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STRATA ENERGY

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3.6 Meteorology, Climatology, and Air Quality

3.6.1 Meteorology and Climatology

The proposed Ross ISR Project is located in a semi-arid or steppe climate. The region is characterized seasonally by cold harsh winters, hot dry summers, and relatively warm moist springs and autumns. Temperature extremes range from roughly -25°F in the winter to 100° F in the summer. The "last freeze" occurs during late May and the "first freeze" mid-to-late September.

Yearly precipitation totals are typically between 10 and 15 inches. The region is prone to severe thunderstorm events throughout the spring and early summer months and much of the annual precipitation is attributed to these events. In a typical year, the area will see 4 or 5 severe thunderstorm events (as defined by the National Weather Service criteria) and 40 to 50 thunderstorm days. Autumn stratiform rain events also contribute to precipitation totals, but to a lesser degree. Snow frequents the region throughout winter months (40-50 in/year), but generally provides less moisture than rain events.

Windy conditions are fairly common to the area. Nearly 5% of the time hourly wind speed averages exceed 25 mph. The predominant wind direction is southerly with the wind blowing out of that direction roughly 20% of the time. A north/northwest secondary mode with higher wind speeds is also present. Surface wind speeds are relatively moderate at a year-round, hourly average of 10 to 11 mph. Higher average wind speeds are encountered during the winter months while summer months experience lower average wind speeds.

For the regional analysis, meteorological data were compiled from 14 sites surrounding the Ross ISR Project. Hourly wind speed, wind direction, precipitation and temperature data were acquired through the Western Regional Climate Center (WRCC) (2010) for 11 Cooperative Observation Program (COOP) and Automated Surface Observing System (ASOS) sites operated by the National Weather Service (NWS). In addition, meteorological data from the Buckskin Mine (BSM) and the Dry Fork Mine (DFM) were obtained through Inter-Mountain Laboratories (IML). The latter two sites are operated in compliance with regulations set forth by WDEQ/AQD for air quality monitoring. The site-specific analysis used meteorological data from the Ross ISR meteorological station, with comparisons to data from the nearby Thunder Basin National Grassland (TBNG) monitoring station as well as the Gillette

Airport (Gillette AP) station. Table 3.6-1 provides the station ID, coordinates, and period of operation for all sites. See Figure 3.6-1 for MET station locations.

These 14 sites have been analyzed collectively to provide a regional climatic temperature and precipitation analysis that includes the proposed project area. The TBNG, Gillette AP, BSM and DFM sites were analyzed for the regional wind summaries. The 11 NWS sites have been incorporated into the snowfall discussion as none of the mine sites record snowfall data. At the project site, hourly average meteorological data have been collected for the year 2010. These site-specific data include wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation, evaporation and evaporation pan water temperature. The nearest available long-term monitoring site is TBNG, where these same parameters are logged (except for precipitation and evaporation) on an hourly interval. Data from this site were retrieved for 2003 through 2007. The TBNG monitoring site is approximately 18 miles from the project site. The closest NWS operated station which continuously records all weather parameters is the Gillette AP site, some 35 miles to the west-southwest.

A regional overview is presented first. This section includes a discussion of the maximum and minimum temperature, relative humidity, annual precipitation including snowfall estimates, and a brief wind speed and direction summary. The BSM, DFM and Gillette AP sites are used in the regional wind analysis. A combination of these and NWS monitoring stations is analyzed for the regional overview of temperature, snowfall and total precipitation.

A site specific analysis follows the regional overview. Most of this analysis is based on the on-site monitoring. It is supplemented by the longer-term TBNG, Gillette AP and BSM meteorological data, with many of the same meteorological parameters listed previously. An in-depth wind analysis summarizes average wind speeds and directions, wind roses, wind speed frequency distributions, and a joint frequency distribution to characterize the on-site wind data by stability class. A discussion of monthly and seasonal data is included for the temperature and wind parameters. Beyond wind and temperature patterns, general climate and upper atmosphere data from the regional evaluation are deemed to be representative of the project site.

3.6.1.1 Regional Overview

3.6.1.1.1 Temperature

The annual average temperature for the region is approximately 46° to 47°F. Table 3.6-2 lists monthly and annual average temperatures for three meteorological stations representative of the region. These include:

1) Gillette AP, roughly 35 miles southwest of the project site
2) BSM, roughly 30 miles west-southwest of the project site
3) DFM, roughly 25 miles west-southwest of the project site

Figure 3.6-2 presents a graph of the data in Table 3.6-2. Data for the BSM and DFM sites represent the last ten years (2000-2009), while the Gillette AP data reflect the last five years (2005-2009). As illustrated, average temperatures from the three sites exhibit remarkable agreement. July has the highest average monthly temperature (74°F), followed by August (70°F). December records the lowest average temperatures for the year (25°F), followed by January (26°F). Along with average temperatures, Table 3.6-2 shows minimum and maximum monthly temperatures for the three sites. These extreme temperatures are also quite similar, with low temperatures during the respective recording periods reaching around -21°F and high temperatures reaching around 104°F.

Large diurnal temperature variations are found in the region due in large part to its high altitude and low humidity. Figure 3.6-3 depicts the monthly diurnal temperature variation for the BSM site from 2000 through 2009. Spring and summer daily variations of 25°F are common with maximum temperature variations of 30° to 40°F observed during extremely dry periods. Less daily variation is observed during the cooler portions of the year as fall and winter have average variations of 10° to 15°F.

The lesser variation in daily temperature can be attributed to the more stable atmospheric conditions in the region during the fall and winter months. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation. At this latitude the winter sun provides much less daytime heating due to its lower angle and shorter daylight hours.

Daily maximum temperatures in the project region average approximately 60°F and daily minimum temperatures average approximately 30°F. July has the highest maximum temperatures with averages near 90°F while the lowest minimum temperatures are observed in January with averages near 10°F. Isotherm maps of interpolated annual average minimum and maximum temperatures are shown in Figure 3.6-4 and Figure 3.6-5, respectively.

3.6.1.1.2 Relative Humidity

The Gillette AP and TBNG are the only sites included in the regional analysis that record relative humidity (or dew point) data. The graph in Figure 3.6-6 charts monthly average relative humidity values for these two sites. The Gillette AP data reflect the period from 2005 through 2009, while the TBNG data represent 2003 through 2007. It can be seen on Figure 3.6-6 that July has the lowest relative humidities averaging around 45%. This is due primarily to the fact that warmer air requires more moisture to become saturated. The winter months of December, January and February bring colder air, which requires less moisture to become saturated and therefore tends to exhibit higher relative humidity. These months show relative humidities from 60% to 70%. Table 3.6-3 presents relative humidity values in tabular form. The overall average relative humidity is 58% at Gillette AP and 61% at TBNG.

Relative humidity is a temperature-based calculation which reflects the fraction of moisture present relative to the amount of moisture contained in saturated air at that temperature. The latter is a function of saturation vapor pressure, which increases with temperature. Since warm air requires more moisture to become saturated, it tends to have lower relative humidity than cooler air. Therefore, maximum relative humidity values occur more frequently in the cooler early mornings while minimum values typically occur during the warmer mid afternoon hours. Average annual readings at the Gillette AP from 2005 through 2009 were 70% and 40% for mornings and afternoons, respectively (Figure 3.6-7). The summer months exhibit a much greater variation in relative humidity between morning and afternoon values due to greater temperature variations.

3.6.1.1.3 Precipitation

The region is characterized by moderately dry conditions. The Gillette AP site received measurable (>0.01 in) precipitation on an average of 87 days per year between 2005 and 2009. Average annual precipitation during that period was nearly 12 inches per year. In general, the project region has an annual average from 10 to 15 inches, with higher averages in the Black Hills (Figure 3.6-8). Spring showers and thunderstorms produce over half of the precipitation. May is typically the wettest month of the year (Figure 3.6-9); with most of the region receiving an average greater than 2 inches for that month. January, by contrast, is the driest month of the year with precipitation averaging generally 0.5 inch or less. The winter months (December-February) typically account for less than 10% of the yearly precipitation totals. A secondary minimum is also evident during August, when atmospheric conditions are more stable and the absence of convective activity limits storm development.

Severe weather does arise throughout the region, but is limited on average to 5 or 6 severe events per year. These severe events are generally split between hail and damaging wind events. Tornadoes can occur but on rare occasions, with less than one tornado per county per year (Martner 1986).

Average annual snowfall in the proposed project area is about 50 to 60 inches. Major snowstorms (more than 5 in/day) are relatively infrequent in the region. The region experiences less than three major snowstorms per year. Monthly snowfall averages for eight NWS sights are presented in Figure 3.6-10. Sundance has the highest annual snowfall of all the sites in the region, with an average of 76 inches. This is due to snow events which occur on the western flank of the northern Black Hills as a result of orographic lifting of the prevailing westerly flow of air. The interpolated values (Figure 3.6-11) show average snowfall of 50 to 60 inches per year in the project vicinity. This range is slightly lower than that indicated in the Wyoming Climate Atlas (Martner 1986) which lists averages for this part of northwestern Crook County at 60 to 70 inches. This difference may be attributable to drought conditions in the region during the last 10 years.

3.6.1.1.4 Wind Patterns

Year-round wind speeds in the area average between 10 and 11 mph. Table 3.6-4 shows considerable agreement among the three representative sites, both for annual and monthly averages. The Gillette AP site averaged 10.5 mph for the 2005-2009 period analyzed in this study. BSM averaged 10.8 mph and DFM averaged 9.9 mph. The differences in average wind speeds between BSM and DFM can be attributed to monitor locations. The BSM meteorological station is situated on a ridge while the DFM station is located in a valley. Mean monthly average wind speeds are lowest in July and highest in January and April. Figure 3.6-12 graphs the monthly average wind speeds at these three monitoring sites.

Table 3.6-4 also shows monthly maximum hourly wind speeds. High wind events are fairly common in this region; wind data from all three sites show every month recording peak hourly wind speeds greater than 30 mph during the five-year period analyzed.

Figures 3.6-13, 3.6-14 and 3.6-15 show five-year wind roses for the three sites. Some variation can be accounted for by local topography, but all three figures show bimodal winds with a north-northwesterly component and a south-southeasterly component. Spring and summer generally exhibit southeasterly winds as the predominant direction, with north/northwest winds dominating the fall and winter seasons. The highest wind speeds tend to occur from the north- northwesterly direction.

3.6.1.1.5 Cooling, Heating, and Growing Degree Days

Figure 3.6-16 summarizes the monthly cooling, heating, and growing degree days for Weston, Wyoming, a NWS meteorological monitoring site roughly 20 miles west of the proposed project area. The data are assumed to be indicative of the proposed project area due to its proximity and comparable elevation.

The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 55° F has been selected as the base temperature. The number of heating degree days is computed by taking the average of the high and low temperature occurring that day and subtracting it from the base temperature. The calculation for growing and cooling degree days is the same, except that the base temperature is subtracted from the average of the high and low temperature for the day. Negative values are disregarded for both calculations.

As expected, the graphs of heating degree days and cooling degree days are inversely related and the number of growing and cooling degree days per month is identical when the same base temperature is chosen. The maximum number of heating degree days occurs in January, at over 1,000 degree days. This coincides with January having the lowest minimum average temperature. Conversely, July registers the most cooling/growing degree days with 500, which also corresponds to July having the highest maximum average temperature.

3.6.1.2 Site Specific Analysis

3.6.1.2.1 Introduction

The site specific discussion is limited to on-site meteorological data collected in 2010, data from the Gillette AP site for the same monitoring period, data from BSM for years 2000 through 2009, and meteorological data from the nearby TBNG site collected during the five-year period from 2003 through 2007. Siting of the Ross ISR Project meteorological station and subsequent, on-site monitoring activities have been conducted in accordance with the Monitoring Plan, detailed in Addendum 3.6-A. Monitored parameters and instrument specifications associated with on-site monitoring are presented in Table 3.6-5. A photograph of the on-site monitoring station appears in Figure 3.6-17.

The Gillette AP data (from the National Weather Service) provide a basis for assessing to what degree the on-site Ross ISR data are representative of the entire region. Data from the TBNG site are not current enough to serve this purpose, but the site is included to incorporate nearby wind monitoring results from a longer period of record. The TBNG site is located 18 miles west of the Ross ISR Project, with topographic features similar to the proposed project area. Since temperature data from TBNG were deemed invalid, the 10-year temperature data from BSM were used. The BSM site is 30 miles west-southwest of the proposed project area and the Gillette AP site is 35 miles west-southwest of the proposed project area. In all four cases, the surrounding area is characterized by rolling hills, minor ridges and ephemeral drainages. The vegetation types are mainly confined to native grasses with some sage brush and very sparse woody plants.

Site specific meteorological data are provided in Addendum 3.6-B. Figure 1 in Addendum 3.6-B provides a meteorological summary for the Ross ISR project site for the year 2010. The averages, maximums, and minimums are specified for each parameter recorded at the site (except for precipitation which shows the total). This figure also shows data recovery rates greater than 95% for all parameters. The Gillette AP site was used for comparison to on-site data during the same monitoring period. Figure 2 in Addendum 3.6-B provides a 2010 meteorological summary for the Gillette AP site.

3.6.1.2.2 Temperature

The annual average project site temperature is similar to the regional average temperature at approximately 47°F. The maximum temperature for 2010 was 98°F and the minimum temperature was -16°F (Addendum 3.6-B Figure 1).

Figure 3 in Addendum 3.6-B shows the monthly average temperatures for the proposed project site in comparison to temperatures for a longer period of record at the BSM site. Addendum 3.6-B Figure 4 compares monthly average temperatures between the proposed project site and the Gillette AP for the same 12-month period. Based on these comparisons and the temperature data summarized in the regional analysis above, it appears that the proposed project site experiences temperature patterns quite typical of the area. Table 1 in Addendum 3.6-B provides the monthly on-site temperature data in tabular form. Daily average temperatures range from 20°F in the winter months to about 70°F in the summer months.

Figure 5 in Addendum 3.6-B shows the on-site, diurnal temperature variation by season. The difference between average daytime and nighttime temperatures is greater during the summer and fall than during the winter and spring. Large diurnal temperature swings in the fall of 2010 may be attributable to an unusually warm and dry September and October.

3.6.1.2.3 Wind Patterns

Figure 6 in Addendum 3.6-B presents a wind rose for the proposed project site during the 12-month monitoring period (2010). For comparison, Figure 3.6-18 shows a wind rose for the TBNG site during the 5-year monitoring period (2003-2007). Both wind roses exhibit a strong southerly wind component, although TBNG has more southwesterly winds and fewer northwesterly winds than the proposed project site. Figures 7 through 9 in Addendum 3.6-B show monthly wind roses for the project site. The predominant wind direction is southerly for all months except May, where south-southeasterly winds predominated. Based on the correlation between one year of on-site data and 5 years of data at the nearby TBNG, year 2010 appears to be typical of long-term wind conditions.

Despite the prevalence of southerly winds, the highest wind speeds at the Ross ISR site tend to occur from the northwest. This phenomenon is even more evident at the Gillette AP site during the same year of monitoring (Figure 10 in Addendum 3.6-B), and reinforced somewhat by the 5-year wind rose at Gillette AP (Figure 3.6-13). Northwest winds are generally associated with weather fronts moving through the region. During periods of fair weather, particularly in the summer months, high pressure located over the northern plains produces moderate south/southeasterly winds in the proposed project area. Synoptic weather systems generally interrupt this pattern, producing high north-northwesterly winds. Spring experiences the greatest variability in wind direction with secondary modes as a result of the synoptic scale transition period that occurs during this time. Low pressure regions develop on the lee side of the Rockies bringing southeasterly winds during storm development. As the low pressure systems form and move off with the general atmospheric flow, winds switch to a north-northwesterly direction.

The average wind speed for the proposed project site was over 11 mph during the 12 months of monitoring. Winds at the nearby TBNG site averaged 11.2 mph over the 5-year period studied. Figure 11 in Addendum 3.6-B compares on-site monthly average wind speeds with Gillette AP data for the same 12-month monitoring period. While the on-site wind speeds are slightly higher, they exhibit the same seasonal pattern observed at Gillette AP. These results indicate the on-site 2010 wind speed data are representative of long-term, regional conditions. The monthly average wind speeds at the project site and TBNG are shown in Figure 12 in Addendum 3.6-B. The graph shows higher wind speeds in the winter and spring, peaking in April.

Figure 13 in Addendum 3.6-B provides a breakdown of wind speeds by wind direction at the Ross ISR site. Winds blow most frequently from the southerly direction, as discussed above, while northwesterly winds tend to be the strongest. Easterly winds have the lowest average velocities. Figure 14 in Addendum 3.6-B shows the wind speed frequency distribution for the site. The cumulative distribution demonstrates that winds exceed 18 mph about 10% of the time, and they exceed 8 mph about 50% of the time. Figures 15 through 18 in Addendum 3.6-B present the same information as Figure 13 in Addendum 3.6-B, except on a quarterly basis.

The Joint Frequency Distribution (JFD) provides more detail on wind speed distribution by wind direction and atmospheric stability class (Table 2 in Addendum 3.6-B). Each entry in the table represents the fraction of the time the wind blows within the given stability class, wind speed range, and direction. Pasquill stability classes are determined using the standard deviation of horizontal wind direction (Sigma Theta) method.

The JFD shows the frequencies of hourly average wind speed for each direction based on atmospheric stability class. 62% of all winds at the project site fall into stability class D which represents near neutral to slightly unstable conditions. The light winds which accompany stable environments can be seen by the stability class F summary (stable), where wind speeds average less than 6.9 mph. Tables 3 through 6 in Addendum 3.6-B present the same information as Table 2 in Addendum 3.6-B, except by individual quarters.

Figure 19 in Addendum 3.6-B shows the on-site, diurnal variation in average wind speed by season. Daytime wind speeds average higher than nighttime wind speeds, and the difference is more pronounced during spring and summer than during winter and fall. This phenomenon is related to the difference in diurnal temperature swings and the degree of atmospheric mixing associated with each season.

3.6.1.2.4 Precipitation

Figure 20 in Addendum 3.6-B compares monthly precipitation at the project site during 2010 to average monthly precipitation at BSM over the previous 10-year period. On-site data reflect a wetter-than-normal early summer and a drier-than-normal fall. Figure 21 in Addendum 3.6-B shows monthly precipitation totals at the on-site and Gillette AP monitoring stations for the same 12-month monitoring period. While the Gillette AP site received more rain in May, precipitation for the rest of the year was comparable between the two sites.

3.6.1.2.5 Evaporation and Relative Humidity

An evaporation gauge was installed at the Ross ISR Project meteorological station in late June 2010. Evaporation data were collected from the time of installation to late October, when the gauge was decommissioned to prevent freeze-up. Figure 22 in Addendum 3.6-B shows average monthly evaporation for the Gillette AP site over a 22-year period. It also shows evaporation totals at the project site during 2010, for those months in which monitoring occurred. The monthly totals are very similar, indicating on-site pan evaporation rates can be expected to resemble regional evaporation rates.

Evaporation rates are related to surface air temperatures, water temperatures, wind speed and relative humidity. It has been shown that air temperatures and wind speeds in the project area are typical of the region as a whole. Water temperatures in the evaporation pan paralleled air temperatures. The graph in Figure 23 in Addendum 3.6-B compares the two temperatures. Pan temperature cycles tend to be smoother but often amplified due to mid-day solar radiation, and tend to lag behind the air temperature cycle due to the high specific heat of water.

Figures 1 and 2 in Addendum 3.6-B show the average on-site and Gillette AP relative humidities for 2010. These are 63.9% and 60.4% respectively, indicating that on-site data are fairly representative of the region. The on-site humidities may be slightly higher due to the Oshoto Reservoir located near the center of the proposed project area.

Figure 24 in Addendum 3.6-B graphs the on-site diurnal variation in average relative humidity by season. Summer and fall exhibit greater fluctuations in relative humidity due to the larger diurnal temperature swings and the direct relationship between the air temperature and the maximum amount of water vapor the air will hold.

3.6.1.3 Monitoring Site Justification and Specifications

The proposed project is situated in northeast Wyoming, with the foothills of the northern Black Hills a few miles to the east. The rationale for the meteorological monitoring site (MET) is documented in the Ross ISR Monitoring Plan (IML 2010a), which is included as Addendum 3.6-A. A map of all air monitoring locations relative to the project boundary is presented in Figure 3.6-19. The MET station appears in the upper left corner of the map.

Table 3.6-5 lists the meteorological instruments employed at the Ross ISR Project MET site. The table shows instrument models, accuracy specifications, and instrument heights above the ground. Figure 3.6-17 shows the monitoring tower and instruments, solar panels, and the evaporation gauge.

Meteorological data collection, management and reporting methods at the project site conform to NRC atmospheric dispersion modeling requirements for uranium milling operations, and meet the acceptance criteria established in the NRC's NUREG-1569. The on-site monitoring program was developed according to NRC Regulatory Guide 3.63, "Onsite Meteorological Measurement

Program for Uranium Recovery Facilities – Data Acquisition and Reporting." The meteorological monitoring program also meets WDEQ requirements for land and air quality permit applications and compliance. Hourly average values for wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation and evaporation are measured by field instruments and recorded by continuous data loggers, all operated and maintained by IML Air Science. Data recovery exceeded 95% for the 12-month monitoring period. All hourly data have been downloaded to IML Air Science's relational database. The database software provides for quality assurance, invalidation of suspect or erroneous data, and various forms of data analysis and presentation.

3.6.1.4 Upper Atmosphere Characterization

The nearest upper-air data available from the National Weather Service are from Rapid City, South Dakota, approximately 100 miles southeast of the proposed project area. Rapid City is approximately 1,000 ft lower in elevation than the proposed project area and is situated on the opposite side of the Black Hills. Therefore, upper-air data from Rapid City may be ill suited to represent the Ross ISR Project site.

WDEQ/AQD has provided statewide mixing heights to be used in dispersion modeling with the Industrial Source Complex (ISC3) model. These are based on the methods of Holzworth (1972) as applied to Lander, located in central Wyoming. For modeling purposes, the annual average mixing heights are assigned according to stability class as follows:

Class A	3,450 meters
Class B	2,300 meters
Class C	2,300 meters
Class D	2,300 meters
Class E	10,000 meters
Class F	10,000 meters

Stability classes E and F are given an arbitrarily high number to indicate the absence of a distinct boundary in the upper atmosphere.

In August of 2000, IML Air Science conducted SODAR (sonic detection and ranging) monitoring at the Black Thunder Mine (IML 2001), located approximately 80 miles south of the Ross ISR Project site. The purpose of this monitoring was to support a comprehensive study of NO_x dispersion characteristics following overburden and coal blasting events. The SODAR instrument provided 3D wind speeds, wind directions, temperatures, temperature gradients, and other atmospheric parameters as a function of height above the ground. The vertical range of the SODAR was 1,500 meters, with a sounding performed every 15 minutes. Each sounding resulted in a calculated "inversion height/mixing height" (the two terms are used interchangeably by the SODAR system supplier). These mixing heights were downloaded into a database and queried, with results shown in Table 3.6-6. Morning and afternoon time intervals were taken from EPA modeling guidance.

The SODAR definition of mixing height appears somewhat ambiguous, and these measurements were all taken in August. Therefore, they are presented here as an additional data source. It is recommended that the WDEQ/AQD mixing heights be used as direct meteorological inputs to the MILDOS-AREA model.

3.6.1.5 Bodies of Water and Special Terrain Features

There are two significant bodies of water that may affect the meteorology of the project site. The first is Keyhole Reservoir, located 20 miles south of the proposed project area, can hold approximately 100,000 acre-ft of water. It is fed and drained by the Belle Fourche River. The second is Oshoto Reservoir, located inside the proposed Ross ISR permit boundary. Evaporation from these reservoirs, coupled with predominant southerly breezes, could slightly influence relative humidity measurements in the proposed project area. As evidenced by the above discussion of relative humidity data, however, it is not likely that this influence is substantial.

The nearest mountain ranges to the project site are:

1) the Bighorn Mountains, approximately 100 miles to the west

2) the Black Hills, approximately 20 miles to the east

It is believed that the Black Hills exert some effect on the meteorology of the proposed project area. This may include shielding of easterly winds and channeling of predominant winds into a north-south pattern. As discussed above, the Black Hills also affect precipitation patterns. As storms track from west to east, upslope air movement near the Black Hills contributes to cooling of the air and moisture condensation.

3.6.1.6 Conclusion

The proposed project region lies in a semi-arid climate in the upper Northern High Plains. The landscape is composed of rolling hills, small drainages and ridges covered with native grasses, sparse sage brush, and some woody areas in the low lying valleys.

Data collected at the Ross ISR Project meteorological station, the TBNG meteorological station, the BSM meteorological station and the Gillette AP meteorological station were all analyzed in the site specific analysis. The TBNG site, located 18 miles west of the Ross ISR Project, was included to compare on-site wind data with the closest available wind data from a longer period of record. The TBNG site is located 18 miles west of the Ross ISR Project, with topographic features comparable to the proposed project area. The BSM and Gillette AP sites were included to supplement the TBNG site in cases where data from the latter were either invalid or not yet posted.

The region experiences average daily maximum temperatures near 90° in July and average daily minimum temperatures around 10° F in January. The site average temperature is expected to be 47° F with extremes of -25° to +100 F. The region is semi arid with annual average precipitation between 10 and 15 inches. Spring and early summer precipitation events are responsible for the majority of the yearly average.

The region is characterized by annual average wind speeds of 10 to 12 mph. Winds at the project site are expected to average about 11 mph annually, with summer averages dipping below 9 mph and winter averages reaching 12 mph. The predominant wind directions are from the south, south-southeast and north-northwest.

On-site monitoring during 2010 demonstrates that meteorological conditions in the area of the proposed project are very similar to conditions in the region as a whole. One possible exception is the prevailing wind direction, for which on-site monitoring shows a stronger southerly component than most of the monitoring stations in the region. This departure from regional conditions was somewhat unexpected, although it is supported by the 2003-2007 wind rose for TBNG. It also became the basis for revising the Ross ISR Project air monitoring plan, as discussed in Addendum 3.6-A.

3.6.2 Air Quality

The purpose of this section is to provide background information on air quality issues, including the regulatory framework and current regional air quality conditions, in the Ross ISR Project area. The regulatory background is presented in the context of both state and federal air quality standards and permitting requirements. Air quality in the proposed project area is summarized on the basis of extensive monitoring of regulated air pollutants. The Powder River Basin of northeastern Wyoming is one of the most heavily monitored regions in the country, and the northern portion of the Powder River Basin contains numerous air quality monitoring stations within a 50-mile radius of the Ross ISR Project.

3.6.2.1 Regulatory Background

Ambient air quality and air pollution emissions are regulated under federal and state laws and regulations. In Wyoming, the WDEQ/AQD is responsible for managing air quality through state regulations promulgated in the Wyoming Air Quality Standards and Regulations (WAQSR) and through the Wyoming State Implementation Plan (SIP). WDEQ/AQD has also been delegated authority by the EPA to implement federal programs of the CAA.

The WDEQ/AQD implements WAQSR and CAA requirements through various air permitting programs. A proponent initiating a project must undergo new source review and obtain a pre-construction permit or a permit waiver authorizing construction of the project. The permitting process can require Best Available Control Technology (BACT) analysis for both major and minor sources of air emissions. This process ensures that the project will comply with the air quality requirements at the time of construction. To ensure on-going compliance, WDEQ/AQD also implements an operating permit program that can require on-going monitoring of emissions sources and/or source control systems.

3.6.2.1.1 National Ambient Air Quality Standards

The CAA requires the EPA to establish NAAQS to protect public health and welfare. These standards define the maximum level of air pollution allowed in the ambient air. The Act established NAAQS for six pollutants, known as “criteria” pollutants, which “… cause or contribute to air pollution which may be reasonably anticipated to endanger public health or welfare and the presence of which in the ambient air results from numerous or diverse mobile or stationary sources." The six criteria pollutants are lead, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and particulate matter (PM_{10} and $PM_{2.5}$), where PM_{10} is coarse particulates with mean aerodynamic diameters less than 10 microns and $PM_{2.5}$ is fine particulates with a diameter of 2.5 microns or less.

The CAA and CAA Amendments allow states to promulgate additional ambient air standards that are at least as stringent, or more stringent, than the NAAQS. A list of the criteria pollutants regulated by the CAA, assumed background concentrations for the proposed project area, and the currently applicable NAAQS set by the EPA for each, are presented in Table 3.6-7. The Wyoming Ambient Air Quality Standards (WAAQS), set by the WDEQ/AQD, are also listed in this table. In some instances, the Wyoming standards are more stringent than the NAAQS, which apply nationwide.

During the new source review process, applicants must demonstrate that the facility will not cause or significantly contribute to exceedance of these standards. These demonstrations are made via atmospheric dispersion modeling or other means, including monitoring data approved by the WDEQ/AQD administrator.

3.6.2.1.2 Attainment/Non-Attainment Area Designations

Pursuant to the CAA, the EPA has developed a method for classifying existing air quality in distinct geographic regions known as air basins, or air quality control regions. For each federal criteria pollutant, each air basin (or designated portion of a basin) is classified as in "attainment" if the area has "attained" compliance with (that is, not exceeded) the adopted NAAQS for that pollutant, or is classified as in "non-attainment" if the levels of ambient air pollution exceed the NAAQS for that pollutant. Areas for which sufficient ambient monitoring data are not available to define attainment status are designated as "unclassified" for those particular pollutants.

States use the EPA method to designate areas within their borders as being in "attainment" or "non-attainment" with the NAAQS. Existing air quality throughout most of the Powder River Basin in Wyoming, including the proposed project area, is designated an attainment area for all pollutants. However, the town of Sheridan, Wyoming, located in Sheridan County about 120 miles northwest of the proposed project area, is a moderate non-attainment area for PM_{10} due to localized sources and activity within the town. There are no other non-attainment areas within 150 miles of the proposed project area.

3.6.2.1.3 Prevention of Significant Deterioration (PSD)

Under requirements of the CAA, the EPA has established PSD rules, intended to prevent deterioration of air quality in attainment (and unclassified) areas. Increases in ambient concentrations of NO_2, SO_2, and PM_{10} are limited to modest increments above the existing or “baseline” air quality in most attainment areas of the country (Class II areas discussed below), and to very small incremental increases in pristine attainment areas (Class I areas discussed below).

For the purposes of PSD, the EPA has categorized each attainment area within the United States into one of three PSD area classifications. PSD Class I is the most restrictive air quality category, and was created by Congress to prevent further deterioration of air quality in national and international parks, national memorial parks and national wilderness areas of a given size threshold which were in existence prior to 1977, or those additional areas which have since been designated Class I under federal regulations (40 CFR 52.21). All remaining areas outside of the designated Class I boundaries were designated Class II areas, which allow a relatively greater deterioration of air quality over that in existence in 1977, although still within the NAAQS. No Class III areas, which would allow further degradation, have been designated.

The federal land managers have also identified certain federal assets with Class II status as “sensitive” Class II areas for which air quality and/or visibility are valued resources.

The closest Class I area to the proposed Ross ISR Project is Wind Cave National Park in South Dakota, located about 100 miles east-southeast of the proposed project area. The next closest Class I area is the Badlands Wilderness Area, located about 120 miles to the southeast. The closest sensitive areas are the Class II Devils Tower National Monument, the Class II Cloud Peak Wilderness Area and the designated Class I Northern Cheyenne Indian Reservation (in Montana), which are approximately 10, 110 and 80 miles from the proposed project area, respectively.

PSD regulations limit the maximum allowable increase (increment) in ambient PM_{10} in a Class I airshed resulting from major stationary sources (new or modified) to 4 μg/m³ (annual geometric mean) and 8 μg/m³ (24-hour average). Increases in other criteria pollutants are similarly limited. Specific types of facilities listed in the PSD rules which emit, or have the potential to emit (PTE), 100 tons per year (tpy) or more of PM_{10} or other criteria air pollutants, or any other facility which emits, or has the PTE, 250 tpy or more of PM_{10} or other criteria air pollutants, are considered major stationary sources and must therefore demonstrate compliance with those incremental standards during the new source permitting process. However, fugitive emissions are not counted against the PSD major source applicability threshold unless the source is so designated by federal rule (40 CFR 52.21). Bentonite mines and surface coal mines in northeastern Wyoming have generally not been subject to permitting under the PSD regulations because the mine emissions fall below these applicability thresholds.

3.6.2.1.4 Best Available Control Technology (BACT)

All sources being permitted within Wyoming must meet state-specific BACT requirements, regardless of whether the source is subject to state/federal PSD review. During new source review, a BACT analysis is developed for the proposed project. The BACT analysis must evaluate all control options for relevant pollutants on the basis of technical, economic and environmental feasibility. BACT for mining operations in the Powder River Basin is largely dictated by categorical control requirements defined in the WAQSR. BACT decisions are mandated through the new source review pre-construction permit.

3.6.2.1.5 New Source Performance Standards (NSPS)

The NSPS are a program of "end-of-stack" technology-based controls/approaches required by the CAA and adopted by reference into the WAQSR. These standards, which apply to specific types of new, modified or re-constructed stationary sources, require the sources to achieve some base level of emissions control. In Wyoming these standards are typically less stringent than state-level BACT limits.

3.6.2.1.6 Federal Operating Permit Program

The CAA Amendments of 1990 required the establishment of a facility-wide permitting program for larger sources of pollution. This program, known as the Federal Operating Permit Program, or "Title V" (codified at Title V of the

1990 CAA Amendments), requires that "major sources" of air pollutants obtain a federal operating permit. Under this program, a "major source" is a facility that has the PTE more than 100 tpy of any regulated pollutant, 10 tpy of any single hazardous air pollutant (HAP), or 25 tpy or more of any combination of HAPs, from applicable sources. The operating permit is a compilation of all applicable air quality requirements for a facility and requires an ongoing demonstration of compliance through testing, monitoring, reporting and recordkeeping requirements. Fugitive emissions from mines do not contribute to the Title V applicability determination; only point sources are considered.

3.6.2.1.7 Summary of Pre-Construction Permitting Procedures

The WDEQ/AQD administers a permitting program to assist the agency in managing the state's air resources. Under this program, anyone planning to construct, modify, or use a facility capable of emitting designated pollutants into the atmosphere must obtain an air quality permit to construct. ISR uranium mines fall into this category. A new ISR facility, milling operation, or a modification to either of these, must be permitted by WDEQ/AQD, pursuant to the provisions of WAQSR Chapter 6, Section 2. Under these provisions, a successful permittee must demonstrate that it will comply with all applicable aspects of the WAQSR including state and federal ambient air standards.

When a permittee decides to construct a new ISR operation, or modify an existing operation so as to cause an increase in criteria pollutant emissions, they must submit an application, which is reviewed by WDEQ/AQD new source review staff and the applicable WDEQ/AQD field office. Typically, a company will meet with the WDEQ/AQD prior to submitting an application to determine issues and details that need to be included in the application. Such an application will include the standard application form, BACT measures that will be implemented, and an inventory of point and fugitive sources of the various regulated pollutants for the facility in question. In particular, emissions of oxides of nitrogen (NO_x) and particulates (PM_{10}) must be quantified. In some cases, WDEQ/AQD may require emissions inventories for other sources in the vicinity, and air quality modeling analyses addressing cumulative impacts in the region.

If modeling is required, it must address annual average impacts only. Short-term PM_{10} modeling is not required by WDEQ/AQD, nor does WDEQ/AQD consider it to be an accurate representation of short-term impacts. A memorandum of agreement between EPA Region VIII and the state of Wyoming (January 24, 1994) allows WDEQ/AQD to conduct monitoring in lieu of short-term modeling for assessing mining-related impacts in the Powder River Basin. WDEQ/AQD has generally required PM_{10} monitoring at surface coal mines in the Powder River Basin. It has not imposed monitoring requirements on bentonite mines or ISR facilities, which typically emit much lower quantities of particulates.

The permit application is reviewed by WDEQ/AQD to determine compliance with all applicable air quality standards and regulations. This includes review of compliance with emission limitations established by NSPS, review of compliance with ambient standards through modeling analyses, and establishment of control measures to meet BACT requirements. The WDEQ/AQD proposed permit conditions are sent to public notice for a 30-day review period after which a final decision on the permit is made (or a public hearing is held prior to a final permit decision).

3.6.2.2 Existing Air Quality

WDEQ monitors air quality through an extensive network of air quality monitors throughout the state. Particulate matter is generally measured as PM_{10}. The eastern portion of the Powder River Basin has an extensive network of PM_{10} monitors operated by the mining industry due to the density of coal mines in the region (Figure 3.6-20). There are also monitors in Sheridan, Gillette, Arvada and Wright, Wyoming.

This network is sited to measure ambient air quality and to infer impacts from specific sources. Source-specific monitors may also be used for developing trends in PM_{10} concentrations. WDEQ uses data from this monitoring network to identify potential air quality problems and to anticipate issues related to air quality. With this information, the WDEQ can stop or reverse trends that negatively affect the ambient air. Part of that effort has resulted in the formation of a coalition involving the counties, coal companies and CBNG operators to focus on minimizing dust from roads.

The WDEQ may also take enforcement action to remedy a situation where monitoring shows a violation of any standard. If a monitored standard is exceeded at a specific source, the state agency may initiate enforcement against that source. In those instances, the state agency may use a negotiated settlement agreement to seek corrective action.

WDEQ operates two visibility monitoring stations in the Powder River Basin, both of which are Interagency Monitoring of Protected Visual Environments (IMPROVE) sites. One of these sites, Thunder Basin National Grassland (TBNG), is located north of Gillette and roughly 18 miles west of the Ross ISR Project. This site includes a nephelometer, a transmissometer, an aerosol monitor (IMPROVE protocol), and meteorological instruments to measure wind speed, direction, temperature, and relative humidity. The site is also equipped with a digital camera and analyzers for ozone and nitrogen oxides (NO, NO_2, NO_x). The second visibility monitoring station is located west of Buffalo and includes a nephelometer, a transmissometer, an aerosol monitor (IMPROVE), meteorological instruments to measure wind speed, direction, temperature, and relative humidity, plus a digital camera.

Air quality monitoring equipment for NO_2 within the Powder River Basin includes a Wyoming Air Resources Monitoring System (WARMS) operated by the BLM to detect sulfur and nitrogen concentrations near Buffalo, Sheridan, and Newcastle and a National Atmospheric Deposition Program (NADP) monitoring system for precipitation chemistry in Newcastle. AQD operates ambient NO_x monitoring systems near the Belle Ayr and Antelope mines. An additional NO_x monitor is located at the Tracy Ranch near the Black Thunder mine.

3.6.2.2.1 Particulates

The federal and state standards for particulate matter pollutants are presented in Table 3.6-7.

3.6.2.2.1.1 Regional Particulate Concentrations – PM_{10}

WDEQ/AQD requires monitoring data to document the air quality at all of the Powder River Basin mines. Each mine monitored PM_{10} for a 24-hour period every six days at multiple monitoring sites through the end of 2001. This frequency was increased by the WDEQ/AQD to one in every three days at many sites beginning in 2002. Continuous PM_{10} monitoring in the Powder River Basin began in 2001 and the number of continuous monitors has increased steadily since. As a result, the eastern Powder River Basin is one of the most densely monitored areas in the country (See Figure 3.6-20). Table 3.6-8 uses the annual arithmetic average of all sites to summarize these data.

The long-term trend in particulate emissions was relatively flat from 1980 through 1998, despite a six-fold increase in coal production and a ten-fold increase in overburden stripping associated with coal mining. This relatively flat trend in particulate emissions is due in large part to the BACT requirements of the Wyoming air quality program. These control measures include watering and chemical treatment of roads, limiting the amount of area disturbed, temporary revegetation of disturbed areas to reduce wind erosion, and expedited final reclamation.

The increased PM_{10} concentrations in 1999 and 2000 (Table 3.6-8) may be related to drought conditions as well as increases in coal and overburden production at the Powder River Basin mines, and coincident increases in other natural resource development activities such as CBNG.

The average annual PM_{10} concentration increased from 15.3 $\mu g/m^3$ in 1997 to 24.4 $\mu g/m^3$ in 2000. The average monitored concentrations decreased to 19.6 $\mu g/m^3$ in 2004, but increased to 25.4 $\mu g/m^3$ by 2007.

County roads are also responsible for some portion of the fugitive dust related to transportation. To help address this problem, nearby Campbell County, CBNG and oil production companies and coal mine operators formed a coalition to implement the most effective dust control measures on a number of county roads. Measures taken have ranged from the implementation of speed limits to paving of heavily traveled roads. The coalition has utilized chemical treatments and alternative road surface materials to control dust as well as closing roads where appropriate or necessary and rebuilding existing roads to higher specifications. The coalition requested money from the Wyoming State Legislature to fund acquisition of Rotomill (ground up asphalt) to be mixed with gravel for use in treating some of the roads in the Powder River Basin. The Rotomill/gravel mixture has been demonstrated to be effective in reducing dust; the life of the mixture on treated roads is estimated to be from five to six years.

There are five surface coal mines within roughly 30 miles of the Ross ISR Project. PM_{10} compliance with the NAAQS and WAAQS 24-hour standards at these mines (and by inference, in the proposed project area) has been demonstrated using continuous PM_{10} monitors and high-volume samplers. Table 3.6-9 presents a summary of PM_{10} monitoring at the northernmost mine (Buckskin) during a recent, 8-year period (2002-2009). Table 3.6-10 summarizes results from the samplers in operation at the other four mines. As a result of these monitoring programs, all five mines have been deemed “in compliance” by WDEQ/AQD.

All of the mines operate in accordance with a Quality Assurance Project Plan specific to each mine. Tables 3.6-9 and 3.6-10 summarize the monitors that are currently or have been in operation at the five mines. The maximum and 2nd maximum annual PM_{10} results are also presented. It can be seen that among these mines the 24-hr PM_{10} NAAQS of 150 µg/m^3 was exceeded three times. The Wyodak mine recorded a value of 165 µg/m^3 in 2005. In 2007 the Rawhide and Eagle Butte mines recorded 178 µg/m^3 and 168 µg/m^3, respectively. All three values were deemed “Exceptional Events” by WDEQ/AQD due to high winds.

3.6.2.2.1.2 Regional Particulate Concentrations – $PM_{2.5}$

The WDEQ/AQD operates a $PM_{2.5}$ particulate sampler at Buckskin Mine’s North Tapered Element Oscillating Microbalance (TEOM) and meteorological monitoring site (Air Quality System (AQS) I.D. 560051899). This site is located approximately 30 miles west of the proposed project area. The sampler operates for 24 hours every 3rd day, according to AQD and EPA sampling guidelines. A summary of the last five years of monitoring is presented in Table 3.6-11.

It can be seen that annual ambient concentrations have averaged roughly one third of the annual $PM_{2.5}$ NAAQS. The maximum 24-hr concentration during the five-year period was 30.9 µg/m^3 in 2008, slightly lower than the 24-hr NAAQS of 35 µg/m^3.

According to a WDEQ/AQD-approved ambient air monitoring plan, the North TEOM site is positioned to measure particulate impacts from the Buckskin Mine, which produces approximately 27 million tons of coal per year. Therefore, the data in Table 3.6-11 include considerable particulate impacts from a nearby mining operation and do not represent the ambient air in the proposed project area. This monitor nevertheless demonstrates compliance with the NAAQS for $PM_{2.5}$.

3.6.2.2.2 Gaseous Pollutants

Aside from particulate emissions, other pollutants that have been extensively monitored near the proposed project area include oxides of nitrogen (NO_x) and ozone.

3.6.2.2.2.1 Regional NO_2 Concentrations

The criteria pollutant associated with NO_x is nitrogen dioxide. Federal and state standards for NO_2 are shown in Table 3.6-7 above. NO_2 is a product of incomplete combustion at sources such as gasoline- and diesel-burning engines or from mine blasting activities. Incomplete combustion during blasting may be caused by wet conditions, incompetent or fractured geological formations, deformation of bore holes, and other factors.

Annual mean NO_2 concentrations have been periodically measured in the Powder River Basin since 1975. The annual mean NO_2 concentrations recorded by those monitoring efforts have all been well below the 100 $\mu g/m^3$ standard. The highest annual mean concentration recorded to date was 22 $\mu g/m^3$ at two separate sites between March 1996 and April 1997. Monitored NO_2 concentrations in the Powder River Basin for a recent five-year period are summarized in Table 3.6-12. Figures 3.6-21 and 3.6-22 show the locations of the Belle Ayr and Antelope mine NO_x monitoring sites, both south of Gillette. The Tracy Ranch site is located roughly midway between these two, and about 80 miles south of the Ross ISR Project site.

EPA has recently adopted a new NO_2 standard which applies to the 98th percentile of the daily high hourly averages. The standard, along with related statistics from the TBNG site (see regional map, Figure 3.6-1), appears in Table 3.6-13. Of the NO_2 monitoring sites in northeast Wyoming, this site is closest to the proposed project area. Table 3.6-13 demonstrates that the maximum daily highs for each year, representing the 99th percentile, are still well below the standard of 0.100 ppm.

In the mid-to late-1990s, the Office of Surface Mining Reclamation and Enforcement (OSM) received complaints from several citizens about blasting clouds from several mines in the Powder River Basin. EPA expressed concerns that NO_2 levels in some of those blasting clouds may have been sufficiently high at times to cause human health effects. In response to those concerns, several studies have been conducted, the mines have modified their blasting techniques, and the WDEQ has imposed additional blasting restrictions at a limited number of mines.

In addition to the requirement for modified blasting practices, WDEQ/AQD requires modeling of annual average NO_2 impacts on ambient air as a condition for permitting any new or modified surface mine or large stationary emission source.

3.6.2.2.2.2 Regional Ozone (O_3) Concentrations

Ozone is a regulated air pollutant that can cause respiratory health effects in people with chronic respiratory problems. Although not one of the criteria pollutants, ozone develops in the atmosphere as a result of other pollutants such as NO_x and volatile organic compounds (VOCs) called precursors. In March 2008 the EPA promulgated a new NAAQS for ozone. The ozone standard was lowered from 0.08 ppm to 0.075 ppm based on the fourth highest 8-hour average value per year at a site, averaged over three years. Ozone readings have on occasion exceeded this new standard in the Upper Green River Basin of Wyoming where certain conditions promote ozone formation. These are believed to be strong temperature inversions, low winds, snow cover, bright sunlight and industrial emissions of VOCs and NO_x. As a result of the high ozone values and the recently lowered standard, on March 12, 2009, Governor Freudenthal submitted a recommendation to the EPA that the agency should designate the Upper Green River Basin as an ozone nonattainment area.

The northern Powder River Basin is still considered an ozone attainment area. Table 3.6-14 shows maximum, mean, and 4th highest daily maximum 8-hour averages for the last five years at a monitor 20 miles west of the proposed Ross ISR Project. While no violations occurred, it is apparent that ambient air in the proposed project area is close to the new ozone standard. This may reflect increased oil and gas activities in the area, increased ozone transport from other regions, or both.

