthquakes have occurred when the change in reservoir pressure was on the order of 1,000 to 5,000 pounds per square inch (psi) or higher. Operations at Lost Creek are expected to induce more limited pressure changes (e.g., approximately 50 to 150 psi).

Except for the No-action Alternative, the impacts on geology from the Other Alternative is the same as presented above for the Preferred Alternative.

No mitigation measures or monitoring programs will be required for the impacts on geology, and cumulative impacts are not anticipated.

4.5 Hydrology

4.5.1 Hydrology Impacts from the Preferred Alternative

The proposed mine units are in confined aquifers several hundred feet below ground surface, and there is no known hydraulic connection between the surface of the Permit Area and those aquifers. In addition, shallow alluvial deposits, if present, are poorly developed. Therefore, the discussion of Hydrology Impacts is separated on the basis of Surface Water Impacts and Groundwater Impacts. The discussion is further organized on the basis of impacts to water quantity, including water uses, and water quality.

4.5.1.1 Surface Water Impacts from the Preferred Alternative

Because of the limited quantity of surface water within the Permit Area and the operational measures that will be taken to avoid impacts to the surface water, no impacts are anticipated. However, the potential impacts are outlined below to better illustrate the need for the mitigation measures described in **Section 4.5.3**.

Surface Water Quantity and Use

As previously noted, perennial or intermittent streams do not exist within the Permit Area or on adjacent lands. Surface-water-use permits with legal descriptions inside and within two miles of the Permit Area were queried using the WSEO Water Rights Database (WSEO, 2006). According to the query, no use permits exist inside or within two miles of the Permit Area. Since ISR operations do not involve the use of or discharge to surface water, the proposed operation has no foreseeable impact to surface water quantity or uses.

Surface Water Quality

The primary surface disturbances associated with ISR operations occur with well drilling, pipeline installations, road and facility construction, and reclamation activities. These disturbances generally involve relatively small areas and have very short-term impacts. The larger areas of surface disturbance, such as the Plant and the main road, may require the diversion of storm water runoff. Without appropriate mitigation measures, the disturbances and diversions could result in adverse impacts, especially at places where relief is higher, due to increased erosion potential from surface water runoff and/or due to transport of sediment. Because of the low relief across the Permit Area, the ephemeral nature of the drainages, and limited precipitation and runoff, the primary areas of concern for sediment accumulation are low spots along the roads and drainages where runoff accumulates and to areas where sheet flow evaporates or infiltrates. There are no 'live' streams that would be impacted.

Activities associated with drilling, pipeline installations, and road and mine construction can lead to reduced vegetation cover and soil compaction from heavy machinery and frequent traffic. Without vegetation, topsoil is vulnerable to erosion from storm events. Soil compaction can result in decreased localized infiltration rates and increased surface runoff, which can increase peak flows and further increase surface erosion. Roads to and from the drill sites can become preferential pathways for surface-water runoff due to compaction and rut depressions. Although soil will be stripped from specific areas, such as mud pits and the Plant, and stockpiled for replacement during reclamation, improperly protected stockpiles can also erode, potentially increasing sediment loads in surface water runoff. During reclamation, activities such as discing to loosen compacted soil could result in increased sedimentation to surface water runoff if the increased erosion potential were not considered, e.g., discing across the direction of flow.

In very rare instances, it may be necessary to locate a production or injection well in an ephemeral drainage. The potential impacts of concern in such instances are impacts to groundwater if the wellhead is not designed to withstand the occasional surface water flow. However, surface water runoff could also be impacted due to a leak from the well piping.

4.5.1.2 Groundwater Impacts from the Preferred Alternative

Potential impacts to groundwater resources from the ISR operations and restoration activities include groundwater consumption, which will necessitate operational decisions to reduce interference between mine units on-site and monitoring to evaluate impacts to existing wells off-site. The ISR process depends on changes to groundwater quality, but those changes are anticipated and mitigated, as outlined below.

Groundwater Quantity and Use

As discussed in **Section 3.5**, groundwater underneath the Permit Area occurs in a series of relatively flat-lying sandstones, confined by shales. In general, the extents, transmissivities, and saturation of these sandstones are sufficient such that wells can produce on the order of a few tens of gpm of water. Two series of uranium-bearing sandstones, grouped geologically and hydrologically as the HJ and KM Horizons, are of interest for this application.

Within the Permit Area

Currently, mining activities consume a bleed of about 0.6% (36 gpm if the flow rate was 6,000 gpm) plus plant fresh water makeup of only about 1 gpm. The original application assumed the plant freshwater makeup would be about 10 gpm, however, through process recycling we have managed to reduce plant consumption to only 1 gpm. With the recent approval of the Class V treatment and injection system, we anticipate that the volume of water wasted to a Class I UIC well will significantly decrease since treated water can be put back into the Battle Spring Formation where it can be used again in the future. A key component of ISR production and restoration is groundwater extraction. During production, most of the extracted groundwater is re-injected into the mine unit. The mine unit is operated with a 0.5 to 1.5 percent bleed that creates an inward hydraulic gradient to the mine unit. This bleed rate accounts for the "consumptive use" of groundwater during production. During restoration, groundwater is initially extracted without re-injection to hydraulically capture groundwater impacted by production and to draw ambient, baseline-quality water into the mine unit from the surrounding aquifer. This groundwater sweep accounts for the largest consumptive use of groundwater during the ISR project. Following sweep, groundwater is extracted and treated using reverse osmosis. The bulk of the treated water is re-injected into the affected aquifer to improve water quality, but a bleed rate is maintained, which will result in continued groundwater consumption, although at a much reduced rate compared to sweep.

As discussed in **Section 3.5** of this application as well as the KM Amendment and the original Lost Creek Environmental Report, pump tests have been conducted to assess the hydraulic characteristics of the HJ and KM Horizons which contain the uranium-bearing sands of interest for this application, overlying and underlying aquifers, and confining units. Pump tests will also be performed before production in each mine unit to: demonstrate the ability to contain lixiviant within the pattern area; demonstrate communication between the pattern area and monitor well ring; help ensure any horizontal excursion could be detected; and further evaluate the hydrologic properties of the production aquifer for efficient ore recovery and monitoring.

Results of the 2013 and 2016 hydrologic investigations indicate that the HJ and KM Horizons are laterally extensive, except where offset by faulting (**Section 3.5**). The HJ production horizon is hydraulically separated from the overlying and underlying aquifers by laterally continuous confining units. The KM production horizon is hydraulically separated from the overlying aquifer by a laterally continuous confining unit (Sagebrush Shale). The underlying aquitard (K Shale) is regionally extensive but not fully contiguous; therefore, it is not considered a confining unit in all areas. Nevertheless, the 2016 LCE pump tests performed at production simulated flow rates, persuasively demonstrated the ability of K Shale or its silty layer equivalent to control vertical flow.

As previously discussed, hydrologic pumptests will be performed in each individual mine unit to demonstrate the ability to control lixiviant.

Groundwater consumption during production and restoration will generally be limited to the production aquifers, and the overlying FG Horizon, which will be the recipient of Class V permeate injection.

To generally quantify the potential impact of drawdown on distant appropriators due to production and restoration operations, the following aquifer characteristics and operational assumptions must be known or estimated:

- production/restoration life;
- average net consumptive use (bleed rate from ISR; groundwater sweep duration and flow rate; and RO duration and flow rate);
- location of pumping centroid;
- observation radius (i.e., two and three miles radially from centroid of pumping);
- formation transmissivity;
- formation thickness;
- formation hydraulic conductivity; and
- formation storativity.

The proposed Lost Creek production and restoration schedule is graphically illustrated on **Figure 4.5-1**. The aquifer characteristics and operational assumptions for each of the mine units are presented in **Table 4.5-1**. The **Table 4.5-1** data were used to predict the drawdown over time (**Figure 4.5-1**) using the Theis semi-steady state analytical solution, which includes the following assumptions:

- The aquifer is confined and has apparent infinite extent.
- The aquifer is homogeneous and isotropic, and of uniform effective thickness over the area influenced by pumping.
- The piezometric surface is horizontal prior to pumping.
- The well is pumped at a constant rate.
- No recharge to the aquifer occurs.
- The pumping well is fully penetrating.
- The well diameter is small, so the well storage is negligible.

The computed drawdown for each mine unit, at the end of restoration, at two-mile and three-mile radial distances from the centroid of pumping are presented in **Table 4.5-1**. The calculated drawdown is very conservative because one of the assumptions is that there is no recharge to the aquifer. These calculations also neglect the impact of the numerous known fault systems, which limit groundwater flow to a significant degree, thus restraining the radial spread of the drawdown cone of depression.

The cumulative drawdown effect of multiple mine units operating simultaneously can be determined by summing the individually computed mine unit drawdown at a common point in time and distance. This summing effect is equally applicable to each phase of mining (i.e., production, sweep and RO).

Although the production duration is unique to each mine unit, the sweep phase typically lasts only 0.3 pore volumes, and the RO phase for six pore volumes. Obviously, the duration in each phase is dependent upon the sustainable flow rate.

Based on a bleed of 0.6 percent, the potential impact from the consumptive use of groundwater is expected to be manageable. In this regard, the vast majority (e.g., on the order of 99 percent) of groundwater used during production and restoration will be treated and re-injected. Potential impacts on groundwater quantity due to consumptive use outside the Permit Area are expected to be small.

Outside the Permit Area

Groundwater-use permits with legal descriptions inside and within three miles of the Permit Area were queried using the WSEO Water Rights Database (WSEO, 2014). Currently, groundwater is not used for domestic or irrigation purposes inside the Permit Area or within three miles of the Permit boundary. In this vicinity, water is used for livestock and wildlife watering as well as for purposes related to mining. The majority of the groundwater-use permits are for monitoring or miscellaneous purposes related to mining and do not represent consumptive use of groundwater.

BLM has four active wells (and four associated stock ponds), in the area of which two are located within the permit area (LC East) (**Figure 3.5-7** in conjunction with **Table 3.5-6**). At least three of the four BLM wells are completed in the FG Horizon, which is geologically isolated from the production zones and should therefore see little or no drawdown from mining (wells Battle Spring Draw Well No. 4451, Boundary Well No. 4775 and Battle Spring Well No. 4777.) The East Eagle Nest Draw well is completed at 370 ft., which is likely within the FG Horizon but geologic correlations with this relatively remote well have not been made to date. The potential impact from mining on these wells is small since they aren't likely in hydrologic communication with the production aquifers. However, water level monitoring of the wells adjacent to the Permit Area and, potentially, mitigation of water resource impacts is warranted, as discussed in **Sections 4.5.4.2** and **4.5.3.2.**

After more than three years of operations at the Lost Creek facility, there has been no measureable impact to water levels at the Sweetwater Mine (email exchange between John Cash of Lost Creek ISR, LLC and Oscar Paulson, Facilities Manager at the

Sweetwater Mill and Mine, January 2017). During the same time period, the water level in the FG Horizon in MU1 has declined on average less than 1.5 feet.

Groundwater Quality

ISR from a mineral deposit is accomplished by reversing the natural processes that deposited the uranium. The native formation waters in the ore zones in the HJ and KM aquifers are not suitable for human consumption because of naturally high levels of dissolved radioactive materials (uranium and Ra-226) (**Section 3.5**). In addition to uranium, other metals may be mobilized by the ISR process. This process affects the ore zone, which must be exempted per the water use classifications of the WDEQ and the aquifer exemption provisions of the EPA UIC regulations.

Excursions represent a potential impact on the adjacent groundwater outside of the mine unit as a result of operations. During production, injection of the lixiviant into the mine unit results in a temporary degradation of water quality in the exempted aquifer compared to pre-production conditions. However, proper balancing of production and injection rates and pressures restricts these water quality changes to that portion of the aquifer within the mine unit. Inadvertent movement of the affected water out of the mine unit is termed an excursion. Excursions of contaminated groundwater in a mine unit can result from an improper balance between injection and recovery rates, undetected high permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining units that could allow movement of the lixiviant out of the ore zone, poor well integrity, and hydrofracturing of the mining zone or surrounding units (if the injection wells were operated above fracture pressure).

Groundwater quality could potentially be impacted during operations due to an accident such as Storage Pond leakage or failure or an uncontrolled release of process liquids due to a mine unit accident. If there should be an uncontrolled pond leak or mine unit accident, potential contamination of the shallow aquifer as well as the surrounding soil could occur. This could occur as a result of a slow leak or a catastrophic failure, a shallow excursion, an overflow due to excess production or restoration flow, or due to the addition of excessive rainwater or runoff. Another potential cause of groundwater impacts from accidents could be the release of injection or production solutions from a mine unit building or associated piping as a result of a spill.

The geologic and hydrologic data presented in **Sections 3.4** and **3.5**, respectively, demonstrate that the occurrence of uranium mineralization is primarily within the HJ and KM Horizons, and that these horizons are generally isolated from underlying and overlying sands during normal production flow rates. This permit application is only for ISR in the HJ and KM Horizons. Hence, the ISR operations are expected to impact water quality only in the HJ and KM Horizons, and restoration operations will be conducted in this horizon following completion of production.

4.5.1.3 Cumulative Hydrologic Impacts

Cumulative Surface Water Impacts

Adverse impacts to surface water are not anticipated due to the absence of nearby surface water bodies and due to the operational practices to prevent erosion and the control measures that will be implemented according to the WYPDES permits obtained from WDEQ.

Within the Permit Area, cumulative impacts to surface water resources from historic and proposed activities are not reasonably foreseeable. Historic and present land uses include, but are not limited to, livestock grazing, exploratory drilling, and federal management of land, water, and wildlife. The proposed activities involve the construction and operation of a uranium facility.

ISR operations minimize disturbance by recovering uranium in solution and leaving the surrounding resources intact. Proposed disturbed areas (mine units, Plant, and access roads) will be reseeded as soon as conditions allow. Ultimately, the disturbed areas will be reclaimed to their pre-operation contours and revegetated to support post-operation land uses. Due to the absence of surface water in the Permit Area, the limited disturbance from ISR operations, and surface reclamation requirements, no cumulative impacts to surface-water resources are anticipated.

Cumulative Groundwater Impacts

Cumulative impacts to groundwater are expected to be minimal due to the distance between the Project and other potential operations, and the time lag between this project and other potential ISR projects in the Great Divide Basin. Should another ISR project be developed, the primary concern would be the cumulative drawdown, which is additive from more than one operation and can be readily estimated. In addition, each operation would be required to conduct water level measurements, so the impacts of the individual operations could be differentiated.

Systematic monitoring and mitigation measures will be performed at the Project. Potential impacts to groundwater from the Project include changes to water levels on- and off-site and to groundwater quality on-site. However, the water levels are projected to recharge within ten to 15 years once groundwater extraction ceases. The addition of the Class V system allows for a large percentage of the bleed water to be treated and re-injected into the shallow FG Horizon where it can be use again. In addition, groundwater restoration will allow for the same water uses after ISR as before, with some potential long-term improvement due to removal of uranium and radium.

4.5.2 Hydrologic Impacts from Other Alternatives

4.5.2.1 Surface Water Impacts from Other Alternative

No significant differences are expected between the potential impacts from the Preferred Alternative and the potential impacts from the alternate of using portable mud pits.

4.5.2.2 Groundwater Impacts from Other Alternatives

No significant differences are expected between the potential impacts from the Preferred Alternative and the potential impacts from the alternate of using portable mud pits.

4.5.3 Mitigation Measures

4.5.3.1 Mitigation Measures for Surface Water Impacts

The primary mitigation activities for surface-water impacts will be: limiting soil compaction; conducting operations in accordance with standard operating procedures (SOPs) and SPCC plans as needed; ensuring that runoff from disturbed areas meet WYPDES permit guidelines for storm water management and sediment reduction; and completing appropriate reclamation practices in a timely manner.

Soil compaction during drilling and pipeline installation can be limited by using existing roads to the extent possible. Roads will cross drainages at right angles to prevent surface runoff flowing along the road from eroding the drainage. Other measures to minimize erosion may include: contouring and re-vegetation to stabilize soils; placement of hay bales, engineered sedimentation breaks and traps, and water contour bars; and the use of diversion ditches, engineered culverts, and energy dissipaters to prevent excessive erosion and to control runoff.

Once a drill site, pipeline route, or facility location has been selected, the appropriate topsoil protection methodology will be employed to prevent excess erosion and movement of sediment into drainages (See **Section 4.3** of this Environmental Report for mitigation of soil impacts.). In addition, BMPs will be followed to divert the flow of runoff water away from exposed soils, store flows and sediment, or otherwise limit runoff and the discharge of pollutants from exposed areas to the degree attainable. There are several design features that would mitigate impacts to surface water and ephemeral drainages. Such practices might include, but not necessarily be limited to, use of silt fences, earth dikes, drainage swales, sediment traps, check dams, straw bales, construction of water contour bars, application of rip rap, grading and contouring, temporary or permanent sediment basins, temporary seeding, permanent seeding, mulching, use of geotextiles, sod stabilization, vegetative buffer strips, and preservation of mature vegetation.

When designing and constructing new roads, weather, elevation contours, land rights, and drainages will be considered. New roads will cross ephemeral drainages or channels at right angles to enhance erosion protection measures. However, as it may not always be feasible or warranted to construct roads or crossings at right angles or along elevation contours, implementation of erosion measures appropriate for the situation will be implemented.

The physical presence of small facilities (e.g., header houses) are not expected to significantly change peak surface water flows because of the relatively flat topography of the drainages at the sites, the low regional precipitation, the absorptive capacity of the soils, and the small area of disturbance relative to the large drainage area within and adjacent to the Permit Area. However, in areas where larger structures (such as the office building and parking lot) may affect surface water drainage patterns, diversion ditches, and engineered culverts were used to prevent erosion and to control runoff. In areas where runoff is concentrated, energy dissipaters may be used to slow the flow of runoff to minimize erosion and sediment loading in the runoff. A sediment control plan will be developed for disturbed areas exceeding five acres (two hectares).

Culverts were installed as appropriate locations during the development of site access roads to maintain existing site surface drainage conditions. Culvert design includes providing adequate capacity (ten-year to 25-year event) for both water and sediment yield. Culvert construction will meet all State of Wyoming standards, including inlet and outlet control, head room, and bedding, where appropriate. On a local scale, surface drainage will be directed away from facilities, roads and topsoil stockpiles using shallow ditches and/or berms. Similar practices will be used as additional secondary roads are constructed to access LC East and Lost Creek wellfields and deep wells.

No paved areas are currently planned for the Permit Area. However, if any areas are paved, storm water runoff from those areas will be collected by a storm water system. The storm water will be temporarily retained in a detention basin to reduce the amounts of oils and other pollutants from entering surface water and ephemeral drainages. These detention ponds will be designed to control the release of storm-water runoff at a rate equal to or slightly less than that of the pre-exploration stage.

During leaching, restoration, and after reclamation, re-vegetation work will be initiated as soon as possible. The spring/summer is generally the best time for re-vegetation work for optimum growth. Either temporary cover crops or the permanent seed mix approved by BLM and LQD, will be used to stabilize the soil and minimize erosion due to runoff.

If appropriate erosion prevention methods are employed, impacts to surface water runoff from exploration and development activities are expected to be insignificant. Similarly, impacts from accidental releases of contaminants such as gasoline, oil, or diesel fuel are expected to produce small impacts on surface-water runoff because cleanup activities will be prompt and thorough, as required in the facility's SOPs. An SPCC plan is not required for the facility since the site is located within a closed basin with no navigable or other existing water in the region.

Wells that are constructed in drainages where runoff has a likely potential to impact the wellhead will need added wellhead protection. This protection will vary depending on the drainage and its potential for runoff. Protection measures may include barriers surrounding the wellhead, protective steel casing, cement blocks or other means to protect the wellhead from damage that may be caused by runoff.