Table 3.6-1. Meteorological Stations Included in Climate Analysis and Parameters Monitored

Name	**Agency**	**Lat**	**Long**	**Elev (ft)**	**Years Operation**	**Wind Speed**	**Wind Direction**	**Temp.**	**Precip.**	**Evap.**	**Relative Humidity**	**Snow**
Buckskin Mine	EPA	44.47	-105.55	4270	1986-2009	X	X	X	X			
Dry Fork Mine	EPA	44.36	-105.42	5910	1995-2009	X	X	X	X			
Thunder Basin	EPA	44.66	-105.29	3864	1999-2009	X	X				X	
Ross ISR	NRC	44.59	-104.98	4669	2010	X	X	X	X	X	X	
Gillette AP	NWS	44.34	-105.54	4354	1902-2009	X	X	X	X	X	X	X
Devils Tower	NWS	44.58	-104.71	3862	1959-2009			X	X			X
Weston	NWS	44.64	-105.30	3530	1951-2009			X	X			X
Moorcroft	NWS	44.27	-104.95	4262	1903-2009			X	X			
Gillette ESE	NWS	44.26	-105.49	4640	1931-2009			X				
Echeta	NWS	44.48	-105.90	4000	1949-2009			X	X			X
Biddle	NWS	45.09	-105.34	3330	1919-2009			X				
Albin	NWS	45.21	-104.26	3310	1945-2009			X	X			
Leiter	NWS	44.85	-106.29	4160	1945-2009			X	X			
Hulett	NWS	44.69	-104.60	3758	1945-2010			X	X			X
Sundance	NWS	44.41	-104.36	4200	1945-2010			X	X			X

Source: IML (2009a), IML (2010b), WRCC (2010), Curtis and Grimes (2007), WDEQ/AQD (2010)

Table 3.6-2. Annual and Monthly Temperature Statistics for Region

	Average Temperature (°F)			Minimum Temperature (°F)			Maximum Temperature (°F)		
MONTH	**BSM**	**DFM**	**Gillette AP**	**BSM**	**DFM**	**Gillette AP**	**BSM**	**DFM**	**Gillette AP**
Jan	25.2	26.9	26.8	-19.1	-14.4	-15.0	61.9	63.2	63.0
Feb	25.9	27.2	28.3	-22.4	-19.2	-21.0	64.2	62.5	64.0
Mar	33.5	34.6	36.1	-13.6	-10.3	-15.0	77.7	77.5	80.0
Apr	43.4	44.1	43.2	0.8	2.0	8.0	79.0	79.8	80.0
May	53.3	53.1	52.9	16.6	18.1	17.0	90.4	89.3	90.0
Jun	63.1	63.2	63.0	32.5	33.1	31.0	101.8	100.7	98.0
Jul	73.8	74.5	73.5	39.8	44.4	38.0	103.1	102.9	106.0
Aug	70.3	70.4	69.6	37.2	37.2	39.0	101.2	99.3	100.0
Sep	59.3	60.0	59.5	27.7	31.8	25.0	94.2	94.6	96.0
Oct	44.3	45.2	44.1	7.9	6.3	5.0	87.7	86.9	88.0
Nov	35.5	36.9	37.3	-7.0	-5.9	-9.0	75.6	76.4	76.0
Dec	24.3	26.1	23.6	-22.1	-19.8	-21.0	59.8	61.4	60.0
Year-Round	46.0	46.9	46.5	-22.4	-19.8	-21.0	103.1	102.9	106.0

Sources: IML (2009a), IML (2010b), WRCC (2010)
Note: see Table 3.6-1 for period of record

Table 3.6-3. Monthly and Annual Average Relative Humidity

MONTH	Average Relative Humidity (%)		Minimum Relative Humidity (%)		Maximum Relative Humidity (%)	
	TBNG	Gillette AP	TBNG	Gillette AP	TBNG	Gillette AP
Jan	68.4	61.4	36.3	12.0	95.1	92.0
Feb	69.5	64.5	37.3	12.0	94.7	96.0
Mar	65.2	61.2	23.3	9.0	97.5	100.0
Apr	61.9	60.8	23.0	9.0	96.3	100.0
May	62.9	62.5	34.1	14.0	94.6	100.0
Jun	58.9	59.2	28.7	7.0	91.9	100.0
Jul	45.4	46.7	17.0	5.0	91.2	97.0
Aug	46.7	47.9	21.6	5.0	86.8	96.0
Sep	52.9	49.7	17.6	4.0	94.4	100.0
Oct	62.0	63.2	24.1	5.0	98.5	100.0
Nov	64.8	56.8	36.5	11.0	94.9	96.0
Dec	69.5	64.3	42.5	8.0	90.8	96.0
Year-Round	60.7	58.2	17.0	4.0	98.5	100.0

Sources: WDEQ/AQD (2010), WRCC (2010)
Note: see Table 3.6-1 for period of record

Table 3.6-4. Gillette AP Monthly Wind Parameters Summary and Comparison to Nearby Mines (2000 through 2009)

	Average Wind Speed (mph)			Maximum Wind Speed (mph)		
MONTH	**BSM**	**DFM**	**Gillette AP**	**BSM**	**DFM**	**Gillette AP**
Jan	11.1	10.0	12.4	45.5	38.3	46.0
Feb	10.6	9.9	10.7	47.3	38.5	48.0
Mar	11.3	10.7	11.6	45.8	39.1	43.0
Apr	11.9	11.0	11.5	40.4	37.0	35.0
May	11.9	10.6	10.7	45.5	38.9	39.0
Jun	10.4	9.3	9.0	42.7	32.2	38.0
Jul	9.7	8.8	8.8	36.6	34.1	32.0
Aug	10.2	9.5	9.1	44.8	41.2	33.0
Sep	10.2	9.3	9.8	33.9	31.2	33.0
Oct	10.6	9.7	10.4	40.3	34.7	38.0
Nov	10.7	9.6	11.1	40.2	34.2	41.0
Dec	11.1	9.9	11.1	43.5	36.7	36.0
Year-Round	10.8	9.9	10.5	47.3	41.2	48.0

Sources: IML (2009a), WRCC (2010)

Table 3.6-5. Ross ISR MET Station Equipment List

Ross ISR Met Station					
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**	**Instrument Height**
Wind Speed	RM Young 05305 Winder Monitor AQ	0 to 112 mph	±0.4 mph or 1% of reading	0.9 mph	10 meters
Wind Direction	RM Young 05305 Winder Monitor AQ	0 to 360°	±3°	1.0 mph	10 meters
Temp.	Vaisalla HMP50-L15 Temp and RH Probe	-25° to 50° C	±0.5° C @ given range	-- ° C	2 meters
Relative Humidity	Vaisalla HMP50-L15 Temp and RH Probe	0 to 98%	±3% at 20 ° C	--	2 meters
Precip.	Hydrologic Services TB3/0.01P Tipping Bucket Rain Gauge	Temp: -20°to 50° C	±0.5% @ 0.5 in/hr rate	--	1 meter
Evaporation	Novalynx 255-100 Evaporation Gauge	0 to 944"	0.25%	--	1 meter
Evaporation Pan Temperature Gauge	Fenwal 107 Temperature Probe	-35° to 50° C	±0.2° C @ 0 - 60° C, ±0.4° C @ -35° C	--	1 meter
Data Logger	Campbell Scientific CR1000 Data Logger	--	--	--	--

Source: IML (2010a)

Table 3.6-6. Black Thunder SODAR Results

Time Period (Filtered)	Number of Data Points	Average Mixing / Inversion Height
Morning (2 am – 6 am)	193	641 meters
Afternoon (12 pm – 4 pm)	152	1,052 meters

Source: IML (2001)

Table 3.6-7. Assumed Background Air Pollutant Concentrations and Applicable Standards, in µg/m^3

Criteria Pollutant	Averaging Time[1]	Background Concentration	Primary NAAQS[2]	Secondary NAAQS[2]	WAAQS	PSD Class I Increments	PSD Class II Increments
Carbon	1-hour	3,336[4]	40,000	40,000	40,000	---	---
Monoxide	8-hour	1,381	10,000	10,000	10,000	---	---
Nitrogen	Annual	5[5]	100	100	100	2.5	25
Dioxide	1-hour	16[5]	187	---	---	---	---
Ozone	8-hour	70[6]	157	157	157	---	---
Sulfur	1-hour	162[7]	200	---	---	---	---
Dioxide	3-hour	181[7]	----	1,300	1,300	25	512
	24-hour	62[7]	365	---	260	5	91
	Annual	13[7]	80	---	60	2	20
PM_{10}[8]	24-hour	54[9]	150	150	150	8	30
	Annual	13[9]	---	---	50	4	17
$PM_{2.5}$[8]	24-hour	13[10]	35	35	65	---	---
	Annual	4[10]	15	15	15	---	---

Notes:

1. Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year
2. Primary standards are designed to protect public health; secondary standards are designed to protect public welfare. Source EPA (2010b)
3. All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD Increment Consumption Analysis.
4. Data collected by Amoco at Ryckman Creek for an eight-month period during 1978-1979, summarized in Riley Ridge EIS (BLM 1983).
5. Data collected at Thunder Basin National Grassland, Campbell County, Wyoming in 2002.
6. Data collected at Thunder Basin National Grassland, Campbell County, Wyoming in 2002-2004 (8-hour 4th high).
7. Data collected by Black Hills Power & Light at Wygen 2, Campbell County, Wyoming in 2002.
8. On October 17, 2006, EPA published final revisions to the NAAQS for particulate matter that took effect on December 18, 2006. The revision strengthens the 24-hour $PM_{2.5}$ standard from 65 to 35 µg/m^3 and revokes the annual PM_{10} standard of 50 µg/m^3. The State of Wyoming will enter into rulemaking to revise the WAAQS.
9. Data collected at the Eagle Butte Mine, Campbell County, Wyoming in 2002.
10. Data collected at the Buckskin Mine in 2002.

Table 3.6-8. Summary of PM_{10} Monitoring in Wyoming's Powder River Basin

	μg/m³ from 1997 to 2007	
Year	**Number of Monitors**	**Average Concentration**
1997	18	15.3
1998	19	15.8
1999	20	21.4
2000	23	24.4
2001	28	23.4
2002	32	21.9
2003	34	20.8
2004	36	19.6
2005	36	21.1
2006	36	23.9
2007	35	25.4

Source: EPA (2010c)

Table 3.6-9. Buckskin Mine Annual PM_{10} Monitoring Results

Year	Quarter	North Avg	North High	North 2nd High	West Avg	West High	West 2nd High	MM Tons Coal	MM BCY Overburden
2002	1	14.9	37.5	34.1	12.9	34.9	30.9		
	2	20.0	95.7	73.4	18.3	60.9	43.4		
	3	25.1	181.7	71.0	21.9	70.5	57.9		
	4	11.1	29.3	22.6	11.5	25.7	23.3		
	Annual	17.8	181.7	95.7	16.2	70.5	60.9	18.3	36.5
2003	1	10.9	35.1	29.8	10.7	49.7	23.4		
	2	15.6	56.3	42.7	14.2	41.3	39.2		
	3	29.2	77.6	76.9	26.5	80.1	63.0		
	4	15.1	47.6	40.3	18.0	202.4	139.1		
	Annual	17.7	77.6	76.9	17.4	202.4	139.1	17.5	31.9
2004	1	14.5	53.7	47.5	13.4	47.3	41.4		
	2	18.7	116.3	41.1	16.8	74.9	33.3		
	3	20.1	42.3	40.2	17.7	38.5	33.7		
	4	13.6	40.1	33.8	11.7	27.7	25.6		
	Annual	16.7	116.3	53.7	14.9	74.9	47.3	20.3	29.5
2005	1	14.0	78.5	47.0	12.7	48.5	30.9		
	2	16.4	68.8	58.7	14.9	48.5	46.6		
	3	25.3	60.0	51.6	24.4	61.1	53.8		
	4	13.1	42.2	41.3	12.3	57.1	32.8		
	Annual	17.2	78.5	68.8	16.1	61.1	57.1	19.6	26.1
2006	1	13.1	41.9	38.3	14.7	54.1	47.2		
	2	21.7	72.1	60.7	19.0	58.6	49.6		
	3	34.2	101.4	84.7	28.5	63.7	58.5		
	4	16.9	63.6	58.2	14.1	39.0	34.5		
	Annual	21.5	101.4	84.7	19.1	63.7	58.6	22.8	27.1
2007	1	18.9	244.0	59.9	17.0	177.7	62.9		
	2	20.2	102.5	59.0	19.6	75.3	54.5		
	3	40.2	107.3	84.6	31.1	72.5	68.9		
	4	18.4	75.6	65.9	13.6	53.7	42.8		
	Annual	24.4	244.0	107.3	20.3	177.7	75.3	25.3	31.7
2008	1	14.9	81.0	66.5	13.3	58.8	47.4		
	2	17.7	53.0	46.9	15.8	46.1	38.6		
	3	38.6	96.6	82.2	25.8	60.1	50.8		
	4	26.3	91.7	78.7	16.2	77.5	55.7		
	Annual	24.4	96.6	91.7	17.8	77.5	60.1	26.1	50.8
2009	1	18.8	70.3	66.3	10.7	37.0	28.2		
	2	19.2	67.5	62.4	13.4	30.6	30.1		
	3	28.6	102.2	81.2	23.0	50.6	45.5		
	4	18.5	61.3	58.3	12.7	65.9	57.5		
	Annual	21,3	102.2	81.2	15.0	65.9	57.5	25.4	60.9

Source: IML (2009b)

Table 3.6-10. Northern Powder River Basin Mines Annual PM_{10} Monitoring Results

Year	Mine Sampler	Dry Fork DF-1	Dry Fork DF-3N & 3M	Eagle Butte EB-2	Eagle Butte EB-5	Eagle Butte EB-3N & 3S	Rawhide Hilltop (TEOM)	Rawhide North (TEOM)	Wyodak Site 1	Wyodak Site 4 (TEOM)
2002	Max 24-hr	85	49	143	54	74	N/A	N/A	52	N/A
	2nd High 24-hr	79	34	66	36	66	N/A	N/A	48	N/A
2003	Max 24-hr	96	45	65	47	76	N/A	N/A	52	N/A
	2nd High 24-hr	95	33	61	34	76	N/A	N/A	50	N/A
2004	Max 24-hr	73	25	62	40	66	61	43	79	131
	2nd High 24-hr	70	24	61	33	64	39	42	62	92
2005	Max 24-hr	113	29	60	49	115	76	61	129	165*
	2nd High 24-hr	107	27	53	48	85	70	59	69	126
2006	Max 24-hr	112	68	73	47	99	72	78	96	143
	2nd High 24-hr	103	44	60	46	93	72	75	71	95
2007	Max 24-hr	109	44	168*	41	144	107	178*	143	129
	2nd High 24-hr	101	40	65	39	139	101	84	100	122
2008	Max 24-hr	74	28	69	49	91	104	66	91	123
	2nd High 24-hr	72	28	67	41	82	91	65	83	103
2009	Max 24-hr	28	24	64	26	61	84	110	101	96
	2nd High 24-hr	26	23	49	22	58	72	69	91	72

*Exceeded 24-hr standard of 150 µg/m^3; WDEQ/AQD deemed Exceptional Event due to high winds
N/A – Sampler not installed
Source: IML (2009b)

Table 3.6-11. Ambient $PM_{2.5}$ Concentrations at Buckskin Mine ($\mu g/m^3$)

Year	Average $PM_{2.5}$	Annual $PM_{2.5}$ NAAQS Standard	Max 24-hr $PM_{2.5}$	24-hr NAAQS Standard
2005	5.1	15	14.2	35
2006	5.2	15	26.9	35
2007	5.3	15	20.7	35
2008	6.2	15	30.9	35
2009	6.2	15	15.9	35

Source: EPA (2010c)

Table 3.6-12. Average Annual Ambient NO_2 Concentrations (μg/m^3)

Year	Antelope Mine	Belle Ayr Mine	TBNG	Campbell Co.	Tracy Ranch
2003	7.5	13.2	5.6	13.2	
2004	2.9	10.3	3.8	9.4	5.5
2005	5.5	9.5	8.4	7.5	7.2
2006	5.1	14.4	8.1	5.7	11.2
2007			3.8	7.5	6.9
2008			8.0	19.7*	
2009	2.7	27.4	7.8	17.6*	17.0*

* Average of daily maximum 1-hour averages
Sources: EPA (2010c), IML (2009b) with unit conversions

Table 3.6-13. Thunder Basin National Grassland Daily High 1-Hour NO_2 Monitoring Results

Year	**Max Daily High**[1]	**Avg Daily High**[1]	**NAAQS**[2]
2005	0.021	0.005	0.100
2006	0.032	0.004	0.100
2007	0.021	0.004	0.100
2008	0.014	0.004	0.100
2009	0.014	0.004	0.100

1 Units are parts per million – Source: EPA (2010c)
2 National standard based on 98th percentile
Source: EPA (2010c)

Table 3.6-14. Thunder Basin National Grassland Ozone Monitoring Results

Year	Max Daily 8-hr High[1]	Mean Daily 8-hr High[1]	4th High Daily 8-hr High[1]	NAAQS[2]
2005	0.068	0.042	0.063	0.075
2006	0.075	0.045	0.072	0.075
2007	0.081	0.044	0.072	0.075
2008	0.078	0.049	0.074	0.075
2009	0.071	0.047	0.062	0.075

1 Units are parts per million (ppm) – Source: EPA (2010c)
2 National standard based on 8-hr rolling average

Figure 3.6-1. NWS, IMPROVE Site and Coal Mine Meteorological Stations

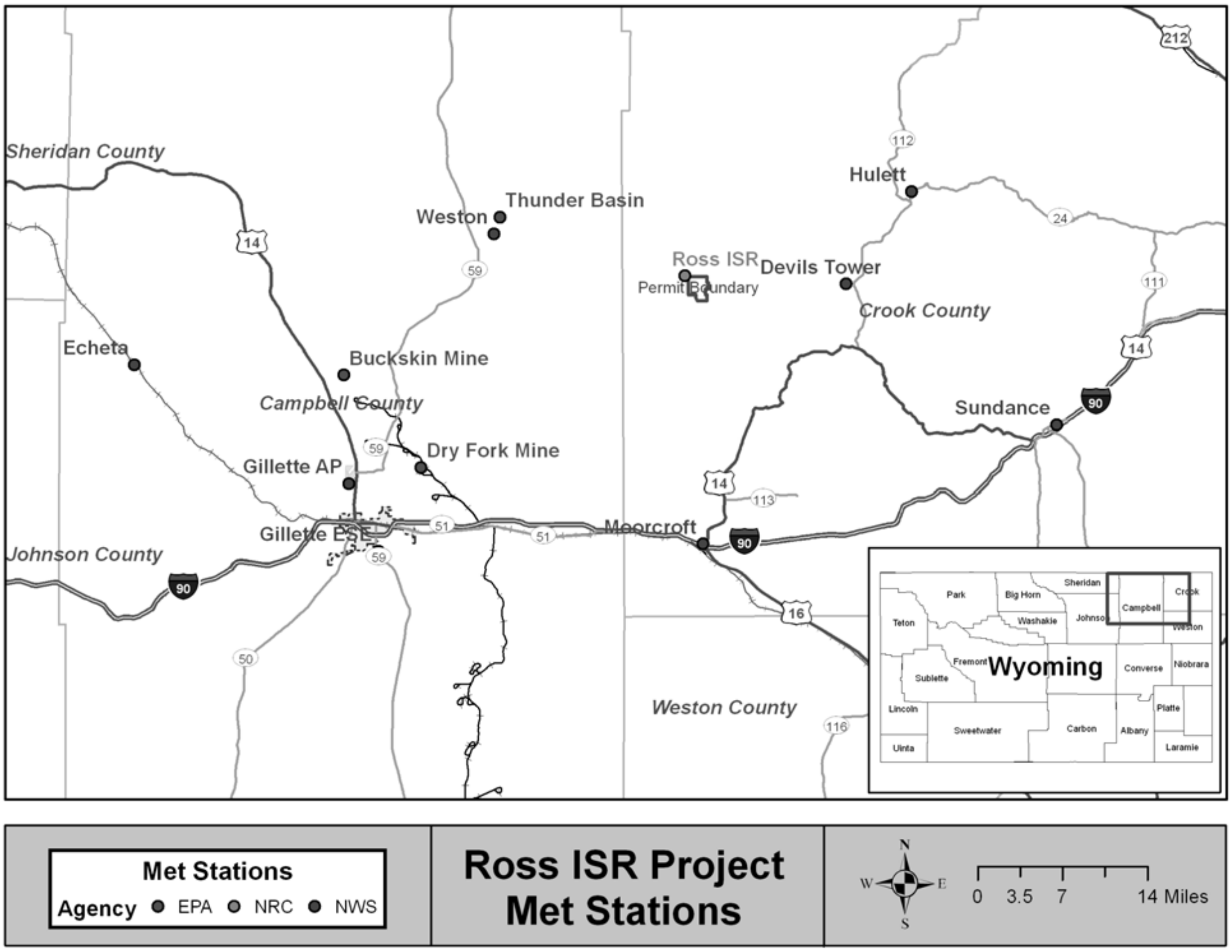


Figure 3.6-2. Regional Average Temperatures
Sources: IML (2009a), WRCC (2010)

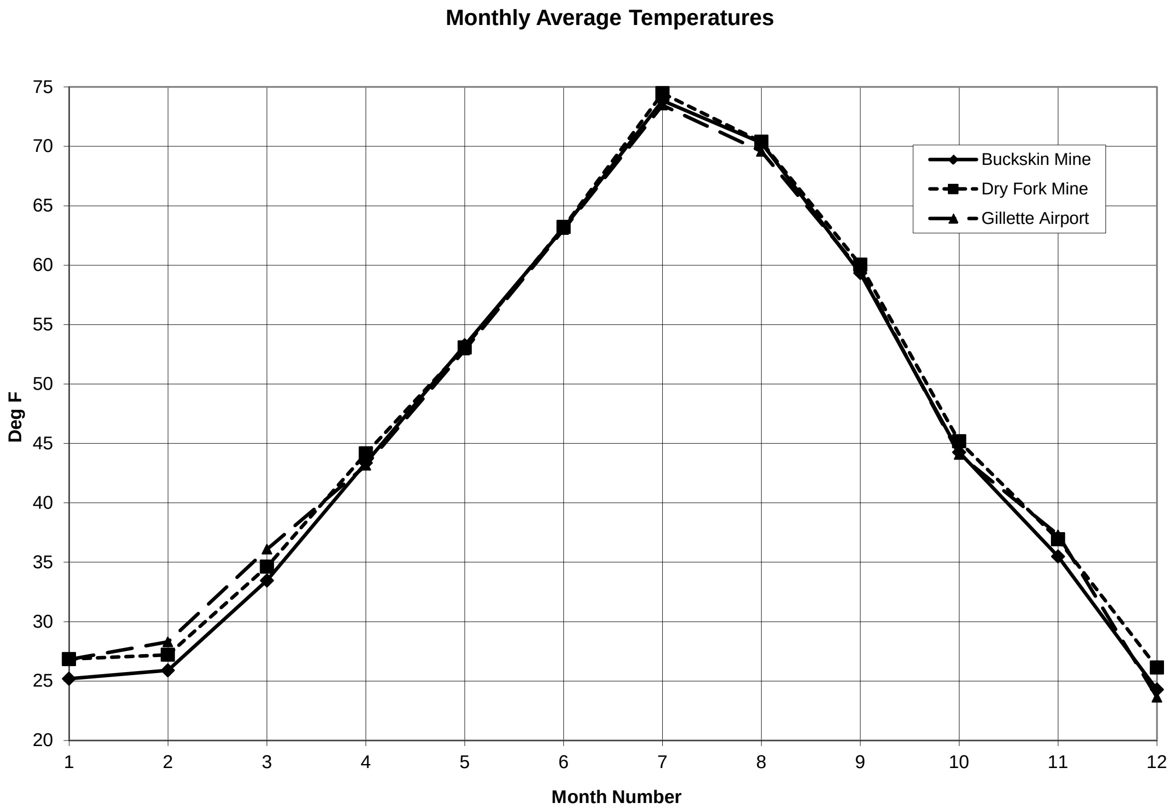


Figure 3.6-3. Buckskin Mine Monthly Diurnal Temperature Variations (From 2000 through 2009)
Source: IML (2009a)

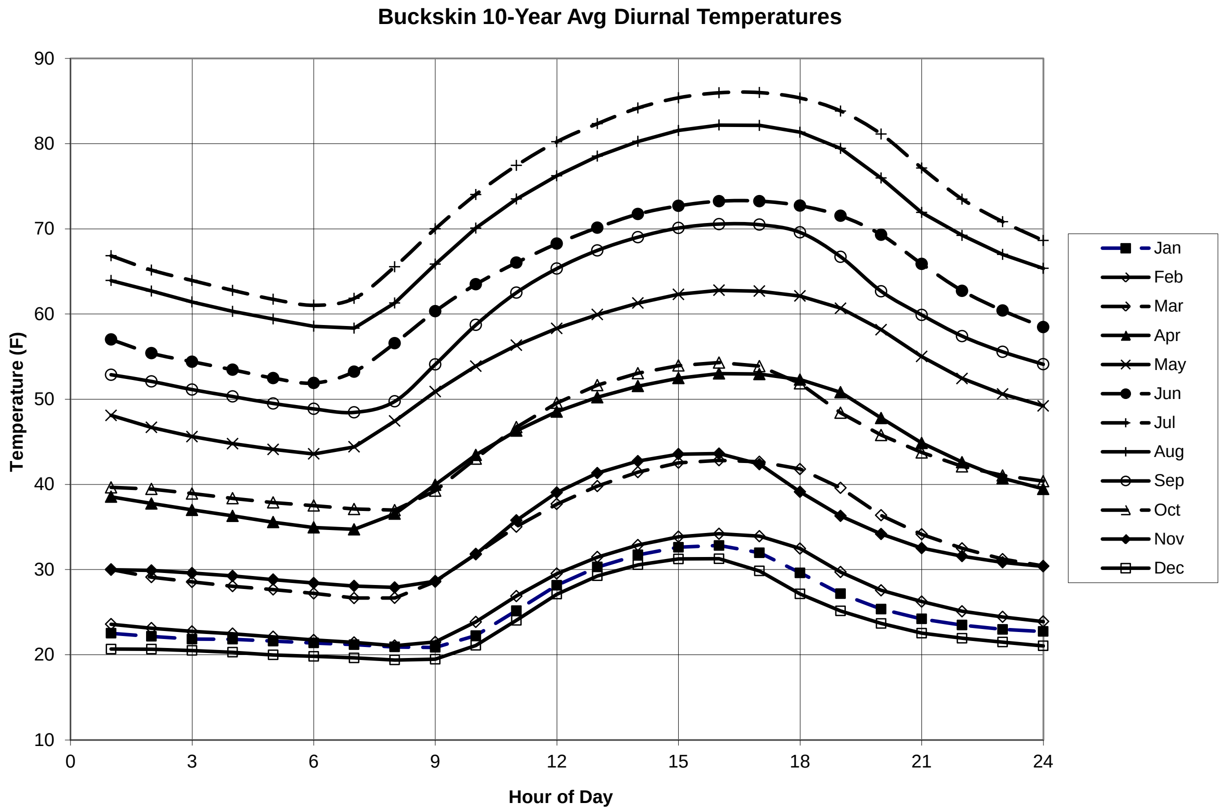


Figure 3.6-4. Regional Annual Average Minimum Temperatures
Source: WRCC (2010)

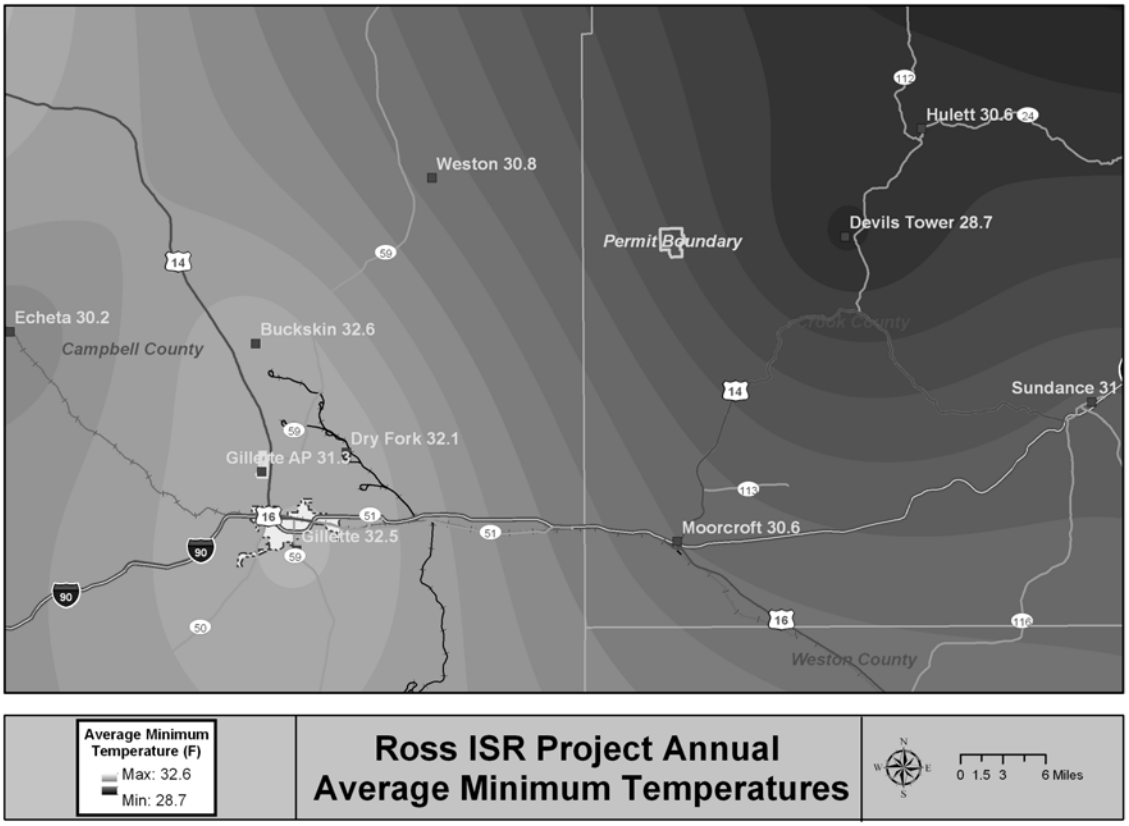


Figure 3.6-5. Regional Annual Average Maximum Temperatures
Source: WRCC (2010)

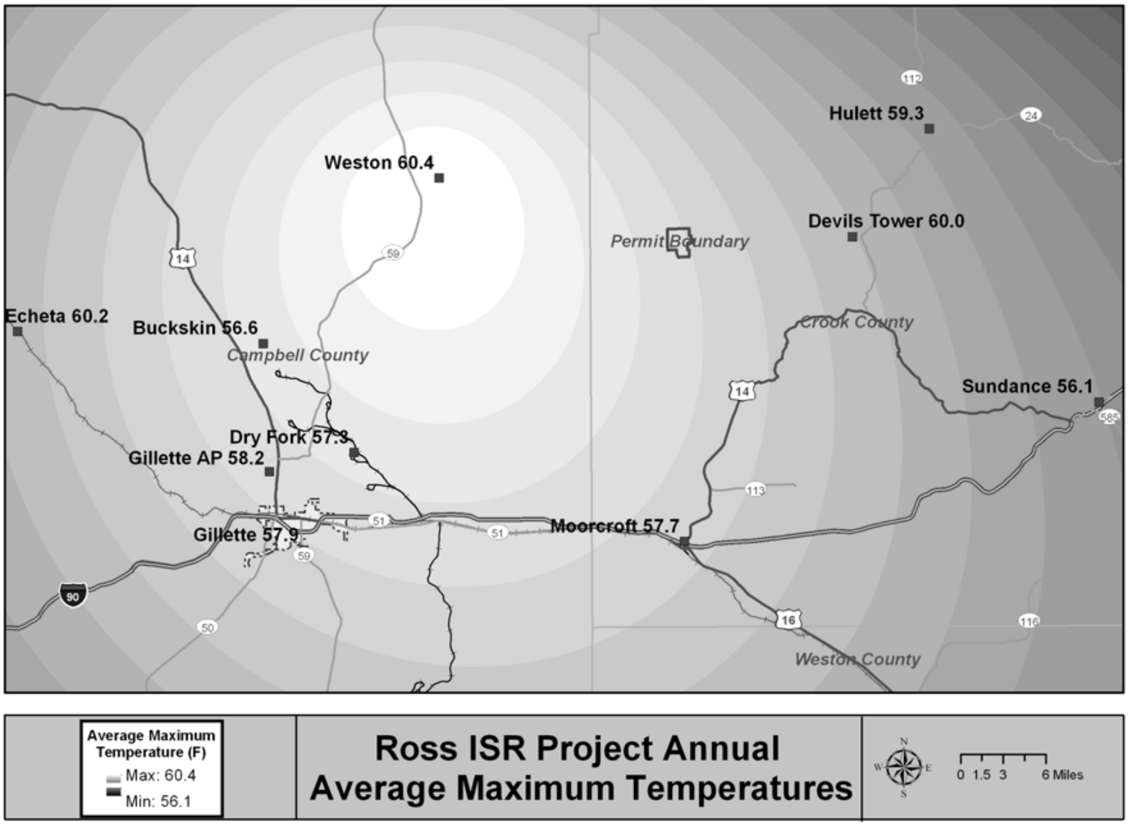


Figure 3.6-6. Mean Monthly Relative Humidity for Gillette AP and TBNG
Sources: WRCC (2010), WDEQ/AQD (2010)

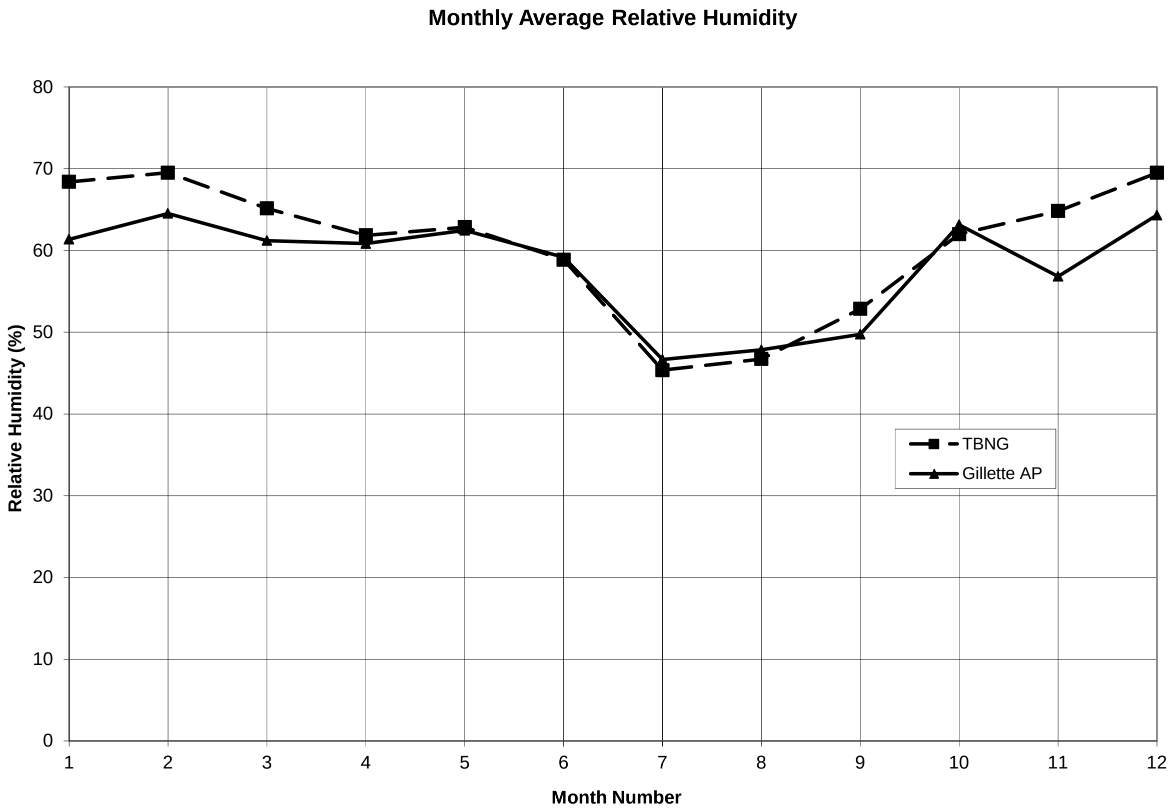


Figure 3.6-7. Diurnal Average Relative Humidity for Gillette AP
Source: WRCC (2010)

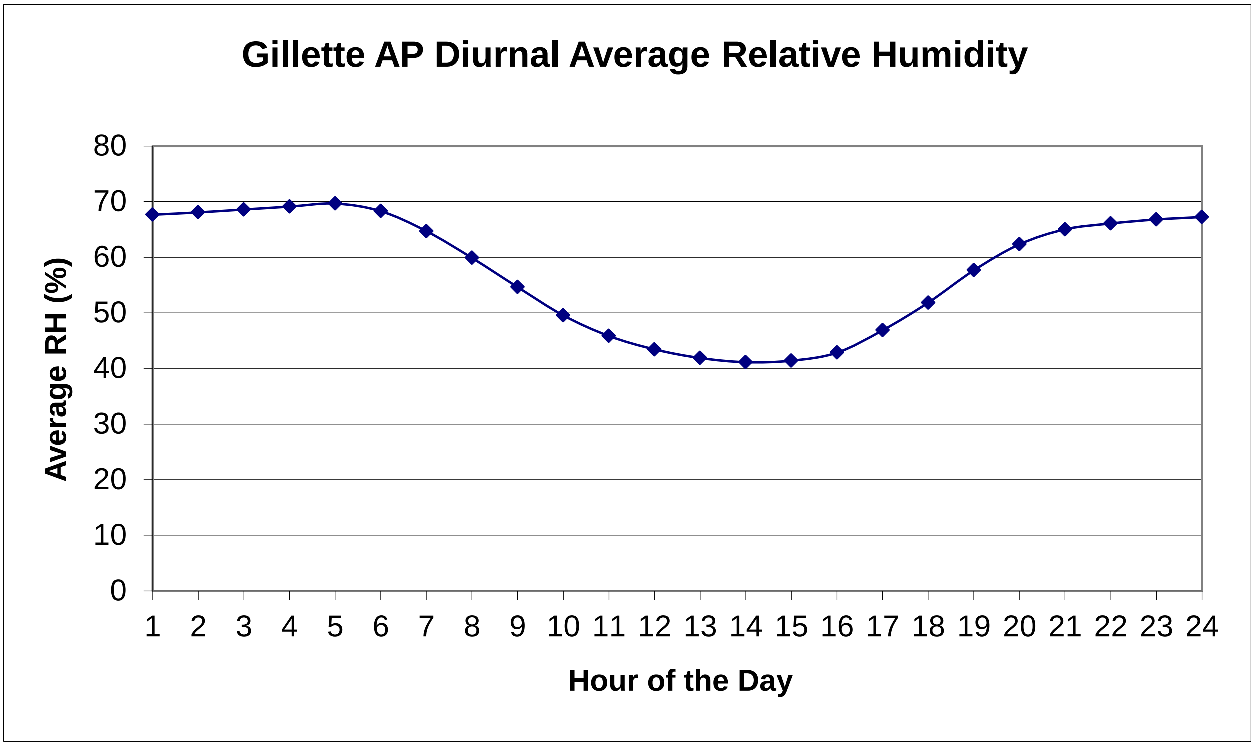


Figure 3.6-8. Regional Annual Average Precipitation
Source: WRCC (2010)

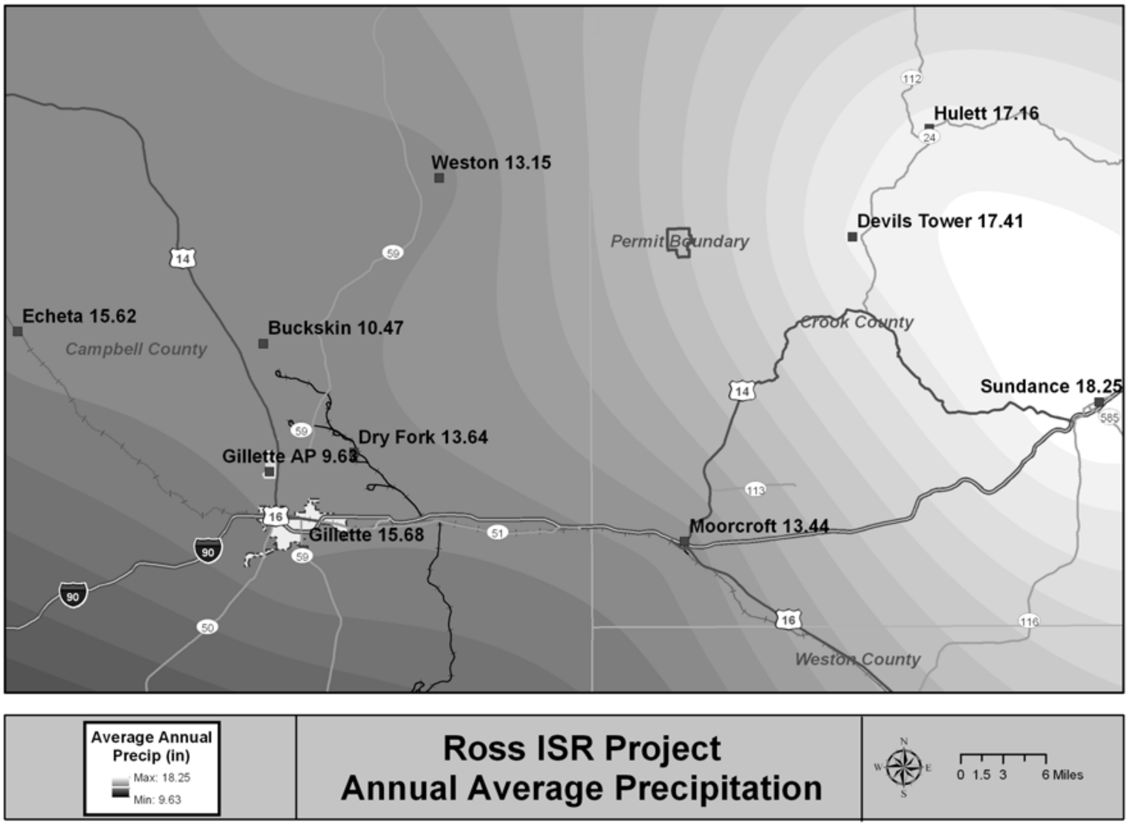


Figure 3.6-9. Gillette AP Monthly Average Precipitation
Source: WRCC (2010)

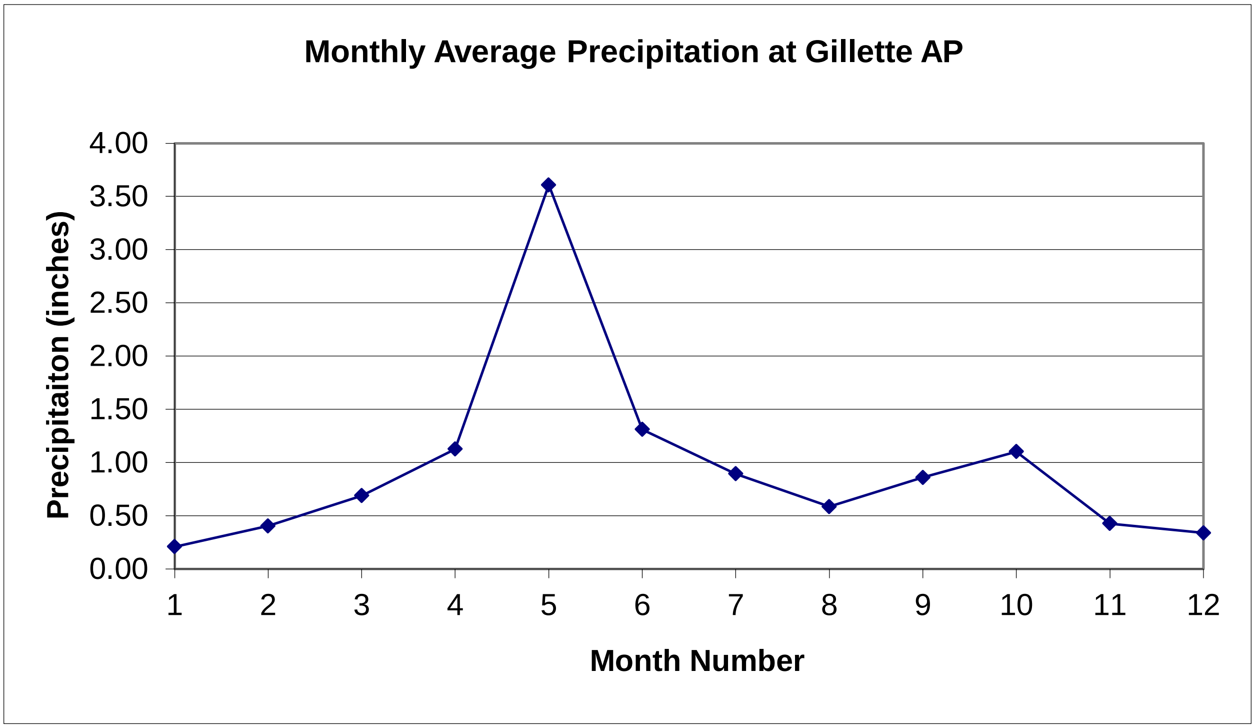


Figure 3.6-10. NWS Station Monthly Snowfall Averages
Source: NCDC (2007)

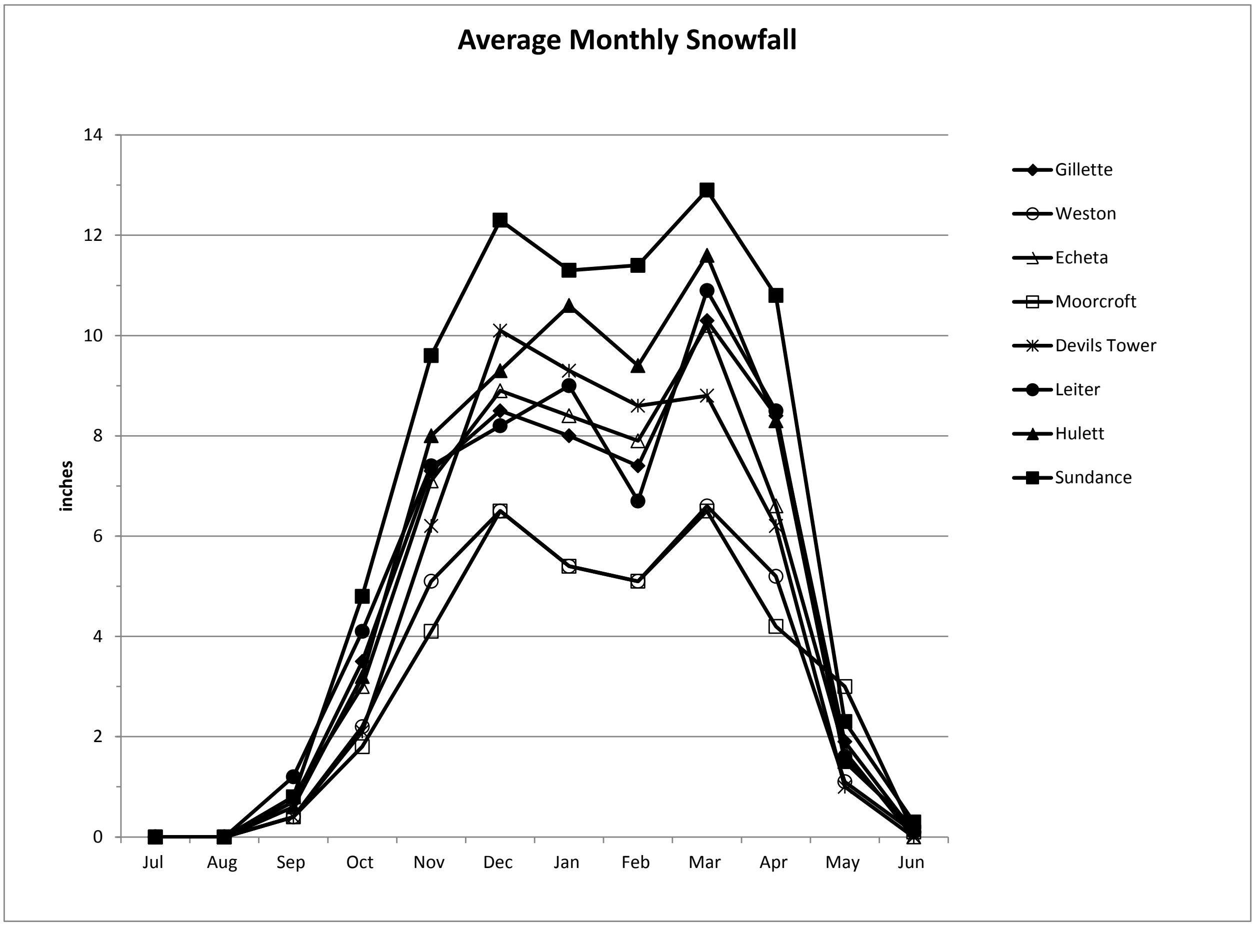


Figure 3.6-11. Regional Annual Average Snowfall
Source: WRCC (2010)

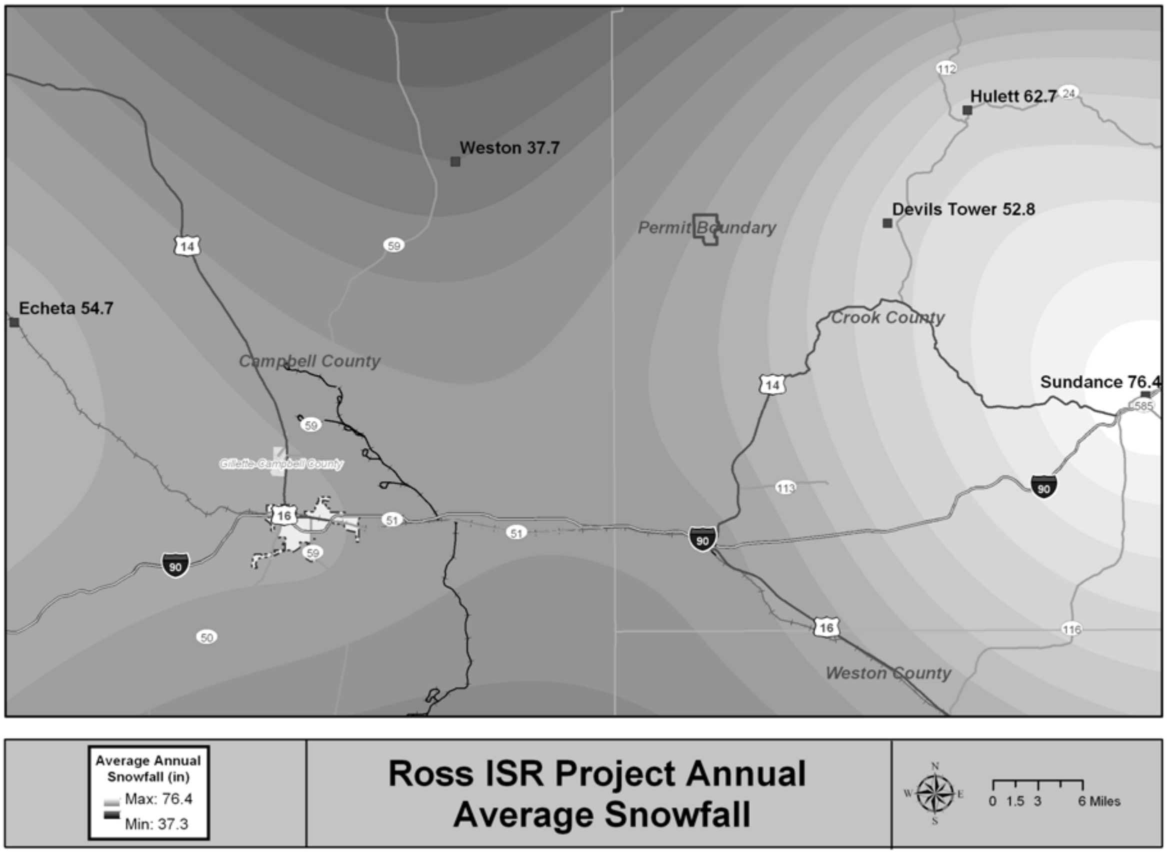


Figure 3.6-12. Regional Wind Speeds by Month
Sources: IML (2009a), WRCC (2010)

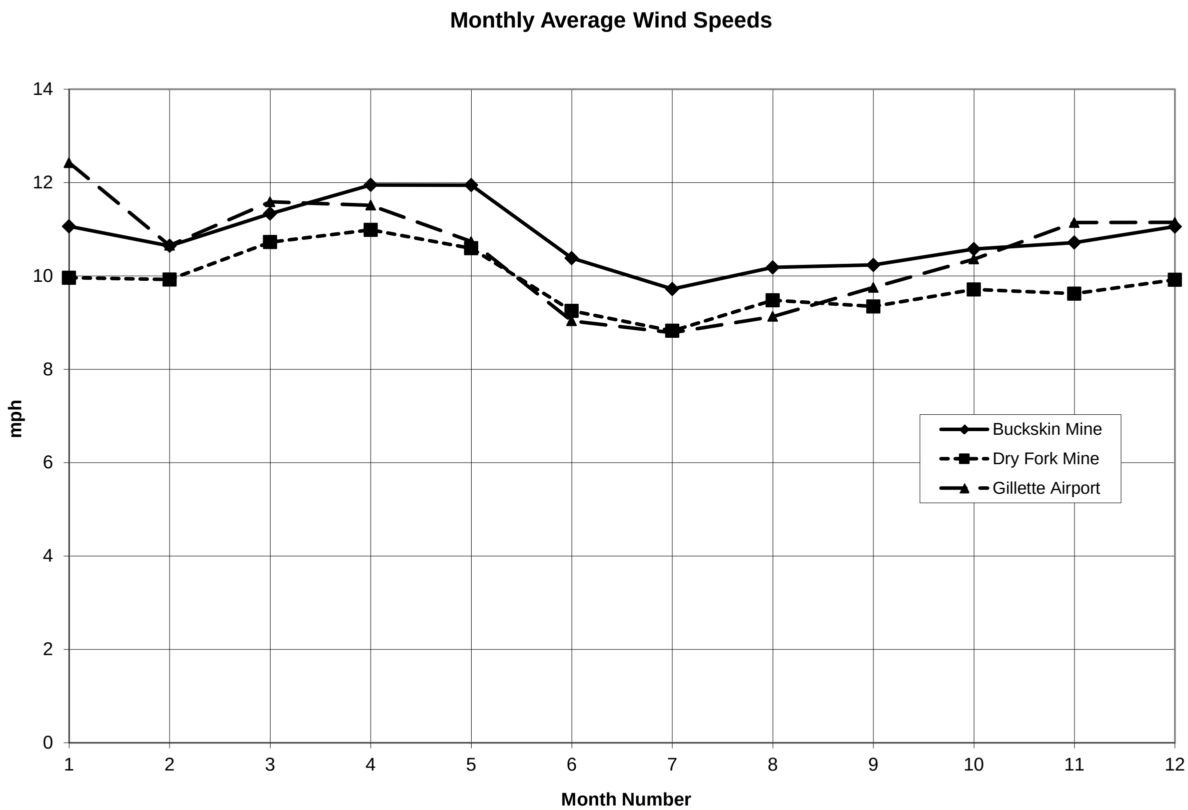


Figure 3.6-13. Gillette AP 5-Year Wind Rose
Source: WRCC (2010)

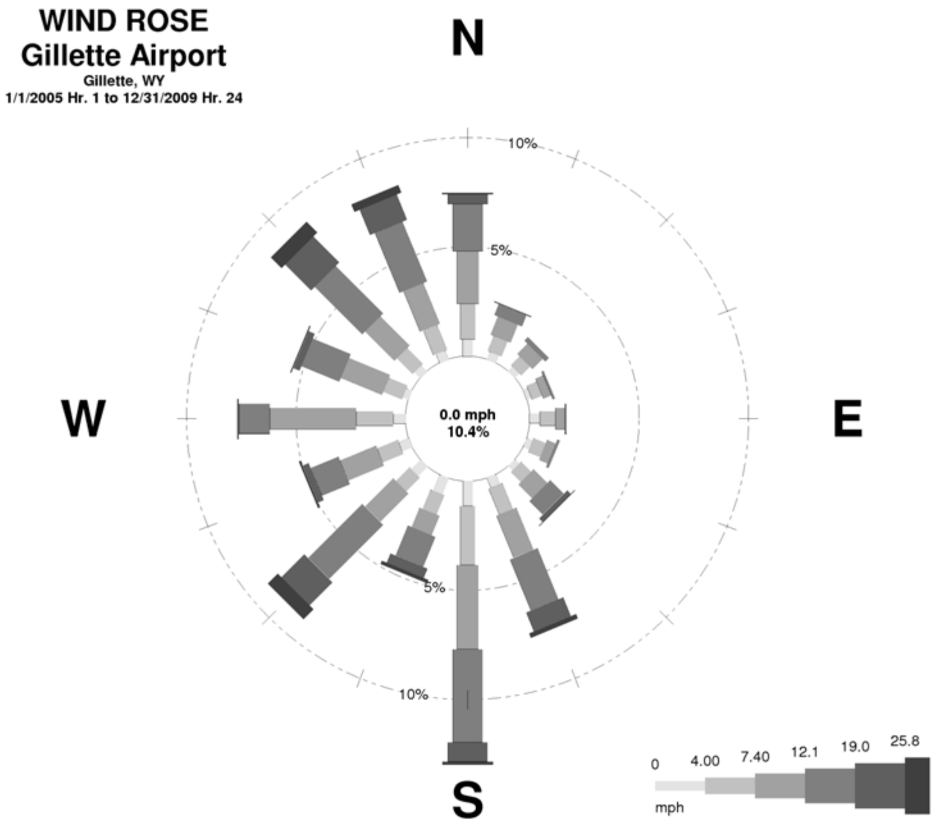


Figure 3.6-14. Buckskin Mine 5-Year Wind Rose
Source: IML (2009a)

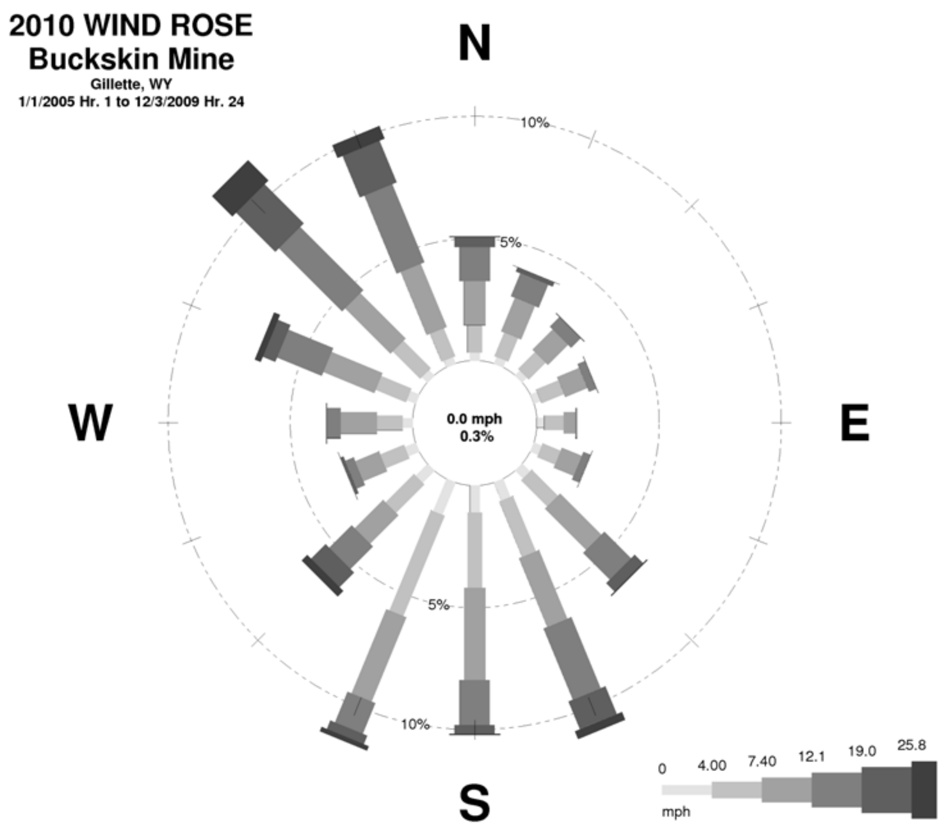


Figure 3.6-15. DFM 5-Year Wind Rose
Source: IML (2009a)

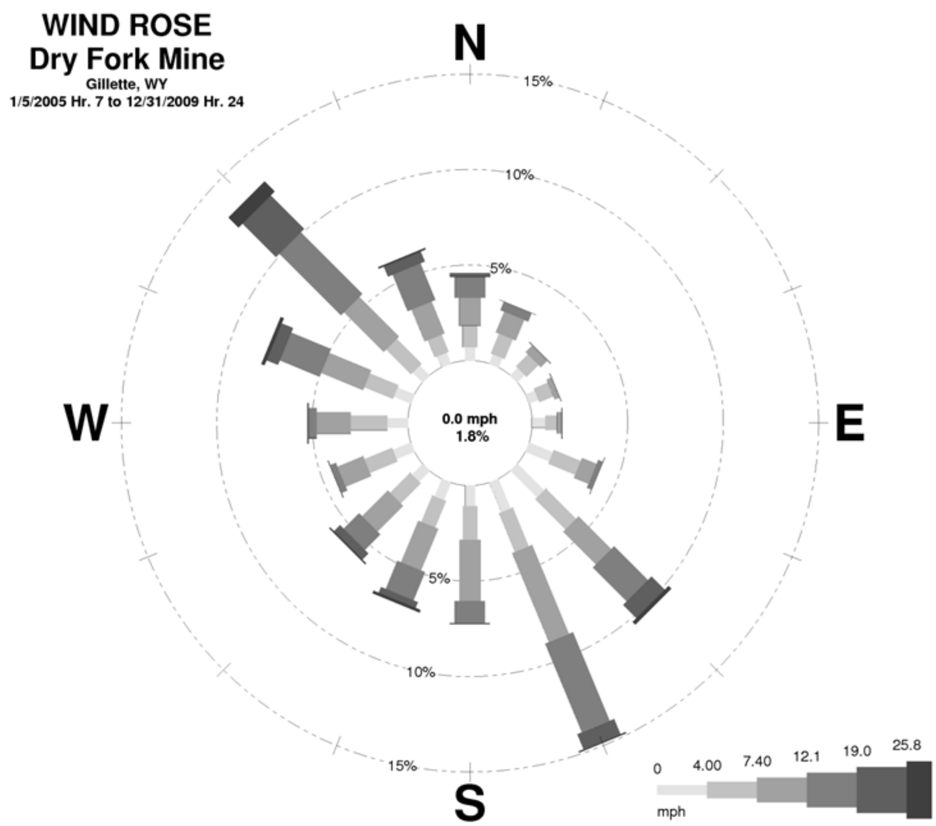


Figure 3.6-16. Gillette Airport Cooling, Heating, and Growing Degree Days
Source: WRCC (2009)

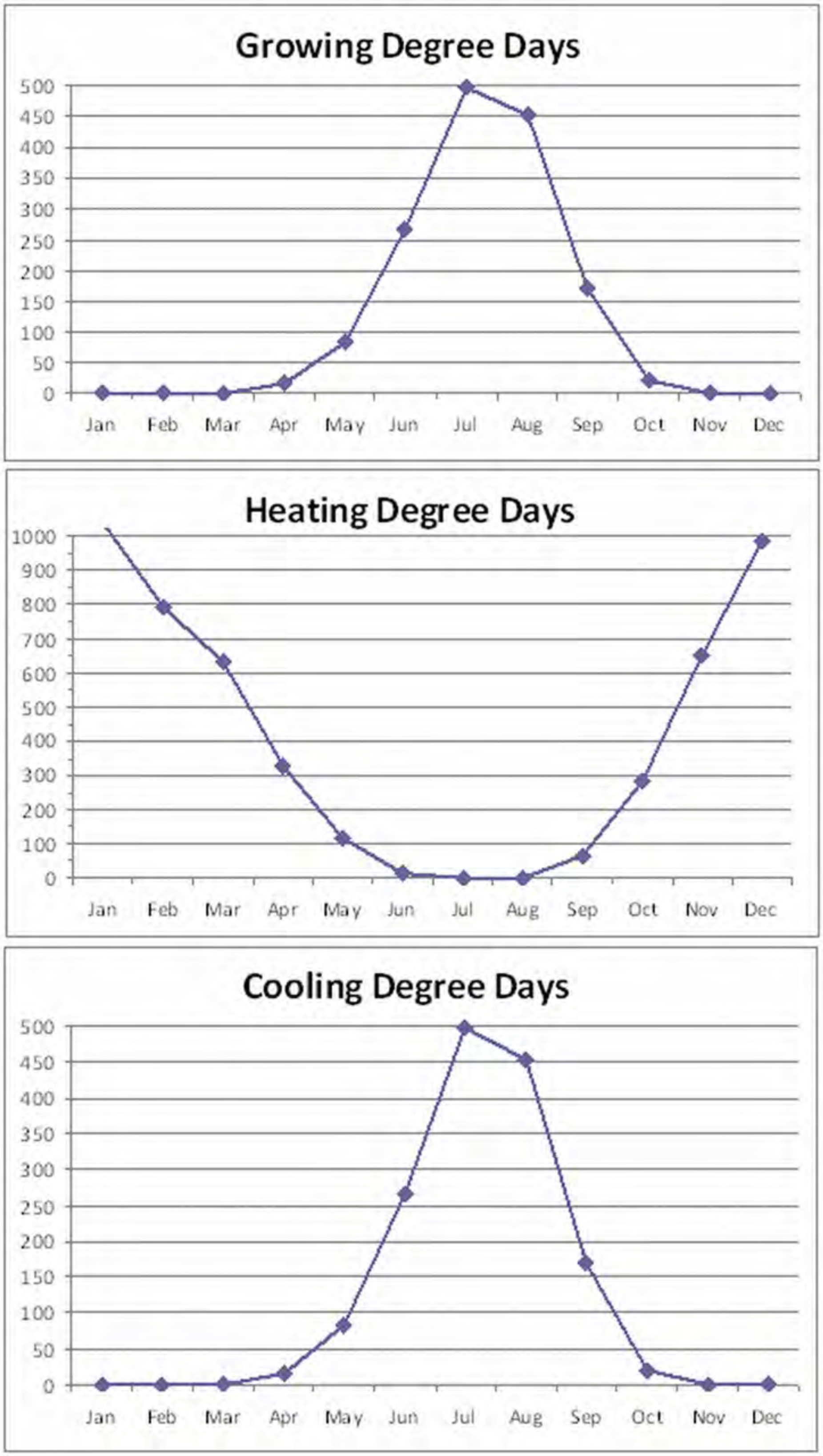


Figure 3.6-17. Ross ISR Project Meteorological Monitoring Station

Figure 3.6-18. TBNG Wind Rose
Source: WDEQ/AQD (2010)

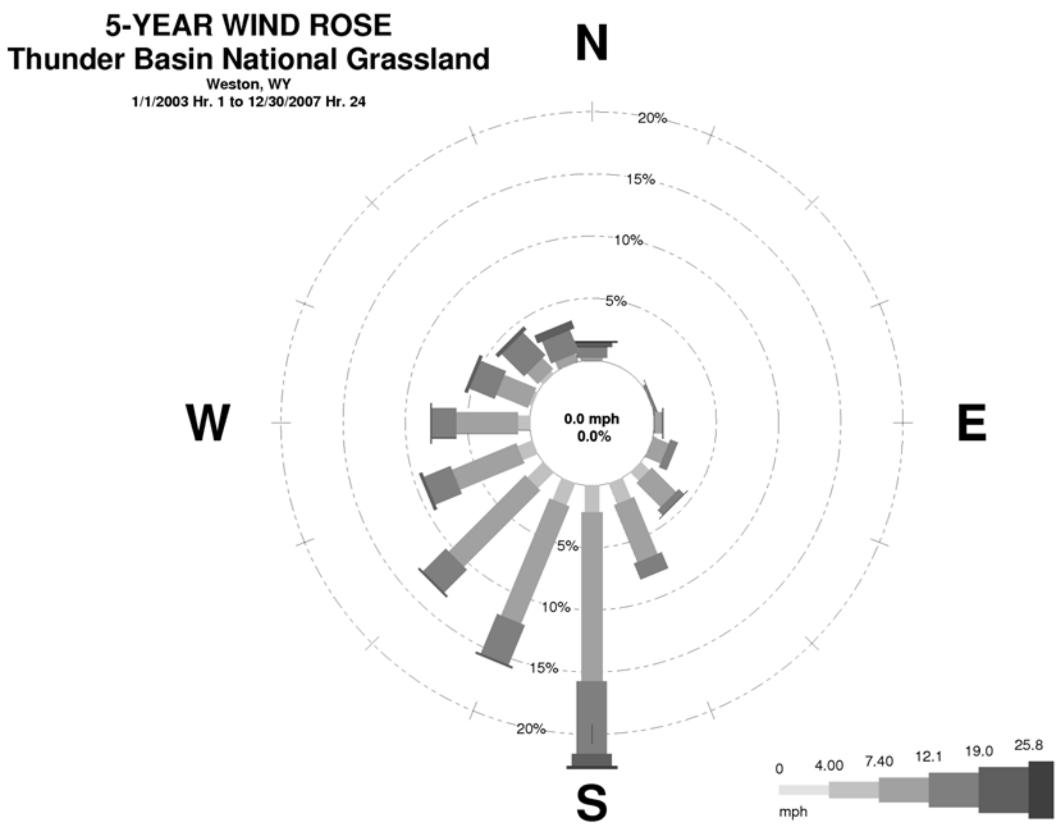


Figure 3.6-19. Ross ISR Meteorological Monitoring Sites

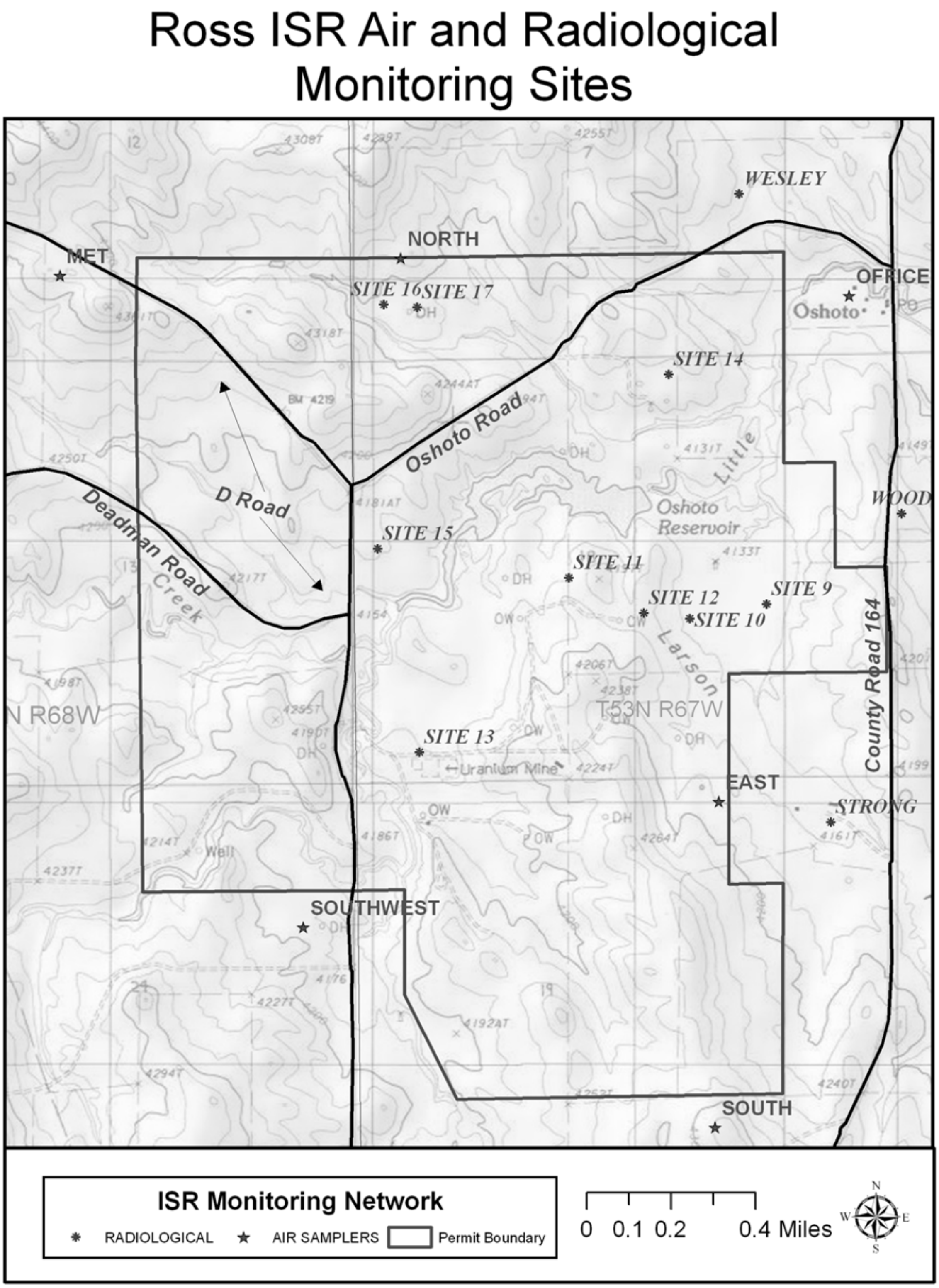


Figure 3.6-20. Active PM_{10} Monitoring Stations in Northeastern Wyoming

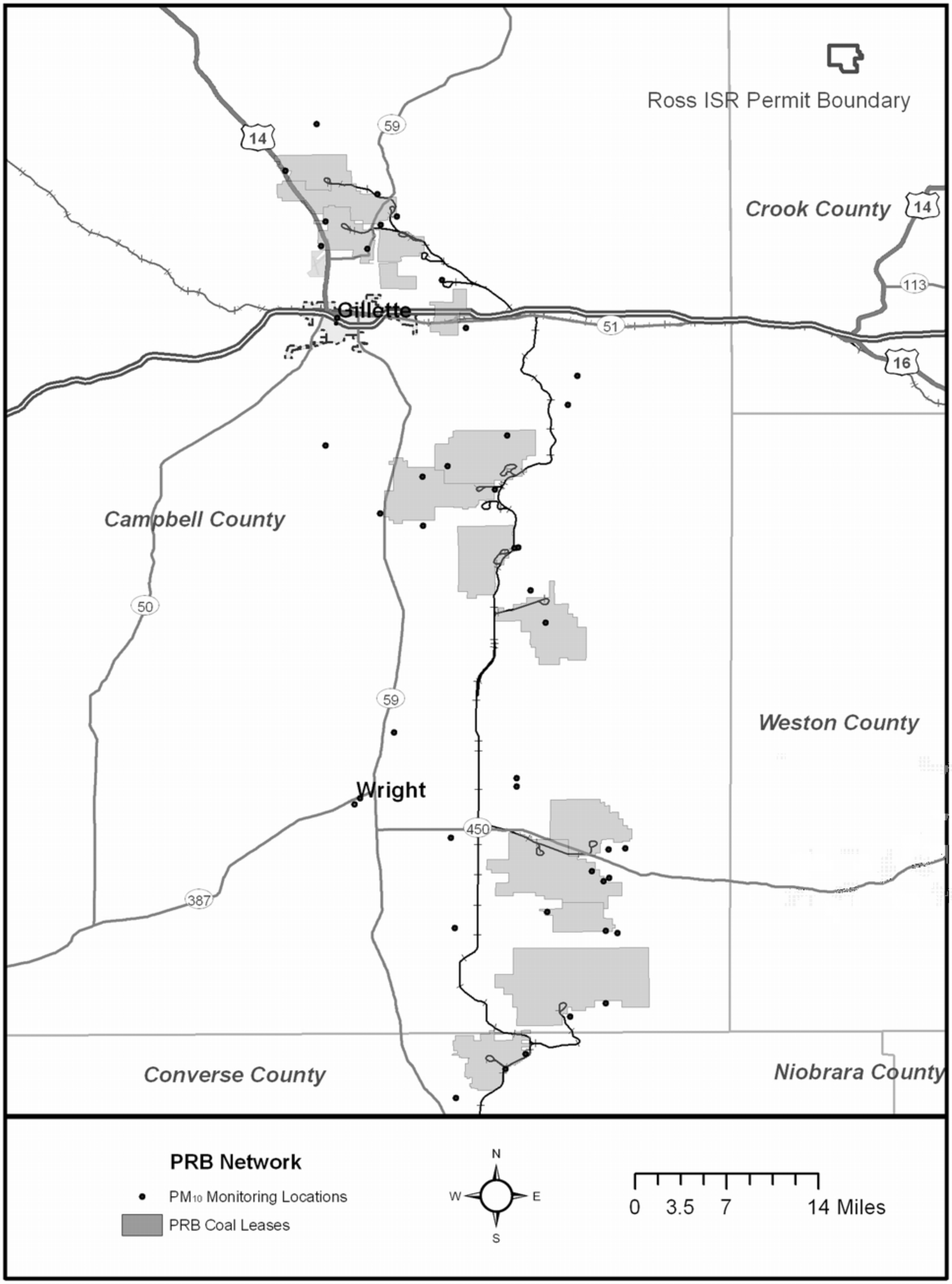


Figure 3.6-21. Belle Ayr NO_x Monitor Location

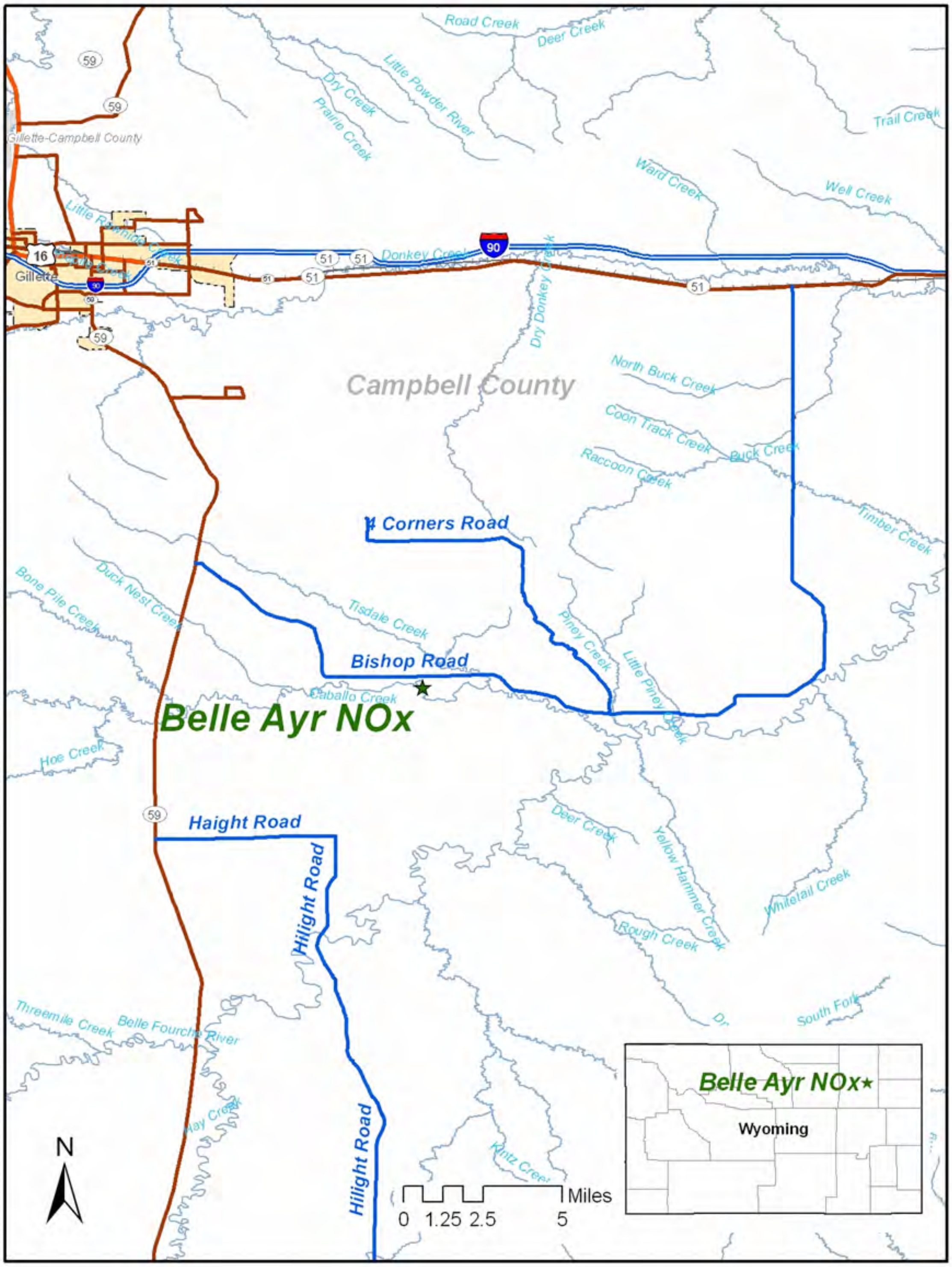
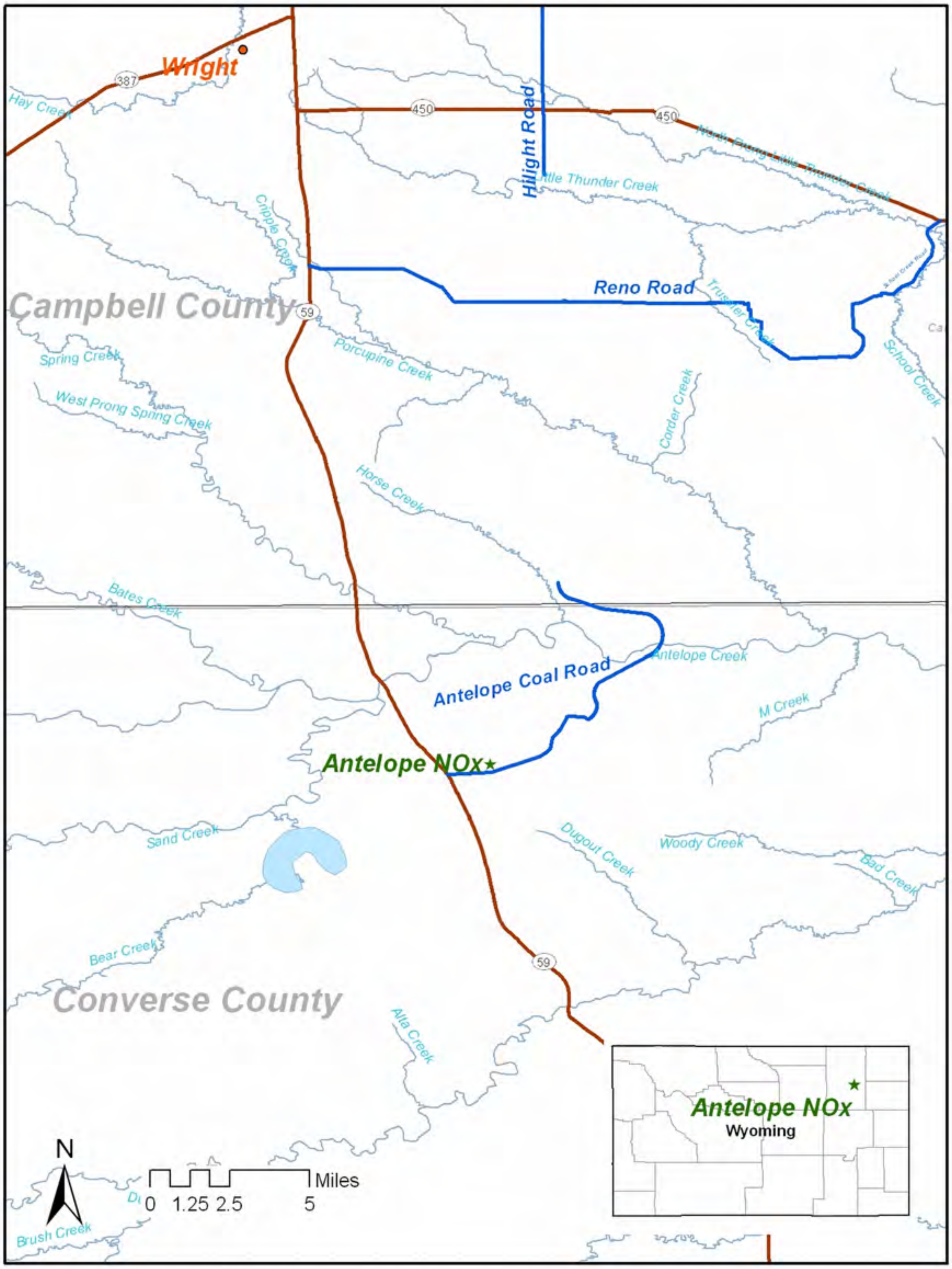


Figure 3.6-22. Antelope NO_x Monitor Location



3.7 Noise

3.7.1 Affected Environment

This section describes the background noise sources within the proposed project area and presents the results of site-specific noise studies conducted by Strata in 2010. Existing noise sources within the proposed project area include county and local road traffic, livestock operations, crop production, oil production operations, and wind. Livestock grazing on rangeland is the primary land use within and in the surrounding 2-mile buffer around the proposed project area. Other land uses include oil production, crop production, transportation, recreation, and wildlife habitat. The nearest noise receptors are 11 residences within 2 miles (3.2 km) of the proposed project area. As described in Section 3.1.5 in this ER, there are no residences within the proposed project area. The nearest residence is 690 feet from the proposed project boundary or about 2,500 feet (0.5 mile) from the proposed CPP.

Due to the remoteness of the proposed project area, low population density of the surrounding area, and lack of noise generated from the primary land use of livestock grazing, existing noise levels are generally low. The majority of the existing ambient noise in the vicinity is generated from wind, bentonite trucking and livestock hauling along the New Haven Road and D Road. Heavy trucks transport bentonite from a mine site 4 miles north to a processing and packaging plant in Upton, Wyoming to the south. Livestock hauling occurs less frequently than bentonite hauling. Local residents use tractors, trailers, and pickup trucks when hauling livestock. Table 3.7-1 presents typical noise levels from vehicles at a distance of 45 feet and speeds ranging from 50 to 75 mph (DOT 1995). Posted speed limits for D Road are 55 mph for automobiles and 45 mph for trucks. The speed limit along the New Haven Road is posted at 45 mph; however, the posted sign is located about 4 miles north of its divergence from D Road. Therefore, northbound traffic traveling on the New Haven Road may not be aware of the change in speed limit until passing by the proposed project area. Assuming vehicles continue their 55 mph speed (45 mph for trucks) off D Road, the noise levels at the nearby residences due to existing traffic should generally not exceed 79 dBA. The actual traffic noise levels at nearby residences are likely lower since the residences are generally more than 45 feet from the county roads. As described in Section 4.7, noise levels from point sources decrease by about 6 dBA for each doubling of distance.

Noise originating from oil operations includes operating pump jacks, workover rigs, and vehicle traffic. The BLM reports that 50 feet from the source, the measured noise level for an operating pump jack is 82 dBA (BLM 2000b). The nearest receptor to a pump jack is approximately 0.6 mile (1 km) away.

3.7.2 Sound Level Standards

Noise standards and sound measurement equipment have been designed to account for the sensitivity of human hearing to different frequencies. The unit of measure used to represent sound pressure levels (decibels) using the A-weighted scale is a dBA (A-weighted decibel). It is a measure designed to simulate human hearing by placing less emphasis on lower frequency noise because the human ear does not perceive sounds at low frequency in the same manner as sounds at higher frequencies. Figure 3.7-1 presents noise levels associated with some commonly heard sounds.

Under the authority of the Noise Control Act of 1972, EPA identifies a 24-hour exposure level of 70 dBA as the level of environmental noise which will not cause any measureable hearing loss over a lifetime. A level of 55 dBA outdoors is identified as preventing activity interference and annoyance. The 24-hour equivalent level is the sound energy averaged over a 24-hour period and is represented by $L_{eq(24)}$. The day-night average sound level (L_{dn}) is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dBA imposed on the equivalent sound levels for nighttime hours of 10 p.m. to 7 a.m. (EPA 1974). People generally have a lower tolerance to noise at night when they are trying to sleep. Therefore 10 dBA is added to the nighttime readings before the overall calculation is made. Outdoor day-night sound levels in rural wilderness areas range from 20 dBA to 30 dBA (EPA 1974).

3.7.3 Noise Study

3.7.3.1 Methods

Two noise studies were conducted to establish baseline noise levels in and around the proposed project area. The first study, conducted on February 15 and 19, 2010, involved measuring baseline noise levels at nearby residences and near oil production and exploratory drilling operations. Field measurements were made using a Quest SoundPro DL-2 sound level meter, which measures noise between 0 and 140 dBA.

Baseline noise measurements were collected at two of the four residences closest to the proposed project area on February 15, 2010. The two residences studied are representative of all four of the nearest residences, which occur at very similar distances from the proposed project area. Figure 3.7-2 identifies the locations where sound levels were measured. Noise levels were recorded for six 30-second intervals facing each of the four cardinal directions. During each 30-second interval, the average, maximum and minimum noise levels were recorded in dBA. Noise levels were measured at the residences between 10 a.m. and noon on February 15. Hourly meteorological data from the Ross MET station show that the wind was blowing out of the south at 3 to 5 mph and the temperature was 8 to 11°F during this study.

Noise measurements were also collected an arbitrary distance (130 feet) from an operating pump jack located within the proposed project area. Noise level measurements were recorded for 12 minutes, including 3 minutes each facing the pump jack 130 feet away from each of the four cardinal directions. Similar to measurements collected at residences, the sound level meter recorded the average, maximum and minimum noise levels in dBA for each 30-second interval.

The final phase of the initial noise study involved measuring the noise generated from an operating exploratory drill rig. Using the same methods as the pump jack, measurements were collected 200 feet from the drill rig. The noise levels near the pump jack and drill rig were measured between 11 a.m. and 1 p.m. on February 19. During this time the wind was blowing out of the south at 5 to 9 mph and the temperature was 19 to 24°F.

The second noise study involved continuously measuring noise levels over a 7-day period at the Strata field office located just outside the northeast corner of the proposed project area. The study was performed to determine the average weekday and weekend levels as well as average day and night noise levels. The average, maximum, and minimum noise levels were recorded in 30-second intervals. The 7-day study was conducted between 8:00 a.m. on February 23, 2010 and 4:00 p.m. on March 2, 2010. During this time the temperature was between 14°F and 47°F, averaging 31°F. The wind speed ranged from 0.8 to 21 mph and averaged 9 mph.

3.7.3.2 Results

Noise level monitoring results at nearby residences are presented in Table 3.7-2. Baseline noise levels at the nearby residences averaged between 35.4 dBA and 37.4 dBA. The maximum recorded noise level was 73.4 dBA. This resulted from a bentonite truck observed traveling on the New Haven Road.

Table 3.7-3 depicts the noise levels measured near an operating pump jack and drill rig. The average noise level measured at a distance of 130 feet from a pump jack was approximately 43 dBA. The maximum level was approximately 49 dBA. The noise levels measured near the pump jack within the proposed project area were well below the typical reported noise level described in Section 3.7.1 (82 dBA at 50 feet). Using the previously described noise reduction rate of 6 dBA for each doubling of distance, the 82 dBA reported at 50 feet would roughly equal 74 dBA at 130 feet. A comparison between the previously reported typical noise level (approximately 74 dBA at 130 feet) and the measured noise level (43 dBA average at 130 feet) demonstrates that the pump jack surveyed in the noise study produces significantly less noise than the typical pump jack cited previously. As described previously, the pump jack noise level was measured at approximately the same distance from each of the four cardinal directions. The average noise levels were 42.9, 42.5, 43.9 and 43.2 dBA for the north, south, east and west directions, respectively. There was no apparent difference in noise level from the upwind (north) to downwind (south) measurements. Full results are provided in Addendum 3.7-A.

Measured noise levels near operating drill rigs located in the northwestern corner of the proposed project area averaged approximately 52 dBA (Table 3.7-3). Two drill rigs were in operation while noise levels were recorded. The rigs were located approximately 200 feet apart and noise levels were recorded 200 feet from the nearest drill rig. The noise levels ranged from 40 to 62 dBA. Fluctuations in values resulted from only one drill rig being in operation to both drill rigs being in operation simultaneously. As described in Section 3.7.2, a level of 55 dBA outdoors is identified as preventing activity interference and annoyance. Since nearby residences are more than 800 feet from the proposed project area, the average noise at the residences resulting from exploratory drilling is significantly less than 55 dBA based on the noise study results.

Results of the 7-day noise study at the Strata field office are provided in Tables 3.7-4(a) through (c), Figure 3.7-3, and Addendum 3.7-A. Table 3.7-4(a) depicts the average daily, daytime/nighttime, weekday/weekend and weekly noise levels recorded during the study. This table shows that the $L_{eq(24)}$ for the entire week averaged 38.0 dBA. There was very little variation in the average weekday (37.8 dBA) and weekend (38.3 dBA) $L_{eq(24)}$. The overall average nighttime noise level (36.2 dBA) was slightly lower than the daytime average (39.0 dBA). The average day-night noise level (L_{dn}) did not vary from weekday to weekend and averaged 41.6 dBA overall.

Figure 3.7-3 illustrates the frequency distribution of noise levels recorded during the 7-day study. The average noise level per 30-second interval was generally between 30 and 40 dBA and only rarely less than 30 dBA or more than 50 dBA. The maximum noise level per 30-second interval was generally about 5 dBA higher that the average noise level. Maximum noise levels typically ranged from 35 to 45 dBA.

Table 3.7-4(b) compares the peak noise levels recorded during the daytime and nighttime for each day of the week. The peak noise level was between 80 and 90 dBA for each day of the study. Peak noise levels are attributed to trucks traveling on the nearby New Haven Road. The peak daytime noise level was about 10% higher than the peak nighttime noise level, but the noise level exceeded 78 dBA during all but one nighttime study interval. The difference between day and night noise levels is better illustrated by Table 3.4(c). This table compares the duration of nuisance noise levels during the daytime and nighttime hours for each day of the study. As described in Section 3.7.2, EPA defines a level of 55 dBA outdoors as preventing activity interference or annoyance. On average, this noise level was exceeded during nearly 60 minutes of the daytime hours (7:00 a.m. through 10:00 p.m.) but less than 10 minutes at night (10:00 p.m. through 7:00 a.m.). This demonstrates that traffic is much lower near the Strata field office during the nighttime hours.

Addendum 3.7-A contains the hourly average, minimum, and maximum noise levels during the 7-day study. It also contains hourly, on-site meteorological data including wind speed, wind direction, and temperature. Graphs are provided in the addendum comparing average noise level with wind speed and temperature. A slight positive correlation was observed between average noise level and wind speed, while a slight negative correlation was observed with temperature. Addendum 3.7-A also includes the noise level measurements recorded at nearby residences and at noise sources. Hourly meteorological data are also provided.

Table 3.7-1. Typical Vehicle Noise Levels

	Noise Level at 45 ft (A-Weighted Decibels, dBA)		
Speed (mph)	**Automobiles**	**Medium Trucks**	**Heavy Trucks**
45*	61	73	79
50	62	74	80
55	64	76	81
60	65	77	82
65	67	78	83
70	68	79	84

Notes: Automobiles: All vehicles with two axles and four wheels
Medium Trucks: All vehicles with two axles and six wheels
Heavy Trucks: All vehicles with three or more axles
*Noise levels for 45 mph were extrapolated to include current speed limits
Source: DOT (1995)

Table 3.7-2. Baseline Noise Measurements at Nearby Residences

Sample Name	Average (dBA)					Maximum (dBA)				
	North	South	East	West	Average	North	South	East	West	Average
N-1	29.6	28.9	47.8	35.5	35.4	37.7	31.4	72.1	61.0	50.6
N-2	36.7	40.1	32.0	41.0	37.4	54.7	73.4	43.1	68.8	60.0

Note: Noise levels were measured for 3 minutes at 30 second intervals facing each of the four cardinal directions.

Table 3.7-3. Sound Level Measurements at Source Locations

Sample Name	Type	Distance from Source (ft)	Average (dBA)	Maximum (dBA)
N-3	Pump Jack	130	43.1	48.5
N-4	Drill Rig	200	52.4	62.2

Note: Noise levels were measured for 12 minutes at 30-second intervals.

Table 3.7-4. Noise Level Study Results at the Strata Field Office

(a) Average Daily Noise Levels

Day	Average Daytime Noise Level (dBA)	Average Nighttime Noise Level (dBA)	Average Overall Noise Level ($L_{eq(24)}$, dBA)	Average Day-Night Noise Level (L_{dn}, dBA)
Monday	38.0	37.1	37.6	41.4
Tuesday	39.5	35.0	38.3	41.0
Wednesday	41.1	37.1	39.6	43.4
Thursday	38.4	34.4	36.9	40.6
Friday	37.8	35.1	36.8	40.6
Weekday Average	**39.0**	**35.7**	**37.8**	**41.4**
Saturday	39.9	36.6	38.6	42.4
Sunday	38.1	37.9	38.0	41.8
Weekend Average	**39.0**	**37.3**	**38.3**	**42.1**
Overall Average	**39.0**	**36.2**	**38.0**	**41.6**

(b) Maximum Daily Noise Levels

Day	Maximum Daytime Noise Level (dBA)	Maximum Nighttime Noise Level (dBA)	Maximum Overall Noise Level (dBA)
Monday	86.9	88.0	88.0
Tuesday	88.0	83.8	88.0
Wednesday	85.8	85.8	85.8
Thursday	87.2	80.0	87.2
Friday	85.4	88.3	88.3
Weekday Average	**86.7**	**85.2**	**87.5**
Saturday	85.7	78.3	85.7
Sunday	83.4	50.6	83.4
Weekend Average	**84.6**	**64.5**	**84.6**
Overall Average	**86.1**	**79.3**	**86.6**

(c) Number of Minutes with Average Noise Level > 55 dBA

Day	Daytime Duration of Noise Level > 55 dBA (min)	Nighttime Duration of Noise Level > 55 dBA (min)	Overall Duration of Noise Level > 55 dBA (min)
Monday	52	6	58
Tuesday	108	9	117
Wednesday	72	19	91
Thursday	50	5	55
Friday	48	7	55
Weekday Average	**66**	**9**	**75**
Saturday	33	1	34
Sunday	27	0	27
Weekend Average	**30**	**1**	**30**
Overall Average	**55**	**7**	**62**

Note: Daytime hours defined as 7:00 a.m. to 10:00 p.m. per EPA (1974)

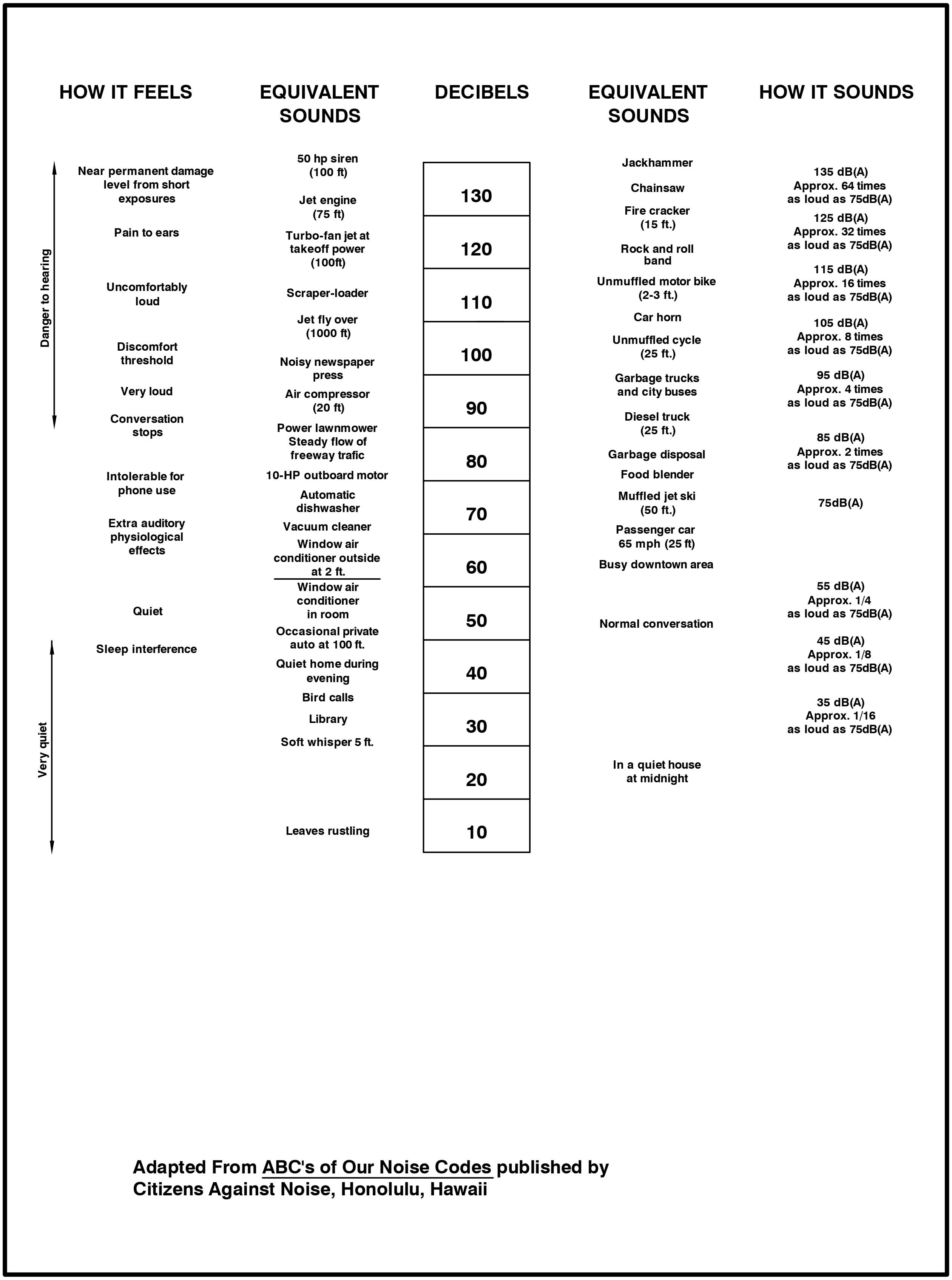


Figure 3.7-1. Relationship Between A-Scale Decibel Readings and Sounds of Daily Life

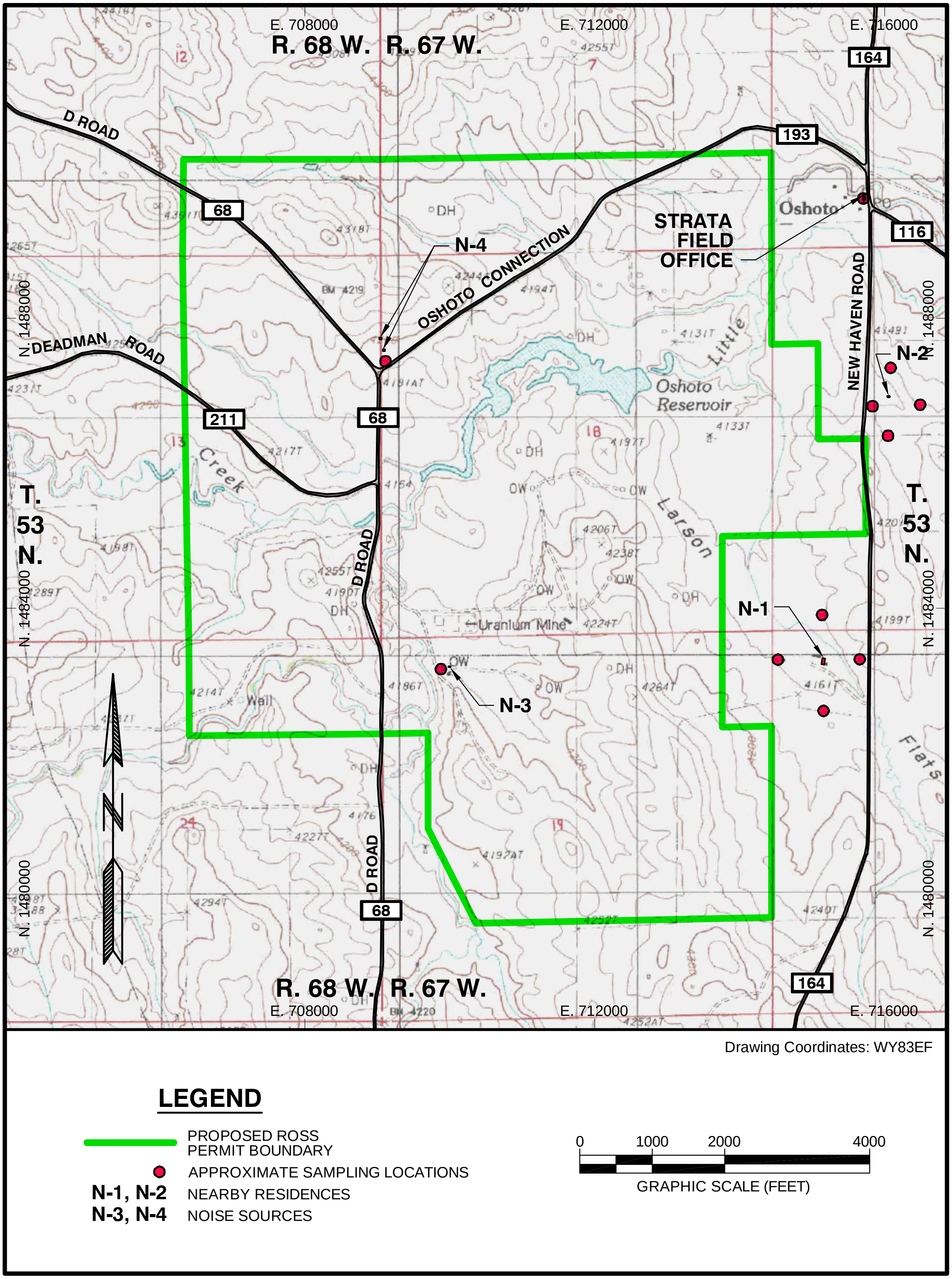


Figure 3.7-2. Sound Level Measurement Locations

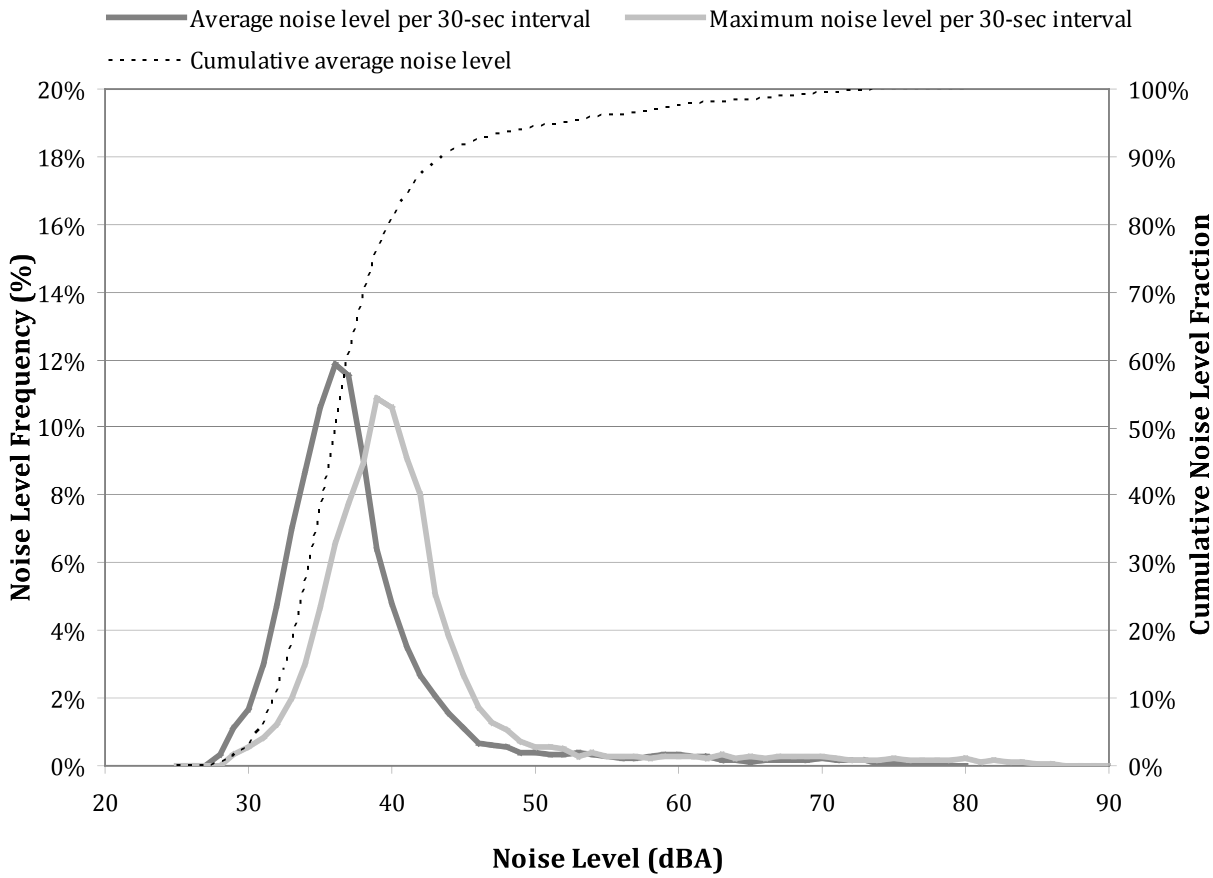


Figure 3.7-3. 7-Day Noise Study Frequency Distribution

Source: 7-day noise study conducted from February 23 to March 2, 2010 at the Strata field office (see Addendum 3.7-A).