4.5.3.2 Mitigation Measures for Groundwater Impacts

The discussion of mitigation measures is separated on the basis of on-site and off-site measures because of the different concerns. On-site, the concerns are related to conducting production and restoration as efficiently as possible, and emphasizing water quality monitoring. Off-site, the concern is related to the extent to which on-site groundwater extraction, particularly during the first phase of restoration, will draw down water levels in the four BLM wells in or within three miles of the Permit Amendment Area (3 of 4 of these wells likely don't have hydrologic communication with the mining horizons).

On-Site Mitigation Measures

Excursions of lixiviant at ISR facilities have the potential to impact adjacent aquifers with radioactive and trace elements that have been mobilized by the ISR process. These excursions are typically classified as horizontal or vertical. A horizontal excursion is a lateral movement of production fluids outside the mine unit monitor well ring. A vertical excursion is a movement of ISR fluids into overlying or underlying aquifers.

While rare, horizontal excursions can occur during ISR operations. However, excursions are typically detected rapidly because of appropriately spaced monitor well networks which are regularly sampled. Once detected, excursions are typically recovered through overproduction in the immediate vicinity of the excursion. The excursions rarely threaten the water quality of an underground source of drinking water because the monitor wells are suitably located within the aquifer exemption area approved by the EPA and WDEQ. LC ISR, LLC anticipates that excursion control will be maintained by detailed investigations and engineering design, SOPs, and employee training.

LC ISR, LLC will control vertical and lateral movement of lixiviant by maintaining mine unit production flow at a rate slightly greater than the injection flow. This difference between production and injection flow is referred to as process bleed. The bleed solution is either recycled in the Plant or is sent to the liquid waste disposal system. When process bleed is properly distributed among the many production/injection patterns within a mine unit, the mine unit is considered balanced.

In the event of a detected leak in a Storage Pond, corrective actions would include lowering the pond level and locating the leak to allow repairs. Shallow groundwater should not be affected, since the outer pond liner is designed to prevent a release of the pond contents. All pond leaks, causes, and corrective actions are reported to NRC and WDEQ.

With respect to potential overflow of a pond, operating procedures require that pond levels be closely monitored as part of the daily inspection. Process flow to the ponds will be minimal in comparison to the pond capacity, thus facilitating diversion to another pond if necessary. In addition, sufficient freeboard will be maintained on all storage ponds to allow for a significant addition of rainwater with no threat of overflow. Finally, the dikes and berms around the ponds will channel runoff away from the ponds.

Groundwater impacts from a spill of injection or production solutions from a mine unit building or associated piping are unlikely due to the depth to groundwater. In addition, any impacts can be prevented by proper design, construction, and testing. In general, piping from the plant to and within the mine unit will be constructed of HDPE with butt-welded joints or the equivalent. All pipelines will be pressure tested before they are placed into operation. It is unlikely that a break would occur in a buried section of line because no additional stress is placed on the pipes. In addition, underground pipelines will be protected from a major cause of potential failure which is vehicles driving over the lines causing breaks. Typically, the only exposed pipes will be at the Plant, at the wellheads, and in the header houses in the mine unit. Trunkline flows and manifold pressures will be monitored for spill detection and process control.

Off-Site Mitigation Measures

As noted in **Section 4.5.1.2**, the water levels in the four BLM stock wells within the amendment area or within three miles of the Permit boundary potentially could be impacted due to the drawdowns associated with groundwater withdrawal for ISR operations and restoration; although this is unlikely. If significant impacts to those wells are observed (e.g., water levels drop to a point that impairs the usefulness of the wells), the following mitigation measures will be considered:

- lowering the pump level in the wells, if possible;
- deepening the wells, if possible; and
- replacing the wells with new wells completed in deeper sands that are not impacted by ISR operations.

4.5.4 Hydrologic Monitoring

4.5.4.1 Surface-Water Monitoring

The drainages throughout the Permit Area are ephemeral and flow only in response to spring runoff or occasional strong thunderstorms. The surface water monitoring sites from which baseline samples were collected are described in **Section 3.0**. Because of the limited flows, and lack of anticipated impacts, continued surface water sampling is not planned except as necessary in response to a specific concern, such as a spill.

4.5.4.2 Groundwater Monitoring

Similar to the discussion of mitigation measures in **Section 4.5.3.2**, the discussion of groundwater monitoring is separated on the basis of on-site and off-site monitoring because of the different concerns. On-site, the concerns are related to helping ensure production and restoration are conducted as efficiently as possible, and emphasize monitoring of water quality (although water level data will also be collected). The monitoring is also intended to ensure excursions do not occur, or if they do occur, they are controlled as quickly as possible to prevent movement of lixiviant and production fluid outside of the monitor ring. Off-site, the concern is related to the extent to which on-site groundwater extraction, particularly during the first phase of restoration, will draw down water levels in off-site wells. There, the emphasis is on water level data.

On-Site Groundwater Monitoring

Mine Units

In addition to the baseline monitoring already conducted, extensive groundwater monitoring will be conducted on a mine unit basis prior to, during and following ISR operations at the Permit Area to identify any potential impacts to water resources of the area. This monitoring is summarized below and described in more detail in the Technical Report.

During ISR operations, water levels will be routinely measured in the production zone (ring wells) and overlying and underlying aquifers. Sudden changes in water levels within the production zone may indicate that the mine unit flow system is out of balance. Flow rates would be adjusted to correct this situation. Increases in water levels in the overlying aquifer or underlying aquifers may be an indication of fluid migration from the production zone. Adjustments to well flow rates or complete shutdown of individual wells may be required to correct this situation. Increases in water levels in the overlying aquifer may also be an indication of casing failure in a production, injection or monitor well. Isolation and shut down of individual wells can be used to determine the well causing the water level increases.

LC ISR, LLC will monitor for lateral movement of lixiviant using a horizontal excursion monitoring system. This system consists of a ring of monitor wells completed in the same aquifer and zone as the injection and production wells. It is anticipated that monitor wells will be installed about 500 feet from the mine unit boundary and appropriately spaced to detect an excursion in a timely manner based on the hydrologic characteristics of each mine unit. Monitor wells will be sampled semi-monthly for approved excursion indicators.

LC ISR, LLC will monitor for vertical excursions in the overlying and underlying aquifers using shallow and deep monitor wells, respectively. Per existing state and federal guidance, these wells will be located within the mine unit boundary at a density of at least one well per four acres, depending on the hydrologic characteristics of each mine unit. Shallow and deep monitor wells will be sampled semi-monthly for approved excursion indicators.

Storage Ponds

To help ensure shallow groundwater is not impacted by the two Storage Ponds, which are part of the waste treatment and handling system and are already constructed and in use at the Lost Creek plant site, the ponds will be designed, inspected and monitored in accordance with NRC Regulatory Guide 3.11. The Storage Ponds, associated inspection schedule and monitoring system, and corrective actions that will be taken in case a leak is detected, are briefly described in **Section 4.12** of this report and in more detail in the Technical Report for the Project.

Class I UIC Wells

These wells are part of the waste treatment and handling system and will be much deeper than any of the mine units. Testing of the mechanical integrity of these wells is required prior to their use, and periodically thereafter, and regulation of injection rates and pressures is also required. These wells are briefly described in **Section 4.12** of this report and in more detail in the Technical Report for the Project.

Off-site Groundwater Monitoring

To help ensure water level drawdowns resulting from the ISR groundwater withdrawals are not interfering with the four BLM wells in the vicinity of the Permit Area, LC ISR, LLC will monitor the water levels in those wells prior to production and quarterly during ISR operations if wellhead design allows. In addition, per NRC requirements, these wells will be sampled quarterly for uranium and radium. Samples will only be collected if the wells are operational.

4.6 Ecology

Construction and operation of the Project have the potential to adversely affect flora and fauna in limited areas. Most of the impacts would occur during the initial construction phase which has already occurred, particularly at the mine units, roads, and the Plant site. The Project is not likely to adversely affect sensitive plant or animal species, because federal- and state-listed or proposed endangered or threatened species or proposed or designated critical habitats do not occur within the Permit Area. Similarly, the absence of permanent surface water within the Permit Area excludes impacts to aquatic resources, which do not exist.

Ecological resources could be affected from the land disturbance of mine unit construction. Construction would involve vegetation removal during clearing for facilities (e.g., individual well sites, header houses, the Plant, roads, parking, field laydown areas, and Storage ponds). Facility construction will be completed in phases, with restoration following each stage to minimize impacts to vegetation and wildlife. Approximate land areas of various habitat types that will be disturbed are presented in (**Table 4.3-1**).

The off-site impacts of construction will be minimal. Construction activities, which have largely concluded already, will produce a minor increase in vehicle traffic and, hence, could increase the number of animals killed on the roadways. Construction will also produce a temporary increase in dust, some of which will be deposited on vegetation both on- and off-site. However, vegetation in this naturally dusty, arid region is expected to be adapted to moderate, temporary increases.

4.6.1 Ecological Impacts from Preferred Alternative

During the Project, less than seven percent of the total Permit Area will be temporarily disturbed. However, ISR operations will be conducted in a series of mine units that are installed, produced, and reclaimed sequentially; therefore, only small portions of the Permit Area will be disturbed at a given time. Unless otherwise arranged and approved by the relevant agencies, all disturbed areas will be reclaimed to support the pre-operational land uses, livestock grazing and wildlife habitat.

The construction of the Plant, main access roads and mine units will involve vegetation removal. The Plant will have long-term disturbance (the life of the Project), while the mine unit areas will have a shorter period of disturbance (approximately two years of disturbance prior to successful revegetation). Impacts from mud pit and pipeline constructions will be short-term, which will be reclaimed within weeks. **Plates 1.2-1a and 1b** display the projected disturbed areas of the Plant and mine units.

LC ISR, LLC consulted state and federal agencies to discuss minimization of impacts to ecological resources. Appropriate state and federal agencies, including WDEQ, WGFD, BLM, and FWS, were consulted in 2006 and 2007.

4.6.1.1 Vegetation Impacts

During the life of the Project, the land area that will be disturbed will be about 642 acres (6.4 percent) of the approximate total Permit Area of 10,005 acres. Approximate land areas of the disturbed vegetation types are listed in (**Table 4.3-1**). After operations are completed, buildings will be removed and disturbed areas will be re-vegetated with native plants. As required, LC ISR, LLC will submit an updated reclamation plan for approval, following review and approval by the appropriate state and federal agencies.

Vegetation will be temporarily impacted during the construction, operation, and reclamation of the Permit Area. During construction activities, vegetation will be removed at some areas of the mine units, supporting facilities, and roads. To stabilize soils and support the ecosystem, vegetation will be established at disturbed areas as soon as conditions allow. During operation activities, mine units and supporting facilities will be accessed frequently using the defined road network. Reclamation will involve abandonment of the mine units, decommissioning and removal of the supporting facilities and roads, and the establishment of vegetation that supports the approved land uses.

Surface disturbance increases the susceptibility of the Permit Area to invasive and noxious weeds. As such, surface disturbance will be minimized and vehicular access will be restricted to specific roads. Disturbed areas will be reseeded with WDEQ and BLM approved seed mixture, as soon as conditions allow, preventing the establishment of competitive weeds. The seed mixture was selected to successfully establish vegetation supportive of the approved land uses. Invasive and noxious weeds will be monitored and if they become an issue, other alternatives, such as herbicide application, will be considered.

The Project is not likely to adversely affect sensitive plant species because federal- and state-listed or proposed endangered or threatened species or proposed or designated critical habitats do not occur within the Permit Area. Similarly, the absence of perennial surface water within the Permit Area prevents development of any aquatic resources.

4.6.1.2 Aquatic Life and Wetlands Impacts

Baseline surveys indicate that aquatic life and wetlands do not exist within the boundaries of the Permit Area. Surface water may be present for a short period of time mainly during snow melting season, but does not sustain aquatic wildlife or wetland species. Therefore, no impacts to aquatic wildlife or wetlands are anticipated.

4.6.1.3 Wildlife Impacts

Wildlife impacts that are likely to occur from construction and operation of the Preferred Alternative include: 1) direct and indirect loss of habitat; 2) increased mortality from collision with vehicles; 3) possible exposure to toxic compounds or chemicals; 4) wildlife displacement due to increased human activity; and 5) increased disruption/stress to wildlife using the sagebrush habitats in the area.

Direct impacts to wildlife habitat would occur in areas that are physically altered by the construction of roads, pipelines, mud pits/wells, field laydown areas, header houses, transmission lines, and the Plant. In addition, direct impacts could occur from increased vehicle mortality. Indirect impacts would occur from Project disturbance associated with Project construction and operation, resulting from increased human presence, dust, and noise. Indirect impacts may displace wildlife or preclude the use of areas near human use/disturbance.

Displacement of wildlife is an unavoidable impact under all alternatives except the no-action alternative. Displacement impacts have the potential to be the most significant to wildlife resources. Wildlife avoidance of disturbed areas and human associated activities could extend beyond the areas of disturbance. The magnitude of wildlife displacement would depend on the species and on many other factors, including noise level, type of human activity, duration of activity, and visual prominence of activity. Wildlife sensitivity to this type of impact varies by wildlife species. For example, ferruginous hawks are very sensitive to human presence/disturbance, while small mammals have a higher tolerance. It is not possible to quantify the magnitude of wildlife displacement. Reactions of wildlife to human disturbance vary greatly by species and even individuals within a species. It is possible that displacement impacts could result in the local reduction of a wildlife population if adjacent habitats are already at carrying capacity. Impacted wildlife populations could have lower reproduction and survival rates, resulting in reduced populations (WGFD, 2004b).

Wildlife use of habitats near human activity (construction, drilling, noise, and buildings) would be expected to decline for species that are sensitive to human presence. Development impacts to wildlife can extend well beyond the actual areas of vegetation or habitat loss. For example, to protect nesting ferruginous hawks the BLM recommends a one-mile buffer around nest sites from human activities (BLM, 2004b). More widespread development in an area can cause habitat fragmentation. Wildlife species can be expected to exhibit some habituation to the human activity associated with Project operation. Use of habitat adjacent to the ISR operations will probably increase as animals become habituated to the activity. After initial drilling, construction, and startup, human activity (noise, traffic, human presence) would be expected to decline, and impacts to wildlife would probably concurrently decrease. However, the combined habitat loss and increased human presence in a previously undisturbed area could be detrimental to big game species, raptors, sage grouse, and other species that have shown sensitivity to human presence. Following reclamation, other ISR locations have proven to be attractive to wildlife especially deer and antelope. Some sage grouse leks within 4 miles of the project have actually increased in male count since production started in 2013. This phenomenon is likely due to better moisture conditions.

Primary wildlife resources of concern that are known to occur in the Permit Area include: big game year-long range; sage grouse leks, nesting habitat, and winter habitat; raptor nesting habitat; and sagebrush endemic species. In addition, the area supports a variety of small mammals, birds, reptiles, and amphibians.

The vegetation map (**Figures 3.6-1 thru 3.6-3**) of the Permit Area shows important vegetation communities and wildlife habitats.

Direct habitat loss from construction will equal approximately 6.4% of the Permit Area, however, the disturbance and associated reclamation will occur in stages. The two major vegetation/habitat types disturbed by Project construction include Lowland and Upland Big Sagebrush Shrubland. Project construction will result in the long-term loss of about 10.5 acres of Lowland Big Sagebrush Shrubland and 124.1 acres of Upland Big Sagebrush Shrubland (**Table 4.3-1**). In addition, approximately 10.8 acres of Lowland Big Sagebrush Shrubland and 496.6 acres of Upland Big Sagebrush Shrubland will be temporarily disturbed, e.g., without total removal of vegetation (**Table 4.3-1**). **Figures 3.6-1 thru 3.6-3** show the Permit Area in relation to key wildlife habitats and features, and vegetation types.

General Wildlife

Project construction could potentially impact 620.7 acres of Upland Big Sagebrush Shrubland and 21.3 acres of Lowland Big Sagebrush Shrubland habitat (**Table 4.3-1**). Once disturbed, it will take five to ten years for sagebrush habitats to re-establish.

Several species of sagebrush obligate birds (passerine birds, including BLM sensitive species) have been found nesting in the sagebrush habitats of the Permit Area. Common species include the Brewer's sparrow, sage sparrow, sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow.

Of special importance is the Lowland Big Sagebrush Shrubland habitat (an area of high sagebrush in swales or draws). The Lowland Big Sagebrush Shrubland habitat had the highest diversity and density of nesting birds at the Permit Area (LWR Consultants Inc., 2007). Long-term loss of four acres of Lowland Big Sagebrush Shrubland habitat would occur with Project construction. Depending on the timing of construction, direct mortality or loss of nests could occur.

Impacts to small mammals, reptiles, and amphibians will include direct mortality during the construction and clearing phase of the Project. There is no way to quantify the extent of direct mortality; however, local populations should recover rapidly

Other direct impacts to passerine birds, small mammals, reptiles, and amphibians could include mortality from motor vehicle collisions or from exposure to toxic chemicals. The waste stream in the Storage Ponds will be evaluated to see if it is potentially harmful to passerine birds and small mammals.

Indirect impacts to passerine birds will include the displacement of shrub-dependent species away from human activities. Birds are mobile and will disperse into adjacent habitat areas. However, adjacent areas may already be at carrying capacity and may not be able to support additional individuals.

Big Game and Wild Horses

The Permit Area provides winter/yearlong range to pronghorn, is not considered mule deer range and is considered transitional range for elk. The site provides range to the Stewart Creek and Lost Creek wild horse herds (BLM, 2006).

Because the site provides marginal habitat to mule deer and elk, minimal impacts are anticipated to these species. There would be no impacts to big-game critical or key winter or summer ranges or migration corridors.

Impacts to big game (especially pronghorn) and wild horses may include direct loss and modification of habitat, displacement from increased human activity, increased mortality from increased traffic on local and regional roads, and increased poaching and/or harvest from improved access, and increased human presence.

About 642 acres of pronghorn and wild horse habitat (Lowland and Upland Big Sagebrush Shrubland) would be disturbed by Project construction (**Table 4.3-1**).

In addition to direct impacts, increased human presence due to construction and operation would affect pronghorn and wild horse use of areas adjacent to the Project. Pronghorn have been shown to become habituated to increased traffic volumes and heavy equipment if the traffic and equipment move in a predictable way (Reeve, 1984). However, initial well drilling activities and unpredictable traffic flows may cause pronghorn to flee. Pronghorn displacement of up to 0.6 miles has been observed from construction activities (Easterly et al., 1991).

General observations in the region indicated that pronghorn densities are higher in undisturbed areas away from human disturbance (BLM, 2004b). Some long-term disturbance of pronghorn habitat would occur with Project construction. The proposed staged reclamation of disturbed areas would provide grass and forb forage within a few years of habitat disturbance. This would reduce habitat loss and would provide quality forage.

Sage grouse

Greater sage grouse are common in the Permit Area. The entire Permit Area provides quality sage grouse habitat. The site provides high quality sage grouse habitat due to lack of habitat fragmentation, interspersion of Upland and Lowland Big Sagebrush Shrubland habitats, and proximity to higher elevation habitat areas to the north. There are four active leks inside the Permit Area or within two miles of the Permit Area (Discover Complex, Prospects South Complex, Greenridge and Eagles Nest. For purposes of this discussion the Permit Area includes both the Lost Creek and LC East Areas (**Figure 3.6-9**). The Crooked Well lek is within the Lost Creek Permit Area but has not been attended by grouse displaying leking activities for over ten years. The Sooner lek is greater than two miles from the Permit Area, but is within 100 yards of Sooner Road, which could be subject to increased traffic volume as a result of Project construction and operations. No surveys have been completed for wintering sage grouse at the Permit Area. Wintering sage grouse prefer dense sagebrush stands that extend above snow cover and provide escape and thermal cover to the birds. Based on habitat conditions, the Lowland Big Sagebrush Shrubland habitat areas likely provide important sage grouse winter habitat (Naugle et al., 2006; WGFD, 2003).