3.8 Historic and Cultural Resources

3.8.1 Regional/Site History

Cultural resources, which are protected under the National Historic Preservation Act (NHPA) of 1966, are nonrenewable remains of past human activity. This portion of Wyoming appears to have been inhabited by aboriginal hunting and gathering people for more than 13,000 years. Throughout the prehistoric past, the area was used by highly mobile hunters and gatherers who exploited a wide variety of resources.

Frison's (1978, 1991) chronology for the Northwestern Plains divides occupations from early to late into the Paleoindian, Early Plains Archaic, Middle Plains Archaic, Late Plains Archaic, Late Prehistoric, and Protohistoric periods. These periods are defined by the years before the present time (B.P.). Frison's chronology is listed below. The Plains designation within the Early, Middle, and Late Archaic periods has been omitted from the list.

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

The Paleoindian period dates from about 13,000 to 7,000 years ago and includes various complexes (Frison 1978). Each of these complexes is correlated with a distinctive projectile point style derived from a general large lanceolate and/or stemmed point morphology. The Paleoindian period is traditionally thought to be synonymous with "big game hunters" who exploited megafauna such as bison and mammoth (plains Paleoindian groups), although evidence of the use of vegetal resources is noted at a few Paleoindian sites (foothill-mountain groups).

The Early Archaic period dates from about 7,000 to 5,000-4,500 years ago. Projectile point styles reflect the change from large lanceolate types that characterize the earlier Paleoindian complexes to large side- or corner-notched types. Subsistence patterns reflect exploitation of a broad spectrum of resources, with a much-diminished utilization of large mammals.

The onset of the Middle Archaic period (4,500 to 3,000 years B.P.) has been defined on the basis of the appearance of the McKean Complex as the predominant complex on the Northwestern Plains around 4,900 years B.P. (Frison 1978, 1991, and 2001). McKean Complex projectile points are stemmed variants of the lanceolate point. These projectile point types continued until 3,100 years B.P. when they were replaced by a variety of large corner-notched points (i.e., Pelican Lake points) (Martin 1999). Sites dating to this period exhibit a new emphasis on plant procurement and processing.

The Late Archaic period (3,000 to 1,850 years B.P.) is generally defined by the appearance of corner-notched dart points. These projectile points dominate most assemblages until the introduction of the bow and arrow around 1,500 years B.P. (Frison 1991). The period witnessed a continual expansion of occupations into the interior grasslands and basins, as well as the foothills and mountains.

The Late Prehistoric period (1,850 to 400 years B.P.) is marked by a transition in projectile point technology around 1,500 years B.P. The large corner-notched dart points characteristic of the Late Archaic period are replaced by smaller corner- and side-notched points for use with the bow and arrow. Around approximately 1,000 years B.P., the entire Northwestern Plains appears to have suffered an abrupt collapse or shift in population (Frison 1991). This population shift appears to reflect a narrower subsistence base focused mainly on communal procurement of pronghorn and bison.

The Protohistoric period (400 to 250 years B.P.) witnesses the beginning of European influence on prehistoric cultures of the Northwestern Plains. Additions to the material culture include most notably the horse and European trade goods, including glass beads, metal, and firearms. Projectile points of this period include side-notched, tri-notched, and unnotched points, with the addition of metal points. The occupants appear to have practiced a highly mobile and unstable residential mobility strategy.

The historic period (250 to 120 years B.P.) is summarized from Schneider et al. (2000). The use of the Oregon Trail by emigrants migrating to the fertile lands of Oregon, California, and the Salt Lake Valley brought numerous pioneers through the State of Wyoming, but few stayed. It was not until the fertile land in the West became highly populated, along with the development of the cattle industry in the late 1860s, that the region currently comprising the State of Wyoming became attractive for settlement. The region offered cattlemen vast grazing land for the fattening of livestock, which could then be shipped across the country via the recently completed (1867-1868) transcontinental railroad in southern Wyoming.

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

Although Euro-Americans began to pass through Wyoming in the early 1800s, these visits were limited to government expeditions of discovery and various British and American fur trapping brigades. Beginning in the 1840s, emigrants of the “great western migration” passed along the Oregon-California Trail along the Platte and through South Pass, but few if any detoured through the Powder River Basin.

The Texas Trail, which operated from 1876 to 1897, was used to move cattle as far north as Canada to take advantage of open range grazing and lucrative government contracts. The trail entered Wyoming where the town of Pine Bluffs now sits. It extended north through eastern Wyoming on a line parallel to today’s US 85, connecting to the current I-90 corridor at Moorcroft, then up the Little Powder River, west of the study area, into Montana. Most of the early cattle herds passed through Wyoming and were used to establish Montana's ranching industry. Eventually, cattlemen began recognized the value of Wyoming's grasslands and started ranching in the state. Several large cattle ranches, such as the TA, T7, and 4J were established in the region. Large cattle herds flourished in northeast Wyoming until drought conditions in 1886 followed by a devastating series of blizzards during the 1886-87 winter effectively ended the era of the cattle baron. The collapse of the big cattle ranches provided an opening for Wyoming's sheep industry. The 4J and G-M ranches became established in the Gillette area and by the late 1890s each ran up to 40,000 head of sheep. The northeast Wyoming sheep industry experience steady declines in the 1910s.

The discovery of gold in Montana to the north in 1862 and in the Black Hills to the east in 1874 brought traffic through northeast Wyoming, but this traffic probably had no physical impact on the study area.

The dry land farming movement of the late 19th and early 20th centuries had a profound effect on the settlement of northeastern Wyoming during the years around World War I. Although the principles of dry land farming were sound, success still required a certain amount of precipitation each year. Wyoming encouraged dry land settlement of its semi-arid lands through a Board of Immigration created in 1911. Newspapers extolled the virtues of dry land farming, and railroads conducted well-organized advertising campaigns on a nationwide basis to settle the regions through which they passed.

The most intensive period of homesteading activity in northeastern Wyoming occurred in the late 1910s and early 1920s. Promotional efforts by the state and the railroads, the prosperous war years for agriculture in 1917 and 1918, and the Stock Raising Act of 1916 with its increased acreage (but lack of mineral rights) all contributed to this boom period. A large amount of land filings consisted of existing farms and ranches expanding their holdings in an optimistic economic climate. However, an equally large number of homesteaders had been misled by promotional advertising and were not adequately prepared for the experiences that awaited them in northeastern Wyoming. It soon became apparent to the would-be dry land farmer that he could not make a living by raising only crops. Some were initially successful in growing wheat, oats, barley and other small grains, along with hay, alfalfa, sweet clover, and other grasses for the increased number of cattle.

A drought in 1919 was followed by a severe winter. The spring of 1920 saw market prices fall. Those homesteaders who were not ruined by the turn in events often became small livestock ranchers and limited their farming to the growing of forage crops and family garden plots. Some were able to obtain cheap land as it was foreclosed or sold for taxes. During the 1920s the size of homesteads in Wyoming nearly doubled and the number of homesteads decreased, indicating the shift to livestock raising (LeCompte and Anderson 1982).

With serious drought beginning in 1932, several federal actions were taken. In April of 1932, portions of northeast Wyoming were eligible for a drought relief program. The Northeast Wyoming Land Utilization Project began repurchasing the sub-marginal homestead lands and making the additional acres of government land available for lease. This helped the small operator to expand the usable grazing land. Cropland taken out of production could be reclaimed and then added to the grazing lease program. Grazing associations were formed to regulate the grazing permits. In 1934, the Agricultural Adjustment Administration began studying portions of Converse, Campbell, Weston, Niobrara, and Crook counties. In all, 2 million acres, including about 560,000 acres of federal owned lands, were included in the Thunder Basin Project (LA-WY-1) to alter land use and to relocate settlers onto viable farmland. Nationally, the program hoped to shift land use from farms to forest, parks, wildlife refuges or grazing districts. In marginal areas cash crops were to be replaced by forage crops, the kind and intensity of grazing would be changed and the size of operating units would be expanded (USFS n.d.). Land purchase work on the Thunder Basin Project began late 1934 and the purchasing of units started in 1935.

During the development program to rehabilitate the range, impounding dams were erected, wells were repaired, springs developed, and homestead fences were obliterated while division fences were constructed for the new community pastures. Farmsteads were obliterated and the range reseeded. Remaining homesteaders and ranchers often purchased or scavenged materials from the repurchased farmsteads. Pits were dug on some homesteads and machinery and demolished buildings buried (many of these were dug up during the World War II scrap drives). Ironically, the rehabilitation project utilized a labor pool of former farmers who had spent years building what the government paid them to destroy. Their efforts were so successful that almost no trace remains of many homesteads.

While counties lost much of their population base as a result of the Resettlement Administration relocation program, they were strengthened financially: schools were closed, maintenance of rural roads was restricted to main arterioles, and delinquent taxes were paid. The remaining subsidized ranches were significantly larger and provided a stabilizing effect on the local economies. Three grazing associations were formed: the Thunder Basin Grazing Association, the Spring Creek Association, and the Inyan Kara Grazing

Association. These associations provided responsible management of the common rangeland.

Uranium was first discovered in Wyoming in 1918 near Lusk. Uranium exploration efforts in the 1950s and 1960s in the Powder River Basin of Wyoming led to a number of discoveries, starting in the Pumpkin Buttes Uranium District of Johnson and Campbell counties. Nuclear Dynamics and Bethlehem Steel Corporation formed the Nubeth Joint Venture (Nubeth), to develop new uranium recovery districts in the western U.S. with specific attention focused on northeastern Wyoming's Powder River Basin.

The initial discovery of uranium near Oshoto was made by a Mr. Albert Stoick using a hand held scintillometer during an over-flight of the area. This was followed by macroscopic sampling efforts and then regional exploration work by the joint venture group (Buswell 1982). In late 1970, airborne radiometric surveys in an area north of Moorcroft indicated large, low-order gamma ray anomalies in an area encompassing over 350 square miles. Host formations were believed to be the Late Cretaceous Lance and Fox Hills Formations. The uranium district was therefore named the Lance District.

Nubeth received a WDEQ/LQD License to Explore (No. 19) in August 1976 and an NRC combined source and 11e.(2) byproduct material license in April 1978 (SUA-1331). An R&D site was constructed in Section 18 of Township 53 North, Range 67 West. The R&D site was operated from August 1978 through April 1979 and recovered only small amounts of uranium. Approximately 50% of the process equipment in the plant was never used. No precipitation of a uranium product took place and all of the recovered uranium was stored as a uranyl carbonate solution.

After pilot ISR uranium recovery tests were completed, the single five-spot used in the test was restored using groundwater sweep. Restoration was completed in February 1983 and Nubeth was notified by the WDEQ that the restoration was satisfactory on April 25, 1983. Final approval for the R&D site decommissioning was granted by the regulatory agencies in 1983 through 1986.

3.8.2 Cultural Resources Survey

3.8.2.1 Methodology

A Class I cultural resources inventory is a summary of existing records and data that discusses all relevant prior studies and their findings for a specific area. A Class III cultural resources survey is an intensive and comprehensive inventory of a proposed project area conducted by professional archaeologists and consultants. The goal of the surveys is to locate and evaluate for the National Register of Historic Places (NRHP) all cultural resources 50 years and older that have exposed surface manifestations within the proposed project area. Cultural properties are recorded at a sufficient level to allow for evaluation for possible inclusion to the NRHP. Determinations of eligibility are made by the managing federal agency in consultation with the State Historic Preservation Office (SHPO).

Sources for the Class I inventory included Wyoming Cultural Records Office (WYCRO) file searches, the WYCRO in-line database, and the BLM Newcastle Field Office cultural records. A WYCRO file search was conducted on February 9, 2010, by GCM Services, Inc. (Butte, Montana), prior to the Class III field work.

A Class III Cultural Resources Evaluation was conducted for the Ross ISR Project during April 2010 by archeologists from GCM Services, Inc.

Following the Class I literature search and prior to fieldwork, GCM Services, Inc. filed a “CRM Tracker” fieldwork notification with the SHPO and BLM. Field base maps were produced for field personnel on 7.5-minute USGS topographic base maps, which included any previously recorded prehistoric site.

An intensive pedestrian inventory of all the land within the proposed project area was conducted. Transect intervals did not exceed 30 meters. All sources of subsurface exposure were examined, such as cut banks, trails, ruts in two track roads, ant hills, and rodent mounds. A reconnaissance of any outcrops with potential for paleontological remains was also part of the Class III field inventory.

Cultural sites were evaluated within the framework of the NRHP. Each site's integrity of location, design, setting, materials, workmanship, feeling and association were considered as well as the site's ability to meet any of the following criteria:

Criterion A: The site is associated with events that have made a significant contribution to the broad patterns of our history.

Criterion B: The site is associated with the lives of persons significant in our past.

Criterion C: The site embodies the distinctive characteristics of a type, period, or method of construction, or that represented the work of a master, or that possesses high artistic values, or that represented a significant and distinguishable entity whose components may lack individual distinction.

Criterion D: The site has yielded or may be likely to yield information important in prehistory or history.

A Criterion D assessment is typically applied to prehistoric archaeological sites in this region. Cultural material content, condition and contextual integrity are critical to making a realistic determination of significance under Criterion D. Sites containing intact activity areas, dateable organics, diagnostic or unique artifacts or features in a state of good contextual preservation have research potential and may be considered as Eligible for the NRHP under Criterion D. Eroded, deflated or mixed deposits, surface lithic sources, primary knapping stations (lithic reduction sites) and other cultural remains lacking a specific temporal context are unlikely to meet Criterion D.

3.8.2.2 Results

The literature search revealed one site that was found in 1995 during an inventory for a phone line or fiber optic line. The site (48CK1603) was described as a prehistoric campsite and lithic scatter. The complete results of the literature search are presented in the Cultural Resources Evaluation, which is included as Addendum 3.8-A of this ER. As discussed below, Strata requests that this report remain confidential. This site was not relocated during the 2010 Class III surveys and had apparently been destroyed as a result of reconstruction of the D Road.

The Class III Cultural Resource Inventory for the proposed project area in Addendum 3.8-A contains information that falls under the confidentiality requirement for archeological resources under the NHPA, Section 304 (U.S.C. 470w-3(a)). The report, including Wyoming Cultural Resource Forms, has also been submitted to SHPO for concurrence and the WDEQ/LQD under a separate cover from GCM Services, Inc. The Wyoming Cultural Resource Forms are not included in Addendum 3.8-A since these forms were not provided to the client due to disclosure restrictions in the NHPA Section 304. Accordingly, disclosure is specifically exempted by statute as specified in 10 CFR 2.390(a)(3). Therefore, Strata requests that all applicable portions of Addendum 3.8-A remain "CONFIDENTIAL" for the purpose of Public Disclosure of this application. Each page of the protected cultural resource information has been marked as follows:

Confidential Information Submitted under 10 CFR 2.390

The cover page for Addendum 3.8-A has been marked with a more detailed statement, as follows:

Confidential Information Submitted under 10 CFR 2.390
Disclosure is Limited under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)).

3.8.3 Paleontological Resources

The formation exposed on the surface of the proposed project area is the Late Cretaceous Lance Formation, which has a good potential to produce a variety of fossils (USFS 2001).

The BLM uses a planning tool called the Potential Fossil Yield Classification System (PFYC), which was developed by the USFS (BLM 2007). The PFYC is a planning tool used to classify geological units, usually at the formation or member level, according to the probability that they will yield paleontological resources that are of concern to land managers. This classification system is based largely on how likely a geologic unit is to produce scientifically significant fossils. The PFYC includes the following five primary classes of geologic units, with some of the units being further divided into subclasses.

Class 1 – Very Low. Igneous and metamorphic (volcanic ashes are excluded from this category) geologic units that are not likely to contain recognizable fossil remains. The probability for impacting any fossils is negligible, and assessment or mitigation of paleontological resources is usually unnecessary.

Class 2 – Low. Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils, including:

- Vertebrate of significant invertebrate or plant fossils not present or very rare.
- Units that are generally younger than 10,000 years before present.
- Recent eolian deposits.
- Sediments that exhibit significant physical and chemical changes.
- The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low, and assessment or mitigation of paleontological resources is not likely to be necessary.

Class 3 – Moderate or Unknown. Fossiliferous geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential, including:

- Often marine in origin with sporadic known occurrences of vertebrate fossils.
- Vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently; predictability known to be low.
- (or)
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.
- Surface disturbing activities may require field assessment to determine appropriate course of action.

Class 4 – High. Class 4 geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation. Surface disturbing activities may adversely affect paleontological resources, and a field survey by a qualified paleontologist is often needed to assess local conditions.

Class 5 – Very High. Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation. A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments.

BLM considers the Lance Formation to fulfill either the PFYC Class 4 or Class 5, depending on the nature of bedrock exposures present (BLM 2008). Lesser amounts of the proposed project area are covered by Quaternary alluvium, which is generally to have a low potential for vertebrate or scientifically significant invertebrate fossils and is a PFYC Class 1 or 2. The Lance Formation has yielded thousands of vertebrate fossils in Wyoming, including many dinosaurs (UW 2010).

Professional archeologists, in effort to locate unique pockets of fossilized bone such as those reported elsewhere in the Lance Formation in eastern Wyoming, closely examined outcrop localities in conjunction with their intensive pedestrian surveys for cultural resources. Paleontological survey results are provided in Addendum 3.8-A.

3.8.4 Tribal Consultation

Native American heritage sites can be classified as prehistoric or historic. Some may be presently in use as offering, fasting, or vision quest sites. Other sites of cultural interest and importance may include rock art, stone circles, various rock features, fortifications or battle sites, burials, and locations that are sacred or part of the oral history and heritage but have no man-made features.

No Native American heritage, special interest, or sacred sites have been formally identified and recorded to date directly associated with the proposed project. However, the geographic position of the area between mountains considered sacred by various Native American cultures (the Big Horn Mountains to the west, the Black Hills to the east, and Devils Tower to the east) creates the possibility that existing locations may have special religious or sacred significance to Native American groups. If such sites or localities are identified at a later date, appropriate action must be taken to address concerns related to those sites. The only Tribal reservation in Wyoming is the Wind River Indian Reservation (approximately 170 miles southwest). The nearest Indian reservations to the proposed project area are the Crow and Northern Cheyenne Indian Reservations in Montana (approximately 100 and 91 miles northwest, respectively) and the Pine Ridge Indian Reservation in South Dakota (approximately 115 miles southeast).

A review of literature indicates that Devils Tower (located approximately 11 miles (18 km) from the site) is a sacred area for several Plains Tribes (Hanson and Chirinos 1991). According to the National Park Service (NPS), over 20 tribes have potential cultural affiliation with Devils Tower National Monument. Six tribes (Arapaho, Crow, Lakota, Cheyenne, Kiowa, and

Shoshone) have historical and geographical ties to the Devils Tower area (NPS 2010). Traditional ceremonial activities which demonstrate the sacred nature of Devils Tower to American Indians include personal rituals (prayer offerings (bundles and cloths), sweatlodge ceremonies, vision quests, and funerals), group rituals (Sun Dance), and sacred narratives (origin legends, legends of culture heroes, and legends of the origins of ceremonies and sacred objects). Among these rituals, all are still practiced at Devils Tower except for funerals (NPS 2010).

According to Executive Order 13175 - Consultation and Coordination with Indian Tribal Governments (NRC 2009b), NRC is encouraged to “promote government-to-government consultation and coordination with Federally-recognized tribes that have a known or potential interest in existing licensed uranium recovery facilities or applications for new facilities.” On November 19, 2010, NRC provided a letter of notification informing 15 tribes that NRC expected to receive an application for the proposed Ross ISR Project. Following the receipt and acceptance of the license application, Strata understands that NRC will meet or communicate with all known Federally-recognized tribes in the area with a potential interest to establish protocol and procedures for government-to-government interaction on the matter. Tribes that have been identified as potentially having concerns about actions in the PRB include the Assiniboine & Lakota (MT), Blackfeet, Blood (Canada), Crow, Cheyenne River Lakota, Crow Creek Lakota, Devil's Lake Lakota, Eastern Shoshone, Flandreau Santee Dakota, Kootnai & Salish, Lower Brule Lakota, Northern Arapaho, Northern Cheyenne, Oglala Lakota, Pigeon (Canada), Rosebud Lakota, Sissteon-Wahpeton Dakota, Southern Arapaho, Southern Cheyenne, Standing Rock Lakota, Three Affiliated Tribes, Turtle Mountain Chippewa, and Yankton Dakota (NPS 2010).

3.9 Visual and Scenic Resources

3.9.1 Regional Visual and Scenic Resources

Visual sensitivity levels are determined by people's concern for what they see and the frequency of travel through an area. Several areas within northeastern Wyoming can be classified as having higher levels of scenic value. These areas include parks, forests, grasslands, rock and water features, and cultural modification. Four areas of managed land are located within 20 miles of the Ross ISR Project, including Devils Tower National Monument to the east of the proposed project area, Thunder Basin National Grassland to the west and south, Keyhole State Park to the southeast, and Black Hills National Forest to the east. These are depicted on Figure 3.1-6 in Section 3.1 of this ER. Devils Tower was proclaimed the first national monument in 1906 and is one of the most conspicuous geologic features of the Black Hills region. The igneous intrusion rises 1,267 feet above the Belle Fourche River and can be seen from miles away. The Devils Tower National Monument includes 1,347 acres of park land covered with pine forests, woodlands, and grasslands. The Thunder Basin National Grassland provides unique opportunities for recreation, including fishing, hiking, and bicycling. Lush green pastures cover the ground and provide wildlife habitat and forage for livestock. The USFS manages the grasslands to conserve the natural resources of grass, water and wildlife habitats. Keyhole State Park is home to a variety of wildlife. Keyhole Reservoir is the primary attraction to the park and provides visitors several recreational opportunities including fishing, camping, and hiking. The Black Hills National Forest encompass numerous streams, lakes, reservoirs, canyons and gulches, caves, varied topography, and vegetation that provide habitats for an abundance of wildlife.

3.9.2 Regulatory Environment, Policy and Guidelines

The Visual Resource Management (VRM) system is the basic tool used by BLM to inventory and manage visual resources on public lands. The VRM system includes a visual resource inventory and an analysis or visual resource contrast rating. The inventory process involves rating the visual appeal of a tract of land, measuring public concern for scenic quality, and determining whether the tract of land is visible from travel routes or observation points (BLM 2010). The system is based on research that has produced ways of assessing aesthetic qualities of the landscape in objective terms. In accordance with the BLM Handbook H-8410-1, a visual resource inventory can be created using three categories (BLM 2010). These categories include scenic quality, visual sensitivity, and distance zones as described below.

Scenic Quality – Scenic quality is a measure of the visual appeal of a tract of land. The evaluation of scenic quality consists of rating the visual appeal of a tract of land on an A, B, or C scale based on seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. Each is ranked on a comparative basis with similar features within the physiographic province. The proposed project area occurs within the Great Plains physiographic province (Fenneman and Johnson 1946).

Visual Sensitivity – Sensitivity levels are determined by people's concern for what they see and the frequency of travel through an area. Public lands are assigned high, medium, or low sensitivity levels by analyzing various factors, including: type of users, amount of use, public interest, adjacent land uses, and special areas.

Distance Zones – Distance zones subdivide landscapes into three zones based on the visibility from travel routes or observation points. The three zones are classified as follows:

- ♦ Foreground-Middleground (f/m): This area can be seen from each travel route for a distance of 3 to 5 miles where management activities might be viewed in detail.
- ♦ Background (b): This area can be seen from each travel route beyond the foreground-middleground zone and up to 15 miles. Vegetation should be visible at least as patterns of light and dark.
- ♦ Seldom Seen (s/s): These areas extend beyond the background zone and are not visible within the foreground-middleground and background zones.

The visual resource inventory categories are used to develop VRM management classes as shown in Table 3.9-1 (BLM 2010). VRM objectives are developed to determine how the land should be managed to protect the scenic quality. The four objectives defined below are used to describe increasing levels of change within the characteristic landscape.

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

- Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- Class III Objective: 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. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

3.9.3 Ross ISR Project Visual Resources

The area considered for visual resources includes the proposed project area and a 2-mile (3.2-km) surrounding area (Figure 3.9-1). No developed parks or recreation areas are located within the visual resources study area. Landscapes within the visual resource study area are characterized by a gently rolling topography and large, open expanses of upland grassland, pasture/hayland, sagebrush shrubland, and intermittent riparian drainages. Intermittent streams are fed by ephemeral drainages which seasonally drain the adjacent uplands. There are also areas of altered landscape within the study area, including 11 residences, oil production facilities (oil well pump jacks, pipeline and utility rights of way, aboveground tanks, and access roads), transportation facilities (public and private roads and road signage), utilities (power and utility transportation lines), agricultural activities (fences, livestock, stock tanks, and cultivated fields), and environmental monitoring installations. Residences, roads, and parks/monuments/national forests in the general vicinity are indicated on Figure 3.9-1. The BLM administers 2.3% (40 acres) of the land within the proposed project area.

The BLM has established VRM classifications and has resource management plans covering public lands in all of Crook (BLM 2000a) and Campbell (BLM 2001) counties. The VRM classifications for the public lands within and near the Ross ISR Project are shown on Figure 3.9-1. In Campbell County, the land near the proposed project area is categorized as VRM Class IV, while the land surrounding the proposed project area in Crook County is categorized as VRM Class III. The visual resources study area occurs entirely within Crook County and is therefore categorized as VRM Class III (BLM 2001). The level of change to the characteristic landscape in Class III management areas can be moderate, and the Proposed Action is compatible with this objective.

A site specific VRM evaluation was conducted in October 2010 on the Ross project area using the BLM methodology provided in BLM Manual 8410 that assessed scenic quality (BLM 2010). The scenic quality inventory for the visual resource study area was evaluated based on the key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. These factors were evaluated and scored according to the rating criteria. The average scenic quality index for the proposed project area was determined by individually rating the scenic quality of four aspects (cardinal compass points) viewed from a high point in the center of the proposed project area. The individual scores were averaged to get a scenic quality score for the proposed project area. The scenic quality field inventory presented in Table 3.9-2 shows that the visual resource evaluation rating calculated for the study area is 10.5 out of a possible 32. According to NUREG-1569, if the visual resource evaluation rating is 19 or less, no further evaluation is required (NRC 2003b).

Photographs of the view from the scenic quality evaluation site for the Ross ISR Project are included in Table 3.9-2. Additional photographs of the proposed project area taken from nearby roads and homes are included in Figure 3.9-2. Devils Tower and portions of the Black Hills National Forest can be seen in the distance from several locations within the visual resource study area. Although the Devils Tower National Monument and surrounding area is classified as a Class II VRM area, the Ross ISR Project will only be visible to climbers scaling the volcanic neck. Figure 3.9-3 depicts the viewshed (areas from which CPP would be visible) for the proposed project area. The CPP was selected for the viewshed evaluation since it would be the most noticeable (largest and tallest) structure in the proposed project area.

Table 3.9-1. Determining BLM Visual Resource Inventory Class

		Visual Sensitivity Levels						
		High			**Medium**			**Low**
Special Areas		I	I	I	I	I	I	I
Scenic Quality	**A**	II	II	II	II	II	II	II
	B	II	III	III* IV*	III	IV	IV	IV
	C	III	IV	IV	IV	IV	IV	IV
		f/m	b	s/s	f/m	b	s/s	s/s
		Distance Zones						

*If adjacent area is Class III or lower assign Class III, if higher assign Class IV.
Source: BLM 2010
Distance zones: f/m – foreground – middleground
b – background
s/s – seldom seen

Table 3.9-2. Scenic Quality Inventory and Evaluation

Scenic Quality Inventory Point – Looking North		
Key Factor	**Rating Criteria**	**Score**
Landform	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features.	1
Vegetation	Some variety of vegetation, but only one or two major types.	3
Water	Present, Little Missouri River and the Oshoto Reservoir are occasionally visible	1
Color	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element.	3
Influence of adjacent scenery	Adjacent scenery has little or no influence on overall visual quality.	0
Scarcity	Interesting within its setting, but fairly common within the region.	1
Cultural Modifications	Modifications add variety but are very discordant and promote strong disharmony.	-2
Total Score		**7**

Photograph from Scenic Quality Inventory Point Looking North

Table 3.9-2. Scenic Quality Inventory and Evaluation (Continued)

Scenic Quality Inventory Point – Looking East

Key Factor	**Rating Criteria**	**Score**
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers.	5
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns.	5
Water	Present, but not noticeable.	0
Color	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element.	3
Influence of adjacent scenery	Adjacent scenery greatly enhances visual quality (Devils Tower)	5
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc.	5
Cultural Modifications	Modifications add little or no visual variety to the area, and introduce no discordant elements.	0
Total Score		**23**

Photograph from Scenic Quality Inventory Point Looking East

Table 3.9-2. Scenic Quality Inventory and Evaluation (Continued)

Scenic Quality Inventory Point – Looking South

Key Factor	**Rating Criteria**	**Score**
Landform	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features	1
Vegetation	Little or no variety or contrast in vegetation.	1
Water	Present, but not noticeable.	0
Color	Subtle color variations, contrast, or interest; generally mute tones.	1
Influence of adjacent scenery	Adjacent scenery has little or no influence on overall visual quality.	0
Scarcity	Interesting within its setting, but fairly common within the region.	1
Cultural Modifications	Modifications add little or no visual variety to the area, and introduce no discordant elements.	0
Total Score		**4**

Photograph from Scenic Quality Inventory Point Looking South

Table 3.9-2. Scenic Quality Inventory and Evaluation (Continued)

Scenic Quality Inventory Point – Looking West

Key Factor	**Rating Criteria**	**Score**
Landform	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features	1
Vegetation	Some variety of vegetation, but only one or two major types	3
Water	Present, but not noticeable.	1
Color	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element.	3
Influence of adjacent scenery	Adjacent scenery has little or no influence on overall visual quality.	0
Scarcity	Interesting within its setting, but fairly common within the region.	1
Cultural Modifications	Modifications add variety but are discordant and promote disharmony.	-1
Total Score		**8**

Photograph from Scenic Quality Inventory Point Looking West

Table 3.9-2. Scenic Quality Inventory and Evaluation (Continued)

Scenic Quality Inventory Site – Average of Four Views

Key Factor	**Score**
Landform	2.00
Vegetation	3.00
Water	0.50
Color	2.50
Influence of adjacent scenery	1.25
Scarcity	2.00
Cultural Modifications	-0.75
Total Score	**10.50**

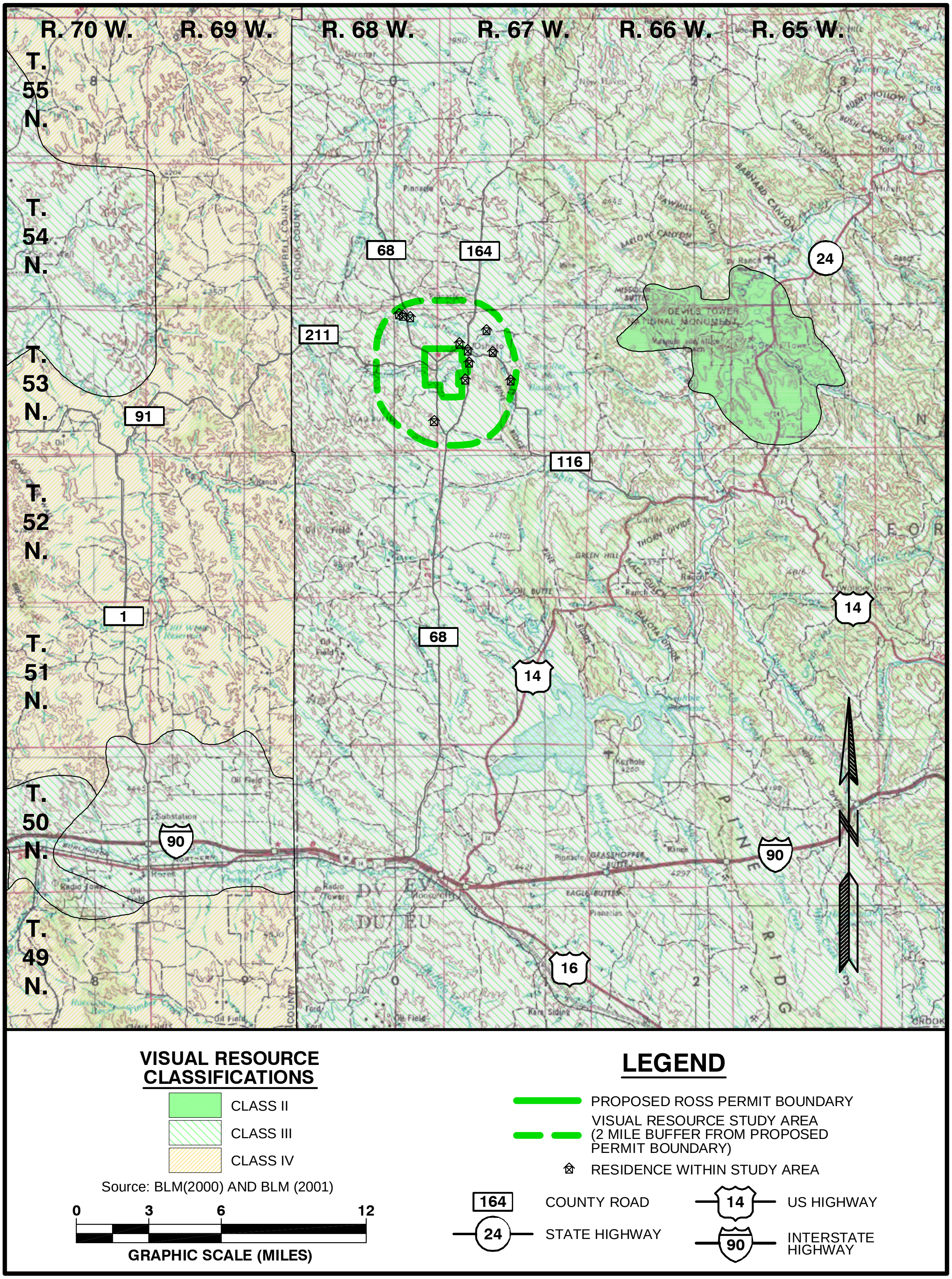


Figure 3.9-1. Regional Visual Resource Management Classification

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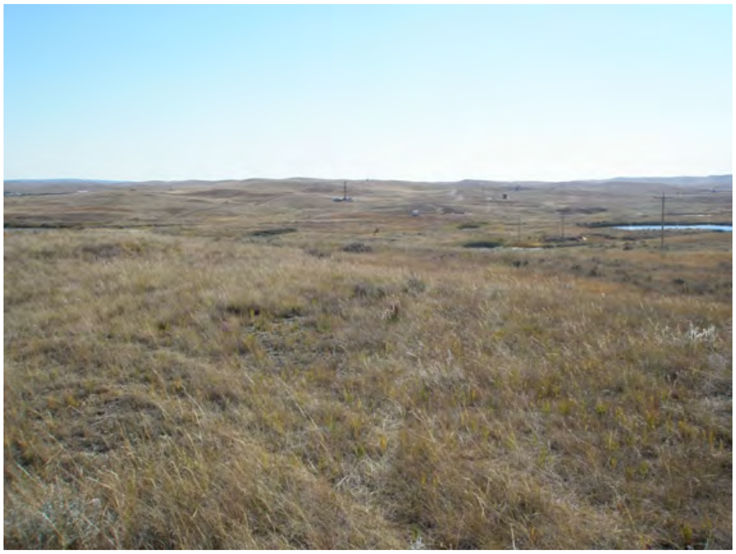
Figure 3.9-2. View Looking Toward Proposed Project Area from Various Locations (See Figure 3.9-3 for photograph locations)

Site 1 - From County Road 68 (South End of Proposed Project Area) Looking East.

Site 2 - From County Road 211 (West End of Proposed Project Area) Looking East.

Site 3 - From County Road 68 (Northwest Corner of Proposed Project Area) Looking East.

Figure 3.9-2. View Looking Toward Proposed Project Area from Various Locations (See Figure 3.9-3 for photograph locations)



Site 4 - From County Road 193 (North Portion of Proposed Project Area) Looking South.

Site 5 - From Nearby Residence (North of Proposed Project Area) Looking South.

Site 6 - From County Road 164 (East Side of Proposed Project Area) Looking West.

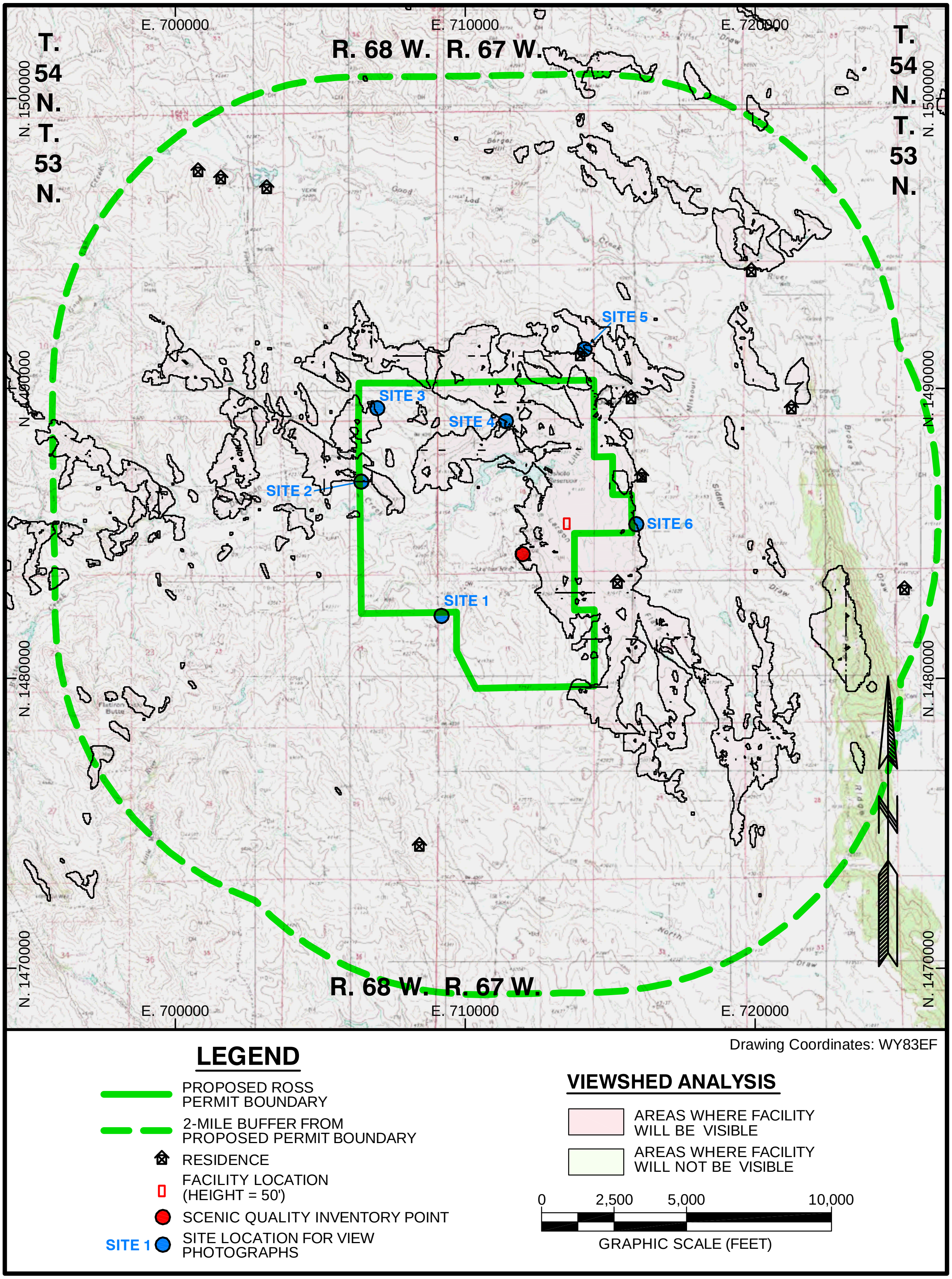


Figure 3.9-3. Viewshed Analysis

3.10 Socioeconomics

Information presented in this section concerns those demographic and social characteristics of the counties and communities that may be affected by the proposed development of a uranium ISR facility at the Ross Project in Crook County, Wyoming. Data were obtained through the 1980, 1990, and 2000 U.S. Census of Population, the 2005, 2006 and 2007 Census Population Estimates program, and various State of Wyoming government agencies.

3.10.1 Population

3.10.1.1 Regional Population

The area within an 80-km (50-mile) radius of the project site (centered at latitude 44.576464° N, longitude 104.957981° W) includes portions of three counties in northeastern Wyoming (Crook, Campbell and Weston), as shown on Figure 3.10-1. The 80-km radius around the site also includes small portions of two counties in Montana (Powder River and Carter) and very small parts of two counties in South Dakota (Butte and Lawrence). The proposed project area is located in western Crook County.

The project's direct zone of social influence is defined for the purposes of this report as the area within which the Proposed Action's socioeconomic impacts and benefits are reasonably anticipated to be concentrated, including the population areas most likely to contribute to the Proposed Action's local workforce and to provide ongoing sources of supplies and commodities during construction and operations. As inferred from Figure 3.10-1, the direct social zone of influence for the Proposed Action socioeconomic baseline report includes the towns and unincorporated areas within two Wyoming counties – Crook County, which hosts the deposits and therefore will benefit from mineral production tax revenues, and nearby Campbell County, which has the nearest urban area (Gillette) and therefore is a potential source of labor, services and materials to support the ISR operation.

Towns within Crook County and their 2000 populations include Hulett (408), Moorcroft (807), Pine Haven (222) and Sundance (1,161). Towns in Campbell County and their 2000 populations include Gillette (20,288) and Wright (1,347). The towns of Upton (2000 population 872) and Osage (2000 population 215), Wyoming, in Weston County, are within the 80-km radius of the proposed project area but not likely to be directly affected by the ISR uranium recovery operation. Likewise, the unincorporated community of Alzada, Montana (2000 population 92) is within the 80-km radius but will not be directly affected. (USCB 2000)

Gillette, Wyoming, the closest urban area to the proposed project area, is approximately 50 miles (80 km) via road southwest of the proposed project area, in Campbell County, and will likely serve as a regional logistics hub and source of workers and supplies for the Ross ISR Project. Moorcroft, Wyoming is within about 23 miles from the proposed project area via road and could be a source of employees and place of residence for project staff.

The majority of population and demographic information contained in this baseline report was obtained from the U.S. Census Bureau (USCB), Census 2000 data, and from the Wyoming Department of Administration and Information, Economic Analysis Division (WDAI/EA 2010a). Table 3.10-1 shows the 2000 and estimated July 2009 populations for Crook and Campbell counties and the incorporated communities within each county, as well as for the State of Wyoming.

In both counties, population growth during the 2000-2009 time period exceeded the state average; this growth was driven primarily by the energy boom. Campbell County is often cited as the energy capital of the nation. Thirty % of the nation's coal is produced in surface mines in Campbell County, and production of oil and gas, including coal bed and conventional natural gas, is an important part of the local and state economy.

NUREG-1569 obliges consideration of population data within a 50-mile (80-km) radius from the proposed project area's approximate center, as shown in Figure 3.10-1. Population by sector and cumulative population by sector based on Figure 3.10-1 are presented in Table 3.10-2. The distance to the nearest residence within each sector was calculated from querying the geographic data in Figure 3.10-1 and is presented in Table 3.10-3.

3.10.1.2 Population Projections

The most recent verifiable population data for Campbell and Crook counties come from the 2000 Federal census. Estimations of population changes for Wyoming counties are periodically calculated by the USCB and are available from the WDAI/EA (2010b). Population estimates for Wyoming and for Campbell and Crook counties for the period 2000 through July 1, 2009 are shown in Table 3.10-4.

As Table 3.10-4 shows, both counties grew faster than the State as a whole between 2000 and 2009. Campbell County's population increased by 30.5% within this time period, compared with the State average of 10.2%. Crook County grew by 13.0%, well below the growth shown by Campbell County but still above the State average. Between 2000 and 2009, the City of Gillette grew by 46.2%, faster than the county as whole and much faster than the entire State. This is largely attributable to the growth in the energy sector, including CBNG, conventional oil and gas, coal mining, and power plant construction.

Projected populations for Wyoming, Campbell and Crook counties through 2030 are shown in Table 3.10-5. The population projections for the communities in Campbell and Crook counties were calculated by applying the county growth rates. Campbell County, and its communities Gillette and Wright, are projected to grow at over 2.5 times the State average through 2030, while Crook County and its communities are projected to grow about 12% faster than the State as a whole

3.10.2 Demography

Demographic data for Crook and Campbell county populations collected for this baseline study include information regarding population breakdown by sex, age, race, and household size, and are summarized and compared to similar data for the State of Wyoming in Table 3.10-6. Demographic data were collected from the Census 2000 statistical pool at both the county and state levels to provide a descriptive picture of the populations within the direct zone of influence in comparison to that of the State of Wyoming as a whole.