Potential impacts to sage grouse include loss of nesting/brood-rearing habitat, loss of wintering habitat, decreased population productivity due to loss of nesting/brood-rearing habitat, increased predation due to increased roosting sites for raptors on power poles and other structures, mortality due to exposure from toxic chemicals, loss of nests due to construction activities, and displacement of birds into adjacent areas.

Project construction would result in the short and long-term loss of 642 acres of potential habitat for sage grouse within the Permit Area. However, vast areas of similar vegetation and habitat are available within and beyond the Permit Area in the region.

Construction of Project facilities, pipeline, transmission line and roads creates a long-term loss of sage grouse habitat and increases fragmentation of existing habitat. Transmission line poles, power lines and other facilities provide roosting sites to raptors and corvids, and can result in increased predation. Other sources of direct impacts may occur from disruptive human activities near leks or other key habitat areas. Human activities can also disrupt normal sage grouse behavior related to breeding, brood-rearing, or foraging. Increased human-caused noise may reduce lek attendance and reduce wintering habitat suitability. Increased dust from Project roads may reduce the palatability of sagebrush plants (WGFD, 2004b). The increased traffic adjacent to the Sooner Lek (located approximately 100 yards from Sooner Road) could result in lower lek attendance.

Raptors

Several species of raptors have been observed within the Permit Area. The only raptor species that has been confirmed nesting at the Permit Area is the ferruginous hawk. Based on 2013 nesting raptor surveys, there are four active ferruginous hawk nest within or near the one-mile buffer of the Permit Area (two nests are just outside the 1-mile buffer and one nest is within the permit area) (**Figure 3.6-14**).

Potential impacts to raptors include loss of nesting and foraging habitat and collisions with other structures and vehicles, nest abandonment and reproductive failure due to increased human activities, reduction in prey populations, and displacement of birds into adjacent areas.

Ferruginous hawks have shown to be sensitive to human disturbance, especially during periods of courtship, nest building, incubation, and brood rearing (Collins and Reynolds, 2005). Nest abandonment and loss of eggs or fledglings could occur with human disturbance during the early nesting period. Mortality from power lines will be minimized by the use of raptor deterrent products and the burial of transmission lines from the transformer to the header houses, and the header houses to the wells.

Special Status Wildlife Species

The bald eagle (formerly listed as threatened) and black-footed ferret (endangered) are the only federally listed, previously listed, or candidate species that may occur in the area (FWS, 2006). The bald eagle may occur as a sporadic migrant, and may forage on the site occasionally. The nearest known bald eagle nest to the site is greater than five miles away. The black-footed ferret is found in active prairie dog colonies. There are no active black or white-tailed colonies on the Permit Area and the nearest active prairie dog colonies are one to two miles south and southwest of the Permit Area. No impacts are anticipated from Project construction and operation to the bald eagle or black-footed ferret.

The Permit Area was evaluated for potential habitat for the long-billed curlew and mountain plover. There is no potential nesting habitat for these species. The Permit Area is dominated by sagebrush vegetation with little open grassland or other open shrubland suitable for nesting mountain plover. No mountain plover were observed on-site while completing other spring and summertime field surveys.

Lowland Big Sagebrush Shrubland habitat provided the highest densities of breeding birds; however, birds were also located in the Upland Big Sagebrush Shrubland Habitat. Project construction and operation may result in the loss of 642 acres of nesting habitat for these species within the Permit Area. Construction and operation activities may displace birds to lower quality habitat areas and could result in localized lower reproduction and increased predation. Other potential direct impacts to sagebrush obligate birds could include mortality from motor vehicles collisions or from exposure to toxic chemicals.

Surveys were conducted for pygmy rabbits at the Permit Area during the summer of 2012. A total of 31 locations of burrows or other possible indicators of pygmy rabbits were recorded. Evidence of pygmy rabbit use was present along all four transects. No pygmy rabbits were sighted during the surveys. However, pygmy rabbits have been seen within the Lost Creek East Permit Area during other studies. (**Figure 3.6-16**) shows pygmy rabbit habitat at the Permit Area in relation to construction and production facilities. Project construction and operation will result in the short-term and long-term loss of 21.3 acres of pygmy rabbit habitat (Lowland Big Sagebrush Shrubland) within the Permit Area. Mortality of individual pygmy rabbits may occur as a result of construction activities in Lowland Big Sagebrush Shrubland habitat. Pygmy rabbits stay within limited habitat areas. Project facilities, mine units, mud pits, Storage Ponds, and access roads may result in exposure to pygmy rabbits of harmful substances or materials.

The state-listed olive-backed pocket mouse and prairie vole were not observed at the Permit Area; however, suitable habitat exists and these species are known to be in the region (WGFD, 2004a). Loss of potential habitat would occur with Project construction and operation.

4.6.1.4 Cumulative Impacts

Within the Permit Area, cumulative impacts to ecology from historic and proposed activities are not reasonably foreseeable due to anticipated reclamation. Historic and present land uses include, but are not limited to, livestock grazing, wildlife habitat, recreation and exploratory drilling. The proposed activities involve the construction and operation of an ISR uranium facility.

Historic and present land uses affect much of the Permit Area. To support present land uses, much of the Permit Area will not be disturbed during the life of the Project. Areas of disturbance will be temporarily stabilized until reclamation activities commence.

ISR operations will minimize disturbance by chemically removing the uranium and leaving the matrix surrounding the ore intact. Proposed disturbed areas (mine units, the Plant, pipelines, and access roads) will be reseeded as soon as conditions allow. Ultimately, the disturbed areas will be reclaimed to their pre-operational contours and revegetated to support the approved land uses. Due to this reclamation, cumulative impacts to ecological resources are not anticipated.

Future activities could affect the cumulative impacts to wildlife and vegetation at the Permit Area. At this time, there are no known projects that would affect the general area.

4.6.2 Ecological Impacts from Other Alternatives

Ecological impacts from the use of portable pits will be comparable to those of the Preferred Alternative. While the use of portable pits would slightly reduce the degree of topsoil disturbance it would increase the disturbance of vegetation since both the drill pad and the disposal site would be disturbed. Since each mud pit is only about 75 square feet the total topsoil disturbance is relatively small. Drill cuttings captured in a portable pit would have to be disposed of somewhere which would likely result in an equivalent amount of topsoil disturbance as the Preferred Alternative.

Standard mud pits present a hazard to cattle from entrapment. However, the mine units are fenced to prevent access by livestock. Wild animals are very rarely entrapped in standard mud pits so the impact to wildlife is negligible. If portable drill pits were used, a mud pit would still have to be installed for burial of the cuttings. This mud pit would present a similar entrapment hazard for cattle as a standard mud pit but the mitigation would be the same (fencing).

Portable mud pits would have to be mucked out several times per drill hole. Mucking out a portable pit is a messy task since the cuttings are saturated with water. It is likely that some quantity of drill mud/cuttings would be spilled onto the topsoil and vegetation. Although only a small area would be impacted, the drill mud would likely stunt vegetation growth for several years until it was naturally dispersed.

4.6.3 Mitigation of Ecological Impacts

Off-site impacts of the Project would be minor. Flora and fauna in the areas surrounding the Permit Area are similar to those on-site and are common in the region. Mitigation measures for erosion and sedimentation are discussed in **Sections 4.3 and 4.5**.

Under normal operations, the only routine release would be low concentrations of radon released to the airshed. Provided the concentration is protective of human health, it would not be expected to adversely affect native plants and animals (Barnthouse, 1995).

In the event of a spill, areas of contamination would be cleaned or removed and properly disposed of in accordance with SOPs. As such, spills are unlikely to extend off-site. The materials most likely to be spilled, such as retained process water, would not contain hazardous constituents in concentrations that would be harmful to wildlife.

The goal of the Project is to be proactive to minimize and mitigate ecological impacts. This will be done by following agency-recommended mitigation, minimization measures and BMPs, regarding restoration, habitat protection and enhancement, and wildlife protection.

4.6.3.1 Vegetation Mitigation

Successful revegetation cover counts (mostly grasses and forbs) are anticipated to occur within two to five years of seeding. In order to reestablish vegetation in this time frame, noxious weeds will be reduced or eliminated. Disturbed areas will be reseeded with the approved seed mixture as soon as conditions allow. This would prevent the establishment of competitive weeds. Should invasive and noxious weeds become an issue, other alternatives will be considered, such as herbicide application.

Due to the remoteness and the limited historical disturbance to the Permit Area, very few weeds are present. Tansy mustard (*Descurainia pinnata*) was the only listed noxious weed species observed during the vegetation surveys. The tansy mustard was observed as scattered individuals in the Lowland Big Sagebrush Shrubland. Areas dominated by weedy species were not observed. Selenium indicator species were not observed.

Temporary fencing may be installed to restrict access to reseeded areas until vegetation is successfully reestablished. The fences will be constructed according to BLM specifications. Upon demonstration of successful revegetation, the fencing will be removed.

Because many of the reclaimed areas are relatively small in comparison with the total Permit Area, and the vegetation communities within the Permit Area are similar, LC ISR, LLC will be able to use the undisturbed portions of the site for collection of vegetation data that can be compared to the reclaimed areas. In addition, LC ISR, LLC will describe the quantitative methods to be used for comparing the total vegetation cover in the reclaimed and undisturbed areas and for evaluating species diversity and composition. These methods, as well as the general locations of native comparison areas, will be submitted to WDEQ for review and approval at least six months prior to the fifth full growing season.

The total vegetation cover, species diversity and composition in revegetated areas will be quantitatively assessed in accordance with WDEQ-approved procedures after the fifth growing season after seeding. Revegetation shall be deemed complete no earlier than the fifth full growing season after seeding and when:

- the revegetation is self-renewing under the site conditions;
- the total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix is at least equal to the total vegetation cover of perennial species (excluding noxious weed species) in the undisturbed portions of the Permit Area; and
- species diversity and composition are suitable for the post-operational land use.

4.6.3.2 Wildlife Mitigation

All wildlife management practices are established in conjunction with the BLM, WGFD and FWS guidelines. The following measures and BMPs are proposed in order to minimize and mitigate impacts to wildlife. These measures are designed to be consistent with regional recommendation by land and wildlife management agencies (BLM, 2004c; WGFD, 2003 and 2004b). These measures will also help minimize impacts to plant communities. Standard construction, erosion control, and other BMPs described in other sections will also help to minimize ecological impacts.

Road and Right of Way (ROW) Measures

- Access roads of the Project will use existing two-track roads to the extent possible to help minimize new disturbance of sagebrush habitat. The roads will be constructed following BLM and WGFD recommendations to minimize the road width, revegetate road shoulders, and limit vehicular speeds.

- All utilities will be located in the same ROW. The proposed pipeline and transmission line will be placed in or adjacent to the access road ROW to help minimize habitat impacts where possible.
- All Project access by employees and visitors will be restricted to the main access road.
- Existing two-track roads that are adjacent to the main access road and Project facilities will be gated and or signed to help prevent additional traffic disturbances in the area. This measure will help prevent disturbance of nesting raptors and sage grouse leks.

Fencing and Screening Measures

- Mine units will be fenced to keep out cattle and wild horses and will be designed to minimize mortality rates. Fences will be temporary and will be removed after ISR operations at the mine unit are complete. Fences will be constructed to BLM specifications.
- All mud pits outside of fenced areas will be fenced during the drilling phase, while the pits are open and contain drilling liquid.
- If the fluid in the storage ponds is determined to be harmful to birds, netting or other appropriate deterrents will be placed to eliminate any hazard to migratory birds, sage grouse or other wildlife. The deterrent will be consistent with agency recommendations.

Transmission Line

- To prevent the electrocution of raptors, the primary transmission line and power poles will be built to the latest approved methods (Olendorf et al., 1996). This would include cross-arm design, transformer design, and perch guards.
- To help minimize raptor roosting on power poles and to minimize predation on sage grouse, appropriate roost guards will be attached to power poles and cross-arms. The design will follow BLM guidelines (Oles, 2007) or other appropriate guidelines.
- Secondary and tertiary transmission lines will be buried in order to minimize risks to raptors and large birds.

Restoration/Reclamation

- Reclamation will be staged during all phases of the construction and operation of the operations plan. Areas that are temporarily disturbed will be restored and reseeded after disturbance prior to the next growing season. Temporary access roads will be restored and reseeded when no longer needed. Non-maintained road shoulders will be seeded and left undisturbed.

- All seed mixes used for restoration will be approved by BLM. Only native species will be used in seed mixes. All seed mixes designed for permanent restoration will include sagebrush.
- Weed control is an important issue for restoration and protection of existing habitats for sage grouse and other species, and plant communities. Weed prevention measures following BLM guidelines and recommendations will be implemented (BLM, 1996 and 2004c).

Reduce Human Disturbance and Incidental Loss of Wildlife

- Inform all employees of applicable wildlife laws and penalties associated with unlawful take and harassment of wildlife.
- Require that employees undergo training describing the types of wildlife in the area susceptible to collisions with motor vehicles, the circumstances when collisions are most likely to occur, and measures that should be taken to avoid wildlife/vehicle collisions.
- All new and improved roads related to the Project will be signed and or gated to minimize public traffic.
- All two-track roads that connect to Project access road(s) will be signed or gated as needed to minimize disturbance of nesting ferruginous hawks or sage grouse leks. This will be coordinated with appropriate staff from the BLM and/or WGFD.
- During lek season, ground disturbing activities will not occur outside active production areas and mine units approved for construction unless approved by BLM. LC ISR will adhere to the relevant stipulations codified in the Governor's Executive Order on sage grouse.

Wildlife Closures and Timing Windows

Standard BLM exclusion periods, as previously approved (**Table 4.6-3**), will be followed to protect key wildlife resources during construction and operation.

Wildlife Enhancements

- If appropriate, LC ISR, LLC will work with BLM and WGFD to complete wildlife enhancements in the Permit Area or nearby areas that are not proposed for operations or disturbance. These enhancements could include: placement of new raptor nest platforms, creation of new water sources, or habitat modifications/improvements to improve specific habitat conditions for sage grouse or other high interest species.
- All seeding will be completed with native species; sagebrush will be included in all seed mixes.

4.6.4 Monitoring of Ecology

Site-specific monitoring programs need to be implemented per WDEQ, FWS, WGFD, and BLM guidelines. Regular inspections on the status of mitigation installments also need to be incorporated into the ecological monitoring plan.

4.6.4.1 Vegetation Monitoring

Vegetation monitoring of the Permit Area will consist of evaluating disturbed areas for the presence of undesirable weed species. If noxious weed species are noted, they will be controlled either by manual removal, mowing, herbicide applications, or other appropriate control measures.

Once disturbed areas have been reclaimed and vegetation is developing, the reclaimed areas will be monitored in accordance with BLM and WDEQ requirements. Evaluation of these areas will continue until the vegetation cover values (exclusive of noxious weeds) become comparable to the native shrubland areas.

4.6.4.2 Wildlife Monitoring

Monitoring of key wildlife resources in and near the Permit Area will be completed on an annual basis through the life of the Project. The purpose of the annual monitoring will be to document key wildlife resources, population trends, and key habitats to help minimize adverse impacts to wildlife.

Annual Report and Meetings

- Annual wildlife monitoring will be coordinated with the Rawlins BLM, and WGFD. Consultation with BLM and WGFD will be conducted prior to completing any annual survey work. A work plan will be approved by BLM and WGFD prior to completing annual monitoring.
- An annual monitoring report will be prepared and submitted to the BLM and WGFD by November 15 of each year. The report will include: survey methods, results, any trends, an assessment of protection measures implemented during the past year; recommendations for protection measures for the coming year; recommended modifications to monitoring or surveying; and any recommendations for additional species to be monitored (e.g., a newly listed species). All data and mapping will be formatted to meet BLM requirements. GIS data and maps will be provided to meet BLM specifications.

Annual Inventory and Monitoring

Wildlife inventory and monitoring will be completed by BLM or WGFD biologists, or a third-party contractor paid for by LC ISR, LLC. Any third-party contractor will be approved by BLM prior to completing any work. Only qualified wildlife biologists or ecologists will be approved to complete wildlife monitoring.

Raptors

- Annual monitoring of known raptor nests will be completed each spring between April and July to determine nest status. Nest surveys can be completed by helicopter or from the ground. Nest monitoring will be conducted using protocol to minimize adverse effects to nesting raptors. Monitoring visits will be scheduled for as late in the nesting season as possible to avoid disturbance during the incubation and early brood rearing periods.
- In addition to annual monitoring of known nests, surveys for new nests will be completed within the Permit Area and a one-mile radius at least every five years. For any area of new disturbance, a survey for new nests will be completed prior to any disturbance.

Sage grouse

- A survey for new leks will be completed within the Permit Area and surrounding two-mile radius every five years or as deemed appropriate by BLM. Surveys may be complete aerially or by ground, following standard survey protocol.
- All known leks will be monitored on an annual basis to determine lek attendance and trends in lek activity. Monitoring will be completed three times during the appropriate season (late March to early May), following standard protocol.

Big Game

No annual monitoring of big game is proposed. To determine the extent of big game road kill all wildlife/vehicle collisions on Project access roads will be recorded and reported in the annual monitoring report. Any other big game mortality due to project features will be recorded and reported.

General Wildlife

No specific monitoring measures are proposed for most wildlife species. Any known mortality of sensitive wildlife species due to Project activities will be recorded and reported. Any large die-offs or other evidence of possible wildlife exposure to toxic chemicals will be reported immediately to BLM, WGFD, and FWS.

Sensitive Species

- Known mortality of sensitive wildlife species due to Project activities will be recorded and reported. Any significant die-offs or other evidence of possible wildlife exposure to toxic chemicals will be reported immediately to BLM, WGFD, and FWS.
- Specific monitoring of sensitive species (except as noted above for raptors and sage grouse) is not proposed.

4.7 Air Quality and Noise

Unlike conventional open-pit mine sites, fugitive dust emissions and noise level increases are minimal at ISR project sites, as operations of major dirt-moving equipment and haul trucks are much less common, and large-scale excavations are not conducted.

4.7.1 Air Quality and Noise Impacts from the Preferred Alternative

4.7.1.1 Air Quality Impacts from the Preferred Alternative

During construction, gaseous and particulate releases from drilling equipment will have a localized impact on air quality. Air-quality impacts during construction will come from dirt-moving activities during drilling and ground-clearing activities, as well as emissions from the use of heavy equipment. Atmospheric stability in the area is low due to the winds and any releases will be quickly dispersed. The closest off-site receptor, Bairoil is located about 15 miles from the Permit Area and not downwind of the prevailing wind direction.

Temporary roads will be used to access well sites. These will be two-track roads, with each track being approximately 1.5 feet wide, and a total width of eight feet. Installation of two-track roads will be minimized where possible. Other potential impacts during this period will come from dust from vehicular traffic on these unpaved roads and gaseous emissions (vehicular and heavy equipment). On-road cars and trucks will have the required emission control equipment.

Estimated vehicle requirements for construction, operations and maintenance may include the motor grader, trackhoe, scraper, compactor, drill rig, water truck, pipe truck, rig pick-up, backhoe, pick-up, generator, welding machine, air compressor, tractor/trailer, and fusion cart. **Table 4.7-1** from the shows the estimated amount of emission from these vehicles.

Non-stationary sources of air pollutants will be the diesel engines on the drill rigs and other construction equipment. Drilling will be conducted as the mine units are developed. By far, this equipment has the greatest use throughout the year; other equipment is used sporadically and will have negligible impacts.

Dust generation from surface disturbance during construction also has the potential to impact air quality. However, this impact is temporary, and revegetation of the disturbed areas not used for project facilities will reduce the amount of surface disturbance.

Another source of dust will come from vehicular traffic, especially on unpaved roads. To estimate the amount of dust generated from project traffic, calculations using EPA Emission Factors for unpaved and paved roads were made.

Compilation of Air Pollutant Emission Factors, Volume I (EPA, 2006) contains the following equation for light-duty vehicles traveling on publicly accessible unpaved roads (equation 1b in the document):

$$E = \frac{k\,(s/12)^{a}(S/30)^{d}}{(M/0.5)^{c}} - C$$

where k, a, b, c and d are empirical constants provided in the document and:

- E = size-specific emission factor in pounds per vehicle miles traveled (lb/VMT),
- s = surface material silt content (percent),
- M = surface material moisture content (percent),
- S = mean vehicle speed (mph), and
- C = emission factor for 1980s vehicle fleet exhaust, brake wear, and tire wear.

To account for rainfall, which naturally mitigates dust generation, the following equation was used:

$$E_{ext} = E\,[(365-P)/365]$$

where:

- E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT;
- E = emission factor from Equation 1a or 1b; and
- P = number of days in a year with at least 0.01 inch (0.254 millimeter) of precipitation (see below).

For paved roads, the following formula was used:

$$E_{ext} = \left[k\left(\frac{sL}{2}\right)^{0.65}\left(\frac{W}{3}\right)^{1.5} - C\right]\left(1-\frac{P}{4N}\right)$$

where:

- E = particulate emission factor (having units matching the units of k);
- k = particle size multiplier for particle size range and units of interest (see below);
- sL = road surface silt loading (grams per square meter [g/m^2]);
- W = average weight (tons) of the vehicles traveling the road;
- C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear;
- E_{ext} = annual or other long-term average emission factor in the same units as k;
- P = number of "wet" days with at least 0.01 inch (0.254 millimeter) of precipitation during the averaging period; and
- N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

For purposes of this calculation, the following estimates and assumptions were made:

- Weight for passenger vehicles used by employees was two tons, average weight (full versus empty) for supply/delivery truck was ten tons, and average weight of resin truck (full versus empty) was 20 tons.
- Distance of unpaved roads is equal to 19 miles. Speed limit of passenger vehicles was 35 mph, delivery and resin trucks were 15 mph.
- Resin trucks made 70 trips a year, delivery trucks made weekly trips (52 a year).
- For employees, it was assumed that 70 percent would be commuting from Casper, and 30 percent from Rawlins. Eighty-seven employees/contractors carpool in 33 vehicles, driving 240 days each year (the number of work days take holidays and vacations into account).
- Emissions were calculated for the operation stage only.

The amount of emissions and dusts generated during the operation phase of the project will be less than those generated during the construction phase. Impacts on air quality will be limited to emissions and dusts from service vehicles from the Plant to the mine units, as well as the transportation of supplies, yellowcake slurry and workers in and out of the Plant. Most of the dust, generated from all vehicles, originates from the unpaved road. The greatest amount of dust will be generated from employee vehicles, with 169.9 tons per year for PM_{10}. The resin truck is modeled to generate 4.3 tons of dust/year, and delivery trucks are modeled to generate 2.7 tons per year from vehicular traffic. Radon may be vented from the Plant as part of normal operations (see detail in **Section 4.12**). Mine unit construction (mainly drilling) will continue throughout operations and emissions and dusts will be generated.

The closest receptors near the project area are approximately 15 miles away. The emissions and dusts generated by the Project during operations will be dispersed rapidly and are expected not to cause any exceedance of applicable air quality standards in the Permit Area.

4.7.1.2 Noise Impacts from the Preferred Alternative

Noise impacts were assessed by measuring noise levels associated with exploration and pre-operational activities on-site, which are as loud as the projected noise levels during construction and operations. The potential impact to off-site receptors was evaluated using a widely accepted noise attenuation model (Golden et al., 1979). The closest residence, church, or school is about 15 miles from the Permit Area (e.g., Bairoil).

During construction, ISR projects create noise due to heavy equipment use and mine unit drilling. Drill rigs, heavy trucks, and equipment will generate noise that will be audible on-site above the 30 to 35 A-weighted decibels (dBA) of the background noise levels. The maximum noise measured during exploration activities was from a cement mixer and a generator running concurrently, which was 102 dBA, four feet from the source. During construction, occasional instantaneous levels could be somewhat higher.

Beginning at a distance of 50 feet, noise levels diminish by six dBA for each doubling of the distance from the source (Golden et al., 1979). Due to natural attenuation, the highest sustained noise at the closest off-site receptor in Bairoil would be 39 dBA, which would not be audible above background noise levels in this community. This calculation used the conservative assumption that no noise attenuation occurred between four and 50 feet. Field observations indicate that drilling activities are inaudible at distances greater than one mile, due to topographic interference and other factors.

Outdoor noise levels at the nearest off-site receptors are well within the 55-dBA guideline, to protect against activity interference and annoyance (EPA, 1978). Noise levels during mine unit construction should cause no off-site impacts, since the Permit Area is not in close proximity to off-site receptors. Mine unit construction will occur only during daylight hours, and the 70 dBA 24-hour average sound-energy guideline to protect hearing will not be exceeded on-site.

Construction of the plant, main access roads, and ponds are complete so no assessment for these activities is made.

Due to the continuous nature of mine unit construction and remediation, there will be only short intervals in which only production activities occur. During production, the only anticipated on-site noise sources are pumps and periodic truck traffic for maintenance visits and inspections. As such, no on-site sources will result in a significant noise increase to off-site receptors during production. During operations, truck transportation of production-related materials and yellowcake slurry will be the only noise source that will affect off-site receptors, and this impact will be very minor. Less than one delivery per day will be required, and the associated increase in truck traffic on US-287 will be less than 0.1 percent, which would not be noticeable.

During restoration and reclamation, impacts are anticipated to be similar to construction, although there would be no active drilling. Truck traffic will be similar to the construction phase due to transportation of waste material to disposal sites, but should not exceed ten truck loads per day.

4.7.1.3 Cumulative Air Quality and Noise Impacts

Air Quality

Most of the dust and emissions generated will peak during construction. Long-term operations will generate insignificant amounts of gaseous emissions, and the impact will be negligible. Wind conditions at the Permit Area will quickly disperse any emissions, and no residential receptors are nearby.

Noise

Since on-site noise sources will not be audible by off-site receptors, all cumulative noise impacts will relate to off-site transport of materials and yellowcake/slurry/resin. Noise impacts related to the Project are so minor that even when combined with other energy-related projects, the impact will be negligible.

4.7.2 Air Quality and Noise Impacts from Other Alternatives

4.7.2.1 Air Quality Impacts from Other Alternatives

The use of portable pits would not substantially change the air-quality impacts described in **Section 4.7.1.1.**

4.7.2.2 Noise Impacts from Other Alternatives

The use of portable pits would not appreciably affect the noise impacts described in **Section 4.7.1.2**. Any reduction in noise realized from not needing to dig mud pits would simply be replaced by the noise generated by hauling the cuttings to a disposal site and burying the cuttings in a new location.

4.7.3 Mitigation of Air Quality and Noise Impacts

4.7.3.1 Mitigation of Air Quality Impacts

No mitigation is required; however, best management practices (BMPs) to minimize dust and emission generation will be employed. Since the use of temporary, non-compacted roads have the potential to generate dust, an on-site speed limit will be set to reduce dust generation. Regular maintenance on engines and pollution-prevention equipment should be conducted and maintained to ensure that emissions are minimized. Bussing and/or carpooling of employees should be encouraged. Disturbed areas within each mine unit will be revegetated prior to the next growing season, after construction is complete, to minimize soil loss and fugitive dust emissions to the atmosphere. Dust control measures for unpaved roads will be conducted and may include water spraying, application of gravel, or application of organic/chemical dust suppressants pursuant to the Air Quality Permit requirements.

4.7.3.2 Mitigation of Noise Impacts

Since the Project will have negligible off-site noise impacts, no mitigation measures are called for, other than regular equipment maintenance.

4.7.4 Air Quality and Noise Monitoring

4.7.4.1 Air Quality Monitoring

Air quality monitoring will be conducted in accordance with WDEQ-Air Quality Division requirements or as stated in the air quality permit issued for the facility. Visual inspection of ground conditions for dust will be conducted at disturbed and unprotected soil locations.

4.7.4.2 Noise Monitoring

Because Project noise is not expected to cause any substantial impact, no monitoring is currently planned.

4.8 Historic and Cultural Resources

Requesting NRC confidentiality. Section submitted separately.

The proposed action will not directly impact any identified historic or cultural resources. If previously unknown cultural resources are discovered, LC ISR will halt operations in the area and contact BLM for further instructions.

4.8.1 Impacts of the Other Alternative on Historic and Cultural Resources

The use of a portable mud pit would minimize the disturbance of soil, and potentially of cultural resources, within the wellfield. However, that benefit would simply be offset by the need to install another pit to install the cuttings outside the wellfield. Regardless of where the mud pit is created, heavy equipment operators are trained to recognize cultural resources and stop digging if they are encountered. All areas of the project which may be impacted have been surveyed by archeologists.

4.8.2 Impacts on Visual and Scenic Resources

4.8.3 Impacts from the Preferred Alternative

The Project will result in temporary, minor impacts to the visual and scenic resources of the area. The nature of the impacts would be in keeping with the visual resource classification of the area by BLM. The management objective for Visual Resource Class III areas is to:

> "Partially retain the existing character of the landscape. The level of change to the landscape should be moderate. Management activities may attract the attention of the casual observer but should not dominate the view of the casual observer. Changes should repeat the basic natural elements found in the predominant natural features of the characteristic landscape" (BLM, 1984).

During operations, visual resources will be impacted to some degree by vegetative disturbance, road building, drilling, piping, and facility construction. A maximum of approximately 165 acres of vegetation will be disturbed at any one time (unreclaimed). This estimate includes the Plant, all on-site roads, operating mine units, mud pits for resource and delineation and monitor wells, and pipelines. The total footprint of the Plant is about 9 acres, and the maximum height of any building will be 45 feet. Mine unit development will occur sequentially, with reclamation in the first mine unit concurrent with construction and operations in later mine units.

Most of these modifications will not be visible from the public road network, which is lightly traveled (**Section 3.2**). The Plant is located 4.5 miles from the nearest county road, and the rolling topography will hide the facilities from travelers, except from a limited number of vantage points. There are no locally important or high-quality views that will be affected by the proposed action. Project facilities will be discernable, but will not be a dominant landscape feature to observers outside the Permit Area.

Impacts will also be temporary, since buildings and roads will be decommissioned and removed at the Project's end, and vegetation will be restored to its previous condition. ISR operations cause no modifications to scenery or topography that will persist after restoration and reclamation.

4.8.3.1 Cumulative Impacts from the Preferred Alternative

Visual impacts are only temporary. Since the Plant will be removed and the site reclaimed at the end of the project, there will be no cumulative impacts with other existing or foreseeable future projects.

The impacts on visual and scenic resources is expected to be very similar to that described in the original Lost Creek ER. However, wellfield and secondary roads constructed to serve LC East mine units will be closer to Sooner Road than the Lost Creek infrastructure and will therefore be more visible. The eastern edges of Mine Units 10 and 11 will be approximately 1 mile from Sooner road while other mine units will be greater than a mile away. Traffic on Sooner Road is very light in this remote part of the Great Divide Basin with occasional use from hunters, bike riders, hikers and other recreationists. Ranchers and miners use Sooner road to access their respective work areas. Disturbance resulting from the KM Amendment will be partially visible from Sooner road but will be several miles away and will blend into the background; especially since no large buildings or other structures will be constructed. Experience has shown that operations at Lost Creek are difficult to see from Sooner Road during the afternoon when the sun is toward the west.

4.8.4 Mitigation of Impacts from the Preferred Alternative

The use of portable pits would slightly reduce the visual impact since there would be fewer topsoil piles. However, these topsoil piles are relatively small and temporary so the impact to visual resources would be small and distant from the nearest public road.

4.8.5 Monitoring Impacts from the Preferred Alternative

The following mitigation measures are planned to minimize the Project impacts on visual and scenic resources.

- Building materials and paint will be chosen to blend with the natural environment, according to BLM guidelines.
- All structures have been designed to be low profile, in order to minimize the number of vantage points from which they will be visible.
- The site will remain clean and well-maintained according to operations protocols.

4.8.6 Monitoring Impacts from the Preferred Alternative

Since impacts to visual and scenic resources will be negligible, no monitoring is currently planned. The annual environmental report will include any changes to the status of the visual and scenic resources on-site.

4.9 Socioeconomics

4.9.1 Socioeconomic Impacts from the Preferred Alternative

The number of employees is not expected to change appreciably as a result of the construction and operation of LC East or the KM Amendment. 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 (annual site wellfield production will not exceed 1.2 million pounds of dried U_3O_8 and the total combined site production from the plant plus toll processing will not exceed 2.2 million pounds of dried U_3O_8 per year).

The major socioeconomic issues relevant to all alternatives are the following.

- The majority of the workforce associated with the Project is likely to come from outside the study area (70 percent). Transfer of workforce from other job sites to the Project will be minimal. As stated above, the work force is not expected to grow appreciably as a result of this amendment request.
- The Project will provide permanent year-round employment, which is generally preferable to seasonal jobs such as tourism and highway construction or temporary jobs such as interstate gas pipeline construction or oil exploration.
- Temporary rental and permanent housing is available for all surrounding communities. Availability has improved in recent years due to a decline in oil and gas and coal development.
- School capacity in the region is sufficient to meet current needs. An increase in the number of school children as a result of this amendment is expected to be negligible.
- Although water and sewer capacity is adequate in Rawlins, the systems are old and need improvements and repair. Infrastructure condition is poor for water and sewer and streets in Rawlins. The infrastructure costs may further increase the price of housing.
- All public services have an adequate capacity for additional population in the Rawlins and Bairoil areas
- Peak employment for the project has likely already occurred (during the construction phase). Going forward with production, the number of employees will likely remain below 60 with an additional 30 drilling contractors.

- LC ISR, LLC currently pays about $250,000/year in property tax as well as $2.05/pound of production for ad valorem and severance taxes combined (calendar year 2015).

4.9.1.1 Labor Force and Income

The estimated direct-hire labor force is presented in **Table 4.10-1** for all alternatives. **Table 4.10-1** depicts the types of jobs that would be ongoing during development and production. All of the wells drilled during a given year will be completed by contract drillers, employing many of the same people during drilling and construction activities. The type of wells drilled requires water-well-style drill rigs. During normal operations (after construction), approximately 30 independent drilling contractors will be on-site, thru the production phase, to complete production goals. LC ISR, LLC plans to employ 57 full-time salaried and hourly employees during operations.

Operations

The operations phase of the Project will require approximately 87 workers, including project and operations managers, project engineer, chief site geologist, drill foreman, casing crew, restoration engineer and crew, construction foreman and crew, geologists, secretary, personnel responsible for environmental, health, and safety related tasks, plant manager, plant operators, equipment operators, electrician, chemist, lab technicians, and drill contractors. Operations and restoration will continue for approximately twelve years **(Figure 1.2-6)**. The professional and hourly employees needed to operate an in situ mine are for the most part readily available; especially in light of recent layoffs at regional in situ mines. In the rare instance a professional employee couldn't be hired, a contracting firm was readily available.

The workforce is comprised of both skilled and non-skilled workers with nearly all employees having some experience in their jobs due to ongoing operations at the site. Therefore, salaries for permanent employees of LC ISR, LLC are anticipated to average approximately $76,000 per year. The total annual payroll for operations is estimated at $3.2 million (based on 42 employees in late 2016; the number of employees will increase up to a maximum of about 60 during full operations). Wage rates are relatively competitive within the region and state. We don't expect wage rates to increase significantly in the foreseeable future since unemployment rates have increased due to lower oil and gas and coal production.

4.9.1.2 Economic Effects

The economic impact of the Project would include the effects of the Project on employment, income and earnings, and direct and indirect economic activity in the local, regional, and national economies. LC ISR, LLC will have a positive effect on most economic indicators. The project is not expected to have an impact on housing or other infrastructure since there will be little to no increase in the number of employees or contractors. Housing is available in the area (Rawlins and Lander) but the trend has been for workers to commute to and from their permanent places of residence rather than move families to locations where housing is expensive or uncertain. A large percentage of employees carpool to the site each day from Casper which is nearly two hours from the site.

The total Project costs are estimated at $200 million not including local, state and federal taxes and capital spent to date to construct the existing facility. A portion of this will be spent in the local area (Rawlins) for diesel fuel, propane, and miscellaneous supplies and repairs. This will be considered a positive impact to the local economy. The majority of supplies will come from Casper. Oxygen and CO_2 will come from Wyoming or Colorado, and soda ash will come from Green River, Wyoming. Wellfield construction materials will be bid out regionally, with a large portion anticipated to come from the Colorado, Wyoming, Utah region.

Tax Revenues

The Project would contribute substantially to the local and state economies in the form of tax revenues generated, as shown in **Table 5.2-1.** Future tax revenues are dependent on uranium prices, which cannot be forecast with any accuracy. Tax revenues generated include ad valorem (gross products) taxes in Sweetwater County, severance taxes for the State of Wyoming, and federal income taxes. Property taxes will also be generated for Sweetwater County.

Increases in tax revenues will provide counties and communities with more discretionary dollars to develop infrastructure and support the population. Receipt of taxes generally lags one year behind production; therefore, affected counties and communities will not receive any funds until two years after drilling activities begin.

Over the life of the Project, all counties and communities in the study area will benefit from increased revenues from ad valorem taxes. Some state mineral royalties and severance taxes would also be distributed to the counties and communities, based on a state distribution formula. Other tax revenues generated, but not included in the table, would include sales, use, and lodging taxes. These amounts have not been estimated, even though they will represent a significant increase in local revenues throughout the region.

4.9.1.3 Housing and Public Facilities and Services

The population of the study area is not anticipated to change appreciably due to the expansion of mining into the LC East area and the KM Horizon since the total number of employees and contractors is expected to remain essentially constant. Any change in population due to the project would have been experienced in the early days of project development and construction when employees were hired.

Construction

Initial project construction, including the processing plant, holding ponds, primary roads, and main powerlines has already been completed. Future wellfield construction will largely be carried out by individuals already on staff. Construction of additional secondary powerlines and deep wells will be short-term projects lasting only a few days to a few weeks. Contractors used for these short-term projects will commonly be local crews with no need for housing. Hotels are readily available in Rawlins, Casper, and Lander if contractors aren't local.

Operations

The current total operations workforce is estimated at about 45 salaried and hourly employees and is sufficient to produce 600,000 pounds from MU1. LC ISR may hire up to a maximum of 15 additional employees above the current labor force if the maximum production rate is warranted. The average employee count is expected to range between 48 and 55. This range is consistent with the original NRC license application for the project.

Public facilities and services have excess capacity throughout the study area.