Review of the tabulated data indicates that the population of Campbell County is younger than the State average, has more people per household, more households with individuals under 18 years of age and fewer households with individuals over 65 years of age, and slightly more female householders with no husband present and with their own children. Conversely, the population of Crook County is older than the State average with an older median age, smaller percentage of households with individuals under 18 years of age, and a higher percentage of households with persons 65 years of age or older. In Crook County the percentage of female householders with no husband present is below the State average, as is the percentage of female householders living with their own children under 18 years of age.

Racial data for the two counties show that the local population is predominantly white, with both counties having a smaller percentage of minorities than the State average. At 3.5%, the Campbell County percentage of Hispanics or Latinos, the largest minority group in both counties, was nearly four times that of Crook County in 2000, but still well below the State average of 6.4%. Between 2000 and July 2009, the Hispanic/Latino sector showed a significant increase as a percent of the population in both counties and in the entire state. A graphic depiction of the area's racial makeup is shown on Figure 3.10-2, again compared to the State average.

3.10.2.1 Schools

Public schools (kindergarten through 12th grade) in Wyoming are generally organized at the county or sub-county level by school district. Campbell and Crook counties each have one public school district. The public school districts in Campbell and Crook counties and their attendant schools and age levels are shown in Table 3.10-7. Figure 3.10-3 depicts the school locations relative to the proposed project area.

Wyoming also has seven community college districts. The Northern Wyoming Community College District consists of the main campus in Sheridan, a satellite college in Gillette, and outreach centers in Buffalo, Kaycee and Wright. The Gillette College campus is the closest post-secondary school to the proposed project area and is in a facility built in 2003.

Table 3.10-8 summarizes school attendance rates in Crook County, Campbell County and Wyoming. Campbell County has higher school attendance rates than Wyoming as a whole in all grade levels except college or graduate school. Crook County is below the State average at the nursery and preschool age, kindergarten and college/graduate school level, and well above the State average at the elementary grades 1-8 and high school levels.

3.10.3 Local Socioeconomic Baseline Conditions

3.10.3.1 Labor Market

The following discussion was taken from Year-end Review of Wyoming's Labor Market 2009 (Cowan 2009) and from the Wyoming Workforce Annual Report 2010 (Wyoming Department of Employment 2010a). Early in 2009, Wyoming followed in the footsteps of the rest of the nation and entered the recession according to the WDAI/EA (Liu 2009). In October 2009, the seasonally adjusted unemployment rate in Wyoming reached 7.4% for the first time since September 1987. Seasonal adjustment is a statistical procedure used to remove the impact of normal regularly recurring events (such as weather, major holidays, and the opening and closing of schools) from economic time series in order to obtain a better understanding of changes in economic conditions from month to month. The Wyoming unemployment rate for 2009 was 6.4%, vs 2.9% and 3.2% for 2007 and 2008, respectively. The labor force — the sum of employed and unemployed persons — also decreased from a high of 294,877 in December 2008 to 292,154 in October 2009. Nationally, the official U.S. Bureau of Labor Statistics (BLS) unemployment rate estimate is referred to as U-3. The annual average U-5 and U-6 rates, which are alternative measures of labor underutilization, have also increased over the last year (Cowan 2009). In 2007 and 2008, the U-5 and U-6 were 3.4% and 5.7%, respectively, for Wyoming. For fourth quarter 2008 through third quarter 2009, the BLS reported that these rates rose to 6.0% and 9.5%, respectively, for Wyoming.

Since March 2009, Wyoming has also experienced over-the-year job losses. By October 2009, jobs had dropped to 287,200, a 5.5% over-the-year decline from 303,800 jobs in October 2008. This marked the first over-the-year job losses in Wyoming since November 1987. Those over-the-year job losses continued from April 1986 through April 1988 when job numbers finally started to increase again.

Mass layoffs have also been increasing in Wyoming since the start of the recession. The Research & Planning-BLS Mass Layoff Statistics (MLS) program of the BLS tracks any layoff of 50 people or more by one employer. The number in Wyoming increased from 5 in 2007 to 8 in 2008 and was projected to reach 12 in 2009. Energy prices dropped dramatically during the recession; the last time this happened was after the Enron collapse in 2001. Wyoming's unemployment rate increased from around 4% in 2001 to a high of 4.7% in June 2003. After that it slowly decreased and was back down to 3.9% by February 2004. It continued to decrease to as low as 2.7% in October 2007 and January 2008 until the more recent recession. It is not clear when Wyoming's unemployment rate will return to low levels.

Unemployment statistics for Wyoming, Campbell and Crook counties as of October 2009 are presented in Table 3.10-9. Both counties consistently show lower unemployment rates than the State as a whole, although both counties also showed significant increases in unemployment rates between October 2008 and October 2009.

The Research & Planning section of the Wyoming Department of Employment reported that the State's seasonally adjusted unemployment rate rose from 7.2% in November 2009 to 7.5% in December 2009, which was not considered to be a statistically significant change. Despite this increase, Wyoming's unemployment rate remained significantly lower than the U.S. rate of 10.0%. Over-the-year job losses State-wide were seen in all but two sectors (educational & health services and government). Employment decreased by 20,600 jobs, or 6.9% from December 2008 to December 2009. Construction (-6,800 jobs, or –24.8%) and natural resources & mining (including oil & gas; -5,800 jobs, or -19.2%) posted the largest job losses.

Notable job losses were also seen in manufacturing (-700 jobs, or –7.1%), wholesale trade (-700 jobs, or –7.6%), retail trade (-2,000 jobs, or -6.0%), transportation & utilities (-800 jobs, or –5.3%), professional & business services (-1,700 jobs, or –9.4%), leisure & hospitality (-1,800 jobs, or –5.5%), and other services (-1,200 jobs, or –9.8%). Employment increased in educational & health services (900 jobs, or 3.6%) and government (including public schools, colleges, and hospitals (800 jobs, or 1.1%).

From November to December 2009 Wyoming lost 1,600 jobs, or 0.6%. This stands in contrast to the normal seasonal increase of approximately 1,200 jobs, or 0.4%. Larger than normal seasonal employment decreases were seen in construction (-3,100 jobs, or –13.1%) and professional & business services (-700 jobs, or –4.1%). Seasonal employment gains occurred in retail trade (400 jobs, or 1.3%), leisure & hospitality (1,700 jobs, or 5.8%), and government (300 jobs, or 0.4%).

Most county unemployment rates followed their normal seasonal pattern and increased from November to December. The highest unemployment rates were found in Johnson (9.3%), Teton (9.0%), Lincoln (8.8%), and Big Horn (8.8%) counties. Sublette County posted the lowest unemployment rate (4.5%) followed by Albany (4.6%) and Goshen (5.9%) counties. Campbell and Crook counties had unemployment rates of 7.0% and 6.6%, respectively, in December 2009 and these had further declined to 6.8% and 6.9%, respectively by April 2010 (Wyoming Department of Employment 2010b).

Table 3.10-10 provides a profile of selected employment data for Wyoming and Campbell and Crook counties based on Census 2000 data. Campbell County has a higher percentage of its population in the labor force than does Crook County or the State as a whole. Campbell County has lower percentages of the labor force in management, professional and related, and service occupations and higher percentages in construction, extraction, maintenance, production, transportation and material moving occupations than either Crook County or the State as a whole.

Both Campbell and Crook counties have over twice the Statewide percentage of the labor force involved in the agriculture, forestry, fishing and hunting and mining industries, and both counties are below the Statewide average in the percentage of the labor force involved in education, health and social services.

In Campbell County over 78% of the labor force is classed as a private wage or salary worker, compared to a Statewide average of about 70% and less than 60% in Crook County. Statewide, about 20.4% of the labor force is classed as government workers, compared to 15.3% in Campbell County and 23.3% in Crook County. At 16.3%, Crook County has a significantly higher percentage of the work force classified as self-employed in their own, not-incorporated business, compared with 8.9% Statewide and only 6% in Campbell County.

3.10.3.2 Employment, Income and Gross Domestic Product

The most recent compilation of data on Wyoming's employment, income and GDP is based on information through 2007 (Rushing 2009). Relevant information from that report is summarized below.

Income is broadly defined as revenue from all sources, including businesses; Federal, State, local, and foreign governments; households; and institutions. Total Personal Income (TPI) is a measure of income received by all residents of a particular area from all sources within that area. TPI is calculated after deduction of personal contributions to Social Security, but before Federal tax deductions. This value includes net earnings by place of residence, rental income, personal dividend income, personal interest income, and transfer receipts. Nationwide, TPI increased 6% from 2006 to 2007; while Wyoming's TPI increased 10.7%. This growth ranked 3rd in the U.S., only behind North Dakota and South Dakota. Similar to employment, TPI growth in Wyoming was largely attributed to increased mineral extraction activities and the associated job growth. For 2007, Wyoming's TPI was nearly $25 billion. Because of Wyoming's small population, its TPI is one of the smallest in the country. Some of the highest TPI numbers in the nation are from states such as California and New York. California was the only state that exceeded one trillion dollars in TPI for 2007. Although the Rocky Mountain region experienced huge gains in TPI from 2006 to 2007, it still had the smallest regional TPI because of smaller population numbers. In 2007, TPI in Campbell County was about $1.9 billion, compared with about $250 million in Crook County.

Per Capita Personal Income (PCPI) is defined as the TPI of an area divided by the population of that area. Since 2002, Wyoming has consistently had a higher PCPI than the United States average. In 2007, Wyoming had a PCPI of $47,047, an increase of 8.5% from 2006. Only North and South Dakota exhibited greater increases of PCPI from 2006 to 2007. The United States reported a PCPI of $38,615, an increase of 4.9% from the previous year. Wyoming's high PCPI can be attributed to its low population and the economic boost it experienced from increased mineral extraction activity. In 2007, PCPI in Campbell County was $47,151 and $43,462 for Crook County.

In 2007, the average wage in the United States was $43,889 and $38,901 in Wyoming. The Nation's capital, the District of Columbia, had the highest wage per job in the United States of $72,587, significantly higher than any other state. This high was due to the large number of Federal government jobs in the District of Columbia. The mining counties of Campbell, Sublette, and Sweetwater had the highest average wages for the State in 2007, each with an average wage per job greater than $45,000. Wyoming's mining industry has expanded; and mining jobs are typically higher paying. High paying mining jobs attract individuals to otherwise unpopulated areas of Wyoming, stimulating growth in smaller communities. In 2007 the average wage per job in Campbell County was just over $50,000; in Crook County the average wage per job was about $31,000. This reflects the relatively smaller percentage of jobs in the mineral extraction industry in Crook County.

Historically referred to as GSP, GDP by state is a comprehensive measure of economic activity within a state. It is the total market value of goods and services produced by the labor and property within a specific state during a specified period of time. Also equivalent to sales less intermediate inputs, GDP is reported using both current (nominal) and chained (real) dollars. Yearly increases can be attributed to the rise in the quantity or price of production. Current dollars reflect the period in which they are being reported; they have not been adjusted for inflation and are the market value of an item, reflecting the value of a dollar for each specific year. Chained dollars, however, are compared and adjusted according to a base year to express real prices. For example, the GDP data use chained 2000 dollars, meaning that the years of 2001 through 2007 are multiplied by the change in the chained-type quantity index number. Using chained dollars allows data users to more accurately evaluate growth through the years.

In 2008, the United States reported a GDP of over $14 trillion. Wyoming's GDP was one of the lowest in the nation, with $35.3 billion in 2008, ahead only of Vermont and North Dakota.

Leading the U.S. GDP are the sectors of Real Estate, Rental and Leasing; Government; and Manufacturing, each responsible for about 12% of the U.S. GDP. In contrast, the Wyoming GDP is dominated by one industry, mining, which accounts for 30.1% of the State's GDP, compared to only 2% of the national GDP. As evidenced by employment, income, and GDP data, the influence and benefits that mining has brought to Wyoming are quite significant. Agriculture, forestry, fishing and hunting account for 1.3% of the Wyoming GDP. Although agriculture does not make up a large portion of the Wyoming GDP, it contributes considerably to the culture and lifestyle of Wyoming residents. Wyoming has a rich agricultural history and many rural residents rely on agriculture for their livelihood. The influence and significance of agriculture may not be evident in a basic analysis of the Wyoming economy, but visiting the State or talking with one of the many ranching or farming families reveals the importance of agriculture to Wyoming's identity.

Farm earnings were down in 2007, with over half of Wyoming counties reporting negative earnings. Sixteen out of the twenty-three counties were affected by the trials and difficulties associated with farming and ranching, resulting in negative earnings. Seven more counties experienced negative earnings in 2007 in comparison to 2006, when only nine counties had negative farm earnings. Several factors, such as rising feed and fuel costs and drought, resulted in lower profits for livestock and crop production. After experiencing one of the most severe droughts in Wyoming's history, pastures and farmlands were in poor condition. In the last few years, the prices for corn and grain have skyrocketed, making it more expensive to feed livestock. Wyoming producers have been receiving lower prices for livestock, which combined with higher fuel and feed prices, lead to reduced profit. In 2007, there were about 8,800 farms and ranches in Wyoming, with the average size being just over 2,745 acres. In contrast, the U.S. average farm size was 418 acres. In 2007 there were about 640 farms or ranches in Campbell County, and their combined losses exceeded $6 million current dollars. In Crook County in 2007, about 450 farms had combined losses of about $1.8 million.

Based on federal data sources, Headwaters Economics produces detailed socioeconomic profiles at the statewide and county level. The profiles, each 41 pages long, contain tables and charts that illustrate long-term trends in population; employment and personal income by industry; average earnings; business development; retirement and other non-labor income; cross-county commuting patterns; and agriculture.

The purpose of the profile is to help community leaders, planners, and residents understand the makeup of their local economy and the trend, identify opportunities for economic development, and prepare for potential problems that arise from a changing economy. With a common base, the performance of the local economy can be compared with that of the nation and state. The following discussion of sectoral composition of the Wyoming and Campbell and Crook county economies was based on these profiles, which are available from WDAI/EA (2010e).

A sectoral composition of the U.S. economy can be used as a benchmark for economic diversity by comparing the local sector breakout to that of the nation. Communities that are heavily reliant on only a few industries may be economically vulnerable to disruptions. By quantitatively measuring the extent to which the sectoral breakout of the local economy mirrors that of the U.S., it is possible to illustrate the major factors that are contributing to any differences. Campbell County is specialized, with a specialization score of 640. By comparison, a county that is structured identically to the U.S. would have a score of 0 (very diverse). The largest observed score in the U.S. is 3,441 (very specialized). In Campbell County the sectors that most diverge from the U.S. norm are:

- Over reliance on mining (21.6% compared to 0.4% in the U.S.)
- Under reliance on manufacturing (2.3% compared to 14.1% in the U.S.)

- ♦ Under reliance on finance and insurance (1.5% compared to 5.0% in the U.S.)
- ♦ Under reliance on health care and social assistance (8.0% compared to 11.2% in the U.S.)

Crook County is also specialized, although less so than Campbell County, with a specialization score of 450. The sectors in Crook County that most diverge from the U.S. norm are:

- ♦ Over reliance on agriculture, forestry, fishing and hunting (15.3% compared to 1.5% in the U.S.)
- ♦ Over reliance on mining (9.5% compared to 0.4% in the U.S.)
- ♦ Under reliance on manufacturing (5.8% compared to 14.1% in the U.S.)
- ♦ Under reliance on health care and social assistance (5.6% compared to 11.2% in the U.S.)

Wyoming's economy is considered "extremely specialized", with a specialization score of 155, making Wyoming the 5th most specialized state. In Wyoming, the sectors that most diverge from the U.S. norm are:

- ♦ Under reliance on manufacturing (4.9% compared to 14.1% in the U.S.)
- ♦ Over reliance on mining (6.4% compared to 0.4% in the U.S.)
- ♦ Over reliance on agriculture, forestry, fishing and hunting (4.3% compared to 1.5% in the U.S.)
- ♦ Under reliance on professional, scientific, and technical services (3.7% compared to 5.9% in the U.S.)

3.10.3.3 Tax Base

The State of Wyoming does not levy a personal or corporate income tax. Wyoming does not impose a tax on intangible assets such as bank accounts, stocks, or bonds, either. In addition, Wyoming does not assess any tax on retirement income earned and received from another state. Revenues to the State of Wyoming come from three sources: taxes on mineral production, earnings on investments, and general fund sources. Taxes on mineral production include property taxes on the assessed value of production, severance taxes, royalties on production of State-owned minerals, and the State's share of federal mineral royalties. General-fund revenues include sales (4%) and use taxes, charges for sales and services, franchise taxes, and cigarette taxes. The third source of State revenues is earnings from the Wyoming Permanent Mineral Trust Fund and pooled investments. The

Consensus Revenue Estimating Group (CREG) is the official estimating body for all revenues received by the Wyoming State Government. The group was created by a mutual informal agreement between the executive and legislative branches in the fall of 1983 as a means of providing a single consensus estimate of revenues to aid in the budgeting process.

Through December 2009 (latest information available at the time of this writing) total FY2010 revenues to the State were $429,333,072, of which about 39.5% came from sales and use taxes, 23.4% from earnings on investments, and 23.3% from mineral severance taxes. The remaining 14.7% came from charges, franchise taxes and “other” sources. Based on these results, CREG projected that the revenues for the full FY2010 (beginning on July 1, 2009) would be $631,600,000 (CREG 2010). CREG noted that, “Year-to-date General Fund sales and use tax revenues for FY10 were about $46.0 million behind FY09 receipts. The slowdown is widespread, impacting all of the State’s 23 counties and most of the major industry sectors.”

Cities and counties receive revenues in the form of property taxes and local sales and use taxes up to 2%, including special assessments such as capital facilities taxes, and revenue sharing from the State. Local governments are responsible for collection of property taxes, which are the primary source of funding for public schools, counties, municipalities and other local government units.

Table 3.10-11 shows the assessed valuation and other general statistics for Wyoming, Campbell and Crook counties as of the end of FY2008. This table clearly shows the positive effect of the value of mineral production in Campbell County as compared to Crook County, which has relatively little mineral production. Although Crook County has a slightly higher average mill levy than Campbell County, the mill levy is applied to a much lower evaluation and so the property taxes raised in Crook County amounted to only a little more than 4% of those raised in Campbell County in FY2010.

Figure 3.10-3 shows the sales tax collections by economic sector in FY2010 for Campbell and Crook counties and the State of Wyoming. The figure clearly illustrates the importance of the retail and wholesale trade and mining sectors of the economy in terms of revenues from sales taxes.

3.10.3.4 Housing

Housing data were obtained from the USCB American Community Survey, which compiles various housing statistics from the most recent census and annual estimates on a state-wide and county-wide basis. Data used for this baseline study included information about the number and type of housing units, homeownership rates, and occupancy rates.

3.10.3.5 Dwelling Types

USCB data are compiled by the WDAI/EA in the annual Equality State Almanac (WDAI/EA 2010f) for various types of housing units, including single-family detached and attached homes, multi-unit dwellings (apartments), mobile homes, and rooms or groups of rooms designed as separate living quarters with direct occupant access. Housing data are subdivided by single unit (detached and attached), multiple units by number, mobile home, and other types of structures. The USCB provides the information on housing units by type of structure as a percentage of total housing units. Table 3.10-12 summarizes the housing data for the proposed project area, including owner-occupied vacancy rates (generally equivalent to for sale) and rental unit vacancy rates and seasonal/recreational/occasional use unit vacancy rates. Owner-occupied housing is proportionately higher in Campbell and Crook counties than the State as a whole, as is the percentage of people living in mobile homes. Rental vacancy rates are higher than the State average in Crook County; homeowner vacancy rates in both counties are below the State average.

3.10.3.6 Medical and Emergency Services

The proposed project area is located in Crook County but is close enough to the Campbell County line that both counties are within the area of potential impact. The Campbell County Memorial Hospital website (CCMH 2010) describes the development of the current facilities as follows: In June 1953, a 31-bed, red brick hospital was built in Gillette at a cost of $275,000. Four physicians and one visiting surgeon served the community of 2,190, which was then on the brink of an oil boom. Residents and community leaders continued looking to the future of healthcare with the opening of Campbell County Memorial Hospital in 1981.

Expansion and improvements to the facility began almost immediately, with construction of a fourth and fifth floor, Emergency Room and Outpatient

Surgery additions and construction of the two-story annex on the north end of the building. The Heptner Radiation Oncology Center was completed in 2002, and an expansion of medical oncology services was completed in 2008 to form the Cancer Care Center at Campbell County Memorial Hospital.

A 6,000 square-foot expansion of the Emergency Department was completed in 2009 and an extensive Laboratory was completed in late 2009. The Lab project includes the first full chemistry automation line in Wyoming.

A $68 million expansion project began in June 2009 with construction of a 3.5 level, 294-space parking structure adjacent to the main entrance. A three-level hospital addition capable of supporting three additional levels will begin construction in 2010. According to the website, “As the community grows and changes, Campbell County Memorial Hospital will continue to develop programs and services to meet the healthcare needs of our citizens.”

In addition to the hospital, Campbell County has outpatient and walk-in clinics, surgery and rehabilitation centers, and numerous senior residence facilities.

The Campbell County Emergency Management Agency (CCEMA) is a function within the Campbell County Commissioner's Office. The Coordinator reports to the Campbell County Commissioner's Administrative Director. CCEMA operates within the guidelines of:

- The Department of Homeland Security (DHS)
- Office of Domestic Preparedness (ODP)
- Federal Emergency Management Agency (FEMA)
- Wyoming Office of Homeland Security (WOHS)
- Environmental Protection Agency (EPA)
- Federal Communications Commission (FCC)

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

Sundance, Moorcroft, and Hulett have an ambulance service to cover each town and surrounding areas. Each service has emergency medical technician (EMT) Intermediates, EMT Basics and emergency medical responders (EMRs) serving on their teams. Of these, Moorcroft is closest to the proposed project area.

A community survey of needs and services was published in June 2010 by the Campbell County CARE Board (Schermetzler June 2010). The primary purpose of this needs assessment was to better understand the needs of people who are in poverty in Campbell County. The survey showed that both low income clients and agencies ranked in order the following as the most highly rated needs of the County:

1) Emergency services
2) Housing
3) Health
4) Nutrition/food
5) Employment and training

With emergency services ranking at the top of this list, and given the remoteness of the proposed project area, it is apparent that the operator of the Ross ISR Project will be required to maintain on staff personnel and equipment necessary to provide emergency services to deal with environmental, safety and health emergencies during construction, operation, aquifer restoration, and decommissioning of the site. Strata will maintain emergency response personnel on staff and will train local emergency responders in preparing and responding to potential environmental, safety and health emergencies resulting from the Ross ISR Project.

3.10.4 Socioeconomic Summary

The socioeconomic profiles for the 23 counties in Wyoming prepared by Headwaters Economics for the WDAI/EA (WDAI/EA 2010e), summarizes certain highlights based on how the county compares to each average for all of the counties in the United States. Selected highlights for Campbell County are as follows:

- Population Growth (annualized rate, 1970-2006) was fast.
- Employment Growth (annualized rate, 1970-2006) was very fast.
- Personal Income Growth (adjusted for inflation, annualized rate, 1970-2006) was very fast.

- Non-labor Income Share of Total in 2006 was very low.
- Median Age (2000 Census) was young.
- Per Capita Income (2006) was very high.
- Average Earnings Per Job (2006) was very high.
- Rich-Poor Ratio (2000 Census) (for each household that made over $100K, how many households made less than $30K) was somewhat low.
- Employment Specialization (2000 Census) was specialized.
- Education Rate based on 2000 Census (% of population 25 and over who have less than a high school diploma) was low.
- Education Rate based on 2000 Census (% of population 25 and over who have a college degree) was roughly average.
- Housing Affordability in 2000 (100 or above means that the median family can afford the median house) was roughly average affordable.
- Government share of total employment was roughly average.
- Unemployment Rate in 2007 (from BLS) was low.

The socioeconomic profile for Crook County contained the following highlights:

- Population Growth (annualized rate, 1970-2006) was roughly average.
- Employment Growth (annualized rate, 1970-2006) was somewhat fast.
- Personal Income Growth (adjusted for inflation, annualized rate, 1970-2006) was somewhat fast.
- Non-labor Income Share of Total in 2006 was somewhat low.
- Median Age (2000 Census) was somewhat old.
- Per Capita Income (2006) was high.
- Average Earnings Per Job (2006) was roughly average.
- Education Rate (2000 Census) (% of population 25 and over who have a college degree) was somewhat high.
- Education Rate in 2000 (% of population 25 and over who have less than a high school diploma) was somewhat low.
- Employment Specialization in 2000 was specialized.
- Rich-Poor Ratio in 2000 (see definition above) was roughly average.

- ♦ Housing Affordability in 2000 was roughly average.
- ♦ Government share of total employment was somewhat high.
- ♦ Unemployment Rate in 2007 was somewhat low.

As this is being written, two things are occurring that are not fully reflected in the data used in the preparation of this report. The 2010 Census is underway, and the nationwide economic recession which began in 2008 is still being felt in terms of high unemployment, declining real estate values, reduced activity in the mineral and construction industries, and other effects. Some of the information and conclusions in this report may be superseded as the country and region work their way through this recession.

3.10.5 Environmental Justice

Executive Order 12898 (February 11, 1994) directs Federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of EO 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. The Council on Environmental Quality (CEQ) defines a minority as "Individual(s) who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic." The CEQ further directs: "Minority populations should be identified where either (a) the minority population of the affected area exceeds 50% or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above stated thresholds (CEQ 1997)."

Table 3.10-6 and Figure 3.10-2 display a breakdown of the analysis area population by race and Hispanic origin. The minority population as a percentage of the analysis area is smaller than that of the entire State of Wyoming. <u>Therefore, a minority population as defined by EO 12898 does not exist in the analysis area.</u>

The CEQ defines "low-income population" as: "Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions or environmental exposure or effect" (CEQ 1997). Table 3.10-13 shows the Census 2000 poverty status for Wyoming and Campbell and Crook Counties. The poverty levels in Campbell and Crook Counties were below the state average in all categories.

The USCB's Small Area Income and Poverty Estimates (SAIPE) program provides annual estimates of income and poverty statistics for all states, counties, and school districts. The main objective of this program is to provide estimates of income and poverty for the administration of federal programs and the allocation of federal funds to local jurisdictions. In addition to these federal programs, there are hundreds of state and local programs that depend on income and poverty estimates for distributing funds and managing programs. Table 3.10-14 displays estimated 2008 poverty levels in Wyoming, Campbell and Crook counties. For all levels, poverty levels in the counties of interest are below Statewide levels.

Because no minority or low-income populations as defined by EO 12898 were identified in the analysis area, no further analysis of environmental justice was conducted.

Table 3.10-1. Area Population Estimates (2000 Compared to 2009)

Location	2000 Population (2000 Census)	Estimated July 2009 Population	Net Population Change 2000 to 2009	Percent Change 2000 to 2009
Crook County, WY	**5,887**	**6,653**	**766**	**13.0**
Hulett	408	516	108	26.5
Moorcroft	807	926	119	14.7
Pine Haven	222	396	174	78.4
Sundance	1,161	1,339	178	15.3
Campbell County, WY	**33,698**	**43,967**	**10,269**	**30.5**
Gillette	19,646	28,726	9,080	46.2
Wright	1,347	1,550	203	15.1
Wyoming	**493,782**	**544,270**	**50,488**	**10.2**

Source: USCB (2000) and WDAI/EA (2010a)
Note: Refer to Table 3.10-6 for demographic data.

Table 3.10-2. Population within a Given Distance from Project Center

	Distance from Project Center, km													
SECTOR	**0 - 1**	**1 - 2**	**2 - 3**	**3 - 4**	**4 - 5**	**5 - 10**	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**	**Grand Total**
N	0	0	0	0	0	7	11	9	8	23	37	30	54	179
Subtotal	*0*	*0*	*0*	*0*	*0*	*7*	*18*	*27*	*35*	*58*	*95*	*125*	*179*	*179*
NNE	0	0	0	0	0	0	16	10	21	15	14	18	2	96
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*16*	*26*	*47*	*62*	*76*	*94*	*96*	*96*
NE	0	1	0	4	0	0	3	57	36	49	21	82	24	277
Subtotal	*0*	*1*	*1*	*5*	*5*	*5*	*8*	*65*	*101*	*150*	*171*	*253*	*277*	*277*
ENE	0	0	0	0	0	0	34	90	620	77	65	50	58	994
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*34*	*124*	*744*	*821*	*886*	*936*	*994*	*994*
E	0	0	0	0	7	3	11	59	27	15	76	215	699	1,112
Subtotal	*0*	*0*	*0*	*0*	*7*	*10*	*21*	*80*	*107*	*122*	*198*	*413*	*1,112*	*1,112*
ESE	0	0	0	0	1	0	16	102	25	725	936	44	3	1,852
Subtotal	*0*	*0*	*0*	*0*	*1*	*1*	*17*	*119*	*144*	*869*	*1,805*	*1,849*	*1,852*	*1,852*
SE	0	2	0	0	0	2	47	50	82	68	115	101	98	565
Subtotal	*0*	*2*	*2*	*2*	*2*	*4*	*51*	*101*	*183*	*251*	*366*	*467*	*565*	*565*
SSE	0	0	0	0	0	0	59	231	162	11	970	162	282	1,877
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*59*	*290*	*452*	*463*	*1,433*	*1,595*	*1,877*	*1,877*
S	0	0	0	0	0	2	9	115	1,158	28	18	9	18	1,357
Subtotal	*0*	*0*	*0*	*0*	*0*	*2*	*11*	*126*	*1,284*	*1,312*	*1,330*	*1,339*	*1,357*	*1,357*
SSW	0	0	2	0	0	0	12	13	295	20	43	6	70	461
Subtotal	*0*	*0*	*2*	*2*	*2*	*2*	*14*	*27*	*322*	*342*	*385*	*391*	*461*	*461*
SW	0	0	0	0	0	0	0	111	162	2,088	23,219	1,003	210	26,793
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*111*	*273*	*2,361*	*25,580*	*26,583*	*26,793*	*26,793*
WSW	0	0	0	0	2	0	0	8	187	186	2,958	533	162	4,036
Subtotal	*0*	*0*	*0*	*0*	*2*	*2*	*2*	*10*	*197*	*383*	*3,341*	*3,874*	*4,036*	*4,036*
W	0	0	0	0	0	0	0	16	7	17	80	31	10	161
Subtotal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*16*	*23*	*40*	*120*	*151*	*161*	*161*
WNW	0	0	0	0	0	2	6	49	24	26	48	88	21	264
Subtotal	*0*	*0*	*0*	*0*	*0*	*2*	*8*	*57*	*81*	*107*	*155*	*243*	*264*	*264*
NW	0	0	0	0	0	2	0	0	11	14	17	50	33	127
Subtotal	*0*	*0*	*0*	*0*	*0*	*2*	*2*	*2*	*13*	*27*	*44*	*94*	*127*	*127*
NNW	0	0	0	0	0	4	6	3	2	17	38	71	35	176
Subtotal	*0*	*0*	*0*	*0*	*0*	*4*	*10*	*13*	*15*	*32*	*70*	*141*	*176*	*176*
Grand Total	0	3	2	4	10	22	230	923	2,827	3,379	28,655	2,493	1,779	40,327

Source: USCB (2000)

Table 3.10-3. Distance to Nearest Residence

	Distance from Project Center	
Sector	**Miles**	**Km**
N	6.10	9.82
NNE	1.38	2.22
NE	1.39	2.24
ENE	1.20	1.93
E	2.88	4.63
ESE	1.03	1.66
SE	4.60	7.40
SSE	10.39	16.72
S	2.06	3.32
SSW	3.83	6.16
SW	13.70	22.05
WSW	9.07	14.60
W	3.01	4.84
WNW	5.01	8.06
NW	2.82	4.54
NNW	2.61	4.20

Source: 2009 aerial imagery and field investigations

Table 3.10-4. Population Estimates, 2000 - 2009

	Population Estimates									**Census**	**Change, 2008-2009**		**Change, 2000-2009**	
Area	**July 1, 2009**	**July 1, 2008**	**July 1, 2007**	**July 1, 2006**	**July 1, 2005**	**July 1, 2004**	**July 1, 2003**	**July 1, 2002**	**July 1, 2001**	**2000 Population**	**Number**	**%**	**Number**	**%**
Wyoming	544,270	532,981	523,414	512,841	506,242	502,988	499,189	497,069	492,982	493,782	11,289	2.1	50,487	10.2
Campbell Co.	43,967	41,474	40,462	38,487	37,061	36,260	36,086	35,869	34,526	33,698	2,493	6.0	10,269	30.5
Gillette	28,726	26,826	25,275	23,615	22,520	21,987	21,882	21,682	20,831	19,646	1,900	7.1	8,377	41.2
Wright	1,550	1,474	1,517	1,479	1,424	1,403	1,411	1,420	1,376	1,347	76	5.2	223	15.1
Crook Co.	6,653	6,554	6,373	6,093	6,017	5,929	5,888	5,867	5,748	5,887	99	1.5	570	13.0
Hulett	516	509	493	459	446	433	431	431	425	408	7	1.4	57	18.6
Moorcroft	926	908	885	851	843	827	831	820	806	807	18	2.0	59	12.2
Pine Haven	396	384	363	331	309	293	263	239	224	222	12	3.1	143	78.4
Sundance	1,339	1,319	1,270	1,213	1,205	1,199	1,207	1,216	1,176	1,161	20	1.5	64	10.6

Sources: USCB (2000) and WDAI/EA (2010b)

Table 3.10-5. Population Projections for Campbell and Crook Counties and Their Communities

AREA	2008 Estimate	2009 Estimate	2010 Forecast	2015 Forecast	2020 Forecast	2025 Forecast	2030 Forecast	Growth, 2008-2030 Number	Growth, 2008-2030 %
WYOMING	**532,981**	**544,270**	**539,740**	**560,000**	**578,730**	**598,100**	**621,160**	**88,179**	**16.5**
Campbell Cnty	**41,474**	**43,967**	**43,440**	**47,800**	**52,130**	**55,800**	**59,990**	**18,516**	**44.6**
Gillette	26,826	28,726	26,893	29,592	32,272	34,544	37,138	10,312	38.4
Wright	1,474	1,550	1,643	1,808	1,971	2,110	2,269	795	53.9
Crook Cnty	**6,554**	**6,653**	**6,550**	**6,850**	**7,100**	**7,340**	**7,630**	**1,076**	**16.4**
Hulett	509	516	476	498	516	534	555	46	9.0
Moorcroft	908	926	888	929	963	995	1,034	126	13.9
Pine Haven	384	396	374	391	406	419	436	52	13.5
Sundance	1,319	1,339	1,256	1,314	1,361	1,407	1,463	144	10.9

Notes:
1. 2010 to 2030 state and county population forecasts were developed based on trends of demographic and economic variables.
2. Municipality population forecasts were simply calculated by applying the place/county ratios to the appropriate county population forecasts.
3. All population forecasts are for increasing trends; decreases shown between 2009 estimates and 2010 forecasts reflect the short-term inaccuracy of the population forecast method.

Source: WDAI/EA 2010b and 2010c

Table 3.10-6. Demographic Data for Area of Direct Impact

Data Type	Campbell County 2000	Campbell County July 1, 2009	Crook County 2000	Crook County July 1, 2009	Wyoming 2000	Wyoming July 1, 2009
Male / female ratio, %	51.4/48.6	51.7/48.2	50.6/49.4	50.6/49.4	50.3/49.7	50.9/49.1
Median age	32.2	31.4	40.2	44.4	36.2	35.9
Average household size, people	2.73	na	2.51	na	2.48	na
Average family size, people	3.16	na	3.01	na	3.00	na
Households with individuals under 18 years, %	45.4	na	33.8	na	35.0	na
Households with individuals 65 years and over, %	10.1	na	25.7	na	20.8	na
Female householder with no husband present, %	8.8	na	5.4	na	8.7	na
with own children under 18 years, %	6.8	na	3.8	na	6.0	na
Race, %						
White	96.1	95.7	97.9	98.0	92.1	93.5
Black / African America	0.2	0.7	0.1	0.2	0.8	0.9
American Indian / Alaskan Native	0.9	1.4	1.0	1.1	2.3	2.6
Asian	0.3	0.7	0.1	0.1	0.6	0.8
Native Hawaiian / Pacific Islander	0.1	0.1	0.0	0.0	0.1	0.1
Other or two or more races	2.4	1.4	1.0	0.7	3.2	1.5
Hispanic / Latino (of any race)	3.5	6.2	0.9	1.3	6.4	8.1

Sources: USCB (2000) and WDAI/EA (2010d)
na - not available

Table 3.10-7. Public Schools in Campbell and Crook Counties

School District	School Name	Grades
Campbell County School District #1	4-J Elementary School	K-6
	Conestoga Elementary	K-6
	Cottonwood Elementary	P-6
	Hillcrest Elementary	K-6
	Lakeview Elementary	K-6
	Little Powder Elementary	K-8
	Meadowlark Elementary	K-6
	Paintbrush Elementary	K-6
	Prairie Wind Elementary	K-6
	Pronghorn Elementary	K-6
	Rawhide Elementary	K-6
	Recluse School	K-8
	Rozet Elementary	P-6
	Stock Trail Elementary	K-6
	Sunflower Elementary	K-6
	Wagonwheel Elementary	K-6
	Sage Valley Junior High School	7-9
	Twin Spruce Junior High School	7-9
	Campbell County High School	10-12
	Westwood High School	9-12
	Wright Jr. & Sr. High School	7-12
Crook County School District #1	Hulett School	K-12
	Moorcroft Elementary	K-6
	Moorcroft Secondary	7-12
	Sundance Elementary	K-6
	Sundance Secondary	7-12
	Bear Lodge High School	8-12

Source: Wyoming Department of Education 2010
Note: See Figure 3.10-3 for school locations.

Table 3.10-8. School Attendance Rates

School Category	Percent of Population ≥3 Years Old Attending School		
	Campbell County	Crook County	Wyoming
Nursery, preschool	1.8	1.4	1.6
Kindergarten	1.5	1.0	1.3
Elementary (grades 1-8)	14.3	12.7	12.1
High school (grades 9-12)	7.8	9.2	6.6
College or graduate school	3.4	1.5	6.0

Source: USCB (2000) obtained from WDAI/EA (2010d)

Table 3.10-9. Unemployment Statistics for October 2009

Region	Labor Force			Employed			Unemployed			Unemployment Rates (%)		
	Oct 2009	**Sept 2009**	**Oct 2008**	**Oct 2009**	**Sept 2009**	**Oct 2008**	**Oct 2009**	**Sept 2009**	**Oct 2008**	**Oct 2009**	**Sept 2009**	**Oct 2008**
Campbell Co.	28,686	28,221	27,402	26,924	26,625	26,909	1,762	1,596	493	6.1	5.7	1.8
Crook Co.	3,388	3,430	3,454	3,186	3,262	3,356	202	168	98	6.0	4.9	2.8
Statewide	292,154	292,513	293,921	272,108	274,285	286,036	20,046	18,228	7,885	6.9	6.2	2.7

Source: Wyoming Department of Employment (2010b)

Table 3.10-10. Selected Employment Characteristics for Wyoming and Campbell and Crook Counties

Subject	Wyoming		Campbell County		Crook County	
	Number	Percent	Number	Percent	Number	Percent
EMPLOYMENT STATUS						
Population 16 years and over	**381,912**	**100.0**	**24,560**	**100.0**	**4,562**	**100.0**
In labor force	257,808	67.5	18,805	76.6	2,937	64.4
Civilian labor force	254,508	66.6	18,805	76.6	2,937	64.4
Employed	241,055	63.1	17,975	73.2	2,839	62.2
Unemployed	13,453	3.5	830	3.4	98	2.1
Percent of civilian labor force		5.3		4.4		3.3
Armed Forces	3,300	0.9	-	-	-	-
Not in labor force	124,104	32.5	5,755	23.4	1,625	35.6
Females 16 years and over	**191,263**	**100.0**	**12,073**	**100.0**	**2,257**	**100.0**
In labor force	117,294	61.3	8,121	67.3	1,291	57.2
Civilian labor force	116,781	61.1	8,121	67.3	1,291	57.2
Employed	111,037	58.1	7,736	64.1	1,263	56.0
Children under 6 years	**35,759**	**100.0**	**2,940**	**100.0**	**334**	**100.0**
All parents in family in labor force	22,813	63.8	1,667	56.7	172	51.5
Employed civilian population 16 years and over	241,055	100.0	17,975	100.0	2,839	100.0
OCCUPATION						
Management, professional, and related occupations	72,258	30.0	4,305	23.9	848	29.9
Service occupations	40,290	16.7	2,468	13.7	431	15.2
Sales and office occupations	58,397	24.2	3,798	21.1	536	18.9
Farming, fishing, and forestry occupations	3,700	1.5	119	0.7	123	4.3
Construction, extraction, and maintenance occupations	35,567	14.8	4,265	23.7	472	16.6
Production, transportation, and material moving occupations	30,843	12.8	3,020	16.8	429	15.1
INDUSTRY						
Agriculture, forestry, fishing and hunting, and mining	25,732	10.7	4,182	23.3	702	24.7
Construction	20,881	8.7	1,775	9.9	235	8.3
Manufacturing	11,749	4.9	407	2.3	165	5.8
Wholesale trade	5,499	2.3	538	3.0	32	1.1
Retail trade	28,457	11.8	1,899	10.6	234	8.2
Transportation and warehousing, and utilities	15,847	6.6	1,341	7.5	207	7.3
Information	5,351	2.2	208	1.2	35	1.2
Finance, insurance, real estate, and rental and leasing	11,402	4.7	480	2.7	73	2.6
Professional, scientific, management, administrative, and waste management services	14,312	5.9	997	5.5	94	3.3
Educational, health and social services	51,737	21.5	2,997	16.7	505	17.8
Arts, entertainment, recreation, accommodation and food services	23,173	9.6	1,540	8.6	217	7.6
Other services (except public administration)	11,785	4.9	951	5.3	142	5.0
Public administration	15,130	6.3	660	3.7	198	7.0
CLASS OF WORKER						
Private wage and salary workers	169,210	70.2	14,093	78.4	1,689	59.5
Government workers	49,187	20.4	2,759	15.3	659	23.2
Self-employed workers in own not incorporated business	21,466	8.9	1,073	6.0	463	16.3
Unpaid family workers	1,192	0.5	50	0.3	28	1.0

Source: USBC (2000)

Table 3.10-10. Selected Employment Characteristics for Wyoming and Campbell and Crook Counties (Continued)

	Wyoming		Campbell County		Crook County	
Subject	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
EMPLOYMENT STATUS						
Population 16 years and over	**381,912**	**100.0**	**24,560**	**100.0**	**4,562**	**100.0**
In labor force	257,808	67.5	18,805	76.6	2,937	64.4
Civilian labor force	254,508	66.6	18,805	76.6	2,937	64.4
Employed	241,055	63.1	17,975	73.2	2,839	62.2
Unemployed	13,453	3.5	830	3.4	98	2.1
Percent of civilian labor force		5.3		4.4		3.3
Armed Forces	3,300	0.9	-	-	-	-
Not in labor force	124,104	32.5	5,755	23.4	1,625	35.6
Females 16 years and over	**191,263**	**100.0**	**12,073**	**100.0**	**2,257**	**100.0**
In labor force	117,294	61.3	8,121	67.3	1,291	57.2
Civilian labor force	116,781	61.1	8,121	67.3	1,291	57.2
Employed	111,037	58.1	7,736	64.1	1,263	56.0
Children under 6 years	**35,759**	**100.0**	**2,940**	**100.0**	**334**	**100.0**
All parents in family in labor force	22,813	63.8	1,667	56.7	172	51.5
Employed civilian population 16 years and over	241,055	100.0	17,975	100.0	2,839	100.0
OCCUPATION						
Management, professional, and related occupations	72,258	30.0	4,305	23.9	848	29.9
Service occupations	40,290	16.7	2,468	13.7	431	15.2
Sales and office occupations	58,397	24.2	3,798	21.1	536	18.9
Farming, fishing, and forestry occupations	3,700	1.5	119	0.7	123	4.3
Construction, extraction, and maintenance occupations	35,567	14.8	4,265	23.7	472	16.6
Production, transportation, and material moving occupations	30,843	12.8	3,020	16.8	429	15.1
INDUSTRY						
Agriculture, forestry, fishing and hunting, and mining	25,732	10.7	4,182	23.3	702	24.7
Construction	20,881	8.7	1,775	9.9	235	8.3
Manufacturing	11,749	4.9	407	2.3	165	5.8
Wholesale trade	5,499	2.3	538	3.0	32	1.1
Retail trade	28,457	11.8	1,899	10.6	234	8.2
Transportation and warehousing, and utilities	15,847	6.6	1,341	7.5	207	7.3
Information	5,351	2.2	208	1.2	35	1.2
Finance, insurance, real estate, and rental and leasing	11,402	4.7	480	2.7	73	2.6
Professional, scientific, management, administrative, and waste management services	14,312	5.9	997	5.5	94	3.3
Educational, health and social services	51,737	21.5	2,997	16.7	505	17.8
Arts, entertainment, recreation, accommodation and food services	23,173	9.6	1,540	8.6	217	7.6
Other services (except public administration)	11,785	4.9	951	5.3	142	5.0
Public administration	15,130	6.3	660	3.7	198	7.0
CLASS OF WORKER						
Private wage and salary workers	169,210	70.2	14,093	78.4	1,689	59.5
Government workers	49,187	20.4	2,759	15.3	659	23.2
Self-employed workers in own not incorporated business	21,466	8.9	1,073	6.0	463	16.3
Unpaid family workers	1,192	0.5	50	0.3	28	1.0

Source: USBC (2000)

Table 3.10-11. Assessed Valuation, Taxes Levied, and Selected General Revenue Statistics, Wyoming and Campbell and Crook Counties (FY 2008)

	Wyoming	**Campbell County**	**Crook County**
Assessed valuation	$21,898,331,198	$4,722,822,444	$160,960,755
Total property taxes levied[1]	$1,408,133,012	$285,703,657	$10,067,332
Sales and use tax distribution	$456,792,489	$81,618,012	$3,676,333
Bank deposits	$6,407,231,000	$816,509,000	$143,559,000
FY2008 avg mill levy	64.303	60.494	62.545
Sales tax collections	$849,216,844	$153,037,064	$5,526,730
Use tax collections	$124,173,967	$20,783,856	$1,261,553

[1] Includes county, municipal, special district and education levees
Source: WDAI/EA (2010f)

Table 3.10-12. Census 2000 Housing Data for the Proposed Project Area

	Wyoming		**Campbell County**		**Crook County**	
HOUSEHOLD BY TYPE	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Total households	**193,608**	**100.0**	**12,207**	**100.0**	**2,308**	**100.0**
Average household size	2.48	-	2.73	-	2.51	-
Average family size	3.00	-	3.16	-	3.01	-
HOUSING OCCUPANCY						
Total housing units	**223,854**	**100.0**	**13,288**	**100.0**	**2,935**	**100.0**
Occupied housing units	193,608	86.5	12,207	91.9	2,308	78.6
Vacant housing units	30,246	13.5	1,081	8.1	627	21.4
For seasonal, recreational, or occasional use	12,389	5.5	215	1.6	344	11.7
Homeowner vacancy rate (percent)		2.1		1.2		1.9
Rental vacancy rate (percent)		9.7		9.0		14.3
HOUSING TENURE						
Occupied housing units	**193,608**	**100.0**	**12,207**	**100.0**	**2,308**	**100.0**
Owner-occupied housing units	135,514	70.0	8,989	73.6	1,845	79.9
Renter-occupied housing units	58,094	30.0	3,218	26.4	463	20.1
Total housing units	**223,854**	**100.0**	**13,288**	**100.0**	**2,935**	**100.0**
1-unit houses	153,425	68.5	7,492	56.4	1,895	64.6
Multi-unit housing	34,007	15.2	2,276	17.1	161	5.5
Mobile homes	35,569	15.9	3,432	25.8	861	29.3
Boat, RV, van, etc.	853	0.4	88	0.7	18	0.6
Units lacking complete plumbing	1,011	0.5	61	0.5	4	0.2
Units lacking complete kitchens	1,246	0.6	39	0.3	9	0.4
Units with no telephone service	6,235	3.2	294	2.4	106	4.6

Source: USCB (2000)

Table 3.10-13. Census 2000 Poverty Levels in Wyoming and Campbell and Crook Counties

Subject	Wyoming		Campbell County		Crook County	
	Number below poverty level	**Percent below poverty level**	**Number below poverty level**	**Percent below poverty level**	**Number below poverty level**	**Percent below poverty level**
POVERTY STATUS IN 1999						
Families	**10,585**	**8.0**	**507**	**5.6**	**129**	**7.8**
With related children under 18 years	8,303	12.4	371	6.7	90	11.5
With related children under 5 years	4,041	16.5	193	9.7	9	4.6
Families with female householder, no husband present	**5,077**	**30.9**	**255**	**25.4**	**40**	**27.2**
With related children under 18 years	4,682	38.1	223	27.0	38	31.7
With related children under 5 years	2,215	53.4	113	40.1	2	14.3
Individuals	**54,777**	**11.4**	**2,544**	**7.6**	**529**	**9.1**
18 years and over	36,562	10.3	1,704	7.4	367	8.7
65 years and over	4,853	8.9	208	12.4	93	11.8
Related children under 18 years	17,284	13.8	791	7.7	154	9.9
Related children 5 to 17 years	11,835	12.5	546	7.0	137	10.8
Unrelated individuals 15 years and over	20,101	23.5	916	20.0	181	21.5

Source: USCB (2000)

Table 3.10-14. Estimated 2008 Poverty Levels in Wyoming and Campbell and Crook Counties

Subject	Wyoming		Campbell County		Crook County	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
All ages in poverty	49,465	9.5	2,376	5.8	476	7.8
Under age 18 in poverty	15,079	11.9	741	6.6	130	9.2
Ages 15-17 in families in poverty	8,604	9.8	412	5.3	80	8.2
Under age 5 in poverty	5,657	15.0	NA	NA	NA	NA

Source: USCB (2010)

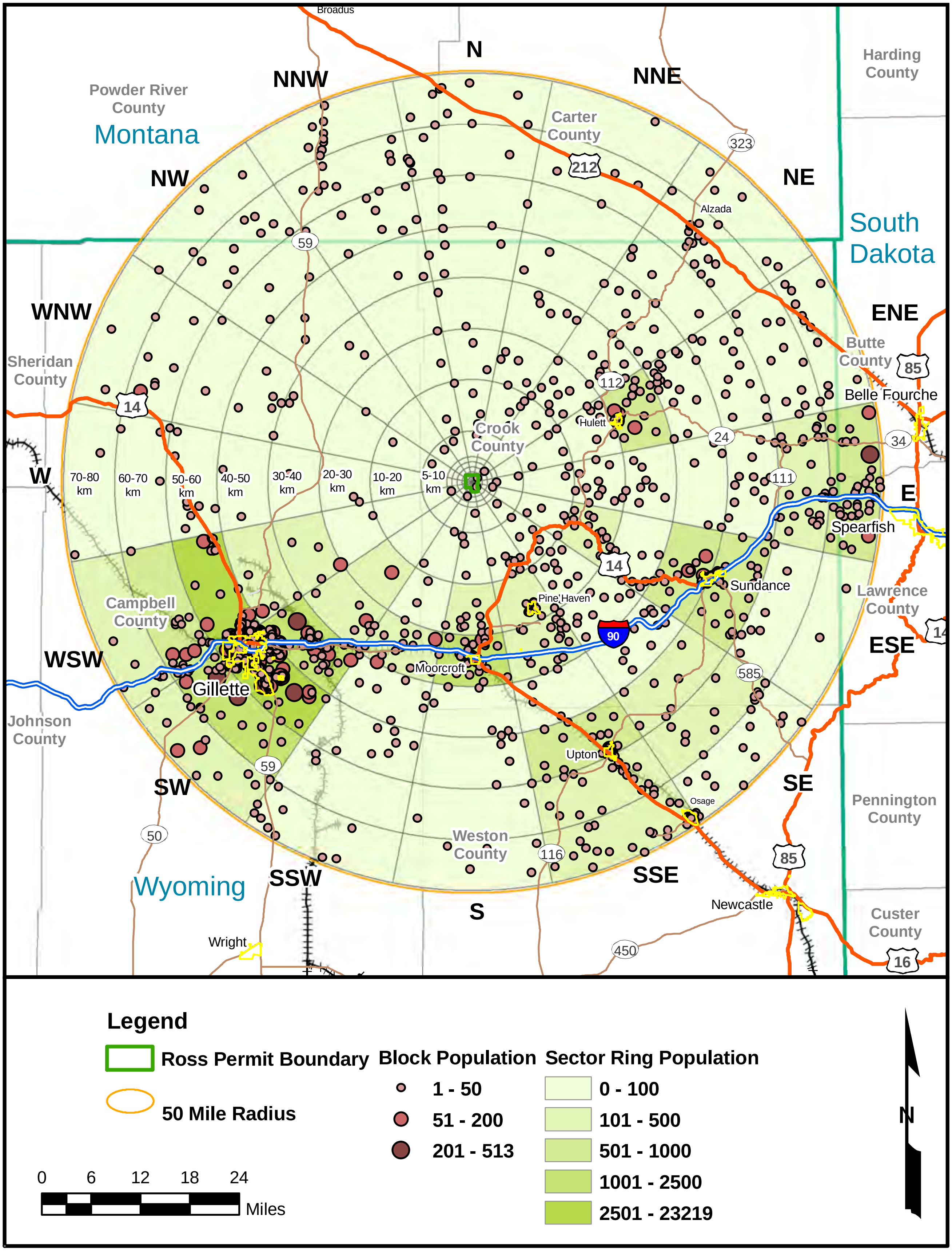


Figure 3.10-1. Population Block Analysis.

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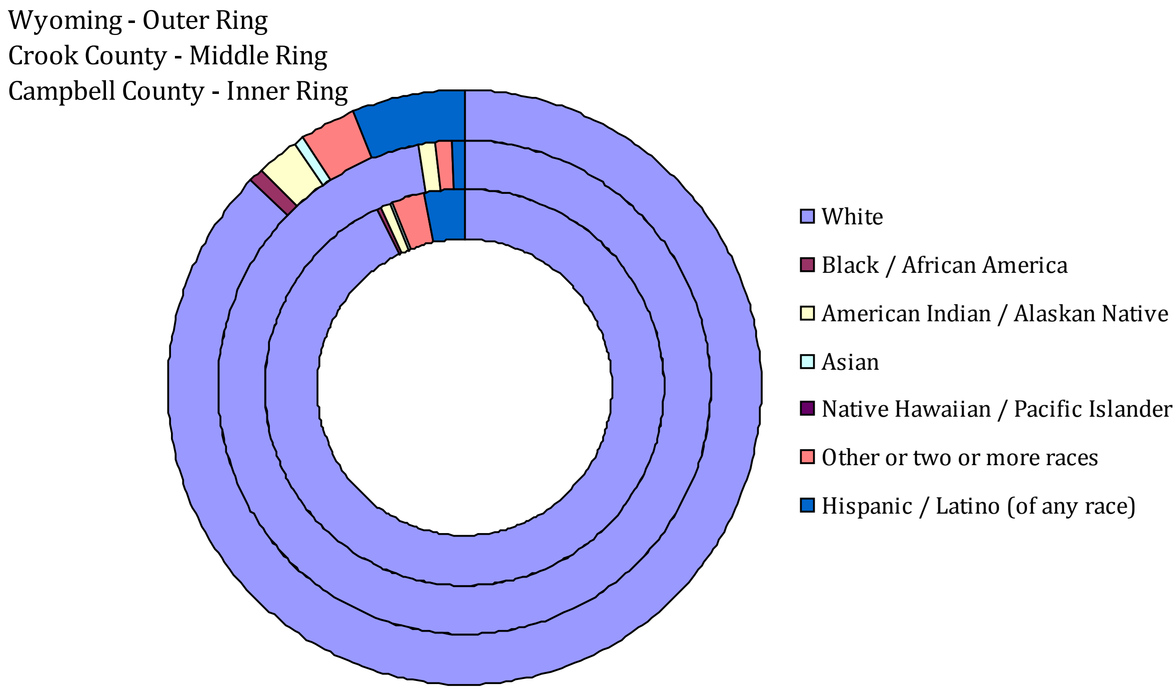
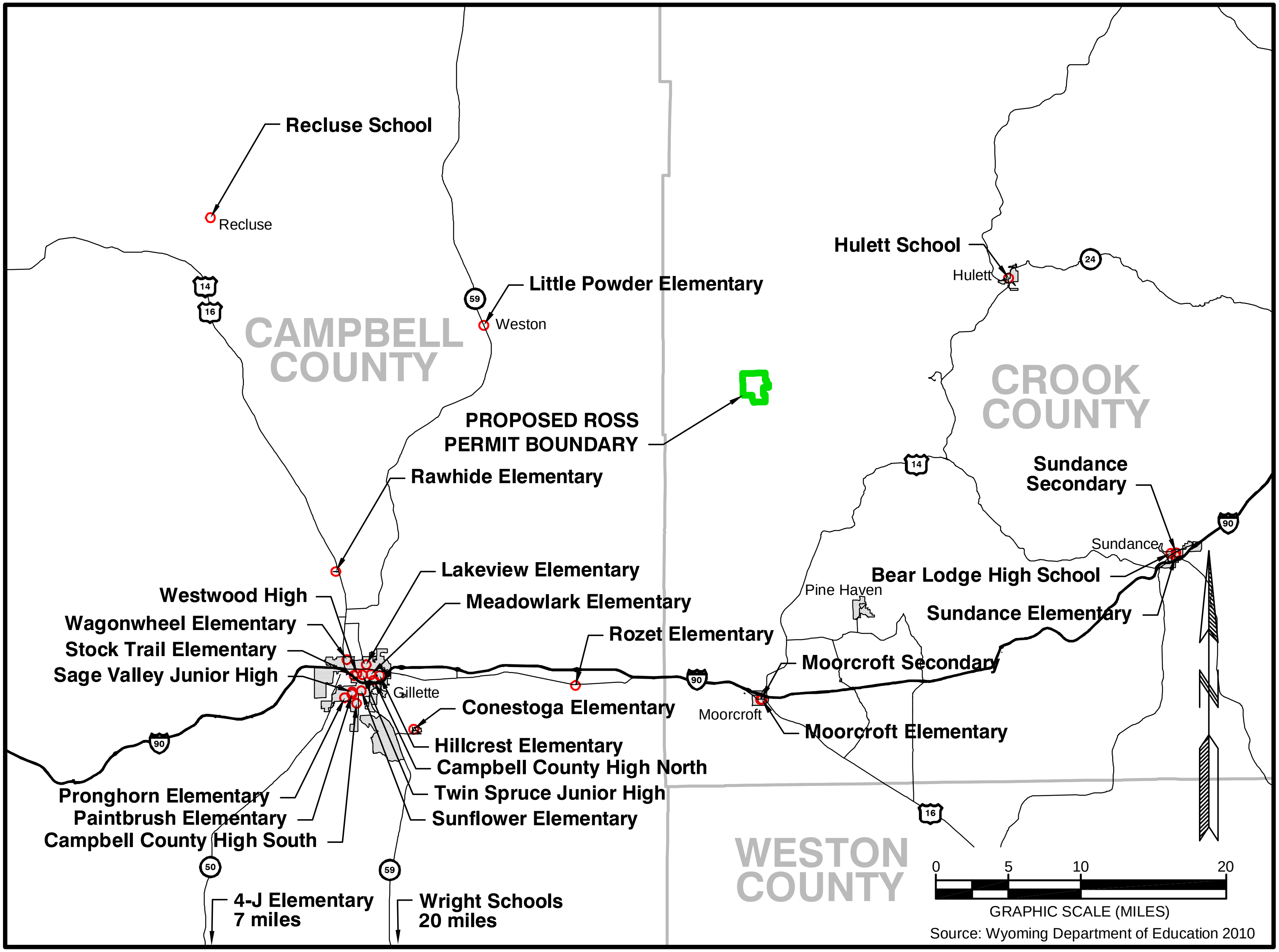


Figure 3.10-2. Campbell and Crook County and Wyoming Racial Makeup Comparison (Source: USCB 2000)

Figure 3.10-3. Public Schools in Campbell and Crook Counties



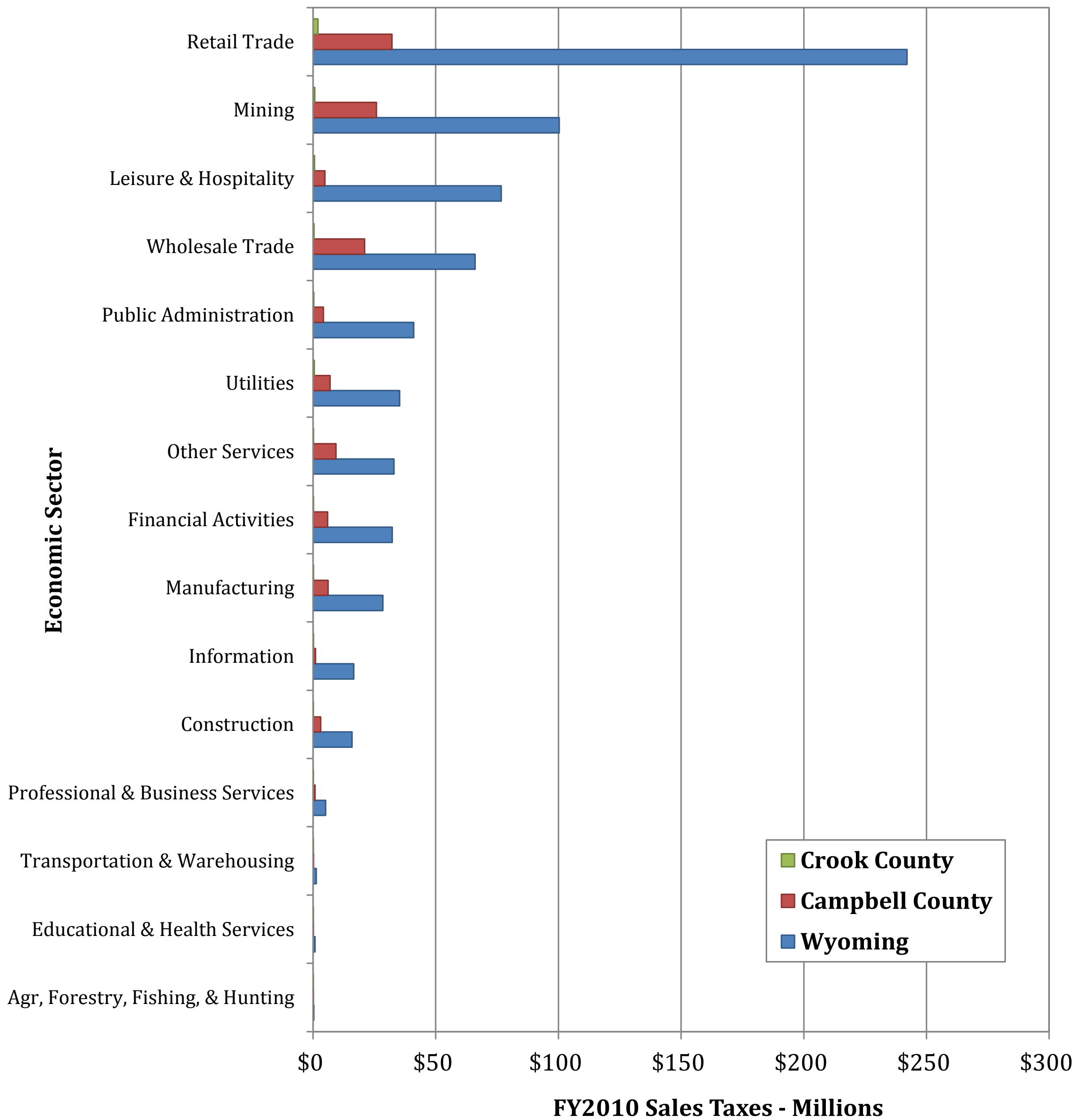


Figure 3.10-4. FY2010 Sales Taxes by Economic Sector
(Source: WDAI/EA 2010g)

3.11 Public and Occupational Health

This section describes existing public and occupational health conditions related to the proposed project area. A discussion of exposures to populations and individuals is presented with a focus on topics related to the intended use of the site. This lays a foundation for later sections that describe potential impacts to the site, especially Section 4.12, Potential Public and Occupational Health Impacts.

3.11.1 Background Radiological Conditions

Background radiation is defined in 10 CFR 20.1003 as, "Radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee."

Background radiation accounts for half of the average annual radiation exposure to the U.S. population, with radon and thoron accounting for a large part of this exposure. Radon and thoron are radioactive gases produced from the decay of uranium-238 and thorium-232, which were distributed during the Earth's formation 4.5 billion years ago. As can be seen in Table 3.11-1, background sources account for 50% of the average annual exposure to an individual in the U.S., and within this source category, radon and thoron account for a majority at 37%. Medical procedures account for most of the other 50%.

Man-made radiation consists of contributions from medical procedures (including nuclear medicine), occupational exposure, consumer products and industrial activities. Of the man-made sources, medical computed tomography accounts for 24% of the total exposure. Within the other categories, occupational exposure and industrial activities contribute less than 0.1%. The nuclear fuel cycle includes ISR uranium recovery and is among the lowest contributors to annual dose at less than 0.03%.

Figure 3.11-1 shows another representation of the percentage breakdown of the sources of background and man-made radiation. The pie chart represents the total average annual dose to an individual in the U.S. from ionizing radiation, both background and man-made.

While useful to discuss percentages of exposure, it is also informative to quantify the dose from the background sources and activities. This provides relative references for the later discussion of potential impacts from the proposed Ross ISR Project.

For the average U.S. resident, the total effective dose from background radiation sources is approximately 3.1 millisievert (mSv) in a year. In addition, the average American receives approximately 3.1 mSv in a year from man-made sources, primarily medical procedures and consumer products. Therefore, the total from natural background and man-made sources for the average U.S. resident is 6.2 mSv (620 mrem) in a year (NCRP 2009). By comparison, the ISR GEIS (pg. 3.2-80) states that the average U.S. citizen receives 3 mSv per year from background radiation sources but only 0.6 mSv per year from man-made sources. National Council on Radiation Protection & Measurements (NCRP) Report No. 160 (NCRP 2009) was unavailable at the time the ISR GEIS, which cites the 1987 NCRP Report No. 93, was prepared. The executive summary to the 2009 NCRP report describes the increase in dose as follows:

> "Since [the early 1980s], the magnitude and distribution among the various sources of radiation exposure to the U.S. population have changed primarily due to increase utilization of ionizing radiation in diagnostic and interventional medical procedures."

Common sources and activities that contribute to radiation dose to the public are shown in Table 3.11-2. As shown in Table 3.11-1, the data from NCRP 160 illustrate that the highest doses from man-made sources are from medical procedures. With respect to energy, using natural gas for cooking in the home imparts a dose of 0.004 mSv in a year (primarily from radon and thoron). The potential dose from nuclear power generation and uranium recovery operations are very low at <0.001 mSv in a year. Therefore, the average dose to a U.S. resident is 4 times higher from cooking than from the nuclear fuel cycle.

The discussion so far has described average doses in the U.S. However, background radiation exposure can vary considerably from place to place within the U.S. and over areas within a region. Natural variation occurs due to effects from elevation (higher cosmic radiation exposure occurs at higher elevations), higher levels of naturally occurring radioactive elements in soil and water in mineralized areas (e.g., igneous formations in the Rocky Mountains) and other factors like local geology and chemistry.

Because background radiation varies significantly across the U.S., it follows that population exposure varies accordingly. Table 3.11-3 shows examples of how radiation dose rates from natural sources vary from place to place. For example, the higher cosmic values shown for Wyoming and Colorado are a reflection of higher elevation and greater amount of naturally occurring radioactive elements in the soil and rock when compared to lower lying coastal states such as Oregon and Virginia.

Radon and thoron are ubiquitous in nature and are found everywhere in outdoor and indoor air. Thoron is generally present in far lower levels than radon; the potential annual average dose in the U.S. from thoron is estimated to be 0.1 mSv, far below that of radon at about 2.0 mSv. (NCRP 2009) Thus, potential exposure to radon will be discussed in more detail.

In addition to variations in annual averages in a region, outdoor radon concentration varies regionally and in localized areas diurnally, temporally and geographically, depending on its emanation rate from upwind soil and its transport through the atmosphere. The amount of radon in the soil or bedrock depends on the type, porosity, and moisture content. Areas that have types of soils or bedrock like granite and limestone have higher natural uranium levels which therefore result in higher radon levels than those with other types of soils or bedrock (NCRP 2009).

When discussing baseline radon concentrations, it is important to note that radon generally does not pose an outdoor health hazard. As described in the GER (NMA 2007):

> "It is very important to understand that while outdoor radon contributes to levels of radon indoors, the predominant source of people's exposure to radon is from exposure to radon daughter levels inside the home primarily originating from the soils beneath the home. As the United States EPA notes 'people need to be occupying a structure and not just standing outdoors' for its radon risk estimates to be applicable (48 Fed. Reg. 15076, 15083)."

Outdoor radon concentrations are generally a small fraction of the average indoor concentrations. Doses from sources in the general environment (such as terrestrial radiation, cosmic radiation, and naturally occurring radon) are not included in the dose calculation for compliance with exposure limits in 10 CFR 20, even if these sources are from technologically enhanced naturally occurring radioactive material (TENORM), such as preexisting radioactive residues from prior uranium mining operations (ISR GEIS, pg. 3.2-81).

As part of developing an application for a radioactive material license for a uranium recovery facility, the NRC requires an applicant to conduct a radiological assessment to determine the impact from ISR uranium recovery. A computer model known as MILDOS-AREA is used to generate estimates of dose to the public (Faillace 1997). The dose rates are then compared to the regulatory limits to demonstrate that no member of the public will be exposed to radiation levels in excess of regulatory limits set by the NRC (NRC 2002). A detailed discussion of the MILDOS-AREA computer code and projected exposure rates for the Ross ISR Project can be found in Section 4.12.2.4 in this ER.

3.11.2 Current and Historical Sources and Levels of Exposure to Radioactive Materials

Other than background and the common sources of man-made exposure discussed above, there are no other nuclear facilities or activities in the region that could result in radiation exposure to the local population. A comprehensive radiological baseline study has been conducted at the Ross project site. This included determining the background dose from cosmic and terrestrial radiation via gamma scanning across the project site. Additionally, thermo luminescent dosimeters, which continuously recorded the terrestrial plus cosmic background radiation, were placed at 15 strategic locations for 12 months. These studies indicated that the background dose rates from cosmic and terrestrial sources average approximately 0.78 to 1.24 mSv/yr (78 to 124 mrem/year) which are consistent with the average values for the State of Wyoming as presented in Table 3.11-3. These are 0.52 mSv/yr (52 mrem/yr) cosmic radiation and 0.27 mSv/yr (27 mrem/yr) terrestrial.

Although the background radiation for the proposed project area is typical of background radiation in Wyoming in general, there are two potential sources of radiation exposure that warrant further discussion. As described in Section 1.2 of this ER, the Nubeth R&D ISR uranium recovery facility was operated within the proposed project area in the late 1970s. Groundwater restoration and decommissioning were approved by NRC and WDEQ in 1983 through 1986, and the R&D site was released for unrestricted use. Gamma ray surveys conducted by Strata as part of the baseline monitoring program revealed elevated exposure rates in the southern section of the proposed project area, near the Nubeth R&D site. It is difficult to assess whether the increased exposure rates are due to Nubeth activities since a gamma survey for a nearby area, previously used as a Nubeth evaporation pond, did not show similar exposure rates. Further, some of the elevated exposure rates identified in the gamma ray surveys are attributed to weathered exposure of naturally occurring bedrock sandstone in the southern portion of the proposed project area. Based on this information and other gamma survey results for the proposed project area, discussed in Section 2.9 of the TR, the Nubeth R&D site poses no radiation exposure risk to the local population.

The second potential source of radiation exposure specific to the proposed project area is that from consuming groundwater with elevated radionuclide concentrations. As described in Section 3.4.3, there are no domestic wells within the proposed project area, but some nearby wells have gross alpha and/or uranium concentrations above EPA MCLs and Wyoming class of use standards. Some also have radon concentrations above the formerly proposed but not enacted EPA MCL.

3.11.3 Major Sources and Levels of Chemical Exposure

The remote location of the proposed project area is characterized by sparse population settlements. The predominant land uses are livestock grazing, dry land crop production, and oil production. The region does not have industrial activities that constitute significant sources of chemical generation. The only chemicals known to be present in the proposed project area are crude oil, produced water, propane, and methanol. There is the potential that existing pole-mounted electrical transformers could contain polychlorinated biphenyls (PCBs), but the potential for chemical exposure is extremely low from the intact and operational transformers. There are no recognized existing sources of any other hazardous chemicals at or near the proposed Ross ISR site.

3.11.4 Occupational Health and Safety

Occupational health and safety hazards within the proposed project area are limited by existing land uses, which are primarily agriculture and oil production. Agricultural and oil production workers face many of the same occupational health and safety hazards. According to the Wyoming Department of Employment (2010c), extraction workers, including oil production workers, had a higher-than-average injury and illness rate in Wyoming in 2008. The most common injuries resulting in days away from work were strains and sprains, often the results of slips/trips/falls or lifting. The Wyoming

Department of Employment does not track occupational injuries for farms or ranches with fewer than 11 employees, but the risks are generally similar. In addition, agricultural workers could be exposed to additional occupational health and safety hazards from tractor roll-overs, all-terrain vehicle (ATV) accidents, and horse-related injuries.

Occupational health and safety risks to future ISR uranium recovery workers from exposure to radiation are regulated by the NRC, mainly through the Radiation Protection Standards contained in 10 CFR 20. In addition to annual radiation dose limits, these regulations incorporate the principal of maintaining doses as low as reasonably achievable (ALARA) such as through the use of proper worker safety training, using engineering and administrative controls to prevent or minimize radiation exposures and effluents, and the measurement and monitoring of radiation doses and effluents.

The ALARA principle takes into consideration the purpose of the licensed activity and its benefits, weighs the associated costs and benefits to reduce radiation doses as appropriate (including selecting the most cost-effective and efficient technology for reducing doses), and quantifies the net benefits for each considered option to reduce radiation doses or exposures to other hazardous materials (e.g., chemicals) used at an ISR facility. Radiation safety measures are required for protecting workers and minimizing worker doses at uranium ISR facilities, ensuring that radiation doses are less than the occupational limits and are maintained ALARA.

Also of concern with respect to occupational health and safety are industrial hazards and exposure to non-radioactive chemicals and other industrial hazards, which for an ISR operation can include normal industrial airborne emissions associated with service equipment (e.g., vehicles), fugitive dust from access roads and wellfield activities, electricity and power tools, slips/trips/falls and various chemicals used in the in-situ extraction process. Industrial safety and the use of chemicals at the Ross ISR site are regulated by the Wyoming Occupational Health and Safety Commission under the Wyoming Occupational Health and Safety Act, Title 27, Labor and Employment, Chapter 11, Occupational Health and Safety.

3.11.5 Summary of Health Effects Studies

Although there do not appear to be "health effects studies" in the open literature specifically related to uranium mining and milling in Wyoming and no health effects studies reported in the literature specific to Crook County (likely due to the sparse population and generally low level of industrial development), there are numerous studies in the literature focusing on the potential health impacts to the public living near uranium recovery activities for many years.

These studies have generally concluded that no additional effects have been observed when compared to the health status of other similar populations not living nearby. A few sources providing the scientific evidence that supports this very important point include:

> U.S. Department of Health and Human Services, Public Health Services, Agency for Toxic Substance and Disease Registry, *Toxicological Profile for Uranium*, 1999. Chapter 1: Public Health Statement for Uranium, Section 1.5: How Can Uranium Effect My Health? – " No human cancer of any type has ever been seen as a result of exposure to natural or depleted uranium."

> *Cancer and Noncancer Mortality in Populations Living Near Uranium and Vanadium Mining and Milling Operations in Montrose County, Colorado, 1950 -2000*. Boice, JD, Mumma, MT et al. Journal of Radiation Research, 167:711-726; 2007: " The absence of elevated mortality rates of cancer in Montrose County over a period of 51 years suggests that the historical milling and mining operations did not adversely affect the health of Montrose County residents"

> *Cancer Mortality in a Texas County with Prior Uranium Mining and Milling Activities, 1950 – 2001.* Boice, JD, Mumma, M et al. Journal of Radiological Protection, 23:247 – 262; 2003 – "No unusual patterns of cancer mortality could be seen in Karnes County over a period of 50 years suggesting that the uranium mining and milling operations had not increased cancer rates among residents."

Table 3.11-1. Radiological Dose from Various Sources in the United States

Radiation Source	Percent Contribution to Radiation Dose for the Average U.S. Individual
Background	
Radon and thoron	37
Cosmic	5
Internal	5
Terrestrial	3
Total Background	50
Man-made	
Computed Tomography (Medical)	24
Nuclear Medicine	12
Interventional Fluoroscopy (Medical)	7
Medical X-rays	5
Consumer Products	2
Occupational Exposure	< 0.1
Industrial Activities	< 0.1
Nuclear Fuel Cycle	< 0.03
Fallout from Nuclear Weapons Testing	< 0.03
Total Man-made	50

Source: NCRP 2009

Table 3.11-2. Radiation Dose Comparisons

Radiation Source	Effective Dose (mSv)
Medical, per procedure:	
CT - Head Scan	2
CT - Chest	7
Chest X-Ray	0.1
Dental X-ray, Bitewing	0.005
Consumer Products and Activities:	
Smoking (1 cigarette per day for a year)	0.018
Air Travel, Washington DC to Los Angeles	0.019
Energy, annual exposure:	
Natural gas (cooking in home)	0.004
Coal burning power plant	0.001
Nuclear power plant	< 0.001
Uranium mining	< 0.001
U.S. Annual Average per Person from All Sources:	6.2
U.S. Annual Limit for a Member of the Public from a Licensed Operation (excludes background)	1
U.S. Annual Limit for a Worker from Occupational Sources (excludes background)	50

Sources: NCRP 2009, NRC 2002, NRC 2007

Table 3.11-3. Natural Background Radiation Doses (mSv in a year)

	Cosmic	Terrestrial	Radon	Internal Sources[a] and Thoron, U.S. Average[b]	Total
Wyoming	0.52	0.27	1.33	0.45	2.57
Colorado	0.49	0.39	3.00	0.45	4.33
Oregon	0.28	0.27	0.57	0.45	1.57
Virginia	0.28	0.27	1.37	0.45	2.30
U.S. Average	0.33	0.21	2.12	0.45	3.11

[a] Internal sources are primarily due to ingestion of naturally occurring materials.
[b] Values for individual states are not available.
Sources: EPA 2006, National Research Council 2009, NCRP 2009

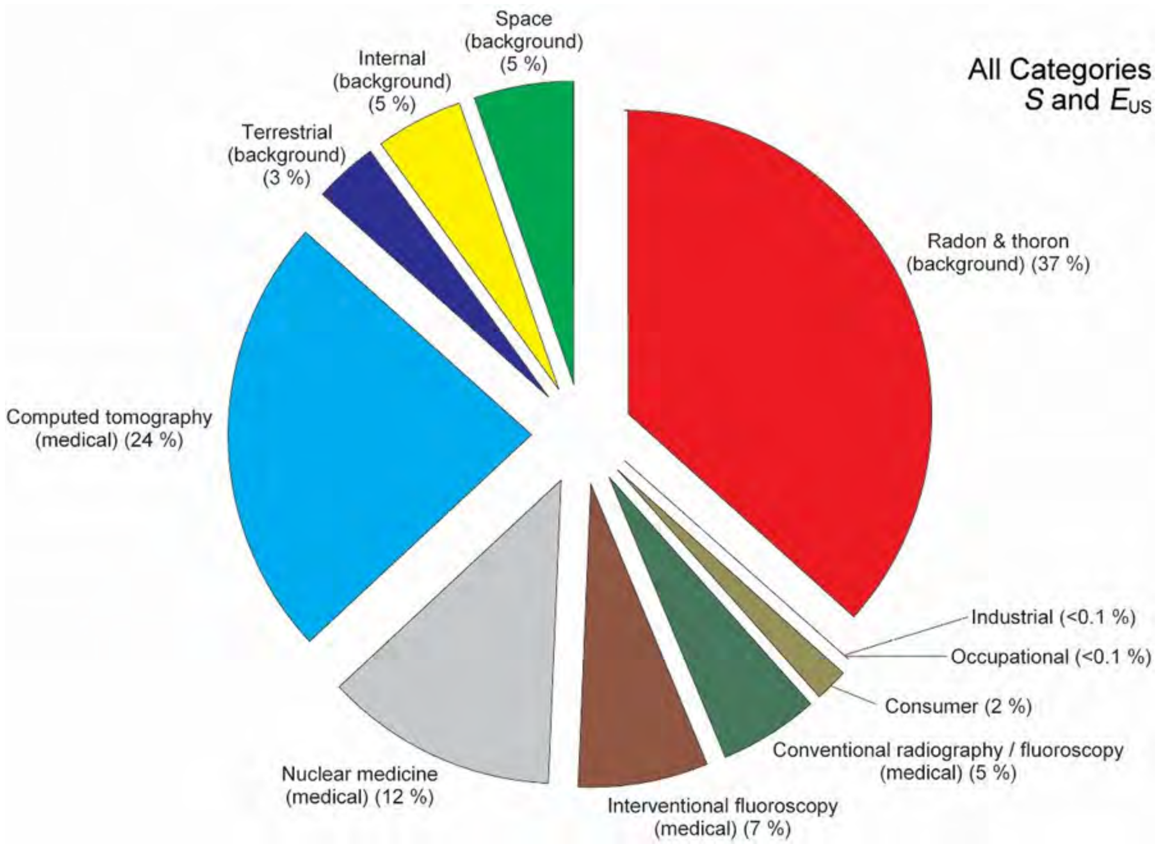


Figure 3.11-1. Percent Contribution of Various Sources of Exposure to the Total Effective Dose[1] Per Individual in the U.S. Population[2] (6.2 mSv[3]) for 2006
(Source: NCRP 2009)

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[1] Total Effective Dose is the sum of doses from external sources and internal material. The term "Effective Dose Equivalent" is used by most federal and state agencies; however, it has been superseded in NCRP recommendations by the term "Effective Dose" (NCRP 2009). The terms are generally considered to be interchangeable.

[2] Collective effective dose (S) (person-sievert) is the cumulative dose to a population of individuals exposed to a given radiation source or group of sources. Effective dose per individual in the U.S. population (E_{US}) (millisievert) is computed by dividing S by the total number of individuals in the U.S. population (300 million in 2006). (NCRP 2009).

[3] Radiation dose is measured in units of either sievert (Sv) or rem and is often referred to in either millisievert (mSv) which is 1 thousandth of a sievert, or millirem (mrem) which is 1 thousandth of a rem. The conversion from mSv to mrem is 1 mSv = 100 mrem. Therefore, the average annual dose to a member of the US population of 6.2 mSv = 620 mrem. These units are used in radiation protection to measure the amount of damage to human tissue from ionizing radiation. (NRC 2009b)

3.12 Waste Management

This section describes the existing sources of waste within the proposed project area and the current waste management practices. The following discussion describes the affected environment only. Proposed waste management practices and potential waste management impacts resulting from the Proposed Action are provided in Section 4.13 of this ER. For consistency with other sections of this ER, including 4.13 and 5.11, wastes are separated into two general categories. The first category is AEA-regulated waste, which comprises 11e.(2) byproduct material, or byproduct material. This is defined in the ISR GEIS (pg. 2-23) as, "tailings or waste generated by extraction or concentration of uranium or thorium processed ores as defined under Section 11e.(2) of the Atomic Energy Act." The second category is non-AEA-regulated waste. Although an R&D ISR uranium recovery facility (Nubeth R&D) was formerly operated within the proposed project area, the facility was successfully decommissioned and the land released for unrestricted use by NRC and WDEQ/LQD. Therefore, there is currently no AEA-regulated waste material within the proposed project area.

The primary land uses within the proposed project area are livestock grazing on rangeland, dry land crop production, and oil production. The activities associated with these land uses generate little waste. Management of this waste is governed by Crook County and WDEQ/SHWD. WDEQ/SHWD maintains a list of recognized hazardous wastes according to characteristics of ignitability, corrosivity, reactivity, and toxicity (WDEQ/SHWD 2008).

Agricultural operations within the proposed project area produce very limited quantities of miscellaneous trash. Some of this may be disposed off-site in small landfills near the proposed project area. No such landfills have been identified within the proposed project area. According to the WDEQ Office of Outreach and Environmental Assistance (OOEA), small landfills are not subject to Wyoming rules and regulations for landfills as long as they are used only to dispose of wastes generated in association with an individual's farming or ranching operation (WDEQ/OOEA 2010). Other waste associated with farming and ranching operations is disposed in the nearest solid waste disposal facility, which is a landfill in Moorcroft approximately 23 road miles south. Additional nearby landfills include Sundance (approximately 38 road miles southeast) and Gillette (approximately 50 road miles southwest). The landfill outside Hulett is currently closed (OSLI 2007).

Oil production facilities within the proposed project area include three producing oil wells, water supply wells, and water injection wells used for EOR. Crude oil and produced water are present at some of the well sites. Wastes generated during the production of crude oil are categorized by EPA as "special wastes" and are exempt from federal hazardous waste regulations under Subtitle C of RCRA. Chemicals stored and used at the oil wells include methanol, used as antifreeze, and propane, used for the operation of pump jacks. Solid waste associated with the oil production facilities includes old production tubing stockpiled near the center of the proposed project area. No other sources or stockpiles of waste associated with oil production facilities have been identified within the proposed project area.

Exploratory uranium drilling also results in wastes, including drill cuttings and drilling wastes. Drilling wastes, as defined by EPA (2008) for ISR facilities, include drill muds, other drilling fluids, sludges, or evaporation products collected in excavated pits from wastewater produced during drilling. These are classified as TENORM, the definition of which is provided by EPA (2008):

> "Naturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing."

Drill cuttings and drilling wastes are typically disposed on-site in mud pits pursuant to EPA TENORM regulations.

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4.0 POTENTIAL ENVIRONMENTAL IMPACTS

The following sections describe the potential environmental impacts associated with the Proposed Action and No Action Alternative. Potential impacts to each resource described in Chapter 3 are presented for normal operational events as well as reasonably foreseeable accidents. Following the standard established in the ISR GEIS, potential impacts are described according to the following categories.

- ♦ **SMALL**: The potential environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.
- ♦ **MODERATE**: The potential environmental effects are sufficient to noticeably alter, but not destabilize, important attributes of the resource.
- ♦ **LARGE**: The potential environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

4.1 Potential Land Use Impacts

The Ross ISR Project is proposed in western Crook County. As discussed in Section 3.1, existing land uses include livestock grazing on rangeland, dry land crop production, oil production, recreation, wildlife habitat, and transportation/utilities. This section describes the potential land use impacts resulting from the Proposed Action and No Action alternative. Section 5.1 describes the mitigation measures proposed by Strata to minimize potential land use impacts.

4.1.1 Proposed Action

The Proposed Action includes construction of 15 to 25 sequentially developed ISR wellfield modules and a CPP for uranium and vanadium processing. Associated infrastructure that would be constructed under the Proposed Action includes access roads, pipelines, utilities, deep disposal wells, lined retention ponds, office buildings, storage facilities, and other structures or facilities used to house work areas and equipment. Table 4.1-1 presents the anticipated disturbance during the year preceding operation and the total anticipated disturbance throughout the duration of the Proposed Action. Of the approximately 1,721 acres within the proposed project area, approximately 280 acres are anticipated to be disturbed over the life of the project. This represents approximately 16% of the total project area, or approximately the same as the 15% average disturbance area for a new ISR facility according to Section 4.2.1.1 of the ISR GEIS. No construction is proposed outside of the proposed project area, including the primary access road, unless required to bring electricity and/or natural gas from nearby transmission lines.

The amount of surface disturbance would be much greater if the uranium were recovered in a conventional mine and mill as opposed to an ISR uranium recovery facility. In Section 2.2.1 of the Moore Ranch SEIS (NRC 2010), NRC notes that a conventional mill could impact up to 5 times as much land area as an ISR facility. The total proposed permit area (1,721 acres) and anticipated total disturbed area (280 acres) are also within or below the typical ranges provided in Section 4.2.1 of the ISR GEIS for ISR facilities. These include total areas of 2,471 to 17,297 acres and total disturbed areas of 120 to 1,860 acres. This demonstrates that the proposed Ross ISR Project is within the bounding ISR GEIS analysis in terms of total proposed permit area and total proposed disturbed area.

4.1.1.1 Potential Construction Impacts

The construction of the Ross ISR Project has the potential to impact land use in the proposed project area through the following mechanisms:

1) Changing and disturbing existing land uses,
2) restricting access or establishing right-of-way access,
3) affecting mineral rights,
4) restricting livestock grazing areas,
5) restricting recreational activities, and
6) altering historic and cultural resources.

4.1.1.1.1 Changing and Disturbing Existing Land Uses

Surface disturbance will occur as result of construction of the CPP and other facilities within the central plant area, wellfield modules, access roads, deep disposal wells, pipelines, and utilities. Potential changes or disturbances in land use resulting from the construction of these facilities are discussed below. Due to the relatively minor nature of disturbance created by construction of an ISR uranium recovery facility, there are only a few areas such as with lined retention ponds disturbed to the extent to which subsoil and geologic markers are removed, causing topographic changes that need backfilling and recontouring during decommissioning. Potential impacts resulting from surface disturbance will be small due to the relatively small disturbance area and due to restoring and re-seeding of much of the disturbed area during the same construction season. Potential future land use impacts resulting from surface disturbance will be negligible, since the entire project area will be returned to pre-operational use and released for unrestricted use following project D&D.

Central Plant Area

The central plant area will include the CPP building, storage facilities, office/warehouse facilities, lined retention ponds, and other piping and equipment. Construction of the central plant area is estimated to disturb approximately 55 acres, including the facilities flood control diversion channel and the primary topsoil stockpile for the central plant area. The entire disturbance is planned during the year preceding operation. Surface disturbing activities associated with construction of the central plant area will include topsoil stripping; excavation, backfilling, compacting, and grading to prepare a level site; building foundation excavation; excavation, backfilling, compacting, and grading for access roads; pond excavation; utility and pipeline trenching; excavation of a mud pit and construction of a well pad for a deep disposal well; excavation and grading of the flood control channel; and trenching for the containment barrier wall.

The land on which the CPP is located is currently used for dry land crop production and pasture for livestock. These land uses will be temporarily changed as the central plant area will be used for industrial purposes throughout the construction, operation, aquifer restoration, and decommissioning phases. Following decommissioning and release of the proposed project area for unrestricted use, the land uses can revert to dry land crop production and pasture.

Wellfield Modules

Each wellfield module will consist of injection and recovery wells connected to a common module building and associated monitor wells. Construction of the 15 to 25 wellfield modules planned within the proposed project area is estimated to disturb up to 160 acres. However, construction will be phased such that only two (2) to six (6) modules will be under construction at one time. During the year preceding operation, the estimated disturbance due to wellfield module construction is 30 acres. The maximum amount of surface disturbance associated with wellfield module construction is estimated to be 40 acres at any one time. As noted in Section 2.11.1 of the ISR GEIS, less than half of the wellfield areas are typically disturbed by construction activities, including access roads, mud pits, module buildings, and pipelines. Surface disturbing activities associated with wellfield module construction will include topsoil stripping, constructing temporary well pads, constructing temporary access roads, excavating mud pits, trenching for pipelines and buried electrical utilities, and excavating foundations for module buildings.

The wellfield modules will be constructed predominantly on land currently used for livestock grazing. This land use will temporarily change for all areas actively disturbed by wellfield construction. However, temporary well pads, mud pits, well pad access roads, and pipelines will be restored and re-seeded at the end of construction. Therefore, disruption to livestock grazing will be temporary except for fenced wellfield areas and the relatively small area surrounding and including each module building.

Other land uses within areas potentially disturbed by wellfield module construction include industrial use (oil production), communication and power lines, transportation, recreation, reservoirs, and wildlife habitat. Strata will work with the operating oil company within the proposed project area, currently Merit Energy, to ensure that Strata causes no interruptions in oil production activities. Communication lines, power lines, and county roads will be avoided during wellfield module construction. There will be no changes in these land uses with the exception of brief traffic interruptions resulting from pipeline and utility crossings of existing county and private roads. Potential recreation impacts are described below, potential impacts to reservoirs are described in Section 4.4.1, and potential impacts to wildlife are described in Section 4.5. All of these potential impacts are expected to be small due to the limited disturbance area associated with wellfield module construction and due to restoring and re-seeding disturbed areas, typically within a single construction season.

Access Roads

Access roads constructed under the Proposed Action will include the primary access road between the New Haven Road and the central plant area, secondary access roads within the central plant area and between the central plant area and the wellfield module buildings, and tertiary access roads used to access monitor wells. The maximum estimated surface disturbance associated with access road construction, excluding access roads within the central plant area, is 30 acres. This includes access road topsoil stockpiles, which will be located throughout the wellfield area. The locations of topsoil stockpiles have yet to be determined, but they will typically be spaced approximately 2,000 feet apart along access roads to minimize compaction associated with long topsoil hauls. The estimated disturbance resulting from access road construction during the year preceding operation is 12 acres.

Surface disturbing activities associated with access road construction include topsoil stripping and stockpiling, excavation, backfill, compaction, and grading. Significant cut and fill are planned only for the primary access road in order to provide a relatively level grade and wide driving lanes for heavy trucks. Secondary access roads will generally follow the existing topography, and tertiary roads will be unconstructed, two-track roads. Additional information on access road construction is included in Section 4.2 in this ER.

Access roads will predominantly be constructed on land currently used for livestock grazing. Potential changes in this land use will be small and temporary. While up to 30 acres are estimated to be disturbed during access road construction, only about half of this area will be surfaced with gravel. For instance, the disturbance width for a secondary access road is estimated to range from 25 to 35 feet, depending on whether pipelines and utilities are included in the access corridor. By comparison, the finished road surface is expected to be only 12 to 20 feet wide. Adjacent disturbed areas will have the topsoil replaced and will be re-seeded at the end of construction. Surface disturbance will also be minimized by locating access roads, pipelines, and utilities in common corridors and by utilizing existing roads wherever possible. The proposed project area has the advantage of encompassing several county roads and oil production access roads. Strata will use these roads wherever possible and coordinate the road use with Crook County and the oil production company. Strata is currently preparing a development plan for Crook County. Strata had assessed baseline traffic levels on county roads and existing road condition, and Strata will work with Crook County throughout the project life to assess potential impacts and address maintenance needs on county roads.

Deep Disposal Wells

Strata will construct up to five deep disposal wells as part of the Proposed Action. The locations of the wells are depicted on Figure 1.2-6. One of the deep disposal wells will be located in the central plant area and the remaining wells will be located throughout the proposed project area. The maximum estimated surface disturbance associated with deep disposal well construction is 5 acres. During the year preceding operation, up to three deep disposal wells may be constructed, including the well in the central plant area. The anticipated disturbance resulting from deep disposal well construction during the year preceding operation is 3 acres. Surface disturbing activities associated with deep disposal well construction include topsoil stripping, well pad grading, and mud pit excavation.

The locations of the four deep disposal wells proposed outside of the central plant area are all on land currently used for livestock grazing on rangeland. One well, proposed in the NWNE Section 13, T53N, R67W, is on land identified in Figure 3.1-2 as cropland and pasture. This land was not used for crop or hay production during the 2009-2010 vegetation surveys for this project, but it has been used for this purpose in the past and could be again in the future. Throughout the life of the Ross ISR Project, areas used for deep disposal wells will change from the existing land uses (grazing and, potentially, crop land) to industrial use. However, the impact will be small, since the deep disposal wells occupy a very small portion (less than 0.3%) of the proposed project area.

<u>Pipelines</u>

Pipelines will include trunk lines carrying barren lixiviant and recovery solutions between the CPP and feeder lines, feeder lines carrying these solutions between the trunk lines and module buildings, individual well flow lines carrying these solutions between the module buildings and injection/recovery wells, and deep disposal well pipelines. The disturbance area associated with individual well flow lines has been included in the estimated wellfield module disturbance area, and the disturbance area associated with trunk lines, feeder lines, and deep disposal well pipelines adjacent to newly constructed access roads has been included in the estimated access road disturbance area. The total estimated disturbance area resulting from trunk line, feeder line and deep disposal well pipelines that are not in an access corridor is 15 acres. The amount anticipated during the year preceding operation is 5 acres.

Surface disturbing activities associated with pipeline construction will include topsoil stripping, trenching, backfill, topsoil replacement, and re-seeding. Pipeline corridors will be restored and re-seeded, typically within the same construction season, and changes in land use will be accordingly brief. Potential changes in land use are small and similar to those described previously for wellfield module construction, but the potential impacts will be smaller due to a smaller disturbance area and lack of fences or buildings associated with pipeline construction. Surface disturbance will be minimized by locating pipelines in common corridors with access roads and utilities wherever possible.

Utilities

Utilities that are anticipated to be installed under the Proposed Action include a buried gas pipeline supplying natural gas to the central plant area, overhead electrical lines supplying electrical power from a nearby transmission line to the CPP and module buildings, and buried electrical lines providing power within the central plant area and within wellfield modules. The total estimated disturbance resulting from utility construction is 15 acres, with up to 5 acres disturbed during the year preceding operation. Potential changes and disruptions to existing land uses will be temporary, since areas disturbed during utility installation will be restored and re-seeded during construction.

4.1.1.1.2 Access Restrictions and Establishment of Right-of-Way

The primary land use within the proposed project area is livestock grazing on rangeland. This land use will be impacted during construction through the exclusion of livestock from disturbed areas and fenced areas. Not all of the construction disturbance will occur at once due to phased wellfield development, and much of the disturbed area will be restored, re-seeded and made accessible. Strata estimates that about one-half of the disturbed area (CPP area and active wellfield modules) will be fenced to exclude livestock during construction. This represents less than 10% of the proposed project area. Access for dry land crop production, wildlife habitat, and recreation will be similarly impacted during construction.

Strata will work with the oil production company operating within the proposed project area to ensure that Strata causes no access restrictions on oil production activities.

No public right-of-way will be established during construction of the Ross ISR Project. All access roads will be private access roads for Strata employees and contractors. All access roads constructed under the Proposed Action will be reclaimed during decommissioning unless they are transferred to the affected landowner during decommissioning.

4.1.1.1.3 Mineral Rights

The only known minerals in the proposed project area other than those proposed to be developed by Strata are conventional oil and gas. There are three producing oil wells, two water injection wells and three water supply wells used for enhanced oil recovery within the proposed project area. Oil is produced from a depth of 6,000 feet and greater, which is approximately 5,400 feet deeper than the uranium mineralization found in the proposed project area. The existing oil wells and water injection wells will not be impacted by the Proposed Action due to the large difference in target completion intervals between oil production (6,000 to 6,500 feet) and ISR injection and recovery wells (400 to 700 feet). One aspect of oil production that will likely be impacted by the Proposed Action is the water supply wells used for enhanced oil recovery. These wells are completed in the ore zone. Strata will work with the oil production company to provide an alternate supply of water or alternate method for enhanced oil recovery as described in Section 5.4 of the ER.

Since no other minerals are currently being extracted in the proposed project area, the Proposed Action will not impact existing non-oil mineral production. However, future development of any other minerals within the proposed project area could be delayed for the duration of the ISR project.

4.1.1.1.4 Livestock Grazing and Agricultural Restrictions

As shown in Table 3.1-2, approximately 95% of the land use within the proposed project area is attributed to livestock grazing and dry land crop production. No further restrictions will be made on these land uses beyond the access restrictions discussed in Section 4.1.1.1.2. Livestock and agricultural land use will be temporarily restricted from disturbed areas, but much of the disturbance area will be restored and re-seeded during a single construction season, so the impacts will often be short lived. Longer term access restrictions will occur for the fenced central plant area and the fenced wellfield areas. As described previously, the total fenced area is estimated to be about half of the total disturbance area, or less than 10% of the proposed project area.

Of the 40 BLM-administered surface acres, only 1.3 acres (3%) are anticipated to be disturbed under the Proposed Action. This small disturbance area will only include perimeter monitor wells and the tertiary roads used to access these wells. Potential impacts to BLM grazing permits are therefore very small. Grazing permits on State of Wyoming surface will potentially be impacted by construction of fenced wellfield areas. The total fenced wellfield area is estimated to be up to 50 acres at any one time. If all of the fenced wellfield areas were on State of Wyoming surface, it could impact up to 16% of the total State of Wyoming surface area within the proposed project area.

Surface use agreements will be established between Strata and surface owners/lessees to provide mitigation or compensation for temporary loss of areas currently used for livestock grazing or crop production.