Transportation systems will be impacted by operations-related commuter traffic and truck traffic transporting materials to and from the Permit Area. Operations workers will commute to and from the site on a daily basis. A typical shift for construction workers (the majority of the staff) would be from 7:00 Ante Meridian (AM) to 3:30 Post Meridian (PM). Due to shift work, approximately 45 workers will be commuting to the Permit Area. LC ISR currently provides transportation to the site for its employees and generally requires that vehicles be used to their maximum safe seating capacity in order to minimize costs. In addition, shipments of processing chemicals and yellowcake will also occur throughout the year as described in **Section 4.2**. The amount of light vehicle traffic will not increase appreciably due to LC East and KM amendments since the employee count is not expected to change significantly. However, the volume of truck traffic will increase but the increase likely won't be noticeable to local residents.

The commuter and truck traffic will have an impact on county, state, and national roadways, particularly Mineral Exploration, Sooner Road, and County Road 22. Maintenance costs will accrue to both Carbon and Sweetwater Counties, while most Project revenues will be generated in Sweetwater County. Traffic on major highways will be less of an impact than those on the county roads. Major public highways have adequate capacity to handle the increase in commuter and truck traffic, but local county and BLM roads may require improvements or more regular maintenance schedules. A transportation risk analysis is presented in **Section 4.2**.

4.9.1.4 Quality of Life

The quality of life is not expected to change as a result of the LC East and KM Amendments since the level of production from the wellfield will not change appreciably and the employee count is not expected to change appreciably. Employees currently working at the site reside in several communities including Bairoil, Lander, Jeffrey City, Rawlins and Casper. Since the work force resides in such a diverse area, the impact of the jobs is somewhat diffused and has little or no impact on the quality of life in these communities.

4.9.1.5 Cumulative Impacts

No other development is anticipated in the area that could result in a cumulative impact with the possible exception of the Choke Cherry wind project that is planned for south of Rawlins. The Choke Cherry Project may have a temporary impact on the availability of hotels and housing in the Rawlins area depending on the rate of development. However, since only a few additional employees are not expected at the Lost Creek Project there will be no competition between workers for housing.

4.9.2 Socioeconomic Impacts from Other Alternatives

Socioeconomic impacts from the alternate use of a portable pit do not differ from those of the Preferred Alternative.

4.9.3 Mitigation of Socioeconomic Impacts

Mitigation of socioeconomic impacts is not anticipated.

4.9.4 Monitoring of Socioeconomic Impacts

No monitoring of socioeconomic impacts is anticipated.

4.10 Environmental Justice

Under Executive Order 12898 (published in the Federal Register February 11, 1994), federal agencies are required to identify and address disproportionately high or adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. A specific consideration of equity and fairness in resource decision-making is encompassed in the issue of environmental justice. As required by law and Title VI, all federal actions will consider potentially disproportionate negative impacts on minority or low-income communities. Within the area potentially affected by the Project, minimal minority populations are affected.

Income levels throughout the study area are diverse. The most recent estimate of per capita personal income for major industries was $42,772 for Carbon County and $50,015 in Sweetwater County in 2008. The most recent poverty status statistics showed a poverty status of 12.3 percent in Carbon County and 9.8 percent in Sweetwater County (**Table 3.11-2**). These rates are similar to the state-wide average of 11.1 percent (American Community Survey, 2015). Since the economic base of the study area is largely ranching and resource extraction, low-income areas are dispersed within the study area. People with incomes below the poverty status may reside within the study area, but not disproportionately.

Table 3.11-2 highlights demographic statistics for identifying potential areas of concern. Various years of census data were used for the analysis of race and income. Since approximately 80 percent of the population is identified as white in Sweetwater and Carbon County, there will be no disproportionately high impacts on any minority race.

4.11 Public and Occupational Health

Potential public and occupational health impacts from the Project are summarized in this section.

4.11.1 Public and Occupational Health Impacts from the Preferred Alternative

The Project will use ISR technology to extract uranium from permeable, uranium-bearing sandstones. Once extracted, the uranium will be recovered by means of ion exchange, elution, and precipitation/filtration to ultimately produce yellowcake slurry or dried yellowcake. The detailed operation plan is located in **Section 1** of this report and **Section 3** of the Technical Report.

The Permit Area is located on federal land, managed by the BLM, and on land owned by the State of Wyoming. There are no permanent residents within 15 miles of the Permit Area, significantly reducing the possibility of public impacts. In addition, the workforce for the ISR operation will be relatively small, especially as compared to the work force needed for surface mining of uranium and conventional mill operation, reducing the possibility of occupational impacts.

4.11.1.1 Nonradiological Impacts

Effluents from the Project containing non-radiological contaminants will not be released into pathways that could impact public and occupational health. In addition, no other aspects of the preferred alternative will impact public and occupational health beyond that reasonably foreseeable from any mining project (e.g., mechanical risks due to operation of machinery).

Gaseous emissions and airborne particulates from the Project are summarized in **Section 4.12.1.1**. The primary concern is radiological, specifically radon release. Results of the MILDOS modeling to evaluate radon impacts are presented in **Section 3.12**.

There will be no impacts to public water supplies or to water sources that may be tapped for public use in the foreseeable future. Impacts to water resources are described in more detail in **Section 4.5**. The impacts to groundwater quantity are mitigated by the recharge, and the impacts to groundwater quality are mitigated due to the requirements for groundwater restoration. Impacts to water resources are not expected to be significant. Net consumptive use of groundwater is anticipated to be no more than 270 gpm for the operational life of the Lost Creek Project (this includes injecting 200 gpm of clean water back into the formation as part of the approved Class V system).

Liquid effluents and the measures used to handle those effluents are summarized in **Section 4.12**. The largest quantity of liquid effluent is from the production bleed, and this effluent, along with others, will be managed in the Storage Ponds and the UIC Class I and Class V wells. The Storage Ponds discharge to the Class I wells. Based on the operation of other ISR facilities in Wyoming, no non-radiological impact on public or occupation health is expected due to the liquid effluent from the Project.

Solid wastes and the measures used to handle those wastes are summarized in **Section 4.12**. As with liquid effluents, use of up-to-date techniques for waste storage, handling, and disposal are being used to preclude impacts to public or occupational health.

4.11.1.2 Radiological Impacts

Efficient ISR operation, including mine unit balancing and monitoring (as described in **Section 1** of this report and in more detail in the Technical Report), and up-to-date techniques for waste storage, handling, and disposal, are being used to keep contaminants of concern out of any pathways that could result in impacts to public or occupational health. Therefore, the radiological impacts of concern for public and occupational health all relate to radon.

No radiological particulates will be generated at the Permit Area, and radon is the only gaseous radiological emission. The MILDOS-AREA code version 3.10 was used to calculate radon doses at 20 locations around the perimeter of the Permit Area and at the community of Bairoil as discussed in **Section 3.12**. MILDOS calculations and output use metric units; this discussion refers to English and metric units for the sake of consistency.

MILDOS modeling indicates that releases from the Plant lead to a calculated total effective dose equivalent (TEDE) to a resident at the northern boundary of the Permit Area, receptor NB1, of about 4.04 millirem (mrem) four years into the project, which is far below the 100-mrem-per-year limit of Title 10 CFR Part 20. This "resident" dose is also extremely conservative, given that the land north of the Permit Area is federal land, not available for residential use. Receptor NB1 is the nearest downwind receptor on the margin of the permit area and is therefore represents the highest potential dose.

Population doses to residents in Bairoil were calculated using MILDOS since it is the nearest downwind residence or community. The maximum dose in Bairoil was calculated to be 1.15E-02 mrem which is several orders of magnitude less than the limit established in 10 CFR 20.

The Other Alternative of using portable pits would likely have no discernable impact on radon emissions or impact public or occupational health.

4.11.2 Mitigation of Impacts from the Preferred Alternative

As mentioned above, there are essentially no impacts to either public or occupational health. Therefore, under SOPs, no mitigation is required.

4.11.3 Public and Occupational Health Impact from the Other Alternative

No known impact on public and occupational health is anticipated from the other alternative of using a portable pit.

4.11.4 Monitoring of Impacts from the Preferred Alternative

Semi-annual reports of effluent release and consequent annual estimates of public dose will be used to monitor potential public health impacts. Further, a series of environmental air samplers, as described in the Technical Report, will assure that unpredicted releases of radon are monitored.

A radiation safety program will be implemented to assure that occupational dose limits are not exceeded. Reports of worker dose will be published and given to each worker annually.

4.12 Waste Management

With respect to waste management; there are no differences in the anticipated impacts, or in the monitoring and mitigation; between the Preferred Alternatives and the Other Alternatives described in **Section 2**.

During the Project, gaseous/airborne, liquid, and solid effluents will be produced from the processes associated with ISR operations. All of the effluents are typical for ISR projects currently operating in Wyoming, and existing technologies are amenable to all aspects of effluent control in the Permit Area. Additional details about the types of effluents, their potential impacts, and the monitoring and mitigation measures are provided below.

4.12.1 Waste Management Impacts

4.12.1.1 Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents will be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent will be radon gas. The types of effluents and the control systems that will be in place for them are summarized below.

Non-Radioactive Emissions and Particulates

Gaseous emissions will result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles will produce small amounts of CO, SO_2 and other internal-combustion engine emissions. Most of the airborne particulates will be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit.

Detailed discussions of non-radioactive emissions and particulates generated during the Project as well as their potential impacts are presented in **Section 4.7** of this report.

Radioactive Emissions

Radioactive airborne effluents will be consistent with other ISR operations in Wyoming because a rotary vacuum yellowcake dryer will be used and any sediment in the ponds will be kept wet. Radiologic sampling performed since the inception of the mine as well as NRC inspection findings support this conclusion.

Radon will be the radioactive gaseous emission from ISR production and processing, as it is present in the orebody and concentrated in the lixiviant solution. Radon will be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells will be continually vented to the surface; however, water levels will typically be low and radon venting will be minimal. Testing for radon emissions at wellheads using radon track etch cups has supported this conclusion. All of the well releases will be outside of buildings and are directly vented to the atmosphere. Radon will also be released during ion exchange resin transfers and subsequent processing steps, as described in more detail below. The radon will be discharged into the atmosphere, where it will disperse rapidly.

The work areas of concern for radon exposure are at the vents from: the bleed storage tanks, the resin transfer points, and the drying/packaging room, as well as low-lying areas and confined spaces. The bleed storage tanks will be used for temporary storage of the production bleed fluid. Because these tanks will be at atmospheric pressure (unlike other tanks in the ore processing circuits) and not always full, radon (as well as oxygen and CO_2) present in the bleed fluid may be liberated into the headspaces of the tanks. Therefore, these tanks will be vented. Resin transfer will occur when an ion exchange vessel is fully loaded and is transferred from the ion exchange circuit to the elution circuit. Because radon may be liberated during the transfer, ventilation will be provided at the resin transfer points and operated during the transfers. A sump will be used to collect any fluids released from the ion exchange vessels during resin processing, from tanks during maintenance procedures and from routine washdown of the area. The yellowcake slurry will be transferred from storage tanks into trucks for transport to a drying and packaging facility. During this transfer, radon gas will potentially escape, so ventilation will be provided in the transfer area. Radon will also be released during the yellowcake drying process. The UIC Class I well pumphouses will also be vented.

The primary impact of concern is to those workers closest to the radon sources. Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings. The secondary impact of concern is to the environment because of the venting of the radon. Occupational and public exposures to radon emitted from the mine units and from the ore processing were analyzed using the MILDOS computer model to ensure the exposures will be within regulatory dose limits (**Section 4.11**, Public and Occupational Health). Based on those analyses, the radon impacts due to occupational exposures can be addressed by the ventilation to the outside of the buildings using high-volume exhaust fans, personal protective equipment (PPE), and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, a Radiation Work Permit (RWP). The radon impacts due to public exposures will be minimal, especially in comparison with natural radon exposures. Routine radiologic monitoring conducted to date and reported in the semi-annual effluent reports supports this conclusion.

4.12.1.2 Liquid Wastes

The Project will generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct material by NRC. The 11(e)(2) byproduct material is defined in Chapter 2, Section 11 of the Atomic Energy Act of 1954 (42 US Code 2014(e)(2)), as amended, as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.". In 2000, this definition was interpreted to include more of the fluids associated with ISR than had been previously included in the definition (NRC, 2000).

The different types of liquid wastes the Project will generate are:

- "native" groundwater generated during well development, sample collection, and pump testing;
- storm water runoff;
- waste petroleum products and chemicals;
- domestic sewage; and
- the three 11(e)(2) byproduct materials:
    - liquid process wastes, including laboratory chemicals;
    - "affected" groundwater generated during well development; and
    - groundwater generated during aquifer restoration and sent to waste.

Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

Native Groundwater Recovered during Well Development, Sample Collection, and Pump Testing

Groundwater is recovered during well installation, sample collection, and pump testing conducted prior to production or from portions of the Permit Area not affected by ISR operations. This "native" groundwater has not been exposed to any ISR process or chemicals. During well development, sample collection, and pump testing, this water will be discharged to the surface or under the provisions of a general WYPDES permit, in a manner that mitigates erosion, or reused in the drilling process. Because of the relatively small quantities of water discharged at any given time, no impacts are anticipated.

Storm Water Runoff

Per the requirements of the WYPDES, the applicable permits for runoff control during construction and operation of the Plant were obtained from the Water Quality Division (WQD) of WDEQ. Because of the dry conditions in the area and the runoff controls, no impacts are anticipated.

Waste Petroleum Products and Chemicals

These wastes will be typical for ISR facilities, including a machinery maintenance shop, and will include items such as waste oil and out-of-date reagents, none of which will have been closely associated with the processing of 11(e)(2) byproduct material. Any of these wastes that are non-hazardous will be stored in appropriate containers prior to disposal, by a contracted waste disposal operator, at an approved off-site waste disposal facility, such as the Carbon County Landfill.

Waste petroleum products will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of OSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes.

Waste chemicals not closely associated with the processing of 11(e)(2) byproduct materials will be clearly labeled and stored, in sealed containers, above ground in accordance with the requirements of OSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or disposal at a licensed disposal facility.

Because of the controlled off-site and on-site disposal procedures, no impacts from the waste petroleum products and laboratory chemicals are anticipated, other than those associated with the UIC Class I wells.

Domestic Sewage

Domestic sewage will be disposed of in an approved septic system that meets the requirements of WDEQ WQD. A Class V UIC permit will be obtained for the septic system prior to construction of the system. The septic system will receive waste from restrooms, shower facilities, and miscellaneous sinks located within the office. The septic system will be maintained by a licensed contractor. Given the lack of shallow groundwater at the site, the remote location, and the relatively small work force, impacts to the Permit Area will be limited.

In addition, chemical toilets may be temporarily placed at mine units and other drilling areas. The chemical toilets will be maintained by a licensed contractor, and no impacts are anticipated in the Permit Area.

Liquid 11(e)(2) Byproduct Materials

The three 11(e)(2) byproduct materials will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I wells, as described below.

Liquid Process Wastes

The ore processing produces three wastes, a production bleed, an eluant bleed, and yellowcake wash water. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters will generate waste. These wastes will be collected, treated, and the waste discharged to the Storage Ponds and UIC Class I wells or will be treated with the resulting clean water sent to UIC Class V injection. Because of the controlled on-site disposal procedures, no impacts from the liquid process wastes, other than those associated with the UIC Class I well, are anticipated in the Permit Area.

"Affected" Groundwater Generated during Well Development

It may be necessary to develop (or redevelop) wells that have been affected by the ISR operations to the extent that surface discharge of the water is not appropriate. During well development, this water will be collected and treated, and the waste will be discharged to the Storage Ponds and UIC Class I wells or treated and sent to UIC Class V injection. Because of the controlled on-site disposal procedures, no impacts from the "affected" groundwater, other than those associated with the UIC Class I wells, are anticipated in the Permit Area.

Groundwater Generated during Aquifer Restoration and Sent to Waste

During the various steps of aquifer restoration (**Section 6** of the Technical Report), groundwater will be generated, and disposal of some or all of the water will be required. During sweep, groundwater will be pumped from the production zone, creating an area of drawdown. This will create an influx of water from outside the production zone that will "sweep" the affected zone. In most cases, the water produced during sweep will be processed for residual uranium content through the ion exchange facility and then disposed directly to the UIC Class I wells and/or treated with the clean water sent to UIC Class V injection. In some cases, the groundwater pumped from the production zone may be treated by RO to reduce the waste volume, and the treated water (permeate) may be used in Plant processes or for makeup water in other restoration activities. To maintain the area of drawdown, the permeate will not be reinjected into the production zone, but will be transferred to other mine units for use as makeup water or injected into the UIC Class I or V wells. The concentrated byproduct material (brine) will be injected into the UIC Class I wells.

During RO, groundwater will be pumped from the production zone. The pumped water will be treated by RO, and the permeate will be injected back into the production zone. To maintain an area of drawdown, an effective bleed will occur by adding additional permeate from other RO activities or by adding clean water to the permeate at a rate less than the produced rate. The brine from the RO treatment will be injected into the UIC Class I wells. Similarly, during other restoration steps, the amount of groundwater pumped from the aquifer will exceed the amount pumped back to the aquifer, and that excess water will be disposed of in the UIC Class I wells. Because of the controlled on-site disposal procedures, no impacts from the liquid process wastes, other than those associated with the UIC Class I wells, are anticipated in the Permit Area.

4.12.1.3 Solid Wastes

Solid wastes, some of which will be classified as NRC 11(e)(2) byproduct materials, will be produced during construction, operation, and reclamation activities of the Project. Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

Solid Non-11(e)(2) Byproduct Materials

The solid non-11(e)(2) byproduct materials will include: non-hazardous materials typical of office and mine facilities, such as paper, wood products, plastic, steel, biodegradable items, and sewage sludge, and hazardous materials also typical of office and ISR facilities, such as waste petroleum products and used batteries. None of these materials are closely associated with ISR and ore processing.

The non-hazardous materials, with the exception of sewage sludge, will be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at an approved off-site solid waste disposal facility, such as the Carbon County Landfill. Hazardous wastes will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of OSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes or will be recycled on-site. Because of the controlled off-site disposal procedures, no impacts from the non-hazardous solid waste disposal are anticipated in the Permit Area.

Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and will include equipment that becomes contaminated during ISR and ore processing. These items include tanks, vessels, PPE, and process pipe and equipment. Such wastes could also include soils contaminated from spills. Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be placed in clearly labeled, covered containers and temporarily stored in restricted areas with clearly visible radioactive warning signs. The solid 11(e)(2) byproduct materials will then be disposed of at an NRC-licensed facility, typically a uranium mill tailings impoundment, by personnel qualified to dispose of radioactive wastes. Because of the controlled off-site disposal procedures, no impacts from the non-hazardous solid waste disposal are anticipated in the Permit Area.

4.12.1.4 Cumulative Impacts

As noted at the beginning of **Section 4** of this report, the evaluation of cumulative impacts is difficult because Lost Creek is an isolated operation at present and no other new operations (mining, oil and gas, etc.) are expected at this time. Because the Project is isolated and the relatively minimal waste management impacts, the impact analysis does not change appreciably whether LC ISR, LLC is the only operation considered or if other operations are considered.

4.12.2 Mitigation of Waste Management Impacts

Effluents will be reduced by minimizing disturbance and reusing/recycling materials whenever possible. On-site waste handling facilities will have proper storage to segregate the materials and signage to indicate the types of materials present. These areas will be routinely checked to ensure proper waste segregation and storage. All materials delivered to or transported from the Permit Area, including wastes, will be packaged in accordance with US DOT and WYDOT requirements.

Employees will receive training, guidance, and PPE to safely handle, store, decontaminate, and dispose of waste materials. Employees will also be trained to recognize potential hazards and to perform assigned duties in a safe and healthy manner to help reduce the possibility of accidental release.