4.1.1.1.5 Restrictions on Recreational Activities

Potential impacts to recreational activities, including hunting, will be small under the Proposed Action. The primary potential for impact will be restricted access. To protect workers, hunting will be restricted from the proposed project area during the life of project, except that Strata might allow limited hunting without rifles (e.g., bow hunting). Big game hunting, including mule deer, white-tailed deer and pronghorn, is currently limited in the proposed project area due to the small percentage of publicly owned lands (approximately 20.6%) and limited access. As discussed in Section 3.1, hunting and recreation are not major land use activities in the proposed project area. There is no public access to BLM lands and limited recreation opportunity on State of Wyoming lands within the proposed project area. Therefore, the impact on these land uses due to the restricted access areas will be small.

4.1.1.1.6 Altering Historic and Cultural Resources

Potential historic and cultural resource impacts resulting from construction of the Ross ISR Project are discussed in Section 4.8, and mitigation measures are presented in Section 5.8. Potential impacts to historic and cultural resources will be kept small by avoiding construction in sites identified by the Class III inventory as potentially eligible for listing on the NRHP, by consultation with the appropriate SHPO and Tribal Historic Preservation Office (THPO), by implementing a phased identification of previously unidentified historic and cultural resources during all phases of the Proposed Action, and by implementing a stop-work provision if any previously undiscovered cultural resources are encountered during construction.

4.1.1.2 Potential Operation Impacts

Potential impacts to land use during operation are expected to be small, and less than those during construction since many of the short-term disturbance areas will be reclaimed. During the operation phase of the project, the primary impacts to land use will occur in conjunction with the expansion of wellfield modules. These potential construction-related impacts are addressed in Section 4.1.1.1.

Potential land use impacts specific to operation and aquifer restoration involve permeate disposal. Strata may use land application or WYPDES discharge to dispose permeate, subject to regulatory approval by NRC and WDEQ. If land application were used for permeate disposal, the affected land would temporarily be restricted from livestock grazing but might be used for crop production. If Strata discharges permeate to the Little Missouri River or a tributary under a WYPDES permit, existing low-water channel crossings could be impacted. In the latter case, potential impacts would be mitigated by discharging water below the Oshoto Reservoir, where the Little Missouri River is an intermittent stream and the relatively small volume of permeate would not significantly impact base flow, or by enhancing affected low-water crossings of the Little Missouri River or the affected tributary. Both land application and WYPDES discharge require permitting through WDEQ/WQD and WDEQ/LQD. In either case effluent limits would be established to protect the receiving soil or stream. Operational monitoring would ensure that the permeate meets all applicable effluent limits. Therefore, potential impacts to existing and future land use resulting from permeate disposal would be small.

4.1.1.3 Potential Aquifer Restoration Impacts

Potential land use impacts during aquifer restoration will be similar to those during operation and are expected to be small. Relatively small portions of the proposed project area will temporarily be used for industrial purposes rather than the predominant pre-operational land used of livestock grazing and dry land crop production. Access will be restricted in fenced areas, but the total fenced area will be a small portion of the proposed project area. If land application is used for permeate disposal, additional access restrictions would occur during the duration of land application. If WYPDES discharge is used for permeate disposal, low-water channel crossings could be impacted. Mitigation measures described previously will minimize potential impacts from permeate disposal.

4.1.1.4 Potential Decommissioning Impacts

Surface disturbance activities would temporarily increase during decommissioning compared to operation and aquifer restoration because of additional equipment associated with land reclamation, dismantling, removing, and disposing of wellfield materials, pipelines and the processing facilities. The decommissioning of surface and subsurface facilities in individual wellfield modules will commence after groundwater restoration and stabilization have received final regulatory approval on a wellfield module by module basis. Wellfield decommissioning includes the plugging and abandonment of all wells and the removal of wellfield piping. Surface facilities and support structures that are no longer required and will not be turned over to landowners or other parties will also be removed.

During decommissioning, the land will be returned to the approximate pre-construction surface topography and drainage patterns. All roads and portions of roads constructed and utilized for access to the facilities and wellfields will be removed and reclaimed unless exempted from reclamation by the request of landowners/lessees.

Revegetation practices will be conducted in accordance with WDEQ/LQD requirements and, for the small areas disturbed on BLM surface, in accordance with BLM requirements. During ISR operations the topsoil stockpiles, and as much as practical of the disturbed wellfield areas, will be seeded to establish vegetative cover to minimize wind and water erosion. After spreading topsoil the area will be seeded with a permanent seed mix. The mix may contain a nurse crop (sterile wheat or oats) to establish a standing vegetative cover along with the permanent seed mix. Mulch may also be used to cover the seed. The seed mix will be chosen to be compatible with the prior land use. The landowner or surface lessee and WDEQ/LQD will be consulted when selecting the seed mix.

Following decommissioning, all land in the proposed project area will be released for unrestricted (i.e., any) use.

4.1.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed, and associated disturbance and impacts to land use would not occur on the portions of the proposed project area.

Table 4.1-1. Anticipated Disturbance within Proposed Project Area

	Acres of Anticipated Disturbance	
Facility	**During Year Preceding Operation**	**Over Life of Proposed Action**
Central Plant Area	55	55
Wellfield Modules	30	160
Access Roads	12	30
Deep Disposal Wells	3	5
Pipelines	5	15
Utilities	5	15
Total	110	280

4.2 Potential Transportation Impacts

This section describes the potential transportation impacts resulting from the Proposed Action and No Action Alternative. As described in Section 3.2, the primary route for transporting materials and personnel to the proposed project area will be north from I-90 along D Road for 18.3 miles, then north along the New Haven Road for 3.0 miles to the proposed primary access road.

4.2.1 Proposed Action

Potential transportation impacts will occur during all phases of the Proposed Action, including construction, operation, aquifer restoration, and decommissioning. The following sections describe the potential impacts during activities associated within each phase, including construction of primary, secondary, and tertiary access roads and transportation of materials and workers to and from the proposed project area.

The main route for transporting all materials to the proposed project area will be north from Interstate 90 along D Road for 18.3 miles, then continuing north along the New Haven Road 3.0 miles to the proposed primary access road. The existing county infrastructure consists of 3 miles of chip seal along D Road until the surfacing becomes reclaimed asphalt pavement and gravel from that point to the north. The New Haven Road is also a gravel surfaced roadway. These two roadways may need minor improvements to improve the surfacing section and roadway top widths to increase roadway durability and safety along these routes to the primary access road. Mitigation measures are discussed further in Section 5.2 and may include placing additional gravel surfacing, providing dust control and routine maintenance. Potential transportation impacts are discussed for each project phase in the sections below.

Strata will work with Crook County throughout the life of this project to provide assistance for Strata's share of impacts to D Road and the New Haven Road. Strata has conducted baseline traffic counts and may assist the county with future traffic counts to aid in quantification of required assistance. Roadway evaluation systems will be adopted to help standardize evaluation and minimize County or Strata personnel from biasing their opinion into the actual roadway condition. This will help maintain relationships between Strata and Crook County while still meeting both parties' needs. Strata is currently preparing a development plan for Crook County that will address potential impacts and mitigation measures for county roads. Strata will also continue communication and cooperation with the operating oil company within the proposed project area (Merit Energy) to address use of private oilfield roads. Finally, Strata may investigate the potential to form a coalition with other companies operating heavy trucks on county roads (e.g., bentonite haulers) to provide additional assistance to Crook County in traffic assessment and road maintenance.

4.2.1.1 Potential Construction Impacts

Access Road Construction

The primary access road will be constructed 3 miles north of the intersection of D Road and the New Haven Road and will begin at the New Haven Road (CR 164). The primary access road will extend approximately ¼ mile from the New Haven Road to a gated entry to the central plant area. Figure 1.2-5 depicts the proposed location of the primary access road. The entire primary access road construction will occur within the proposed permit boundary. The preliminary design of the primary access road includes a 32-foot wide gravel surfaced roadway consisting of two 12-foot lanes and two 4-foot shoulders to accommodate large trucks and equipment. Significant cut and fill are anticipated for the primary access road in order to provide a relatively level grade (less than 6%) and wide driving lanes for heavy trucks. The primary access road approach on the New Haven Road will be permitted through Crook County, and, if necessary, WYDOT.

Prior to primary access road construction, Strata will evaluate the condition of affected portions of D Road and the New Haven Road. Strata might work with Crook County to upgrade the existing county roadways to allow a similar top width for added safety along the primary access route. However, based on the preliminary evaluation of the existing roadways presented in Section 3.2, the reclaimed asphalt pavement and gravel portions of D Road and the affected gravel portion of the New Haven Road are currently in good condition.

Stopping sight distance along the New Haven Road has been analyzed. For a 45 mph roadway a distance of 360 feet is required for adequate stopping sight distance (AASHTO 2004). The stopping sight distance analysis bases the driver's eye height at 3.5 feet and an object height of 2 feet at a distance of 360 feet. Using aerial flight topography to calculate sight distance, the analysis concluded that adequate (more than 360 feet) stopping sight distance is available for both northbound and southbound traffic on the New Haven Road as traffic approaches the proposed primary access road location.

Secondary access roads will include roads constructed within the central plant area and roads constructed between the central plant area and the wellfield modules. Within the central plant area, secondary access roads will be constructed with approximately the same roadway section as the primary access road. Roads within the central plant area will be designed with adequate turning radii to accommodate large trucks and trailers. Secondary access roads constructed between the central plant area and wellfield module buildings will be 12 to 20-foot wide gravel surfaced roads that will allow easy movement of opposing vehicles, at low speeds, on an all-weather surface. Secondary access roads will generally follow existing topography, and little cut or fill will be required for their construction.

Temporary wellfield access roads and monitor well access roads (tertiary roads) will generally be un-constructed, two-track trail roads approximately 8 to 10 feet wide. Temporary and tertiary access roads will typically not have any surfacing and will generally have no cut or fill associated with their construction. As these roadways become unused they will be reclaimed to their natural condition by replacing topsoil, if previously removed, ripping the soil, as needed, to reduce compaction and re-seeding.

The preliminary layout of proposed access roads is shown in Figure 4.2-1. Potential impacts resulting from road construction are discussed in the following sections and briefly summarized below.

- Potential land use impacts - Section 4.1
- Potential soil impacts – Section 4.3
- Potential water resources impacts - Section 4.4
- Potential vegetation and wildlife impacts – Section 4.5
- Potential vehicle emissions and dust impacts – Section 4.6
- Potential noise impacts – Section 4.7
- Potential historic and cultural resources impacts – Section 4.8
- Potential visual and scenic resources impacts – Section 4.9

Potential land use impacts resulting from access road construction include temporarily changing and disturbing land use. This will be minimized by utilizing existing county and oilfield roads where possible and promptly restoring and re-seeding temporary and tertiary access roads when no longer used. The disturbance area associated with access road construction will also be minimized by implementing a one-way in/one-way out driving approach, where sequentially developed wellfield modules will be accessed through previously developed modules, and therefore will use previously constructed access roads. This will avoid constructing new access roads from the central plant area to remote wellfield modules. Instead, shorter roads will be constructed from existing wellfield modules. While this may slightly increase the driving distance to some wellfield modules, it will minimize the required number and overall length of access roads.

Potential soil impacts include increased erosion from vegetation removal and soil disturbance and soil compaction. Erosion will be mitigated through minimizing access road width and the number of access roads (through use of existing roads). Soil compaction will be mitigated through ripping affected soil, as needed, during decommissioning.

Potential water resource impacts include water quality degradation due to sediment transport. Sediment transport will be minimized through the use of erosion control BMPs such as silt fence, sediment logs, and straw bale check dams. Sediment transport will also be minimized by restoring and revegetating disturbed areas not covered with gravel, typically during a single construction season.

Potential wildlife impacts include vehicle collisions and wildlife avoidance due to noise, dust, or human and mechanical presence. These potential impacts will be mitigated through speed limits, dust abatement, and avoiding sensitive areas such as wetland and reservoir habitat during access road construction.

Potential vehicle emissions and dust impacts include emissions from heavy equipment and passenger vehicles during access road construction and fugitive dust generated from surface disturbing activities. These will be mitigated by minimizing access road width and the number of access roads (through use of existing roads) and by implementing dust control BMPs.

Potential noise impacts include increased noise levels, primarily due to the heavy equipment operated during access road construction. Mitigation measures include restricting access road construction activities during nighttime hours and controlling speeds.

Potential historic and cultural resources impacts include disturbing cultural resource sites and temporarily limiting access to cultural resource sites. Mitigation measures include avoidance, where possible, of potentially NRHP-eligible cultural resource sites, consultation with SHPO and affected THPOs, and implementing a stop-work provision if any previously unidentified cultural resources are discovered during access road construction.

Potential visual and scenic resource impacts include altering the landscape and generating dust. These impacts will be minimized by minimizing road width and the number of access roads (through use of existing roads), by constructing secondary and tertiary access roads along existing topography to minimize cut/fill and reduce the visual contrast created by straight roads, by implementing dust control BMPs, and by controlling speeds.

Traffic

Estimated workers and traffic counts are shown in Table 4.2-1. During construction, the highest level of traffic is anticipated due to the relatively large workforce and due to material and equipment shipments. Based on an anticipated workforce of up to 200 during construction, the traffic increase on affected roads is estimated to be up to 400 vehicles per day (200 round trips or 400 one-way trips on affected roads), based on the conservative assumption that each worker will drive in a separate passenger vehicle. In addition, up to 12 heavy truck shipments are anticipated each day (24 one-way trips). These include primarily incoming shipments of materials, equipment, and fuel used to construct the CPP facilities, wellfield modules, access roads, etc. Infrequent outgoing shipments (approximately 1 per week) will include solid waste and small quantities of hazardous waste such as used oil.

Table 4.2-2 estimates the increase in passenger vehicle and truck traffic on I-90 and affected portions of D Road and the New Haven Road during each project phase. Projected traffic volumes and the calculation methods used to generate traffic projections are described in Section 3.2. The year 2015 was selected as a typical year to assess traffic impacts, but the impacts would be similar to and somewhat smaller proportionally than impacts using the higher traffic projections for 2020 or 2030.

The existing and projected traffic volumes along I-90 at Moorcroft are relatively low for the Interstate infrastructure. In 2015, the projected traffic on this portion of I-90, without consideration of the Proposed Action, is 6,537 vehicles per day, including 18% trucks. During construction, traffic is estimated to increase by up to 424 vehicle trips per day, including 24 truck trips. This represents a 6% increase in total I-90 traffic, a 2% increase in I-90 truck traffic and a slight decrease in the proportion of truck traffic from 18% to 17%. These changes are minor, and the potential impacts to I-90 are small. Minor damage to the Interstate system may occur but will be handled by fees levied as the trucks delivering heavy or overweight goods enter the State. No additional upgrades or modifications are anticipated to the Interstate system at this time.

Proportional increases in traffic along affected portions of D Road and the New Haven Road will be much greater than I-90. Table 4.2-2 shows that traffic on these roads may increase approximately three fold during construction of the proposed Ross ISR Project. It should be noted that the estimated impacts from passenger vehicles are conservatively high, since some workers will likely car pool. Nevertheless, projected traffic volumes during construction will have moderate to large impacts on the traffic levels on affected county roads. This could generate additional dust and noise, additional wear and tear, and additional potential for wildlife and vehicle collisions. Mitigation measures for potential traffic impacts on these roads are described in Section 5.2 and include assisting Crook County with county road assessment, maintenance, and upgrades; developing and implementing a speed limit policy for Strata employees and contractors traveling on county roads; and, potentially, implementing a park and ride system to transport workers to and from the site from Moorcroft or Gillette.

A key mitigation measure will be working with Crook County to address speed limit posting and enforcement on affected portions of D Road and the New Haven Road. The 2010 traffic study conducted by Strata showed that the median speed on these 45-mph county roads is currently 49 to 51 mph. As part of the speed control mitigation plan, Strata plans to either provide additional speed limit signs directly or fund additional signs. Providing new and more frequent speed limit signs will address the roadway users' knowledge.

Strata currently has a speed limit policy for Strata employees and contractors, and Strata will implement a speed limit policy not only for local access roads within the proposed project area but also for county roads used to access the site. Reduced speeds will lower the potential for fatal single vehicle crashes and wildlife incidents along with decreasing dust and roadway damage. Potential wildlife impacts are discussed further in Section 4.5 and potential fugitive dust impacts are discussed in Section 4.6.

4.2.1.2 Potential Operation Impacts

During the operation phase materials transportation to and from the proposed project area can be classified into the following categories:

1) Shipment of yellowcake from the Ross ISR CPP to a uranium conversion facility
2) Shipment of process chemicals and fuel from suppliers to the site.
3) Shipment of loaded resin to the site
4) Shipment of vanadium to a processing facility
5) Shipment of 11e.(2) byproduct material from the site to a licensed disposal facility
6) Shipment of solid waste from the site to a local municipal landfill
7) Shipment of hazardous waste from the site to a WDEQ/SHWD disposal facility

All shipments of materials and supplies to and from the proposed project area will be transported by appropriately licensed transporters and subject to both federal and state transportation regulations.

Anticipated passenger vehicle and truck traffic estimates during operations are provided in Table 4.2-2. Based on an anticipated workforce (employees and contractors) of 60 people, the anticipated passenger vehicle traffic will be 120 trips per day, again conservatively assuming that each person drives alone. The anticipated truck traffic is up to 8 shipments (16 trips) per day. The type and quantity of shipments are described below. The total number of vehicle trips per day during operation is estimated to be 136, and the total number of truck trips per day is estimated to be 16. Overall, potential traffic impacts during operation will be significantly less than those during construction due to a smaller workforce and reduced shipping frequency. Potential impacts would be reduced if Strata were to implement a park and ride system from Moorcroft or Gillette. This would be more likely to occur during operation than construction due to regular employee schedules.

Yellowcake Shipment

Transportation of dried yellowcake will be made in exclusive-use transport vehicles to a licensed conversion facility in Metropolis, Illinois for further processing. The potential shipment route is shown in Figure 4.2-2. The distance from the central plant area to the conversion facility is approximately 1,260 miles. A representative driving route is described below:

- Drive south on CR 164 (the New Haven Road) for 3.0 miles
- Continue straight onto CR 68 (D Road) for 18.3 miles
- Turn left at CR 12 (Bertha Road) and go 450 feet
- Turn left on Highway 51 and travel 1.4 miles
- Turn onto I-90 E for 449 miles to Sioux Falls, South Dakota
- Take I-29 S for 346 miles to Kansas City
- Take I-435 E for 28.4 miles around Kansas City
- Take I-70 E for 241 miles to St. Louis
- Take I-64 E/IL-3N for 75.2 miles to Mt. Vernon, Illinois
- Take I-57 S for 47.3 miles
- Take I-24 E for 36.8 miles to Metropolis, IL

The dried yellowcake produced at the CPP will be packaged in 55-gallon, DOT-approved steel drums. Based on weight limits for legal transport, each shipment will contain approximately 40,000 pounds of yellowcake. Based on the maximum annual production rate of 3 million pounds of yellowcake per year, up to 75 shipments could be required annually or an average of one shipment every 4.9 days. This is within the annual range of 21 to 145 yellowcake shipments for typical ISR facilities presented in Table 2.8-1 of the ISR GEIS.

Strata will contract with an appropriately licensed transport company that specializes in shipment of yellowcake. The transport company will have extensive emergency response programs including spill response equipment on board. Drivers will be trained in emergency response procedures, and there will be constant monitoring of truck location and operating parameters. The transport companies will also have standing contracts with environmental emergency response contractors for spill cleanup. Yellowcake shipments will be handled as low-specific-activity (LSA) material. In addition, Strata will commit to training local emergency response personnel in the specific hazards and spill control procedures associated with yellowcake, and Strata will commit to performing a radiological survey of the affected area following spill cleanup if a yellowcake spill should occur.

NUREG-0706 states that the probability of a truck accident is in the range of 1.6 to 2.6 x 10^{-6}/mile. Based on the average of these two values, the likelihood of a truck shipping yellowcake being involved in an accident of any type during a one-year period is approximately 20%. This probability was obtained by multiplying the probability of an accident per vehicle-mile (2.1 x 10^{-6}/mile) by the maximum number of shipments per year (75) and the distance per shipment (1,260 miles). It is important to note that a minority of accidents will result in release of yellowcake. According to a report prepared for the Federal Motor Carrier Safety Administration (2001), the likelihood that an en route accident will result in a release, based on 12 categories of hazardous material transportation, is about 31%. Further, as described in Section 4.2.2.2 of the ISR GEIS, 30% or less of the shipment contents were released in previously reported accidents involving yellowcake release. Therefore, while there is an estimated 20% probability that an accident involving yellowcake shipment will occur in any one year, there is only about a 31% probability that the accident will result in a release of yellowcake, and then the volume of yellowcake released will likely be 30% or less of the quantity shipped. Based on a 40,000-pound typical load, this would result in a release of 12,000 pounds or less of yellowcake.

Potential impacts resulting from the release of yellowcake include a very small risk of radiological impacts to people in the vicinity of a potential accident. As described in Section 4.2.2.2 of the ISR GEIS, an analysis of potential risk from an ISR facility generating 34 shipments of yellowcake per year yielded an estimate of 0.01 (complete loss of package contents) and 0.0008 (partial release) cancer deaths per year from yellowcake accidents. The ISR GEIS notes that, "These analyses are conservative and tend to overestimate impacts." Nevertheless, applying these conservative risk factors to the maximum of 75 shipments per year produced from the Proposed Action yields estimates of 0.02 (complete loss of package contents) and 0.002 (partial release).

The primary potential impact associated with an accident involving the spill of yellowcake would be potential impacts to soil in the immediate spill area. Potential impacts would be minimized by implementing an emergency response plan for yellowcake spill cleanup. Emergency response protocols would include communication and emergency spill kits on each vehicle and emergency response kits at shipping and receiving facilities. Yellowcake spills would be quickly cleaned up by the licensed yellowcake transporter, potentially with involvement from a local emergency response team. As described previously, Strata will commit to training local emergency response personnel in the specific hazards and spill control procedures associated with yellowcake transport. Strata will also continue briefings for local stakeholders on security and safety. Affected soils would be salvaged from the spill area and the area would be reclaimed to pre-existing conditions. As described previously, Strata will commit to performing a radiological survey by Strata personnel of the affected area following spill cleanup.

Process Chemical and Fuel Shipment

It is estimated that up to 4 bulk chemical, fuel, and supply deliveries will be made per working day throughout the operational life of the project. Table 4.2-3 provides a list of potential process chemicals and fuels that may be used at the Ross ISR facility.

Transportation of process chemicals and fuel will follow all applicable DOT hazardous material shipping regulations and requirements. Nevertheless, environmental impacts could occur if a truck transporting process chemicals or fuel is involved in an accident. Any spills will be contained and the affected area remediated.

Process chemicals range from nonreactive solids with very low environmental risk if released (e.g., sodium chloride) to liquids with significant environmental risk if released (e.g., sulfuric acid) to toxic gases such as anhydrous ammonia. Anhydrous ammonia may be used at the CPP to adjust the pH of the eluate solution in the precipitation tanks and will be used as part of the vanadium circuit. A significant environmental impact could result if a truck carrying anhydrous ammonia were involved in an accident. Since ammonia is transported as a compressed, liquefied gas, an accident could release a large volume of ammonia vapor which could pose an environmental hazard if it were to occur in a populated area or near surface water supporting aquatic life. The anhydrous ammonia will be likely be transported to the proposed project area from Casper, Wyoming, 180 miles southwest of the proposed project area. Alternate shipping locations include Billings, Montana, 280 miles northwest, and Rapid City, South Dakota, 135 miles east. Each shipment will contain 2,500 gallons. Based on the estimated annual usage of about 70,000 gallons of anhydrous ammonia, the frequency of shipments is approximately 28 trucks per year. Using the accident rate of 4.3 x 10^{-6} accidents/mile from Section 7.1.5.3 of NUREG-0706, the chance of a traffic accident involving these trucks is approximately 2% per year, using the 180-mile distance to Casper. NUREG-0706 also provides a probability of an injury to a member of the general public resulting from an average shipment of anhydrous ammonia as 4.8 x 10^{-7}/mile. Based on this probability, the average annual probability of an injury to a member of the general public resulting from an ammonia transportation accident is 0.2%. Risks involving other process chemicals would generally be equal to or less than the risk in transporting ammonia.

Transportation accidents involving fuel (diesel, gasoline, and propane) shipment also present potential environmental impacts. During operation it is estimated that approximately 1 shipment of fuel will be transported to the site each day. Fuel will be transported from a nearby town such as Moorcroft, Gillette or Sundance, which will minimize the trip distance and keep the probability of an accident very low.

<u>Loaded Resin Shipments</u>

The uranium recovery circuit at the CPP will be designed to process up to 3 million pounds per year of U_3O_8. The Ross ISR Project wellfield is estimated to produce 750,000 pounds per year of U_3O_8; therefore the CPP will be capable of processing additional uranium-loaded IX resin from satellite ISR facilities, including those owned and/or operated by Strata and those owned and/or operated by other ISR licensees, and from other water treatment entities generating uranium-loaded IX resins that are the same or substantially similar to those generated at ISR facilities. Uranium-loaded IX resin would be transported to the Ross ISR Project in tanker trailers with 500 cubic-foot capacity. Based on a typical concentration of 50 g/L U_3O_8 (ISR GEIS Section 4.2.2.2), each truckload of uranium-loaded IX resin will contain approximately 1,500 pounds U_3O_8. Based on a maximum processing rate of 2.25 million pounds of U_3O_8 equivalent derived from uranium-loaded IX resin, up to 4 shipments would be made to the facility each day. A transportation accident resulting in release of uranium-loaded IX resin would have a lower risk than the relatively low risk from an accident involving yellowcake described previously. As described in Section 4.2.2.2 of the ISR GEIS, IX resin contains a much lower concentration of uranium than yellowcake and the uranium is chemically bound to the IX resin and is therefore less likely to spread and easier to remediate in the event of a spill. Further, although there would be more frequent shipments of uranium-loaded IX resin than yellowcake, the distance traveled would typically be less, so the total distance traveled would likely be less. If an accident occurred with loaded resin the impacted soils would be salvaged and shipped to a licensed 11e.(2) byproduct material disposal site, the topsoil and vegetation would be replaced, and Strata would perform a post-reclamation radiological survey to verify that no long-term hazards would be present.

Vanadium Shipment

Vanadium will be shipped in sealed transport vehicles to prevent uncontrolled release into the atmosphere. AMV is considered a hazardous material by the USDOT (40 CFR Part 172.101). As such, vanadium will be shipped by an appropriately licensed transporter to a processing facility.

It is estimated that the quantity of vanadium produced from the Ross ISR Project may be up to 60% of the yellowcake quantity. This would be up to 1.8 million pounds per year. Since the weight limits for legal transport are 40,000 pounds, up to 45 shipments would be required annually. This level of traffic would not significantly affect the project-related traffic compared to the commuting traffic associated with the project workforce or the heavy truck traffic associated with equipment and material shipments. The location of the vanadium processing facility has not been finalized, but based on the reduced shipment frequency and the lack of radiological hazard compared to yellowcake shipment, the potential risk associated with vanadium shipment will be smaller than that associated with yellowcake shipment.

11e.(2) Byproduct Material Shipment

11e.(2) byproduct material will be transported to a licensed disposal site. Before operations begin, Strata will have an agreement in place with a licensed disposal facility to accept 11e.(2) byproduct material. Shipments will be handled as LSA material and will generally be made bulk in sealed roll off containers in accordance with the applicable DOT hazardous materials shipping provisions. Because of the low volume of 11e.(2) byproduct material generated, these shipments will be infrequent and average about 5 per year during operation. This is based on an estimated 11e.(2) byproduct material quantity of 100 cubic yards per year and a typical shipment size of 20 cubic yards.

The risk of an accident involving the transporting of 11e.(2) byproduct material will be kept to a minimum by the use of proper packaging and exclusive use shipments. Similar to transportation of yellowcake, Strata will contract with a transport company that provides training and emergency response procedures specific to the transport of 11e.(2) byproduct material.

At present strata plans to ship 11e.(2) byproduct material to one of the following four disposal facilities:

- ♦ Pathfinder Mines Corporation – Shirley Basin Facility
- ♦ White Mesa Uranium Mill – Blanding, UT
- ♦ Energy Solutions LLC – Clive Disposal Site – Clive, UT
- ♦ Waste Control Specialists LLC – Andrews, TX

In the future, Strata may also consider shipping 11e.(2) byproduct material to Kennecott's Sweetwater Uranium Mill. This facility is currently on standby and therefore was not included in the potential transportation impacts for the Proposed Action.

Potential transportation routes to 11e.(2) byproduct material disposal facilities are depicted on Figure 4.2-3. Potential transportation routes to each site are listed below:

- ♦ Pathfinder Mines Corporation – Shirley Basin Facility (total distance approximately 235 miles)
    - ◊ Drive south on CR 164 (the New Haven Road) for 3.0 miles
    - ◊ Continue straight onto CR 68 (D Road) for 18.3 miles
    - ◊ Turn left at CR 12 (Bertha Road) and go 450 feet
    - ◊ Turn left on Highway 51 and travel 1.4 miles
    - ◊ Turn onto I-90 W and go 30.2 miles
    - ◊ Take WY-50 S 51.2 miles
    - ◊ Turn right at WY-387 W and go 31.7 miles
    - ◊ Turn left at WY-259 S and go 18.1 miles
    - ◊ Turn onto I-25 S and go 21.2 miles to Casper
    - ◊ Take WY-220 W 18.0 miles

- ◊ Turn left at WY-487 S and go 35.3 miles to the Shirley Basin Facility

♦ White Mesa Uranium Mill – Blanding, UT (total distance approximately 750 miles)

- ◊ Drive south on CR 164 (the New Haven Road) for 3.0 miles
- ◊ Continue straight onto CR 68 (D Road) for 18.3 miles
- ◊ Turn left at CR 12 (Bertha Road) and go 450 feet
- ◊ Turn left on Highway 51 and travel 1.4 miles
- ◊ Turn onto I-90 W and go 30.2 miles to Gillette, WY
- ◊ Take WY-50 S 51.2 miles
- ◊ Turn right at WY-387 W and go 31.7 miles
- ◊ Turn left at WY-259 S and go 18.1 miles
- ◊ Turn onto I-25 S and go 21.2 miles to Casper
- ◊ Turn onto WY-220 W and follow 71.0 miles to Muddy Gap, WY
- ◊ Continue straight onto US-287 S/WY-789 S for 44.1 miles to Rawlins, WY
- ◊ Turn onto I-80 W and go 24.4 miles
- ◊ Turn onto WY-789 S and go 53.4 miles to Colorado border
- ◊ Continue on CO-13 S/CO-789 S for 128 miles to Rifle, CO
- ◊ Turn onto I-70 W and go 136 miles to Crescent Junction, UT
- ◊ Turn onto US-191 S and go 106 miles to Blanding, UT

♦ Energy Solutions LLC – Clive Disposal Site – Clive, UT (total distance approximately 660 miles)

- ◊ Drive south on CR 164 (the New Haven Road) for 3.0 miles
- ◊ Continue straight onto CR 68 (D Road) for 18.3 miles
- ◊ Turn left at CR 12 (Bertha Road) and go 450 feet
- ◊ Turn left on Highway 51 and travel 1.4 miles
- ◊ Turn onto I-90 W and go 30.2 miles to Gillette, WY
- ◊ Take WY-50 S 51.2 miles
- ◊ Turn right at WY-387 W and go 31.7 miles
- ◊ Turn left at WY-259 S and go 18.1 miles
- ◊ Turn onto I-25 S and go 21.2 miles to Casper
- ◊ Turn onto WY-220 W and follow 71.0 miles to Muddy Gap, WY
- ◊ Continue straight onto US-287 S/WY-789 S for 44.1 miles to Rawlins, WY
- ◊ Turn onto I-80 W and go 359 miles to Clive, UT

♦ Waste Control Specialists LLC – Andrews, TX (total distance approximately 1,000 miles)

- ◊ Drive south on CR 164 (the New Haven Road) for 3.0 miles
- ◊ Continue straight onto CR 68 (D Road) for 18.3 miles

- ◊ Turn left at CR 12 (Bertha Road) and go 450 feet
- ◊ Turn left on Highway 51 and travel 1.4 miles
- ◊ Turn onto I-90 W and go 26.7 miles to Gillette, WY
- ◊ Turn left at WY-59 S and go 113 miles to Douglas, WY
- ◊ Turn onto I-25 S and go 488 miles to Springer, NM
- ◊ Turn onto US-412 E/US-56 E and go 19.7 miles
- ◊ Turn right at NM-39 S and go 93.4 miles to Logan, NM
- ◊ Turn right at US-54 W and go 2.3 miles
- ◊ Turn left at NM-469 S and go 43.4 miles to Grady, NM
- ◊ Turn onto NM-209 S for 35.5 miles to Clovis, NM
- ◊ Continue onto US-70 W for 18.4 miles to Portales, NM
- ◊ Turn onto NM-206 S and go 83.7 miles to Lovington, NM
- ◊ Merge onto US-82 W and go 3.6 miles
- ◊ Continue onto NM-18 S for 40.5 miles
- ◊ Turn left at NM-176 E/NM-234 E and go 5.0 miles to Waste Control Specialists LLC

The 11e.(2) byproduct material shipments will be very infrequent (approximately 5 per year during operation) and will not significantly impact the daily traffic compared to other operations at the site.

Solid Waste Shipment

Solid waste will be transported to municipal landfills in Moorcroft (approximately 23 road miles south), Sundance (approximately 38 road miles southeast) and/or Gillette (approximately 52 road miles southwest). It is estimated that 1 trip per week will be required to ship solid waste to the appropriate facilities during operation. The solid waste shipments will result in minimal traffic impacts. Section 4.13 describes the estimated quantities, management, disposal, minimization, and potential impacts of solid waste disposal in more detail.

Hazardous Waste Shipment

Potential hazardous waste impacts are discussed in Section 4.13. Strata anticipates that the Ross ISR Project will be classified as a conditionally exempt small quantity generator by WDEQ/SHWD. As such, the project will be required to generate less than 220 pounds of hazardous waste in any calendar month and store less than 2,200 pounds of hazardous waste at any one time. Hazardous waste generated from the project may include small quantities of used oil from equipment and vehicles, oil contaminated soil, oily rags, used batteries, expired laboratory reagents, fluorescent light bulbs, solvents, cleaners, and degreasers. These items will be transported to an off-site treatment, storage and disposal or recycling facility that is licensed by WDEQ/SHWD or a nearby State to manage hazardous waste. These shipments are considered minimal, at approximately 1 shipment per month, and will not result in significant traffic impacts.

4.2.1.3 Potential Aquifer Restoration Impacts

The potential transportation impacts during aquifer restoration are expected to be equal to or less than potential impacts during operation. The number of workers is expected to decline significantly during aquifer restoration, and the traffic on I-90 and affected portions of D Road and the New Haven Road will decline proportionally. Yellowcake, vanadium, and loaded resin shipments may remain the same if the CPP continues to process loaded IX resins during aquifer restoration. The shipments of process chemicals will similarly depend on whether the CPP will continue to process loaded resin after the Ross wellfield modules are no longer in operation.

4.2.1.4 Potential Decommissioning Impacts

During the decommissioning phase the workforce is expected to increase to approximately 90 workers. Traffic along affected portions of I-90, D Road, and the New Haven Road will increase, but will be at levels far below those expected during construction. Fuel shipments will increase due to the operation of heavy equipment during decommissioning activities. Little or no yellowcake or vanadium will be shipped during decommissioning. Decommissioning will result in an increase in shipments of 11e.(2) byproduct material and solid waste. It is estimated that the frequency of 11e.(2) byproduct material shipments will increase from approximately 5 per year during operation and aquifer restoration to between 100 and 200 shipments per year during decommissioning. These will still be relatively infrequent compared to passenger vehicles and will have a small impact on traffic. Solid waste shipments are expected to increase from about 1 per week during operation and aquifer restoration to about 2 per week during decommissioning. Hazardous waste shipments are expected to remain unchanged at about 1 per month throughout all four project phases. Potential transportation impacts are expected to be similar during decommissioning as those occurring during the previous three project phases.

4.2.2 No Action Alternative

There would be no transportation impacts from the No Action Alternative, since the Ross ISR Project would not be constructed.

Table 4.2-1. Estimated Workers and Traffic Counts

Project Phase	Average Daily Workers	Passenger Vehicle Traffic (veh/day)	Heavy Truck Traffic (veh/day)
Construction	200	400	24
Operation	60	120	16
Aquifer Restoration	20	40	12
Decommissioning	90	180	10

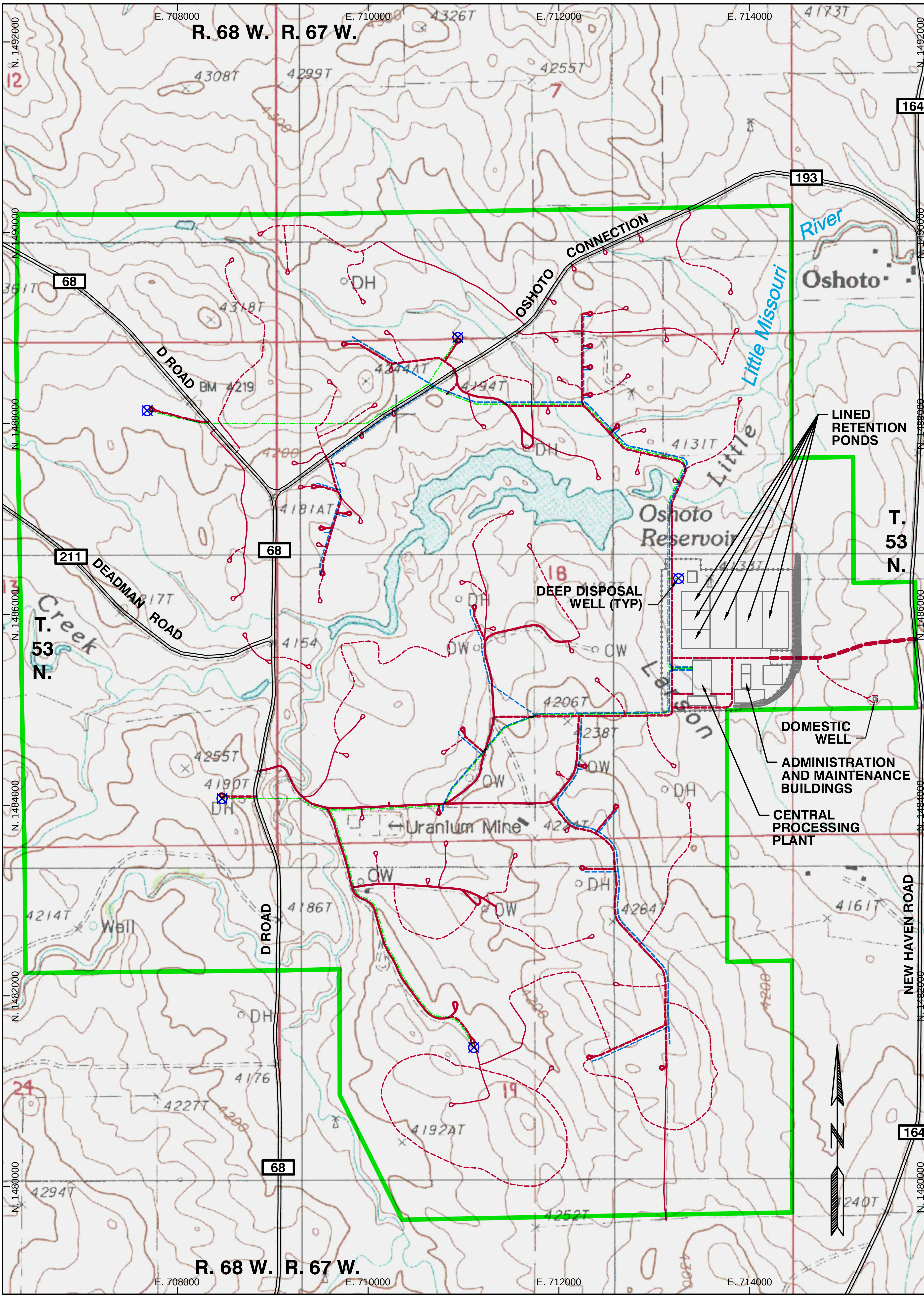
Note: Vehicle counts are to and from the proposed project area (two one-way trips per vehicle).

Table 4.2-2. Projected Traffic Impacts on Public Roads

ROUTE	ROUTE DESCRIPTION	2015 Projected ADT (veh/day)		CONSTRUCTION Projected ADT (veh/day)				OPERATION Projected ADT (veh/day)				AQUIFER RESTORATION Projected ADT (veh/day)				DECOMMISSIONING Projected ADT (veh/day)			
		ALL VEHICLES	TRUCKS	ALL VEHICLES	% Increase	TRUCKS	% Increase	ALL VEHICLES	% Increase	TRUCKS	% Increase	ALL VEHICLES	% Increase	TRUCKS	% Increase	ALL VEHICLES	% Increase	TRUCKS	% Increase
I-90	Interstate 90 at JCT Route 44 (West Moorcroft INT)	6,537	1192	6,961	6%	1216	2%	6,673	2%	1208	1%	6,589	1%	1204	1%	6,727	3%	1202	1%
CR 68	D Road (I-90 to New Haven Road Intersection)	126	9	510	305%	33	267%	262	108%	25	178%	178	41%	21	133%	316	151%	19	111%
CR 164	New Haven Road (D Road Intersection to Primary Access Road)	119	12	503	323%	36	200%	255	114%	28	133%	171	44%	24	100%	309	160%	22	83%

Table 4.2-3 Bulk Chemicals Required at the Ross ISR Project

Shipped as Dry Bulk Solids		Shipped as Liquid or Gases	
Sodium bicarbonate	$NaHCO_3$	Oxygen	O_2
Sodium hydroxide	NaOH	Carbon dioxide	CO_2
Sodium carbonate	$NaCO_3$	Sulfuric acid	H_2SO_4
Sodium chloride	NaCl	Anhydrous ammonia	NH_3
Ammonium sulfate	$(NH_4)_2SO_4$	Hydrochloric acid	HCl
Barium chloride	$BaCl_2$	Hydrogen peroxide	H_2O_2
		Diesel	
		Gasoline	
		Propane	
		Bottled gases	



Drawing Coordinates: WY83EF

ROSS PROJECT AREA

LEGEND

PROPOSED ROSS PERMIT BOUNDARY

164 EXISTING COUNTY ROAD

0 500 1000 2000

GRAPHIC SCALE (FEET)

FACILITIES

- PROPOSED CONVEYANCE PIPELINE
- PROPOSED DEEP DISPOSAL WELL PIPING
- PROPOSED PRIMARY ACCESS ROAD
- EXISTING SECONDARY ACCESS ROAD
- PROPOSED SECONDARY ACCESS ROAD
- EXISTING 2-TRACK ROAD
- PROPOSED TERTIARY ROAD
- PROPOSED DEEP DISPOSAL WELL

STRATA ENERGY

REVISIONS

Date	Description

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

ENVIRONMENTAL REPORT
FIGURE 4.2-1

EXISTING AND PLANNED ROADS

Drawn By: MBM
Checked By: JWF
Date: 11/19/10

FILE: ROSS_ER_TRAN_RDS

WWC ENGINEERING
www.wwcengineering.com

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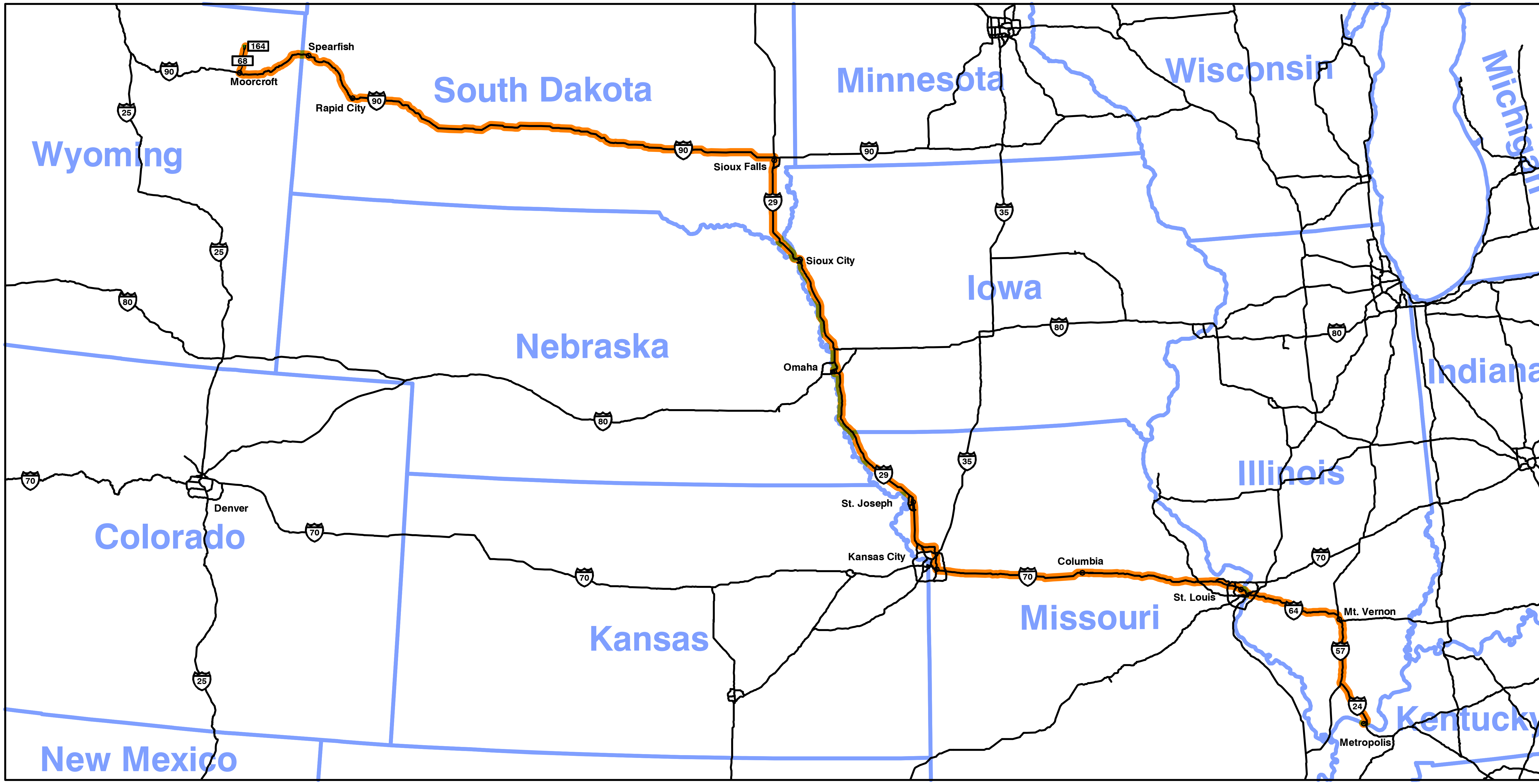

TRANSPORTATION ROUTE

LEGEND

- 164 COUNTY ROAD
- 59 STATE HIGHWAY
- 14 US HIGHWAY
- 90 INTERSTATE HIGHWAY

0 37.5 75 150

GRAPHIC SCALE (MILES)

N

STRATA ENERGY

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

REVISIONS

Date	Description

ENVIRONMENTAL REPORT
FIGURE 4.2-2

POTENTIAL
YELLOWCAKE SHIPMENT
TRANSPORTATION ROUTE

Drawn By: MBM
Checked By: BEW
Date: 11/20/10

WWC ENGINEERING
www.wwcengineering.com

FILE: ROSS_TR_TRAN_YELLOWCAKE

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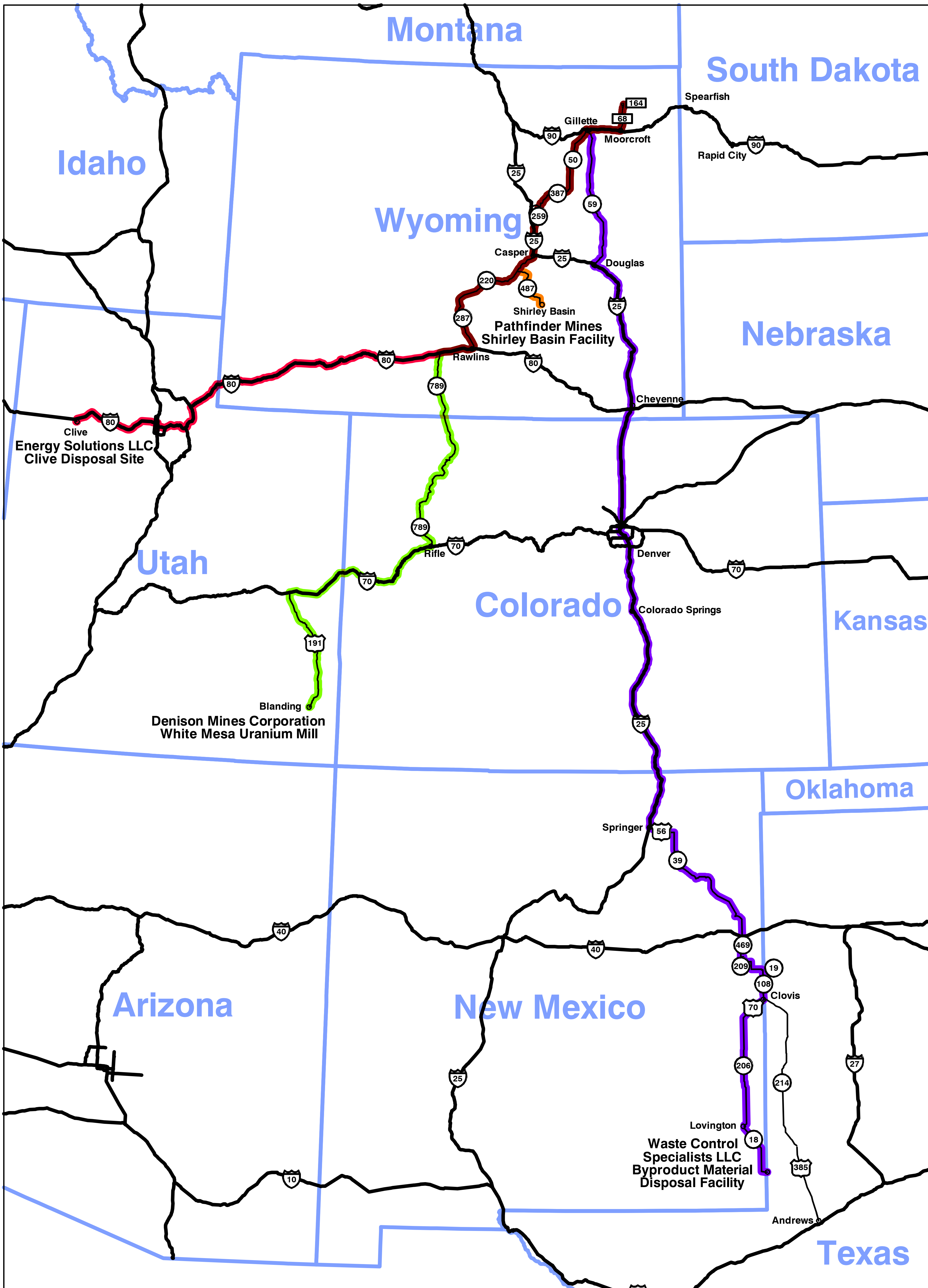


TRANSPORTATION ROUTES

LEGEND

164	COUNTY ROAD
59	STATE HIGHWAY
14	US HIGHWAY
90	INTERSTATE HIGHWAY

0 37.5 75 150

GRAPHIC SCALE (MILES)

N

STRATA ENERGY

REVISIONS

Date	Description

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

ENVIRONMENTAL REPORT
FIGURE 4.2-3

POTENTIAL
11e.(2) BYPRODUCT MATERIAL
TRANSPORTATION ROUTES

Drawn By: MBM
Checked By: JWF
Date: 10/14/10

WWC ENGINEERING
www.wwcengineering.com

FILE: ROSS_TR_TRAN_WASTE

4.3 Potential Geology and Soils Impacts

4.3.1 Proposed Action

Potential impacts to geology and soils will occur during construction of the CPP and other facilities within the central plant area, wellfield modules, access roads, deep disposal wells, pipelines, and utilities. Section 4.1 of this ER describes how up to 280 acres of land, or about 16% of the proposed project area, may be disturbed during the life of the project. Activities potentially resulting in soil impacts include clearing vegetation, topsoil stripping, excavation, backfill, compaction, grading, and utility and pipeline trenching. There is limited potential impact to geology due to the minor depth of disturbance associated with construction of the ISR facility.