SOPs will be accessible for guidance on routine activities; for unusual circumstances, an approved work plan and approved RWP will provide guidance for non-routine work or maintenance activities. Spill Prevention and Response Plans will also be in place to help reduce the possibility of accidental release, and to provide for appropriate action in the event of a release.

4.12.2.1 Gaseous Emissions and Airborne Particulates

Regular maintenance of vehicles, SOPs, and PPE will be used to reduce non-radioactive gaseous emissions. Alternatives will be considered to help reduce fuel consumption and emissions.

Restricted vehicular access and speed limits will be used to minimize dust from roads; additional dust control measures may include water spraying, application of gravel, or application of organic/chemical dust suppressants. Disturbance will be minimized to the extent possible, and disturbed areas will be revegetated during the first available seeding window. Standardized delivery procedures that minimize material loss (and address health and safety concerns) and efficient construction practices will be used to minimize generation of such particulates.

Fumes from the limited use of liquid chemicals, such as hydrochloric or sulfuric acid, will be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities will produce some non-radioactive gaseous emissions, such as CO_2, oxygen, and water vapor, but the primary effluent of concern from pressure venting is radon gas, as discussed in more detail below. Because of the limited quantities of non-radioactive gaseous emissions, no discernable impacts are expected.

Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings using high-volume exhaust fans, PPE, and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, an RWP. Occupational and public exposures to radon, emitted from the mine units and from the ore processing, were analyzed using the MILDOS computer model to ensure the discharged amount will be within regulatory dose limits (**Section 4.11,** Public and Occupational Health).

4.12.2.2 Liquid Wastes

A variety of mitigation measures will be employed to reduce or eliminate impacts from liquid wastes, as outlined below.

Native Groundwater Recovered during Well Development, Sample Collection, and Pump Testing

During well development, sample collection, and pump testing, groundwater will be discharged to the surface or under the provisions of a general WYPDES permit, if appropriate, in a manner that mitigates erosion, or reused in the drilling process.

Storm Water Runoff

Procedural and engineering controls will be implemented such that storm water runoff from the area of the Plant will not pose a potential source of pollution, in accordance with the applicable requirements of the WYPDES storm water permit.

Waste Petroleum Products and Chemicals

The primary mitigation measures that will be employed to minimize or eliminate waste management impacts will be reduction of wastes and proper storage, handling, and disposal. In addition, by disposing of the waste petroleum products at a licensed facility off-site, this type of waste will not be present in the Permit Area after the Project is completed.

Domestic Sewage

Proper construction and maintenance will reduce potentially adverse impacts from the septic system.

Liquid 11(e)(2) Byproduct Materials

The three 11(e)(2) byproduct materials will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I and V wells. Prevention measures will be in place to help reduce potential impacts from unanticipated releases of these materials. Pipeline flows and manifold pressures will be monitored for spill detection, and process control will be such that any release of liquid waste will be contained within the structure. A concrete curb has been built around the entire Plant building. This pad is designed to contain the contents of the largest tank within the building in the event of a rupture. In the event of a piping failure, the pump system will shut down, limiting any release. Liquid inside the building, both from a spill or from washdown water, will be drained through a sump and treated as 11(e)(2) byproduct material.

To reduce the possibility of a pond failure, the Storage Ponds was designed and built to NRC standards using impermeable synthetic liners. A leak detection system was installed, and all Storage Ponds are inspected on a regular basis. Any sludge that accumulates in the Storage Ponds and the pond liners will be removed during decommissioning and disposed off-site at a licensed 11(e)(2) disposal facility.

Three UIC Class I wells have been constructed following all applicable regulations and guidelines. Two additional UIC Class I wells have been approved for Lost Creek but not installed to date. This application seeks approval of three additional UIC Class I wells at LC East. Routine inspection and testing will be conducted to minimize any impacts that may occur from the malfunction of these wells. The UIC Class I wells in the Permit Area will be plugged and abandoned as part of decommissioning of the Project.

4.12.2.3 Solid Wastes

As noted at the beginning of this section, the primary mitigation measures that will be employed to mitigate waste management impacts will be reduction of wastes and proper storage, handling, and disposal of wastes. In addition, by disposing of the waste petroleum products at a licensed facility off-site, this type of waste will not be present in the Permit Area after the Project is completed.

4.12.3 Waste Management Impacts from the Other Alternative

The utilization of portable pits will require additional manpower and equipment to move the cuttings from the pit to another location for burial. Portable pits would also slow the drilling process since drilling would have to stop while the portable pit is mucked out several times per drill hole. This additional cost will increase the project cost without a well defined benefit.

4.12.4 Monitoring of Waste Management Impacts

4.12.4.1 Gaseous Emissions and Airborne Particulates

The monitoring programs for non-radioactive emissions and particulates and for radon are described briefly in **Sections 4.7.4** and **4.12.2.1**, respectively, and in more detail in the Technical Report.

4.12.4.2 Liquid Wastes

Storage Ponds and UIC Class I wells will be routinely inspected, maintained and tested to ensure that any impact-generating potential be kept to minimum. The monitoring programs for the Storage Ponds and the UIC Class I wells consist of daily documented inspections. The ponds also have monthly, quarterly and annual inspections by qualified inspectors. The complete monitoring programs are described in the Technical Report.

4.12.4.3 Solid Wastes

Monitoring of solid wastes, other than for proper storage, is not necessary because all of these materials will be disposed off-site by licensed contractors.

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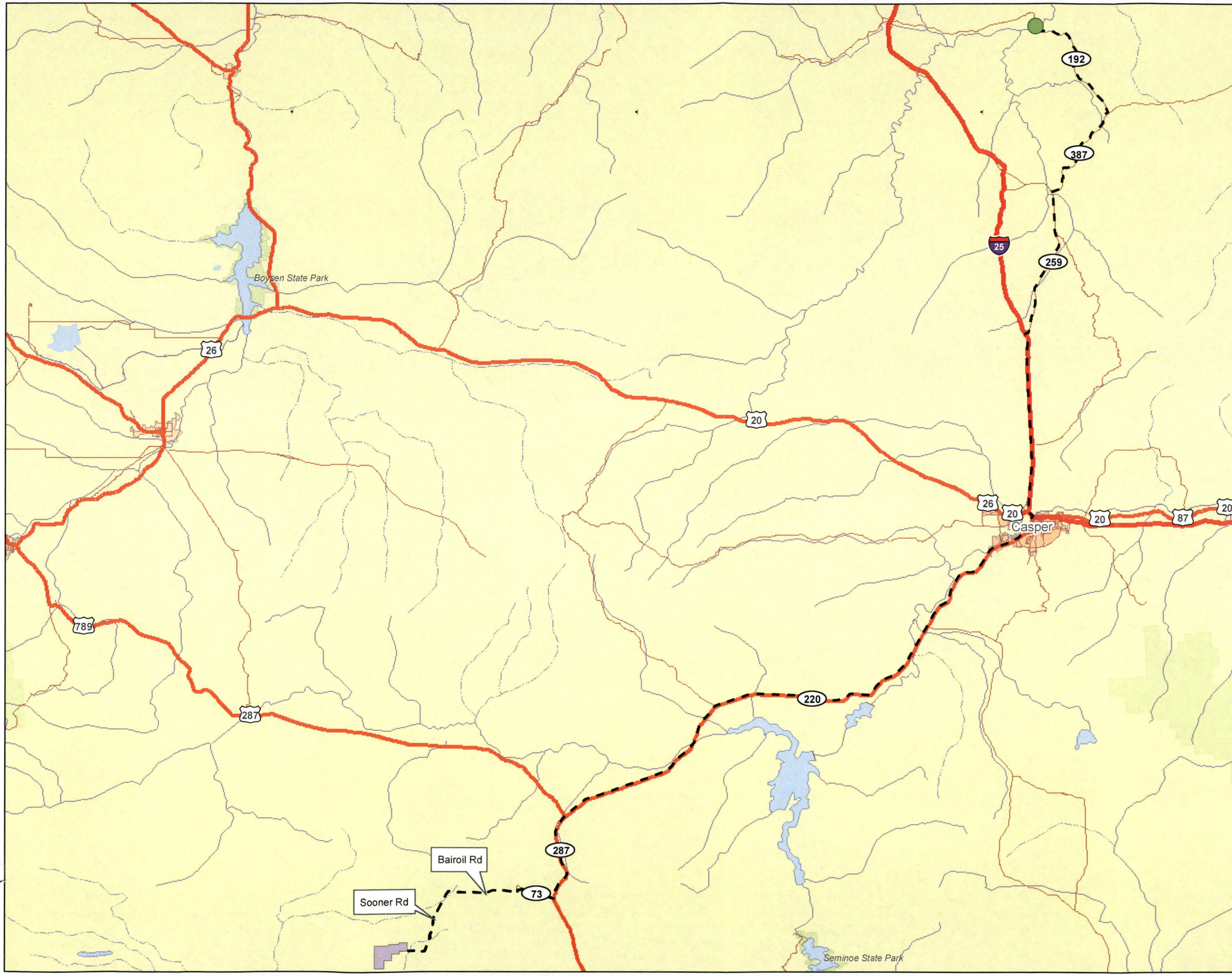


Lost Creek ISR, LLC
Littleton, Colorado USA

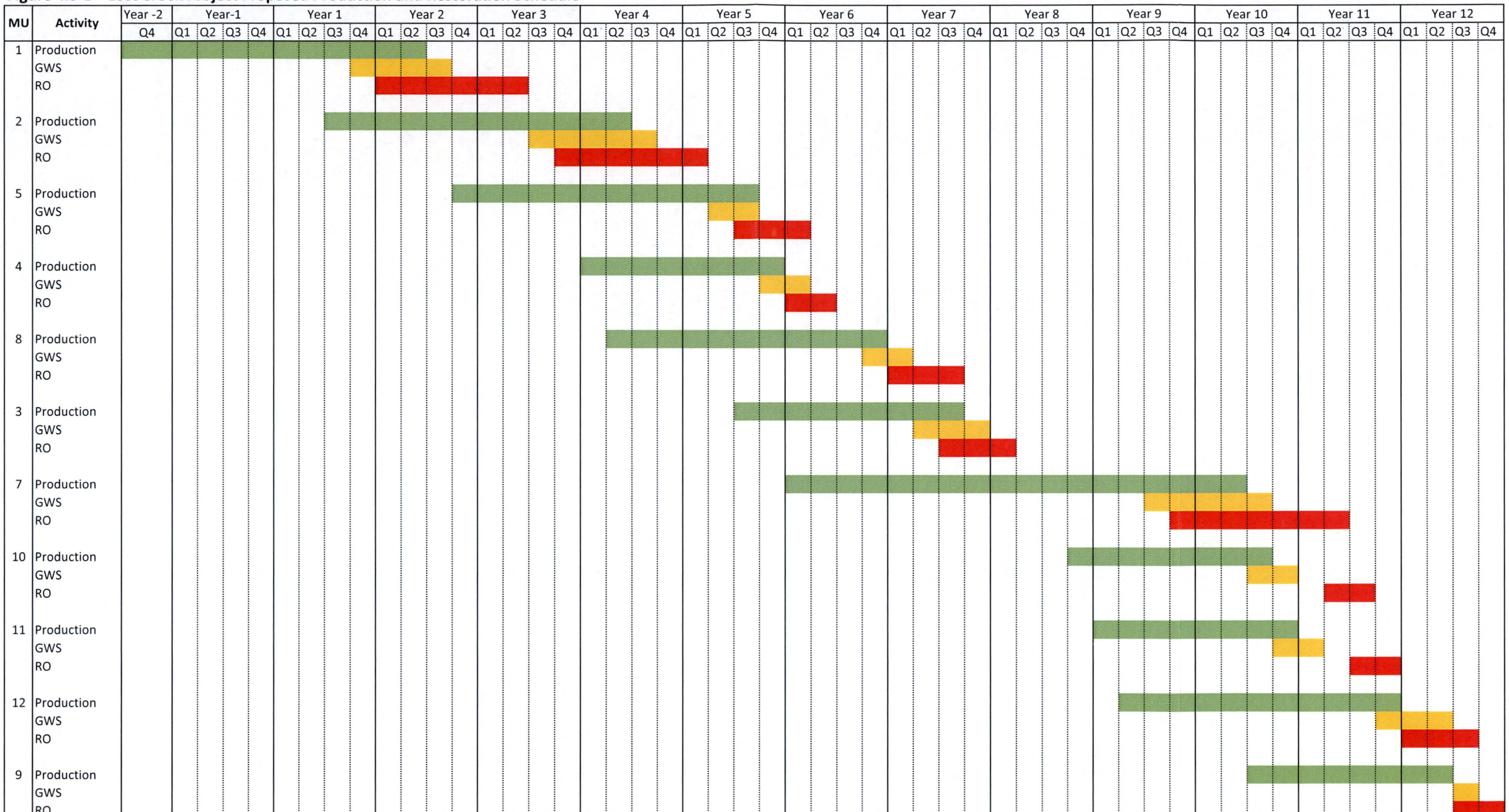
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

Legend
Lost Creek Permit Area
Sussex
Transportation Route

FIGURE 4.2-1
TRANSPORTATION TO SUSSEX, WY
Lost Creek Permit Area

Issued For: NRC ER   Drawn By: EB
Issued/Revised: January 2017
Drawing No: NRC-ER-4.2-1-10.18.07-EJS
0   15 Miles

Figure 4.5-1 Lost Creek Project Proposed Production and Restoration Schedule



Note:
MU = Mine Unit
GWS = Groundwater Sweep Restoration
RO = Reverse Osmosis Restoration

Table 4.2-1 Bulk Chemicals Required at the Permit Area

Shipped as Dry Bulk Solids	Shipped as Liquids and Gases
Sodium carbonate	Gasoline
Salt	Diesel fuel
Soda ash	Propane
Drilling mud	Oxygen
	Carbon dioxide
	Sulfuric acid
	Hydrogen peroxide
	Drilling mud
	Hydrochloric acid

Table 4.3-1 Acreage of Expected Disturbance, Vegetation Type, Topsoil Salvage (Page 1 of 2)

Facility[1]	Term of Disturbance[2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area Within Disturbance From Which Topsoil Will Be Removed (acres)		Topsoil Salvage[3] (yd^3)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
Plant	LT	8.8	3.7	5.1	3.7	5.1	28,366	Map area is 12.5 acres (5.3 acres of Lowland & 7.2 acres of Upland Big Sagebrush): however, only about 70% (8.8 acres) will have vegetation removed & topsoil stripped. As a conservative estimate, all of the Lowland Big Sagebrush was included in the disturbance (Fig. D8-1). Topsoil stockpiled in the NE portion of the Plant site.
Staging Areas								
Permanent	LT	1.5	1.5	0.0	1.5	0.0	4,835	
Potential	ST	1.5	1.5	0.0	1.5	0.0	4,835	
Potential	ST	1.5	1.5	0.0	1.5	0.0	4,835	Permanent staging area is in Upland Big Sagebrush. Topsoil stockpile NE of the area. Potential staging areas, if needed, will be similarly located.
Total-Staging Areas		**4.5**	**4.5**	**0.0**	**4.5**	**0.0**	**14,505**	
Deep Wells								
Drilling pad and mud pits	ST	24.0	20.6	3.4	20.6	3.4	58,080	Topsoil stockpiles adjacent to pads[4]
Well House	LT	13.3	13.3	0.0	13.3	0.0	32,186	Topsoil stockpiles adjacent to well houses.[4]
Total-Deep Wells		**37.3**	**33.9**	**3.4**	**33.9**	**3.4**	**90,266**	
Pipelines (outside patterns)[5]								
Main Trunklines to Wellfields	ST	57.6	56.6	1.0	56.6	1.0	139,392	Trunkline includes pipelines along Access Road and to Plant. Along all pipelines, topsoil will be wind-rowed adjacent to pipelines (separate from deeper material)
Pipeline to Deep Wells	ST	8.9	8.4	0.5	8.4	0.5	21,538	
Total-Pipelines		**66.5**	**65.0**	**1.5**	**65.0**	**1.5**	**160,930**	
Drill Pads (outside patterns)[6]								
Exploration Holes	ST	19.3	19.3	0.0	19.3	0.0	46,706	On the order of 770 exploration holes are planned. No exploration holes will be drilled in Lowland big Sagebrush
Monitoring Wells								
Mine Unit 1	ST	0.7	0.6	0.2	0.5	0.2	2,256	
Mine Unit 2	ST	0.9	0.7	0.2	0.7	0.2	2,837	
MU3	ST	0.9	0.9	0.0	0.9	0.0	2,556	
MU4	ST	0.4	0.4	0.0	0.4	0.0	1,162	
MU5	ST	0.9	0.9	0.0	0.9	0.0	2,614	
MU7	ST	1.6	1.6	0.0	1.6	0.0	4,646	
MU8	ST	1.6	1.6	0.0	1.6	0.0	4,646	
MU9	ST	1.4	1.4	0.0	1.4	0.0	4,066	
MU10	ST	1.5	1.5	0.0	1.5	0.0	4,356	
MU11	ST	1.2	1.2	0.0	1.2	0.0	3,485	
MU12	ST	0.9	0.9	0.0	0.9	0.0	2,614	
Total-Drill Pads		**31.3**	**30.9**	**0.3**	**30.9**	**0.3**	**81,943**	
Roads[7]								
Access Road Within Main Permit Area	LT	17.2	15.1	2.1	15.1	2.1	55,346	Topsoil will be stockpiled at intervals adjacent to the roads.
Access Road East & West of Main Permit Area	LT	19.1	16.8	2.3	16.8	2.3	61,664	Topsoil will be stockpiled at intervals adjacent to the roads.
Total for Secondary Roads	LT	26.2	25.7	0.5	25.7	0.5	63,404	
Two-Track Roads	LT	48.5	48.0	0.5	0.0	0.0	0	
Total-Roads		**111.0**	**105.6**	**5.4**	**57.6**	**4.9**	**180,414**	
Patterns (Plate OP-2a and OP-2b)								
Delineation Holes[8]	LT	---	---	---	77.4	5.1	73,140	
Mine Unit 1	4.4% LT	52.7	52.2	0.5	2.3	0.2	4,060	
	10% ST				5.2	0.1	8,502	

Table 4.3-1 Acreage of Expected Disturbance, Vegetation Type, Topsoil Salvage (Page 2 of 2)

Facility[1]	Term of Disturbance [2]	Total Disturbance (acres)	Area of Disturbance (acres)		Area Within Disturbance From Which Topsoil Will Be Removed (acres)		Topsoil Salvage [3] (yd^3)	Comment
			Upland Big Sagebrush	Lowland Big Sagebrush	Upland Big Sagebrush	Lowland Big Sagebrush		
	4.4% LT				3.2	0.2	5,480	Vegetation disturbance within the pattern area is expected to be 100% of the area. Long-term topsoil disturbance is assumed to be 4.4% of the area; Short-term topsoil disturbance is assumed to be 10% of the area. LT stockpiles will be adjacent to header houses; ST stockpiles will be adjacent to feature (e.g., mud pit) or wind-rowed (e.g., pipeline). In instances where the HJ patterns overlie the KM patterns (RA3, RA8, RA10 and RA12, the disturbance is only counted once. The original disturbance estimates did not account for the BLM stream buffering requirement that was published in the Record of Decision. The buffer requirement will result in significantly less disturbance in lowland big sagebrush. However, minor disturbance in lowland big sage brush, on the order of 0.5 acres per wellfield, will still ocurr.
Mine Unit 2	10% ST	72.7	72.2	0.5	7.2	0.1	11,729	
	4.4% LT				1.2	0.2	2,236	
MU3	10% ST	27.0	26.5	0.5	2.7	0.1	4,356	
	4.4% LT				1.2	0.2	2,272	
MU4	10% ST	27.5	27.0	0.5	2.7	0.1	4,437	
	4.4% LT				1.3	0.2	2,414	
MU5	10% ST	29.5	29.0	0.5	2.9	0.1	4,759	
	4.4% LT				2.9	0.2	4,990	
MU7	10% ST	65.8	65.3	0.5	6.5	0.1	10,616	
	4.4% LT				0.9	0.2	1,860	
MU8	10% ST	21.7	21.2	0.5	2.1	0.1	3,501	
	4.4% LT				0.9	0.2	1,874	
MU9	10% ST	21.9	21.4	0.5	2.1	0.1	3,533	
	4.4% LT				0.9	0.2	1,753	
MU10	10% ST	20.2	19.7	0.5	2.0	0.1	3,259	
	4.4% LT				0.8	0.2	1,576	
MU11	10% ST	17.7	17.2	0.5	1.7	0.1	2,856	
	4.4% LT				1.1	0.2	2,158	
MU12	10% ST	25.9	25.4	0.5	2.5	0.1	4,179	
Total-Patterns		382.6	377.1	5.5	131.7	8.1	165,539	
	LT-Topsoil	--	--	--	170.05	17.60	349,614	
	ST-Topsoil	--	--	--	157.15	5.82	372,349	
Total Disturbance [9]	Vegetation	642.0	620.7	21.3	--	--	--	

[1] Facility locations are shown on Plates OP-2a and OP-2b.

[2] LT = Long Term topsoil stockpile, i.e. duration of project. ST = Short Term topsoil stockpile, i..e., a few days to a few months.

[3] Recommended topsoil stripping depths were 24 inches or less (Attachment OP-5a and 5b of original Permit to Mine Application). For estimating topsoil salvage volumes, a topsoil depths of 18 to 24 inches was used so topsoil stockpile volumes (& associated footprints) would represent the maximum

[4] Well WDW1 (SW corner of Permit Area) was the original exploration well drilled in 2008 & the area has been reclaimed

[5] The width of disturbance associated with the pipelines was assumed to be: 46 feet for trunklines; 10 feet for the pipelines to the deep wells ; and 10 feet for the pipelines to the mine units. These assumed widths are sufficient to account for the pipeline trench and laydown of topsoils and subsoil.

[6] Each drill pad, whether for exploration or delineation, is assigned a total disturbance of 33 ft. by 33 ft. which equates to 0.025 acres. This area accounts for the area of the mud pit, topsoil, and subsoil piles, and disturbance to vegetation created during reclamation efforts.

[7] Two track roads are assumed to create 8.8 feet of disturbance, secondary roads create 20.0 ft. of disturbance and primary access roads create 32 feet of disturbance (Figure OP-3c of original Permit to Mine Application).

[8] Delineation drilling within the pattern area will be on a 100-ft grid. Depending on geologic interpretation of the delineation hole information, the holes may or may not correspond to subsequent production or injection well locations. As a conservative estimate, it is assumed that none of the hole and well locations coincide. Bas on a total of 3,300 holes (300 holes per mine unit) and a drill pad area of 0.025 acres, a total of about 82.5 acres of topsoil will be stripped for the entire mine.

[9] No credit is taken for pre-existing disturbance although areas of existing disturbance will be used when available, e.g., roads follow existing two-tracks where possible.

Table 4.5-1 Aquifer Characteristics for Drawdown Computation

Mining Sequence	Mining Horizon	Project Area	Formation Transmissivity (ft^2/d)	Formation Thickness (ft.)	Hydraulic Conductivity (ft./d)	Formation Storativity	Location of Pumping Centroid Easting	Location of Pumping Centroid Northing	Production / Restortion Life (days)	Average Net Consumptive Use (gpm)	†Computed Drawdown at: 2 miles ft.	†Computed Drawdown at: 3 miles ft.
MU1	HJ	LC	80	120	0.67	1.1×10^{-4}	2211666.87	595489.20	3,924	39.8	35.0	18.3
MU2	HJ	LC	80	120	0.67	1.1×10^{-4}	2206608.70	594139.05	4,928	45.0	52.5	24.9
MU5	KM	LCE	86	110	0.78	2.3×10^{-4}	2216303.19	596233.19	3,650	23.1	19.3	4.8
MU4	HJ	LC	80	120	0.67	1.1×10^{-4}	2201523.78	594457.18	2,555	18.2	7.2	2.6
MU8	KM	LCE	86	110	0.78	2.3×10^{-4}	2217421.85	592346.10	3,650	22.0	3.8	0.3
MU3	HJ	LCE	86	110	0.78	1.1×10^{-4}	2213942.10	595962.82	3,011	31.3	5.5	2.8
MU7	HJ	LCE	86	110	0.78	2.3×10^{-4}	2217011.39	592241.47	5,840	38.0	26.9	5.4
MU10	KM	LC	80	120	0.67	2.3×10^{-4}	2225648.42	597503.05	2,737	17.1	2.2	1.0
MU11	HJ	LCE	86	110	0.78	2.3×10^{-4}	2229136.43	606179.22	2,464	15.7	2.1	1.0
MU12	KM	LCE	86	110	0.78	2.3×10^{-4}	2205780.24	594466.40	2,555	22.9	4.1	2.4
MU9	KM	LCE	86	110	0.78	2.3×10^{-4}	2223159.26	596462.85	3,011	16.8	2.4	1.2

† = Computed drawdown at end of RO phase
LC = Lost Creek Project Area
LCE = Lost Creek East Project Area
ft. = feet
d = day
gpm = gallons per minute

Table 4.6-3 Wildlife Exclusion Periods

Species	Exclusion Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sage Grouse	No surface occupancy within 0.6 miles of occupied leks unless otherwise authorized. Exploration outside of approved mine units and initial construction will take place between July 1 and March 14 (BLM EIS sect. 4.9.5.3) Site access on established roads, plant processing, and mining will occur year round.												
Raptors	Avoid disturbance within ¾ buffer from February 1st to July 31st except: • 1 mile buffer for Ferruginous Hawks • 2 ½ mile buffer for Bald Eagle, Golden Eagle												
Big Game	No surface disturbance on winter game ranges.												

Table 4.7-1 Estimated Emission (pounds/year) from Vehicles

NOx	53,777
CO	11,585
SOx	3,536
PM_{10}	3,780
CO_2	1,999,815
TOC	4,390

Table 4.10-1 Estimated Work Force Requirements for All Alternatives

Project Phase	Employment Category	Total workers
Construction and Development (completed)	Drill Rig Contractors (10 rigs)	30
	LC ISR, LLC Construction employees	10
	LC ISR, LLC Other Employees (samplers, geologists, supervision, drilling support)	10 to 20
	Plant Construction Contractors	20
	Total Peak Employment	**70 to 80**
Operations	Operation Staff - Plant and Well fields	57
	Drilling Contractors (10 rigs)	30
	Average Employment	**87**

Section 5.0
Cost Benefit Analysis

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5.0 COST-BENEFIT ANALYSIS

LC ISR, LLC has evaluated the costs and the benefits associated with uranium production in order to formulate the Project. Historically, several companies considered mining uranium within the Permit Area, but the costs outweighed the benefits at that time. The existing Lost Creek facility has demonstrated over the past 3.5 years that uranium mining in the Great Divide Basin is technically feasible and profitable. The increasing demand for uranium and likely associated price increases lead LC ISR, LLC to believe the benefits of expanding the existing facility outweigh the costs.

Although the specific amount of yellowcake produced will depend on the market price and the cost of production, LC ISR, LLC anticipates producing about one million pounds of uranium per year from the wellfields. Based on current information and projections, the anticipated life of the Project is twelve years. Current demand/supply projections indicate that the price should remain sufficiently high to support the Project over that time frame. If approved as part of this application, the Plant could take loaded resins and or yellowcake slurry from other ISR sites in the region, even after the ISR production from site wellfields is complete.

5.1 Costs

Since exploratory studies of the Permit Area were commenced in the late 1960's, production methods have been improved to minimize costs. The primary method of producing uranium from deposits such as those in the Permit Area has shifted from conventional open-pit or underground mining to ISR. Open-pit and underground mining require the ores be physically removed from the ground, which would be associated with not only high operating costs (especially with low-grade ores), but also with increased exposure of radioactive materials to the atmosphere and with significant surface disturbance. In contrast, ISR operations lower the operating cost and minimize disturbance by chemically removing the mineral and leaving the matrix surrounding the ore intact. While some alternatives to various steps in ISR operations have been considered for the Project, such as facility locations, the overall costs do not differ substantially with the choice of alternative.

5.1.1 Health and Environmental Costs

LC ISR, LLC proposes expansion of the Project for the societal benefit of a uranium supply, knowing that health and environmental costs will be minimized by ISR operations. The health and environmental costs that were evaluated include:

- disturbance of soil and vegetation,
- disturbance to wildlife and wildlife habitat,
- disturbance of hydrogeology,
- use of groundwater,
- depletion of uranium minerals,
- production of waste,
- potential exposure to radioactive material, and
- impact on aesthetics.

The soil, vegetation, hydrology, wildlife, and wildlife habitat will be temporarily disturbed during the Project. These natural resources were characterized during studies of the baseline conditions at the Permit Area, which are summarized in **Section 3** of this report. The resources will be reclaimed to support the approved post-project land use of livestock and wildlife grazing, which is similar to the pre-project land use, in accordance with applicable standards and regulations. Reclamation activities are described in more detail in **Section 1** of this report and **Section 6** of the Technical Report. Because ISR operations are conducted in a series of mine units, which are installed, produced, and reclaimed sequentially, only portions of the Permit Area will be disturbed at a given time.

Inherent to the proposed action, the uranium mineral will be depleted. However, this mineral will provide a source of fuel for producing nuclear energy. Currently, the nation and the public are supporting alternative sources of energy, including nuclear energy, to reduce dependence on foreign petroleum supplies and to reduce carbon emissions. The proposed action will remove uranium, in a safe and controlled manner, from the geological formation in which it naturally occurs. By doing so, the radioactivity of the material associated with uranium will be reduced. This will improve the health of humans and the environment that may otherwise be exposed to the ores.

Groundwater will serve as a tool to recover uranium. Groundwater will be: pumped from the production wells in the ore zone; oxidized by the addition of lixiviant (a bicarbonate-based solution); re-introduced to the ore zone through the injection wells; recovered from the production wells; treated at the Plant for removal of uranium; and circulated through this system again and again. Ultimately, the majority of the water will be restored and returned to the aquifer containing the ore zone. A fraction of the groundwater will be consumed as waste. This fraction of consumed groundwater will be minimized by concentrating the waste through multiple wastewater treatments where feasible.

Various types of wastes will be produced from the Project. These wastes may be categorized as domestic sewage, non-radiological wastes, and radiological wastes. Materials will be decontaminated or treated to reduce the volume of waste. Radiological waste will be removed from the Permit Area and disposed at an NRC-licensed facility or will be disposed of in a UIC Class I well, depending on the type of waste, in accordance with current NRC regulations. All other wastes will also be disposed of according to the applicable local, state, and federal regulations.

Exposures to radioactive materials were estimated using results from the radiation survey and the MILDOS model. Estimated public exposure to radioactive materials is negligible due to the remote location of the Permit Area, the nature of ISR operations, and the ore processing technologies. Occupational exposure will be reduced or eliminated by providing the proper training, guidance, and PPE to safely handle, store, decontaminate, and/or dispose waste materials.

Interference with other uses of the Permit Area will be limited due to the lack of development in the area and the reclamation requirements. For example, due to limited development of groundwater in the area to date, minimal impact to other water users outside the Permit Area is anticipated. As another example, hunting will be restricted at the Permit Area during production and reclamation to reduce safety concerns; but in the long term, hunting access will be improved due to road construction and maintenance. To ensure that future users of the Permit Area are aware of the presence of abandoned wells, a deed notice of the mine unit locations will be required. Any decreases in aesthetics at the Permit Area, such as increased noise, will be minimal due to the remoteness of the Permit Area, the nature of ISR operations, improved technologies, and required reclamation. In addition, the activities at the Permit Area, such as well installation, are similar to the activities associated with other extractive industries in the region (e.g., oil and gas drilling).

There is no difference in health and environmental costs between the Preferred Alternative and the Other Alternative considered for the Project.

5.1.2 Internal Costs

In order to quantitatively compare the costs to the benefits of the expansion, internal and external costs were estimated. Internal costs impact LC ISR, LLC and cover the construction, operation, and reclamation phases of the Project.

The primary internal costs will include:

- capital costs associated with obtaining claims and regulatory approvals, including permits, and environmental studies;
- capital costs of facility construction;
- operation and maintenance costs;
- costs of groundwater restoration;

- costs of facility decommissioning, including radiological decontamination; and
- costs of surface reclamation.

These estimated costs are provided in **Table 5.1-1**. Because of the sequential development of mine units during ISR operations, some of the facility construction costs are distributed throughout the life-of-Project rather than concentrated during the initial Project development.

The Other Alternative considered for the project will be more expensive than the Preferred Alternative due to the additional handling and transport of drill cuttings.

5.1.3 External costs

External costs impact the local economy and include the services and resources of the neighboring communities. The primary external costs will affect:

- housing;
- public facilities and services;
- historic, scenic, and recreational resources; and
- natural and material resources.

As with the internal costs, some of the external costs are distributed throughout the life of the Project due to the nature of ISR operations, rather than concentrated during the initial Project development.

Impacts to housing availability are expected to be dispersed because of the remoteness of the Permit Area, because the existing work force is not expected to grow appreciably, the relatively small number of the workforce (both on payroll and on contract), and the progressive nature of construction and reclamation in the Permit Area. During production, personnel will be on-site 24 hours per day.) Because of energy-related projects throughout Wyoming, workforce and housing availability has become a critical factor in some locations depending on current commodity pricing and the extent of development at any given time. However, in response, state and local agencies have been assisting industries and communities to address these issues. At this time, ample housing is available in the region.

The costs associated with increased demand of public facilities and services are expected to be minimal. Water supply and some waste disposal facilities will need to be developed by the operator of the Project, because of the lack of such facilities in the vicinity of the Permit Area. (The nearest population center, Bairoil, is about 15 miles to the northeast.) The relatively small increase in the workforce will not overtax education and health resources. Existing emergency response and medical treatment capabilities handle industrial accidents similar to those that could occur at the Permit Area; and a variety of industrial and hazardous materials are transported on Interstate 80 through Rawlins, which is about a 50-mile drive southeast of the Permit Area. Therefore, basic services are already established that can support the Project. Representatives from LC ISR, LLC met with the Sweetwater County commissioners on October 16, 2007 to discuss the original mine plan. LC ISR, LLC described the operations and schedule of the Project to the commissioners and answered related questions. Subsequently, LC ISR, LLC has participated in a public meeting organized by BLM to discuss the proposed expansion described in this application. Additional public consultation is planned.

Historic, scenic, and recreational resources within the Permit Area were identified during studies of the baseline conditions, as summarized in **Sections 3.9** and **3.10** of this report. One cultural site was mitigated through excavation after approval by the BLM. Mitigation plans for sites of historical significance are described in **Section 4.8** of this report. The limited presence of local residents and/or regular visitors, lack of roads, and austere topography reduces the number of people who might be impacted by noise or facility visibility. The construction equipment and facilities in the landscape (e.g., drilling rigs, header houses and the Plant) are of limited height and will be visible to bypassing travelers on Sooner Road from some vantage points. However, most of the facility, including the plant, will be in the distance with only two wellfields within one mile of the public road. In addition, reclamation is required once the facilities are decommissioned. As noted earlier, hunting, which is the primary recreational activity, will be restricted for safety reasons during operations, but will not be permanently affected, and may be improved due to wildlife habitat reclamation and improved transportation routes.

During the implementation of the Project, natural and material resources will be used. The natural resources include uranium and groundwater. The goal of the Project is to maximize uranium recovery; thus, uranium will be depleted. Groundwater will be used as a medium to extract the uranium; the Project is designed to re-use the groundwater as much as possible and limit losses to waste. Material resources needed for the Project include a variety of industrial products such as automotive fluids, building materials, well casing, piping, and cement, as well as energy. Processing chemicals will also be needed, although most of these are relatively benign.

There is no difference in external costs between the Preferred Alternative and the Other Alternative considered for the Project.

5.2 Benefits

Outside of the economic benefits to the operator, the estimated community benefits resulting from the Project are shown in **Table 5.2-1**. The local communities within Sweetwater County will benefit economically from the Project development, construction, and operation because of employment opportunities, including skilled jobs on the Project and an improved tax base for other local jobs. The economic benefit of expenditures related to the Project will magnify as funds are dispersed throughout the communities. Approximately 70 to 90 individuals (including both full-time employees and subcontractors) will be employed during the Project. Local businesses will also be subcontracted for many services, such as drilling, and will employ additional individuals. Domestic supplies and equipment will be purchased from local vendors.

The local, state, and federal governments will receive various revenues from employee income taxes, severance taxes, ad valorem taxes, and sales taxes. The estimated benefit from taxes is shown in **Table 5.2-1**.

In addition to the specific, tangible Project benefits, the Project also provides more diverse benefits. For example, regional recreation may be enhanced following the reclamation of the disturbed area, because of improved access and the reclamation of the Permit Area to wildlife and livestock grazing. As another example, due to the remoteness and low population of the Great Divide Basin in which the Project is located, the baseline studies and monitoring associated with the Project have greatly increased the information available on natural resources. Required monitoring during the Project will continue to provide scientific data about this basin.

The Project will support energy-independent and environment-friendly policies. The uranium production will assist to supply a reliable, economical, domestic source of uranium while applying new technologies to minimize disturbance. The Project will also help offset the deficit in annual domestic uranium production and help meet increasing energy demands. Between 1989 and 2003, annual domestic uranium production decreased by 75 percent; with declines continuing from 2014 to 2016. The US produces about two percent of the world uranium, while it consumes over 25 percent of the total 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. The Project, once in full-scale production, will add up to 2,200,000 pounds of U_3O_8 per year to the market. The existing processing facilities, can also process loaded resins and/or slurry from other regional mines.

There is no difference in the benefits between the Preferred Alternative and the Other Alternatives considered for the Project.

Table 5.1-1 Estimated Project Costs

Item	Present Worth (US dollars x 1,000)
Obtaining the right to mine (claims & permits)	13,000 [1]
Facility construction	68,000 [1]
Operation and maintenance[3]	139,000 [2]
Ground-water restoration	12,000 [2]
Decommissioning (including decontamination)	12,000 [2]
Surface reclamation	3,000 [2]

Notes:

[1] Amounts previously spent
[2] Amounts remaining to be spent
[3] Includes manpower costs during restoration

Table 5.2-1 Estimated Project Benefits

Item	Present Worth [1] (US dollars x 1,000)
Taxes	158,660
Employment	73,926
Supplies and equipment	98,493
Services	97,621
Improved recreation	43
Improved roads	57
Environmental studies and monitoring	2,000

[1] Assumptions: 58 employees, ten contract drill rigs (3 contractors for each rig) per construction year, and a realized sales price of 60.00 US dollars per pound U_3O_8

Section 6.0

Summary of Environmental Consequences

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6.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table 6.0-1 presents the Summary of Environmental Consequences by topic (e.g., Land Use), in the same order as topics are presented in **Sections 3** and **4** of this report.

For each topic, the anticipated impacts during construction and operation of the Project are summarized, based on the Project operation plans outlined in **Section 1** of this report, and described in the Technical Report for this project. Monitoring programs are also summarized, based on the programs described in **Section 4** of this report, and described in the Technical Report. Mitigation plans are summarized from the groundwater restoration and surface reclamation requirements outlined in **Section 1** of this Environmental Report and described in more detail in the Technical Report.

In general, there are few unavoidable long-term environmental consequences; primarily because of existing federal and state requirements on groundwater restoration and surface reclamation, which have been in place for a number of years. The primary consequences are the changes in the groundwater conditions of the ore zones that are produced, including the oxidation/reduction conditions and the water levels. However, because adequate characterization of the ore zones is essential for efficient operations and best ore recovery and because of requirements for groundwater restoration, the changes in water quality are mitigated to a considerable extent. Assessment of existing and reasonably foreseeable water uses, evaluation of drawdown and recharge rates, and efficient production and restoration provide opportunities to mitigate any adverse impacts from water level changes. In addition, ISR operations continue to improve the understanding of the processes and impacts of ISR. In many instances, such as the Project, the groundwater monitoring data collected during the operation, provides the only information on the depth(s) and extent of uranium ore zones, their natural impact on water quality, and the water resources of the area.

Table 6.0-1 addresses the Preferred Alternative described in **Section 2** of this report. Because the environmental, cultural and public consequences from the Preferred Alternative and the Other Alternative are essentially the same the table is divided into only two columns. The first column includes information related to the alternative other than the No-Action Alternative; and the second column includes information related to the No-Action Alternative. Although the alternative of only mining the HJ Horizon and not the KM Horizon was discussed and dismissed in **Section 2**, it is noteworthy that the nature of the impacts are the same regardless of which Horizons are mined. Only the duration of the impact and the spatial distribution change in relation to which areas are mined.

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)

Preferred Alternative and Other Alternatives (Section 2.0)	No Action Alternative
Land Uses	
Construction Impacts *Some reduction in grazing capacity due to installation of secondary roads, wellfields and deep well pads. Plant, main roads, some major trunklines and powerlines already constructed.*	*Current land uses, including stock and wildlife grazing, seasonal hunting, and increased drilling activities for oil/gas/other mineral resources are not expected to change.*
Operational Impacts *Some reduction in grazing capacity due to use of roads and facilities. Limitations on seasonal hunting to protect workers, prevent damage to facilities, and provide security. Any drilling for oil/gas/other mineral resources will need to be carefully coordinated to prevent damage to facilities, including wells and pipelines and prevent interference with uranium production.*	
Monitoring and Mitigation *No specific monitoring of land uses is required, but periodic inspections, annual reports, and permit review required by WDEQ-LQD will allow for evaluation of significant changes in land use in the general area.* *Impacts, which are expected to be minimal, will be mitigated by reclamation/ restoration of the Permit Area. These activities will include tasks such as well plugging and vegetation re-establishment in accordance with criteria for the approved post-production land uses.*	
Unavoidable Environmental Consequences *Limited due to requirements for reclamation/restoration to established criteria for the post-project land uses specified in the approved reclamation plan. Future drilling for water, oil, or gas or site excavation will need to take into account presence of abandoned wells at the site, but the presence of the wells will be recorded through a deed notice per WDEQ-LQD requirements.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Transportation	
Construction Impacts *Construction of plant, ponds, and primary roads is already completed so assessment focuses on construction of additional wellfields and associated infrastructure. Primary on-site impacts will be construction of a variety of access roads and delivery of wellfield supplies. Off-site impacts will include a slight increase in traffic, although anticipated vehicle size and weight (e.g. drilling rigs and haul trucks) should not differ significantly from current use.*	*Current transportation options, primarily paved and dirt roads, are not expected to change other than upgrades and regular maintenance to existing traffic routes.*
Operational Impacts *Primary on-site impacts will be road use, which will require maintenance of the roads, culverts, and related items. Primary off-site impacts will be slightly increased traffic. Containers used for transport of yellowcake slurry, resin and dried yellowcake will be designed to prevent spills during reasonably foreseeable accidents, but the weight and length of the transport trucks will not differ from typical trucks. Transportation of hazardous materials will be limited.*	
Unavoidable Environmental Consequences *Limited due to requirements for identification of those roads that will be removed/reclaimed to established criteria after production is complete and identification of those roads that will remain to support the approved post-project land use.*	
Soils	
Construction Impacts *Construction of plant, ponds and main access roads is already complete so the assessment focuses on construction of wellfields and associated infrastructure. Soil compaction due to construction traffic, erosion due to disturbance, or loss due to building placement. Impacts are similar in nature to those experienced in ongoing site wellfield construction.*	
Operational Impacts *Potential contamination from spills, soil compaction from operational trafficking.*	*No assessment of the soils in this portion of the Great Basin was available prior to*

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)

Preferred Alternative and Other Alternatives (Section 2.0)	No Action Alternative
<u>Monitoring and Mitigation</u> *Baseline assessment of soil resources throughout the Permit Area and in more detail in each mine unit will result in site-specific protection measures, including: stripping where necessary (e.g., plant site, roads, and mud pits for wells); marking short-term topsoil stockpiles; and constructing long-term stockpiles with adequate erosion protection. Reclamation will be staged during all phases of the construction and operation. Areas that are temporarily disturbed will be restored and reseeded immediately after disturbance.* *Operational monitoring will include periodic checks of topsoil stockpiles for undue erosion. Procedures will also be in place for spill response. Requirements for reclamation/restoration to established criteria for the post-project land uses specified in the approved reclamation plan will result in replacement of any stripped topsoil.*	*initiation of baseline data collection for this project.*
<u>Unavoidable Environmental Consequences</u> *Limited due to requirements for topsoil protection during construction & operation, and for topsoil replacement & vegetation re-establishment in accordance with approved reclamation plan.*	
Geology	
<u>Construction and Operational Impacts</u> *None foreseeable.*	
<u>Monitoring and Mitigation</u> *Not required.*	*Subsurface information for the Great Basin in Wyoming is generally somewhat limited and data collection efforts are generally limited except for exploration work associated with projects such as this.*
<u>Unavoidable Environmental Consequences</u> *None foreseeable.*	
Hydrology – Surface Water	
<u>Construction Impacts</u> *The lack of surface water in the Permit Area significantly reduces the potential for impacts. Facility and road construction and well installation*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
could result in disturbance to existing drainage patterns and an increased sediment load in runoff if appropriate procedures are not followed for installation of culverts and protection of areas which have been stripped of topsoil or in which vegetation has been disturbed.	
Operational Impacts *Impacts will not be significantly greater during construction than during operation, since mine units (with associated rig and truck supply traffic) are generally installed sequentially. In addition to the limited occurrence of surface water, there are no surface water rights in and around the Permit Area that could be impacted.*	*Information on surface water quantity and quality in the Great Divide Basin is generally limited, particularly due to the limited number of major drainages, and data collection efforts are generally limited.*
Monitoring and Mitigation *Baseline assessment of surface water quantity and quality throughout the Permit Area and in more detail in each mine unit allows for development of site-specific surface water protection measures, including: installation of culverts; sediment ponds; and other facilities that may be necessary to minimize erosion.* *Operational monitoring will include continuation of surface water quantity and quality monitoring as necessary. However, the only surface water at the site is ephemeral flow in response to stormwater runoff and snowmelt. Procedures will also be in place for spill response.*	
Unavoidable Environmental Consequences *Limited due to lack of surface water and low topographic relief in Permit Area. In addition, requirements for surface water monitoring as necessary, proper construction, maintenance, and reclamation of roads and facilities in accordance with approved operation and reclamation plans will minimize any potential consequences.*	
Hydrology – Ground Water	
Construction Impacts *Exploration drilling and well installation will impact ground water quantity slightly due to use of ground water. Ground water quality could be impacted due to introduction of drilling mud and potential for connection of aquifers.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)

Preferred Alternative and Other Alternatives (Section 2.0)	No Action Alternative
<u>Operational Impacts</u> *In situ recovery, by definition, changes the water quality in the ore zone, in particular the oxidation/reduction conditions, and mobilizes uranium by introducing lixiviant (bicarbonate solution) and circulating it through the aquifer. Impacts to ground water quantity are limited due to re-use of the water, and <1.5% of the water in the ore zone is generally removed to help ensure the production fluids do not migrate from the ore zone. Ground water restoration after production is designed to re-establish the pre-production ground water class of use, as defined by WDEQ/WQD. The 1st restoration phase, ground water sweep, may require removal of an equivalent quantity of water to that in the ore zone. The later phases of restoration have less impact on ground water quantity and are designed to remove metals and salts that may have been mobilized during production.*	*Information on ground water quantity and quality in the Great Divide Basin is generally limited, despite the presence of significant quantities of ground water in the Basin, and data collection efforts are generally limited.* *At present, there are no federal or state restrictions on water quality for private wells in Wyoming, although some guidelines exist. Also, there are no regulatory requirements for sampling private wells prior to use. There are guidelines provided, but these generally do not cover radionuclides, except in areas where near-surface natural radon emissions may impact building use. Occasionally, a lending institution may require sampling, but again, radionuclides are often not covered.*
<u>Monitoring and Mitigation</u> *Baseline assessment of water quantity and quality has been essential for design of efficient production, including choosing appropriate lixiviants, design of production/ injection well patterns and monitoring programs, and selecting optimal pumping rates. Review of existing water rights has also provided information for determining if mitigation measures are necessary.* *During operation and restoration, regular monitoring of wells within and around each mine unit, and in overlying and underlying aquifers, will be conducted to ensure there has not been any movement of lixiviant outside the ore zone and to determine production or restoration progress. In addition, production and injection rates and volumes will be balanced to help ensure the lixiviant circulation is within the ore zone. Well integrity testing will also be conducted, and all drill hole and well plugging will be done in accordance with applicable requirements. In addition, water levels will be monitored in wells outside the Permit Area that could be impacted by operations, based on projected drawdowns. If necessary, alternate water sources will be obtained for those well users*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
should water levels decline sufficiently to interfere with adequate supply.	
Unavoidable Environmental Consequences *Economic incentives for efficient production and regulatory requirements for ground water restoration help reduce impacts. In Wyoming, the restoration requirements are to return ground water quality to that commensurate with the uses for which the water could have been used before production. NRC requires restoration to background or ACLs. Removal of the uranium may even result in improved post-production water quality, due to the reduction in radionuclides, if production and restoration are conducted efficiently. Based on restoration progress at other ISR operations in Wyoming, long-term changes in ground water quality are generally limited to elevated concentrations of one or two parameters compared to pre-production concentrations. A deed notice of the mine unit boundaries also is required to help ensure future subsurface activities, such as drilling of oil and gas wells, can avoid interference with the abandoned drill holes and wells.*	
Ecological Resources – Vegetation	
Construction Impacts *Secondary road and deep well construction and wellfield installation will result in removal of vegetation in specific, limited portions of the Permit Area.*	
Operational Impacts *Minimal, especially if monitoring and maintenance traffic stays on designated routes.*	*Current vegetation communities are not expected to change except in response to change in other site characteristics, such as land use or transportation routes.*
Monitoring and Mitigation *Baseline assessment of vegetation communities throughout the Permit Area and in more detail in each mine unit allows for identification of areas where disturbance should be prevented or minimized, but no such areas have been found to date. In addition, the disturbance will not impact either of the vegetation communities present on-site disproportionately. The baseline assessment also allowed for design of a reclamation seed mix suited for site conditions and usage.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
During operations, weed control and erosion protection will reduce the potential for adverse impacts to existing vegetation. *During reclamation, proper seed bed preparation and seeding practices, weed control, grazing control on newly reseeded areas, and monitoring of the seed expression and plant growth will allow for vegetation re-establishment to complement existing conditions.*	
<u>Unavoidable Environmental Consequences</u> *Limited due to requirements for minimizing disturbance during mine unit installation, for establishing traffic patterns during operations, for weed control, and for topsoil replacement and vegetation re-establishment in accordance with approved reclamation plan.*	
Ecological Resources – Aquatic Life and Wetlands	
The baseline field investigations indicate aquatic life and wetlands do not exist within the Permit Area; therefore, there will be no impacts to aquatic wildlife and wetlands.	
Ecological Resources - Wildlife	
<u>Construction Impacts</u> *Secondary road and deep well construction and wellfield installation will disturb wildlife in specific, limited portions of the Permit Area..*	
<u>Operational Impacts</u> *Outside of the facility area, the structures and equipment at ISR facilities do not generally interfere with wildlife and often provide additional cover. Monitoring and maintenance traffic may impact wildlife.*	*Current wildlife communities are not expected to change except in response to change in other site characteristics, such as land use or transportation routes.*
<u>Monitoring and Mitigation</u> *Baseline assessment of the species and their use of the Permit Area (e.g., feeding, nesting, cover, and/or migration route) allows for development of site-specific protection measures, and regulatory requirements in place at the time of construction and operations, such as timing restrictions on drilling and related activities will be implemented. For reclamation, use of a seed mix reflective of pre-project conditions will*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
help develop post-project habitat. *Monitoring will include periodic assessment of wildlife for comparison with baseline conditions.*	
Unavoidable Environmental Consequences *Limited due to requirements for reclamation to established criteria for the post-project land uses specified in the approved reclamation plan.*	
Air Quality	
Construction Impacts *Secondary road and deep well construction and well installation will generate dust and engine emissions from equipment.*	
Operational Impacts *Similar to impacts during construction, plus the emission of radon during processing. Radon emissions are discussed in more detail under Public and Occupational Health. Radionuclide particulates are not anticipated because no yellowcake dryer will be used on-site and because the Storage Ponds will be kept wet.*	*Current dust contributions from travel on dirt roads, and emissions from heavy equipment and drilling operations will continue.*
Monitoring and Mitigation *Baseline assessment of meteorological conditions allows for development of site-specific air quality protection measures. The primary protection measure for dust will be wetting of roads with water or chemical dust suppressants (such as magnesium chloride which is commonly used at mines in Wyoming) as necessary. The primary protection measure for engine emissions will be proper engine maintenance. Limitations for road use on an as-needed basis, speed limits, and similar measures will also help reduce dust and engine emissions. Radon emissions, which are monitored pursuant to the NRC approved plan, are discussed in more detail under Public and Occupational Health.*	
Unavoidable Environmental Consequences *Limited due to mitigation requirements.*	
Noise	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)

Preferred Alternative and Other Alternatives (Section 2.0)	No Action Alternative
Construction and Operational Impacts *The plant, main roads and ponds have already been constructed. Noise will be similar to that present during on-going wellfield construction and operations activities.*	
Monitoring and Mitigation *None considered necessary.*	*Current noise contributions from truck traffic, heavy equipment, and drilling operations (e.g., uranium exploration by other operators) will continue.*
Unavoidable Environmental Consequences *None anticipated.*	
Historic and Cultural Resources	
Construction and Operational Impacts *None anticipated due to requirements for baseline delineation of historic and cultural resources, including determination of specific resource sites for which mitigation will be necessary prior to any disturbance. Baseline studies indicate only a limited number of sites within the Permit Area, and of those sites, prevalence of relatively modern, industrial artifacts (e.g., old mineral exploration artifacts) rather than older archeological and paleontological artifacts. In addition, the operator will request that all resource information will be held confidential by reviewing regulatory agencies to avoid providing information to the public that could lead to unauthorized disturbance of the resource sites.*	
Monitoring and Mitigation *Mitigation plans for resource sites specified by the State Historic Preservation Office (SHPO), after their review of the baseline resource survey, will be developed by the operator and approved by SHPO as part of the permit application process. After mitigation, the operator must submit a report to SHPO identifying the steps taken in accordance with the approved plan. Based on current plans, only a limited number of sites are present within the Permit Area and of those, only two or three may require mitigation.*	*Possible inadvertent or intentional disturbance or destruction of sites because sites are not fenced or otherwise protected.*
Unavoidable Environmental Consequences *Limited due to requirement for baseline assessments and mitigation plans for any sites determined to be of particular significance by SHPO.*	
Visual/Scenic Resources	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)

Preferred Alternative and Other Alternatives (Section 2.0)	No Action Alternative
Construction and Operational Impacts *Minimal due to: 'wide-open' spaces; limited presence of local residents and/or regular visitors to the area who might be affected; similarity of existing 'intrusions' on the landscape (e.g., drilling rigs and compressors) to those in the Permit Area; and limited height of Process Plant.*	
Monitoring and Mitigation *None considered necessary.*	*None.*
Unavoidable Environmental Consequences *None anticipated.*	
Socioeconomic Impacts	
Construction and Operational Impacts *Slight increase in employment opportunities and corresponding increase to tax base. No impact to housing or other public services is expected due to the limited number of new hires. Compared to other development projects in the region, the Lost Creek Project will employ relatively few workers, and the majority of those will need to be skilled.*	
Monitoring and Mitigation *Communication with state and local agencies evaluating socioeconomic conditions.*	*Continued strain on existing infrastructure due primarily to increased oil and gas development, but also due to increased tourism and public land use for a variety of activities (e.g., hunting and off-road recreational vehicles).*
Unavoidable Consequences *No disproportionate consequences are anticipated.*	
Public and Occupational Health	
Construction Impacts *Typical of those for any construction site and primarily related to mechanical health and safety issues, such as working on drilling rigs and driving heavy equipment.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Operational Impacts *Primarily related to mechanical health and safety issues. Radon emissions associated with the uranium processing will be vented from any enclosed spaces, such as Header Houses and the Process Plant.*	*Current public and occupational health concerns are primarily mechanical health and safety issues typical of the extractive industries, including oil and gas drilling and coal mining, in Wyoming.*
Monitoring and Mitigation *Worker education and training for all workers, designation of areas in which only those workers with additional education and training on radionuclides may enter, and health and air monitoring targeted to the work areas. Preparation for reasonably foreseeable accidents, including mechanical accidents and those accidents with potential chemical releases to the environment. Calculation of radon emissions from uranium processing and designation of restricted areas based on calculations and other factors which require restricted access. Analysis of dose consequences from reasonably foreseeable accidents.*	
Unavoidable Consequences *None anticipated, especially as exposure rates to naturally occurring radioactivity far exceed projected radon emissions from the project.*	*Exposure rates to naturally occurring radioactivity are relatively high in the region due to the geologic conditions.*
Waste Management	
Construction Impacts *Other than removal of trash typically associated with construction and drilling projects, no additional waste management impacts are anticipated.*	
Operational Impacts *Trash typically associated with mine operations, e.g., office waste, will be collected for disposal at a landfill. Sewage will be disposed of in the septic systems already constructed at the plant. Storage Ponds, provide for storage of waste water from uranium processing prior to disposal in UIC Class I wells and are constructed with leak detection systems to reduce possibility of impacts. Use of UIC Class I wells will change quality and pressure in the injection formation. Class V treatment and disposal will result in a significant reduction of waste water being sent to the UIC Class I wells.*	*None.*

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project (KM and LC East Amendments)	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Monitoring and Mitigation *Regular inspection of waste storage areas and review of waste disposal practices to ensure proper containers, labels, storage, and segregation. Reasonable efforts to ensure any contracted waste haulers are properly licensed, equipped, and staffed. Regular inspection of piping systems used to route waste water. For Storage Ponds, regular inspection of liner and leak detection system. Installation of system to discourage birds from pond area if necessary. During reclamation, disposal of any pond sludge, liner, impacted material under the ponds, and associated equipment as 11(e)(2) byproduct material, and revegetation of the pond site in accordance with approved reclamation plan. For the UIC Class I and V wells, baseline assessment of water quantity and quality to determining operating pressures and waste compatibility and to ensure selected injection formation provides for appropriate waste isolation. During operation, monitoring of injection rates and pressures, and periodic well integrity testing. Well plugging after wells no longer needed.*	
Unavoidable Environmental Consequences *None anticipated except for changes to the quality and pressure in the injection formation.*	

Section 7.0
List of Preparers

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7.0 LIST OF PREPARERS

In support of the LC East Project, 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.

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