Based on the total anticipated disturbance area of 280 acres (Section 4.1) and the average topsoil depth of 1.74 feet (Section 3.3), the volume of topsoil stockpiled during the life of the project is estimated to be up to about 800,000 cubic yards. This estimate is conservatively high due to the following factors: (1) as much as possible, wellfield infrastructure and access roads will be located outside of the 100-year flood plain, where topsoil is relatively thin compared to flood-prone areas; (2) topsoil will not generally be removed from unconstructed, 2-track access roads including tertiary access roads and temporary access roads; and (3) much of the topsoil will be replaced promptly after removal, such as that temporarily removed during pipeline and utility trenching. One relatively large topsoil stockpile will be located near the central plant area, and access road topsoil stockpiles will be located throughout the wellfield, where they will typically be spaced approximately 2,000 feet apart along access roads to minimize compaction, fugitive dust, noise, and emissions associated with long topsoil hauls.

Due to the relatively minor nature of disturbance associated the proposed Ross ISR Project, there will be few areas of subsoil disturbance. These will primarily be limited to the central plant area. The subsoil will be disturbed by cut, fill, and grading operations necessary to construct a relatively level plant site and by excavation of the lined retention ponds, containment barrier wall, and facilities flood control diversion channel. The quantity of excess subsoil generated from construction of the central plant area is estimated to be about 80,000 cubic yards. This material may be used to provide a slightly elevated and relatively level primary access road, or it may be stored in a stockpile separate from the topsoil stockpiles. During decommissioning, the subsoil will be replaced and the central plant area will be contoured to approximately match pre-construction topography.

4.3.1.1 Potential Construction Impacts

4.3.1.1.1 Potential Construction Impacts to Soil

Potential soil impacts may include soil loss, compaction, salinity, loss of soil productivity, and soil contamination.

Soil Loss

The two greatest sources of potential soil loss are wind and water erosion. As described in Section 3.3, the soils within the proposed project area have a moderate to severe potential to be affected by wind erosion. Only one soil type, making up less than 3% of the proposed project area, has a severe potential for wind erosion Water erosion hazards range from negligible to moderate.

Surface disturbing activities will expose soil and subsoil and temporarily increase the potential for soil loss due to wind and water erosion. Mitigation measures designed to minimize soil loss include: a) constructing topsoil stockpiles on the leeward side of hills, where possible, b) constructing topsoil stockpiles away from ephemeral stream channels or any other flood-prone areas, c) avoiding construction within areas susceptible to flooding, or minimizing the disturbance in surface water drainages (i.e., roads and pipelines will cross drainages perpendicular to the flow direction), d) wetting exposed soil during construction to minimize soil loss and resulting dust from wind erosion, e) implementing sediment control BMPs in all disturbed areas such as silt fence, sediment logs, and straw bale check dams, f) implementing additional sediment control BMPs for topsoil stockpiles, including providing a ring ditch and water collection sump to trap storm water and sediment in accordance with WDEQ/LQD requirements, and g) restoring and re-seeding disturbed areas, typically within a single construction season. Additional details about soil loss mitigation measures are presented in Section 5.3 in this ER.

Soil Compaction

Soils within the proposed project area have the potential to be compacted, particularly during construction, when heavy equipment operation will be at the highest level. Soil compaction could result in a decrease in infiltration thereby increasing runoff. To decrease the potential for compaction, Strata will use existing roads where possible and rip compacted soils, as needed, during decommissioning as described in Section 5.3 in this ER. Strata has been employing various methods of soil reclamation according to landowner preference during regional baseline monitoring and exploratory drilling. These methods have included ripping compacted soil with the teeth of a grader, loosening compacted soil with a disc, or simply replacing topsoil and re-seeding. These techniques will continue to be refined and coordinated with WDEQ/LQD and the affected landowners.

Salinity

The salinity of the soils within the proposed project area was evaluated during the baseline soil survey. Saline soils are very susceptible to soil loss caused by development. The results indicate that saline soils are not present in the proposed project area, and therefore the potential soil loss risk is low. No soil salinity hazards will typically be present during construction.

Loss of Soil Productivity

Soil productivity may be affected during construction. Excavation activities may impact the structure and microbial activity of the topsoil resulting in a loss of organic matter. Similarly, soils may be mixed or compacted during excavation and stockpiling resulting in the breakdown of soil structure and loss of pore space. These activities not only impact the soil, but may create conditions not conducive to vegetation. To minimize soil productivity impacts, Strata will utilize BMPs described in Section 5.3 such as properly segregating topsoil from subsoil during topsoil stripping and seeding topsoil stockpiles with a temporary seed mixture.

Soil Contamination

During construction, potential soil impacts could occur from introduction of drilling fluids or drilling muds to soils near the recovery, injection, and monitor wells. The volume of drilling fluids and muds will be small, and these will be contained within mud pits constructed at each well. The potential soil contamination impact resulting from drilling fluids or mud is therefore small. Additional details are provided under TENORM waste management in Section 4.13 of this ER.

Potential soil impacts could also occur from leaking fuel or oil from heavy construction equipment and passenger vehicles operated during construction. The volume of leaks would typically be small and result in only localized impacts. Oil-contaminated soil would be disposed off-site as described in Section 4.13. The release of any spill or leak will be mitigated by immediate cleanup response.

4.3.1.1.2 Potential Construction Impacts to Geology

Potential geology impacts would only occur during construction and decommissioning, when relatively minor disturbance will occur to the subsoil and, potentially, the surficial aquifer in the vicinity of the lined retention ponds and containment barrier wall. Potential impacts are primarily related to changes in surficial aquifer flow patterns and water levels and potential water quality degradation. All of these are addressed in Section 4.4.

NUREG-1748 notes that geological resources are more likely to exert an impact than be impacted by ISR construction and operation. Two geologic hazards present in Wyoming are volcanoes and earthquakes.

The proposed project area is located 250 miles east Yellowstone National Park. Yellowstone is centered on an active volcano system that has resulted in three immense explosive volcanic eruptions in the past 2.1 million years (USGS 2010). According to the USGS (2005), a large volcanic eruption at Yellowstone could bury vast areas of the U.S. with volcanic debris. It could also create lava flows, the impact of which would be limited to areas within and adjacent to the park, but far from the proposed project area. USGS (2005) notes that the probability of a large, caldera-forming eruption within the next few thousand years is "exceedingly low."

A geologic hazard related to Yellowstone is seismic activity. Section 3.3.7 describes the seismic hazard of the proposed project area. This section describes how there are no active faults with surface expression in or near the proposed project area and how only two magnitude 3.0 or greater earthquakes have been recorded in or near Crook County. The section also describes how a magnitude 6.25 floating earthquake placed 15 km (9.3 mi) from the proposed project area would generate horizontal accelerations of approximately 0.15g, which is a Level VI earthquake. The 2,500-year probabilistic map presented in Section 3.3.7 shows that the peak ground acceleration with a 2% probability of exceedance in 50-years is 0.06 to 0.08g, which equates to a Level V earthquake. Level V or VI earthquakes are felt by almost everyone around but do not cause significant damage. Since structures at the Ross ISR Project will be designed according to the 2,500-year probabilistic map, the risk of significant earthquake damage to the proposed facilities is small, as the total anticipated project life is approximately 8 to 12 years.

4.3.1.2 Potential Operation Impacts to Geology and Soil

During operation and aquifer restoration, there will be a very low risk of hydraulic fracturing during operation of injection wells, including Class III injection wells in the ore zone and Class I deep disposal wells. Potential impacts will be avoided by maintaining the injection pressure at a level that does not exceed the fracture gradient of the receiving formation (OZ aquifer for Class III wells and Deadwood/Flathead Formations for Class I wells).

During operation, potential soil impacts could occur from compaction, especially vehicles driving on wellfield access roads; from salinity, if land application is used for permeate disposal; and from spills or leaks. Soil compaction could occur on all access roads, but potential impacts would be most noticeable on tertiary access roads, which will typically be unconstructed, 2-track roads without gravel surfacing. These roads will be used throughout operation for monitor well sampling and MITs. Compaction will be mitigated by ripping tertiary roads during reclamation and importing topsoil if needed during decommissioning.

There is a small potential for soil salinity impacts to occur if land application is used for permeate disposal. However, the highly treated permeate would not likely contain sufficient levels of dissolved constituents to increase soil salinity, as long as adequate leaching is available in irrigated areas. Soil salinity impacts and baseline soil salinity at the surface and root zone would be addressed in a site-specific land application plan submitted for regulatory approval prior to land application.

During operation, there will be additional soil contamination risks that require specific mitigation measures. These include potential spills from pipelines, module buildings, and process vessels. A pipeline leak could potentially result in topsoil or subsoil contamination depending on the type of fluid, quantity of spilled fluid, and location of the leak. In the wellfield, potential pipeline leaks include ruptures of injection or recovery well feeder lines, lixiviant or recovery solution trunk lines, or deep disposal well pipelines. Small leaks could also occur at pipe joints and fittings at the well heads. Until remedied, these leaks may drip injection, recovery, or deep disposal well solutions onto the surrounding soil. To minimize the potential for pipeline leaks, Strata will hydrostatically test all pipelines during construction and institute leak detection monitoring as described in TR Section 3.1.7. Wellfield leak detection monitoring and control will include continuous measurement of flows and pressures for injection and recovery trunklines and feeder lines, inclusion of leak detection sensors in valve manholes, and inclusion of leak detection sensors in well head sumps.

A leaking pipeline within a module building could potentially impact the surrounding soil. This risk will be minimized by providing secondary containment for module buildings in the form of concrete sumps and by providing leak detection equipment.

Engineering controls will ensure that there is minimal potential impact to soil from the unintended release of process fluids or chemicals within the central plant area. Within the central plant area, potential releases of process fluids or chemicals to the environment include leaking pipelines, leaking chemical storage tanks or process vessels, major damage (i.e., rupture) of a process vessel, transportation accidents, or leaking ponds. The first level of protection is primary containment within pipelines, vessels, ponds, etc., all of which will be leakage tested during construction. The second level of protection is secondary containment. Secondary containment will be provided in the form of curbs, berms, and sumps for all chemical storage tanks, process vessels, and all piping and equipment inside the CPP building. A double liner and leak detection system will also be provided for lined retention ponds within the central plant area.

No potential impacts to geology have been identified during operation. The primary geologic hazard to the facility is that from earthquakes, which could potentially damage a process vessel, chemical storage tank, pipeline, or lined retention pond, and cause a contaminant release. As described previously, a Level V earthquake is predicted to occur in the proposed project area once every 2,500 years. The probability of occurring during the 4 to 8 year operational life of the CPP and wellfield is therefore less than 0.3%. Since the CPP building will be designed according to the 2,500-year probabilistic map, the risk of contaminant release from an earthquake is very small.

4.3.1.3 Potential Aquifer Restoration Impacts

During aquifer restoration, the potential soil impacts include compaction, salinity (if land application is used), and contamination from spills and leaks. The risks will generally be lower than those occurring during operation, since there will be less wellfield traffic compacting soils, little if any excess permeate will be available for land application, and there will be less fluids transported in wellfield pipelines (e.g., there will be no lixiviant or recovery solutions from producing wellfield modules).

No potential impacts to geology have been identified during aquifer restoration.

4.3.1.4 Potential Decommissioning Impacts

During decommissioning, potential soil impacts will be similar to those occurring during construction. The risk of compacting soil will temporarily increase due to increased heavy equipment operation. Local impacts will also potentially occur as contaminated soils are removed and disposed. Heavy equipment operation also increases the risk of soil contamination from fuel or oil leaks. These will be mitigated by ripping compacted soils prior to topsoil replacement and re-seeding and by immediately cleaning up any oil or fuel-contaminated soil.

The only recognized potential geologic impact from decommissioning is physical impacts to the surficial aquifer within the central plant area. For example, if the containment barrier wall (CBW) were allowed to persist after decommissioning, hydrogeologic impacts could occur within the surficial aquifer. This will be mitigated by reclaiming the CBW as described in Section 6.2.6 in the TR. Reclamation of the CBW will be accomplished by creating a series of breaches, also known as finger drains, along the upgradient and downgradient reaches and filling these breaches with gravel.

4.3.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed, and associated disturbance and impacts to geology and soils would not occur within the proposed project area.

4.4 Potential Water Resources Impacts

The Ross ISR Project has the potential to impact surface water and groundwater to varying degrees during each phase of the project. As discussed in Section 3.4, surface water and groundwater within the proposed project area are used for livestock and wildlife watering and industrial use.

4.4.1 Potential Surface Water Impacts

The Ross ISR Project is proposed in the drainage basin of the upper Little Missouri River. Figure 4.4-1 depicts the proposed facilities in relation to surface water features. The project has been designed to minimize surface water impacts. As stated in Section 4.2.4.1 of the ISR GEIS, potential impacts to surface water include degrading water quality, increased sedimentation, stream channel modification, reduced or altered flow rates, and encroachment on wetlands. These potential impacts are addressed in the following sections.

4.4.1.1 Potential Construction Impacts to Surface Water

During construction, potential surface water impacts could occur primarily from site disturbing activities such as wellfield, access road, pipeline, utility, and central plant area development. The site disturbing activities will include vegetation removal and topsoil stockpiling, limited periods of low impact stream channel disturbance and minor wetland encroachment. These activities have the potential to result in minor hydrocarbon spills, primarily related to fuel and lubricants from heavy equipment operation.

Vegetation removal and soil disturbance is described in Section 4.1. These activities will occur in all aspects of construction of the Ross ISR Project. The primary potential impact from the removal of vegetation and disturbance of soil is water quality degradation. Surface water quality within the proposed project area has the potential to be adversely impacted by increasing suspended sediment concentrations due to vegetation removal and soil disturbance. A summary of the proposed disturbance is presented in Table 4.1-1. This includes disturbance of up to 280 acres during the life of the Proposed Action, or about 16% of the proposed project area. Figure 4.4-1 depicts the location of all facilities proposed within the proposed project area. During construction temporary sediment control features will be used until vegetation can be re-established to minimize the potential impacts to surface water due to vegetation removal and soil disturbance. Temporary sediment control features described in Section 5.4 will include silt fence, sediment logs, straw bale check dams or other BMPs.

Stream channels within the proposed project area will be minimally impacted from construction activities. Roads will be constructed away from drainages where possible. In the instances where it is necessary to cross a stream channel, the crossing will be made perpendicular to the channel and will include a culvert capable of passing the runoff resulting from the 10-year, 24-hour precipitation event. Strata estimates that three stream channel crossings will be constructed and one existing stream channel crossing will need to be rehabilitated. In addition, there are several instances where tertiary access roads will cross ephemeral draws. These channel crossings will consist of an unconstructed, two-track trail. Ephemeral channel crossings will involve minimal disturbance and will not be used during flow events. The potential impacts to surface water from ephemeral channel crossings will include increased sediment load due to vegetation and soil disturbance. Sediment load will be mitigated by sediment control BMPs.

Pipeline stream channel crossings will potentially impact surface water in similar fashion to road crossings. Pipeline crossings will be constructed in the same corridor as road crossings where possible to minimize disturbance. Three pipeline stream channel crossings are anticipated within the proposed project area. The impacts to surface water flow from construction activities across a stream channel will be minimized by routing flow around active construction operations, storing it in temporary sediment ponds, or passing it through sediment control measures prior to discharge.

ISR wells will not be constructed in stream channels, but some wells may be constructed in the 100-yr floodplain within the proposed project area. BMPs will be implemented to minimize sediment transport due to well installation (e.g., silt fence, sediment logs, straw bale check dams, etc.) and to protect the injection, recovery and monitor wells from flooding (e.g., cement seals around the well casing and watertight caps).

As shown in Figure 4.4-1 the central plant area will be constructed near an ephemeral stream channel and will have the potential to affect surface water quality and flow. A flood control diversion channel will be constructed around the central plant area to route surface water flow around the facilities up to and including the 100-year, 24-hour precipitation event. The diversion channel will significantly reduce the risk of flooding or surface water contamination.

Accidental spills and leaks (e.g., equipment leaks) may also affect surface water during construction. The impacts to water quality associated with leaks, spills, or equipment failures will be dependent upon several factors including: type of material spilled, size of spill, location of spill relative to surface water, and remediation. Potential impacts from accidental spills and leaks will be small due to the small volume, rapid cleanup response, location of construction activities away from surface water features when possible, and containment controls such as mud pits.

Surface water may be impacted during construction due to water discharge from aquifer testing, construction dewatering necessary for CPP infrastructure, and pipeline integrity testing. During construction of the wellfield, Strata will apply for a temporary WYPDES permit to discharge construction water generated from these types of activities. BMPs such as energy dissipation and sediment control devices at the point of discharge will minimize potential surface water impacts from WYPDES discharge. Additionally, Strata will implement a storm water pollution prevention plan (SWPPP) to address storm water runoff during construction. Prior to construction, Strata will prepare and submit to WDEQ/WQD an SWPPP along with a notice of intent for coverage under the Large Construction General WYPDES Storm Water Permit. The SWPPP will describe the nature and sequence of construction activities, identify potential sources of pollution, and describe BMPs to be used, including erosion and sediment controls (e.g., silt fence, sediment logs, straw bale check dams, etc.) and operational controls (e.g., housekeeping, signage, hydrocarbon storage, etc.). The SWPPP will be reviewed by WDEQ/WQD prior to issuing coverage under the general WYPDES permit.

The proposed project area includes approximately 65 acres of potential wetlands, as discussed in Section 3.4.3. The majority of the wetlands are situated along the Little Missouri River and adjacent to Oshoto Reservoir. Construction within the proposed project area has the potential to impact up to 2 acres of wetlands. Impacts to wetlands will be mitigated, as required by USACE, by enhancing existing wetlands or constructing new wetlands. Based on this evaluation, construction impacts to surface water are expected to be small.

4.4.1.2 Potential Operation Impacts to Surface Water

During operation, there are few surface disturbing activities, and vegetation will have been re-established in previously disturbed construction areas. Therefore, the potential water quality impacts from sediment transport will be much lower during operation than during construction. Since new wellfield modules will continually be constructed during operation, sediment control BMPs will continue to be implemented to ensure that potential sediment transport and related surface water impacts remain small.

Prior to uranium recovery operations, Strata will apply to WDEQ/WQD for coverage under the Industrial General WYPDES Storm Water Permit or an individual storm water permit. As part of the application, Strata will prepare an SWPPP that describes erosion and sediment controls as well as operational controls that will be used during operation to ensure that storm water discharges from the facility do not cause a violation of surface water quality standards (i.e., Chapter 1 of the Wyoming Water Quality Rules and Regulations). Qualified Strata personnel will inspect storm water BMPs semiannually or as required by the WYPDES storm water permit and maintain inspection reports on file. The SWPPP will be updated as needed, such as in response to potential problems identified during inspections or changes in operation (e.g., transition from operation to aquifer restoration). The WYPDES storm water permit will also require storm water discharge sampling and compliance with numeric effluent limits.

During operation, there will be additional risks to surface water quality that require specific mitigation measures. These include potential spills from pipelines, module buildings, and process vessels. A pipeline leak near or beneath a stream channel could potentially result in surface water quality degradation depending on the type of fluid, quantity of spilled fluid, and location of the leak. In order to protect surface water at pipeline crossings, Strata will incorporate WDEQ/WQD requirements for potable water stream crossings into the design and construction of all pipeline stream crossings. These include providing a minimum of 2 feet (0.61 m) of cover (4 to 6 feet will typically be provided) over the pipe to guard against damage from livestock and to protect against freezing, providing pipe with flexible, watertight joints such as PVC or HDPE, and installing accessible isolation valves at both ends of water crossings so that the section can be isolated for testing or repair. In addition, Strata will hydrostatically test all pipelines during construction.

Module buildings will not be located within stream channels or within the 100-year floodplain. Nevertheless, surface water quality could be impacted if a leak inside a module building reached a stream channel or reservoir. Potential surface water quality impacts from spills in module buildings will be minimized by leak testing all pipe and equipment during installation, providing secondary containment for module buildings in the form of concrete sumps, providing leak detection equipment and by frequent inspection by wellfield operators.

Four levels of containment or surface water control will ensure that there is minimal potential impact to surface water from the unintended release of process fluids or chemicals within the central plant area. Within the central plant area, potential releases of process fluids or chemicals to the environment include leaking pipelines, leaking chemical storage tanks or process vessels, major damage (i.e., rupture) of a process vessel, transportation accidents, or leaking ponds. The first level of protection is primary containment within pipelines, vessels, ponds, etc., all of which will be integrity tested during construction. The second level of protection is secondary containment. Secondary containment will be provided in the form of curbs, berms, and sumps for all chemical storage tanks, process vessels, and all piping and equipment inside the CPP building and the adjacent chemical storage area. A double liner and leak detection system will also be provided for lined retention ponds within the central plant area. The third level of protection is the storm water control system within the central plant area, which will route all storm water to a sediment pond. The fourth level of protection is the facilities flood control diversion channel, which will prevent storm water originating in the ephemeral stream channel upstream of the central plant area from encountering process fluids or chemicals.

Two permeate disposal options could potentially impact surface water during operation, including WYPDES discharge and land application. Potential impacts resulting from WYPDES discharge include water quality impacts to the receiving channel and potential impacts to downstream ephemeral channel crossings. The water quality of the receiving channel would be protected by adhering to the flow limits and effluent quality established by WDEQ/WQD in the WYPDES permit as protective of the baseline water quality and uses of the surface water receiving the discharge (i.e., the Little Missouri River). Potential impacts to ephemeral crossings would be mitigated by discharging water below the Oshoto Reservoir, where the Little Missouri River is an intermittent stream and the relatively small volume of permeate would not significantly impact base flow, or by enhancing affected ephemeral crossings of the Little Missouri River or the affected tributary. The quantity of permeate discharged under a WYPDES permit would typically be 50 gpm (0.1 cfs) or less, which would have very minor potential impacts to ephemeral crossings and then only to those very near the discharge location. If crop enhancement via land application or subsurface drip irrigation is used for permeate disposal, there is the potential that water could flow from irrigated fields to nearby drainages and potentially impact surface water quality. Mitigation measures such as agronomic water application rates, surface runoff controls, and contingencies for reducing or stopping the irrigation system in the event of surface runoff would be addressed in a site-specific land application plan submitted to NRC and WDEQ/LQD for regulatory approval prior to constructing a land application or subsurface drip system. Based on this evaluation, surface water impacts during operation are expected to be small.

4.4.1.3 Potential Aquifer Restoration Impacts to Surface Water

Potential surface water impacts from aquifer restoration activities are similar to those occurring during operation and include sediment transport due to surface disturbing activities, potential releases of process fluids or chemicals from leaks, spills or equipment ruptures in the wellfield or central plant area, and potential surface water quality and ephemeral crossing impacts from WYPDES discharge or land application. These potential impacts are all expected to be similarly small to those resulting from operation activities. Surface disturbing activities will be limited during aquifer restoration, reducing the potential for sediment transport from disturbed areas. During aquifer restoration the same levels of protection described previously will be provided to minimize potential surface water impacts from unintended release of process fluids or chemicals within the wellfield or central plant area.

One potential surface water impact related to aquifer restoration is the potential reduction in Little Missouri River flow due to groundwater consumption in the ore zone. This potential impact is described in the groundwater model report included as Addendum 2.7-H in the TR. Modeling indicates that water from the Little Missouri River infiltrates into the ore zone aquifer where the river crosses the ore zone outcrop near the northeast corner of the proposed project area. As described in the ISR simulation results (Section 4.9.3 in the groundwater model report),

> "Conceptually, near the outcrop, water from the Little Missouri River infiltrates into the SM and OZ aquifers. Water not infiltrating into the OZ and SM aquifers exits the model via drains installed where Good Lad Creek and the Little Missouri River cross the outcrop. Prior to ISR operations an estimated 1.5 gpm was leaving the model via the drains. At the end of [modeled] ISR operations no water was exiting the model via the drains."

ISR simulation through the groundwater model indicates that slightly more water might infiltrate from the Little Missouri River (up to several gallons per minute) during operation and aquifer restoration, and therefore slightly less water will flow downstream. The potential impact will be small, since the 1.5 gpm predicted from modeling represents a relatively small incremental impact beyond the impact that has already likely occurred from water withdrawals for enhanced oil recovery. According to groundwater modeling, the decrease in water available to the Little Missouri River is currently around 6.5 gpm due to water withdrawals from the ore zone. Further, the 1.5 gpm modeled impact represents a very small fraction of the annual flow in the Little Missouri River. As indicated in Section 3.4 of this ER, the estimated average annual Little Missouri River discharge where it exits Wyoming is 42.8 cfs. A decrease in 1.5 gpm (0.003 cfs) represents less than 0.01% reduction in Little Missouri River flow from Wyoming to Montana. Figure 4.4-2 depicts a conceptual hydrologic model of the proposed project area. This figure shows where the Little Missouri River is believed to recharge the ore zone east of the proposed project area.

4.4.1.4 Potential Decommissioning Impacts to Surface Water

Sediment yield and stormwater runoff have the potential to increase during decommissioning due to disturbances associated with equipment and structure removal and site reclamation activities. In general, impacts will be slightly less than to those discussed during construction, since reclamation and decommissioning of the wellfield modules will be ongoing throughout the life of the project, thereby reducing the area of disturbance during the final decommissioning activities. Surface water impacts during decommissioning will be kept small through implementation of sediment control and operational BMPs that will be described in the SWPPP.

4.4.1.5 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed or operated, and associated impacts to surface water quality and quantity would not occur.

4.4.2 Potential Groundwater Impacts

The groundwater quality and quantity within the proposed project area could potentially be impacted during each phase of the Ross ISR Project. Impacts to groundwater could potentially occur to the non-exempt aquifer surrounding the ore zone (OZ), the overlying (SM) and underlying aquifers (DM), and the surficial aquifer (SA). The following sections present the potential impacts to groundwater. Groundwater mitigation measures are detailed in Section 5.4.2.

4.4.2.1 Potential Construction Impacts to the Surficial Aquifer (SA)

Potential water quality impacts to the surficial aquifer that may occur during construction include spills or leaks from construction equipment and the introduction of drilling fluids and muds. The surficial aquifer possesses the greatest potential to be impacted by these leaks. Strata will reduce the potential for a spill or leak by implementing BMPs, including spill prevention, spill control and remediation. The potential for groundwater to be impacted by drilling fluids and muds is minimal due to the small volume of materials used for drilling and casing and due to the presence of mud pits, which will prevent the spread of drilling fluids. Moreover, typical bentonite or polymer-based drilling additives are designed for limited infiltration (a few inches) and act to isolate the hole from the surrounding materials via a wall-cake or veneer of drilling fluid filtrate, further diminishing the potential for impacts.

Potential impacts to the surficial aquifer quantity during construction will be related to the level of use of the Oshoto Reservoir (in the vicinity of the Oshoto Reservoir, reservoir stage and surficial aquifer water level are closely related) and installation of the containment barrier wall (CBW) surrounding the central plant area (see Section 3.1.8 of the TR for a discussion of the central plant area hydraulic controls). Drilling and construction activities may utilize the industrial appropriation assigned to Oshoto Reservoir, and therefore may decrease the amount of water infiltrating to the surficial aquifer from the reservoir. Given the volume of water stored in the reservoir (172.7 ac-ft by permit) and limited amounts used for drilling, dust/fire suppression and other construction activities, potential impacts to the water quantity of the surficial aquifer related to withdrawals from Oshoto Reservoir will be small.

Construction of the CBW may also impact the quantity of water in the surficial aquifer as the CBW will isolate the surficial aquifer at the CPP and preconstruction dewatering within the central plant area will lower water levels locally in the surficial aquifer. Disruptions to the surficial aquifer will be localized, and the normal groundwater flow regime will not be disrupted. It is anticipated that the construction dewatering following installation of the CBW will be a one-time event and require little continuing maintenance. Ground and surface water collected within the CBW during construction is anticipated to meet discharge standards and be returned to the environment via a temporary dewatering discharge permit from the WDEQ/WQD WYPDES Program. Surficial aquifer water levels may increase outside of the CBW in response to the decreased permeability induced by the CBW, but this impact is expected to be small and should not have an adverse influence on the greater system.

4.4.2.2 Potential Construction Impacts to Deeper, Confined Aquifers (SM, OZ and DM)

Water quality of the primary aquifers at depth should not be impacted during the construction phase. In addition, as indicated in Section 4.2.4.2.1 of the ISR GEIS, the amounts of groundwater typically used for dust suppression, cement mixing and drilling support are small and would have a small and temporary impact to groundwater supplies. However, water quantity of the SM aquifer may see slight impacts if a domestic/industrial well is drilled for construction purposes. Water demands during construction are estimated to be 5-10 gpm. Based on yields from regional baseline wells and other wells completed in the aquifer, groundwater modeling (Addendum 2.7-H of the TR) indicates the SM aquifer could support this level of use with little drawdown.

Ongoing delineation drilling has the potential to impact aquifers overlying (SM), underlying (DM) and laterally adjacent to the mineralized sands of the Lower Lance/Fox Hills ore zone (OZ). Improperly abandoned boreholes could result in the mixing of industrial use groundwater from the OZ aquifer with the chloride-dominated groundwater of the DM aquifer or the stock water quality of the overlying SM aquifer. Strata exploration and delineation drilling programs within and adjacent to the proposed project area have utilized hydrologic isolation principles to guide drilling mud quality programs and borehole abandonment practices and procedures. Strata will continue to comply with WDEQ/LQD guidelines for hole abandonment by cementing or employing heavily mixed bentonite grout installed from the total depth to the surface to further limit the potential for groundwater migration within any proposed area perimeter monitor (sentry) well ring. A key characteristic of the hydrologic isolation program is limiting over-penetration during drilling programs. Both Strata and predecessors rarely drilled beyond 20 feet into the basal shale, thereby decreasing the potential for communication between the OZ aquifer and the underlying DM aquifer. In addition, heavy bentonite grout, cement and plug gel have proven to isolate the overlying SM aquifer based on numerous aquifer tests designed to evaluate overlying confining shale integrity.

Ongoing multi-purpose well installation programs have the potential to impact groundwater quality by mixing industrial and stock water quality aquifers by over-penetration or lack of well integrity. Given the significant amount of geologic data (>2,000 exploration and delineation holes) combined with a three-dimensional, Microsoft Access-driven database resource model, Strata can accurately determine total depths and prevent over-penetration into underlying aquifers. Beyond the immediate economic consideration, over-drilling reduces the efficiency of both ISR uranium recovery and restoration efforts. These factors drive programs to limit the potential for this unwanted water quality impact. Strata also employs on-site geologic/engineering oversight during any drilling project for all phases of well drilling, installation and abandonment. On-site geological/engineering supervision would continue during the construction phase. Wells installed for further hydrologic studies, baseline characterization and production infrastructure will pass MIT prior to utilization. Detailed well completion data including WSEO permits, MIT documentation and cement volume calculations will be provided with the wellfield data package in support of the Class III Injection Permit application required by WDEQ/LQD. Based on this evaluation, construction impacts to deeper aquifers are expected to be small.

4.4.2.3 Potential Operation Impacts

During uranium recovery operations, potential impacts to groundwater may result from spills and leaks, excursions, wellfield development drilling, and deep well injection. A number of factors limit the potential for these impacts, including natural conditions, regulatory oversight and final restoration of the exempted aquifer. Natural conditions that limit impacts include geologic isolation of the mineralized sandstones, hydraulic confinement within the mineralized intervals and geochemical isolation due to the static nature of the redox boundary. A second factor limiting the potential for impacts lies in the amount of regulatory oversight required to recover uranium via these methods. Regulated techniques for ISR operations, including well construction, MIT, wellfield integrity testing, UCLs for highly mobile constituents to provide "early warning" of potential excursions, extensive monitor well systems, and wellfield balance and bleed, have evolved to the point where these procedures complement and enhance the above-noted naturally occurring conditions to provide ongoing, iterative mitigation measures with the flexibility to adjust to site-specific conditions in order to protect adjacent sources of drinking water. Finally, restoration of the exempted aquifer following operations provides a third significant factor limiting the potential for impacts. Because ISR development is typically iterative and progressive, practioners are constantly improving techniques for recovery and more importantly, restoration of the aquifer. The natural confining conditions, when combined with the flushing of recovery solutions to achieve restoration, together serve as the primary bases for mitigation of any potential long-term impacts to adjacent sources of drinking water.

4.4.2.3.1 Potential Operation Impacts to Surficial Aquifer Quality

During operation the surficial aquifer has the potential to be impacted by leaks and spills. Lixiviant will be continuously injected and recovered from the wellfield modules during operation. The recovery solutions will be transported through pipelines to module buildings and pumped to the CPP for processing. A potential impact to the surficial aquifer could result from failure of a pipeline or a shallow break in the casing of an injection well. Since the pipelines will be buried, leaking solution has potential to seep into the surficial aquifer. To ensure pipelines do not fail Strata will hydrostatically test all pipelines prior to use and install leak detection devices in manholes along the pipelines. Strata will also monitor recovery and injection pipelines and immediately shut down affected pumps if a leak is detected (Section 3.1.4 and 3.1.7 of the TR detail pipeline integrity and instrumentation/control methods). MIT will be conducted on all Class III injection wells, recovery wells and monitor wells to ensure that the surficial aquifer is protected. The MIT will follow WDEQ/LQD Chapter 11 guidelines as will the construction of the wells (Section 3.1.2.3 of the TR details MIT methods).

An accidental spill or leak onto the surface may also have the potential to impact the surficial aquifer within the proposed central plant area. The central plant area has the greatest potential for a spill since it is where the majority of chemicals will be stored and where process vessels will be located. Strata will implement many spill control, containment, and remediation measures in the central plant area. These include secondary containment for process vessels and chemical storage tanks, a geosynthetic liner beneath the CPP foundation, dual liners with leak detection systems for lined retention ponds, a sediment pond to capture storm water runoff, and a bentonite slurry CBW to prevent the subsurface migration of contaminants from the central plant area.

Strata proposes to construct several ponds within the central plant area for sediment capture, permeate storage, and brine and other 11e.(2) liquid waste storage. The water quality of the surficial aquifer could be impacted if a pond overflows or liner fails. The potential for a release to the environment from the lined retention ponds will be minimized through careful construction and inspection of the pond liners during construction, routine inspection of the leak detection systems, and control of pond water levels. Since Strata will design all ponds with dual liners and leak detection and in accordance with state and federal regulations, the likelihood of a leak is low. In the event of a leak, sufficient capacity will be reserved in the other pond cells to rapidly transfer the contents of the leaking cell and minimize the volume of the leak. In addition, the CBW will serve to isolate any spill or leak within the central plant area from the surrounding surficial aquifer. In the event of a spill or leak, the engineered controls in place to monitor and dewater within the CBW would be utilized to capture any impacted groundwater and return it to a lined retention pond.

Strata continues to evaluate the beneficial use of permeate produced during operations. Potential uses include enhanced crop production via land application and subsurface drip irrigation system. Both alternatives have the potential to impact the water quality of the surficial aquifer. However, properly designed and operated crop enhancement systems using permeate are not anticipated to degrade water quality in the surficial aquifer due to the anticipated high quality of permeate. Although there is a possibility that the dissolution of salts in the soil profile by water not taken up by evapotranspiration could impact the surficial aquifer water quality, the likelihood of this occurring can be minimized by agronomic water application rates, surface runoff controls, and contingencies for reducing or stopping the irrigation system in the event of surface runoff. These mitigation measures would be addressed in a site-specific land application plan submitted to NRC and WDEQ/LQD for regulatory approval prior to constructing a land application system.

4.4.2.3.2 Potential Operation Impacts to Surficial Aquifer Water Quantity

Potential impacts to surficial aquifer quantity would be small. Potential impacts from the CBW during operations would be similar to the construction phase and thus limited. Continued utilization of the Oshoto Reservoir for drilling water would have a small impact on the surficial system as these uses are minor. Beneficial use of permeate via enhanced crop production through land application or subsurface drip irrigation systems would result in small potential impacts with application rates at or slightly above agronomic rates. In general, during operation the amount of water in the surficial aquifer is not expected to deviate from baseline conditions.

4.4.2.3.3 Potential Operation Impacts to the Water Quality of the SM, OZ and DM Aquifers

Prior to injection, Strata will pursue a Class III Injection Permit through the WDEQ/LQD and EPA based on data collected during wellfield package development. Based on water quality samples collected during baseline data collection, the OZ aquifer groundwater is assumed to be Class IV (industrial use only) based on WDEQ/WQD Chapter 8, Table 1 criteria. Exceedances of the class of use standards were measured for TDS, sulfate, ammonia, radium-226 & 228 and gross alpha. Exceedances of EPA primary drinking water standards were measured for uranium, radium-226 & 228 and gross alpha. Given these exceedances, water from this aquifer is not suitable for human or livestock/wildlife consumption. While the OZ aquifer was never requested for exemption as a source of drinking water at the R&D site, the presence of commercially producible uranium/vanadium mineralization, confinement of the OZ and apparent poor water quality should allow WDEQ/LQD to support exempting portions of the aquifer within the perimeter monitor well ring(s) as either Class IV or V groundwater. Following a decision by WDEQ/LQD on the exemption status, WDEQ/LQD will request an aquifer exemption from EPA. Strata will not inject water into a non-exempted aquifer.

During operations, the groundwater quality in the exempted aquifer will be impacted as part of the ISR uranium recovery process. The uranium and vanadium in the ore zone will be oxidized and mobilized by introducing lixiviant (native groundwater and reagents) into the OZ aquifer through the Class III injection wells. In addition to the uranium and vanadium, other constituents will be mobilized, including anions, cations, and trace metals (Section 6.1.6.2 of the TR indicates the estimated water quality of the OZ aquifer at the end of uranium recovery operations). Impacts to the exempted aquifer water quality will be short term, since aquifer restoration will take place in a phased manner with uranium recovery.

There is potential to impact the quality of the non-exempted OZ aquifer outside of the perimeter monitor well rings via a lateral excursion resulting from a local wellfield imbalance. A wellfield imbalance occurs when the rate of injected solution exceeds what is being extracted by the recovery wells resulting in migration of lixiviant laterally away from the wellfield area. Natural conditions within the Lance/Fox Hills OZ aquifer limit the potential for this type of impact. These natural conditions, governed by the sedimentary environment during deposition (discussed in detail in Sections 3.3 and 3.4), resulted in highly heterogeneous sandstones with similarly varied permeabilities, both vertically and laterally. To quote Buswell (1982), "The heterogeneous permeability and transmissivity of the host sediments modifies the migration of groundwater … the alteration projections [roll fronts] formed in response to increased flow through the more permeable channel sandstones." The limits of mineralization also define the limits of the higher permeability sediments. Otherwise, uranium mineralization would be more ubiquitous, and not concentrated in the various roll front deposits underlying the proposed project area. Therefore the conditions that led to the mineralization also work to limit the potential for migration of injected lixiviant beyond the wellfield areas.

Beyond natural limiting factors, Strata proposes to minimize the potential for lixiviant migration through a variety of operational methods. First, wellfield integrity will be demonstrated as a requirement of the Class III Injection Permit application. Second, groundwater modeling conducted in support of the NRC and WDEQ/LQD applications for uranium recovery and permit to mine demonstrates that groundwater movement through these complex sedimentary systems can be accurately modeled and, more importantly, predicted. The predictive capability of Strata's groundwater model (see TR Addendum 2.7-H) was used to develop monitor well layouts protective of the non-exempt portions of the OZ aquifer. In addition to the water quality testing of the DM, SM and OZ aquifers (both inside and outside the proposed wellfield area), hydrologic testing through pumping of recovery wells in the wellfield area and measuring response in surrounding perimeter monitor wells is a significant component of the Class III Injection Permit application. Wellfield pumping and measured response in the perimeter monitor wells not only demonstrates wellfield integrity through similarity of completions but also allows accurate estimation of the horizontal hydraulic conductivity between the wellfield area and perimeter monitor well ring. By updating the groundwater model with wellfield-specific hydraulic conductivity estimates, a foundation for strong operational monitoring and control will be achieved as operational modeling platforms will utilize the same data during uranium recovery activities. Moreover, these data will support development of optimized injection and recovery well networks that account for natural heterogeneity and allow efficient targeting of the mineralized portions of the exempt aquifer.

The same principles apply to limiting the water quality impacts to underlying and overlying adjacent aquifers of the DM and SM monitoring units. The fine-grained clays and silts that envelop the ore zone not only limited uranium mineralization but further work to limit the potential for vertical migration of the lixiviant-fortified groundwater during operations. Geologic evaluation and hydrologic testing conducted in support of the Class III Injection Permit application will also be utilized to demonstrate the integrity of these confining units, through monitoring the DM and SM monitor wells while pumping the recovery wells. Previous aquifer testing both by Nubeth and Strata has recorded no response in vertically adjacent aquifers; moreover, the amount of confining head and contrasting water qualities observed in these aquifers further demonstrate ore zone isolation. With proper well construction and wellfield operation, ISR activities can safely take place at the Ross ISR Project. In addition, prior to ISR uranium recovery, all exploration drill holes that can be located within the perimeter monitor well ring and beneath the central plant area will be plugged and abandoned as described in TR Addendum 2.6-B.

In addition to the limiting factors such as natural conditions and an enhanced understanding of the groundwater flow regime developed to support the Class III Injection Permit application, significant operational instrumentation and control networks are proposed by Strata to further minimize the potential for water quality impacts to adjacent non-exempted aquifers. By utilizing three primary tools, the operational groundwater model, instrumentation in the wellfields and monitoring networks, and a strong control infrastructure to adjust injection and recovery activities, wellfields can be operated to prevent adjacent aquifer impacts. Instrumentation in the wells may include dedicated pressure transducers with dataloggers in the perimeter, deep and shallow monitor wells. In addition to water quality sampling of the monitor wells every 10 to 14 days, water levels will be captured by the operational groundwater model or reservoir engineering platform and used to continuously update operations. This data capture, particularly from the perimeter wells, will allow for continuous adjustments to injection and recovery rates in order to keep the wellfield balanced while simultaneously limiting the amount of production bleed necessary to maintain an inward hydraulic gradient. A properly balanced wellfield ensures complete recovery of lixiviant. The instrumentation and control system would also provide an early warning (prior to geochemical change) of a potential migration of uranium recovery fluids. Simulations of excursions (addressed in detail in TR Addendum 2.7-H) demonstrate that an increase in head due to a local wellfield imbalance would be quickly observed in adjacent perimeter monitor wells. The increase in hydraulic head would be a reversal from longer term, downward trends due to production bleed and a readily apparent indicator of a wellfield imbalance.

Instrumentation and control networks, through the use of PLCs, would also help to prevent local wellfield imbalances and a subsequent impact to a non-exempt adjacent aquifer. Monitoring of recovery well rates both in the module buildings and plant control room combined with measuring injection pressure, would ensure that wellfield balance is maintained. Additionally, in the event of an operational upset, the operational groundwater model, integrated with the injection and recovery well instruments, would allow for a rapid determination of potential migration paths, thereby allowing the operator to quickly mitigate any conditions that might lead to a water quality change in an adjacent aquifer.

Water quality impacts to the vertically adjacent SM and DM aquifers, though isolated from the ore zone by natural conditions, could potentially occur through a compromise of the confining intervals. The geologic modeling and hydrologic testing conducted to date indicate that no natural conduits are available for vertical migration of uranium recovery fluids. However, an improperly abandoned borehole or an improperly sealed well could introduce injected lixiviant into a vertically adjacent non-exempt aquifer. While not evaluated by the regional groundwater model developed in support of initial licensing, given the hydraulic pressures present in the DM and SM aquifers, instrumentation such as pressure transducers and dataloggers would provide similar early warning of a vertical migration. In addition, monitor wells targeting the DM and SM aquifers would be sampled for excursion indicator parameters similar to the perimeter monitor wells to ensure that the confining units have not been compromised.

Four primary methods limit the potential for a confining shale to be compromised through anthropogenic activities. First, penetration into the DM aquifer during wellfield installation would be limited to the necessary wells required to monitor the interval. Second, exploration and delineation boreholes would be plugged from the bottom of the hole to the surface with low hydraulic conductivity materials such as cement or heavily mixed bentonite grout. Third, methods approved by WDEQ/LQD and in compliance with WDEQ/LQD Chapter 11, Section 6 construction requirements for well locations, casing types and, most importantly, annular sealing techniques would be followed. Proper annular sealing methods ensure that vertical migration pathways are not created outside of the casing and inside of the borehole walls. Key characteristics of the well installation programs would include a sufficiently sized borehole diameter to provide adequate annular space for sealing materials, selection of appropriate annular seal materials such as cement with a weight of 15 pounds per gallon, displacement of the cement slurry sufficient to fill the entire annular volume from the bottom of the casing to ground surface, allowing sufficient curing time so that additional well construction work does not jeopardize the annular integrity, and selection of casing type with sufficient strength and diameter to prevent collapse and to accommodate the necessary injection pressures. Fourth, Strata will implement an approved MIT program for all Class III wells to ensure casing integrity. Key characteristics of the proposed MIT program include using a pressure-based testing method, a proactive testing program that targets wells displaying anomalous pressures or characteristics, retesting every 5 years and any time a well is re-entered by a drill bit or underreaming tool, maintenance of records and quarterly reporting of all wells tested along with any subsequent actions (repair or abandonment). In the unlikely event that a well fails MIT, it would either be repaired or abandoned using permit approved procedures. Through the use of hydraulic isolation techniques during all phases of wellfield development, potential impacts to adjacent non-exempt aquifers would be minimized.

In summary, between natural processes, advanced instrumentation and control technologies, and implementation of approved drilling and well installation programs, the potential to impact groundwater quality beyond the exempted aquifer is small. In addition, strong economic factors drive Strata to ensure isolation of the uranium/vanadium recovery activities to select portions of the mineralized, exempt aquifer. Beyond the immediate costs to investigate, mitigate and monitor an excursion, reagents utilized to facilitate production are costly and are wasted when used outside of the mineralized areas. These economic factors provide an additional, significant incentive for Strata to ensure that the lixiviant injected into the OZ system is confined to the portions of the aquifer containing mineralization. Moreover, water treatment has tangible costs, and measures taken to prevent excursions also enhance Strata's ability to limit how much water requires treatment during aquifer restoration. This factor is most pronounced in terms of maintaining sufficient production bleed to sustain a cone of depression in the exempted aquifer while simultaneously limiting the amount of fresh water brought into the wellfield area. Strata will have every incentive to limit conditions that could result in an impact outside of the exempted aquifer area, and operation impacts to the water quality in the deeper aquifers are expected to be small.

4.4.2.3.4 Potential Operation Impacts to Water Quantity of the SM, OZ and DM Aquifers

The potential for impacts to the amount of water available in the SM and DM aquifers resulting from the proposed action is small given the natural confinement and measures discussed in Section 4.4.2.3.3. However, in the unlikely event of a vertical excursion of lixiviant-fortified groundwater to the SM or DM aquifers, mitigation measures may require withdrawal and treatment of impacted groundwater. These withdrawals would be minimal given that in all likelihood the excursion conduit would be due to anthropogenic activities (e.g., well failure or unplugged borehole) and would result in a limited extent of impact. Given the relatively small borehole diameter used for exploration and delineation, little water would be capable of migrating through one or more of these conduits. An additional control on the amount of water that could impact the SM or DM systems is the frequent monitoring visits to the wells targeting these systems. Very little time would be available for discernable amounts of undetected lixiviant to enter these aquifers. Therefore, a small amount of water would have to be removed from the system to return to baseline characteristics.

Potential impacts to the SM aquifer water quantity due to withdrawals during operation and restoration in the OZ were evaluated through the regional groundwater model (TR Addendum 2.7-H, Section 4.9.3). Modeling indicates that potential impacts to this highly confined system would be minimal. Under the two recovery scenarios evaluated, the estimated maximum amounts of drawdown ranged from 5 feet to 15 feet inside of the proposed permit boundary. For the purposes of this analysis, the more conservative scenario, with the Merit Energy water supply wells in operation, was used. Figure 4.4-3 depicts the maximum amount of estimated drawdown following both operation and aquifer restoration phases at the Proposed Ross ISR Project. Given that the amount of available head in the SM unit ranges from 120 feet to 250 feet, a worst case scenario (least amount of available head and maximum drawdown) is predicted to result in a 12.5% decrease in the amount of available head. Impacts to the SM aquifer are predicted to be small during operation and aquifer restoration activities.

In addition to estimating the impacts to the SM aquifer water quantity within the proposed project area, groundwater modeling simulations also evaluated potential impacts to adjacent stock, domestic and industrial use wells in the area. Only one well, the Kiehl Water Well #2, may see limited drawdown due to both uranium recovery operations and aquifer restoration. Table 4.4-1 summarizes the location, use and estimated drawdowns at the well. Under the worst case scenario, the maximum estimated amount of drawdown is predicted to be 2.3 feet or 4.8% of the total available head. This minimal amount of drawdown is not expected to materially decrease the yield from the well.

Water quantity impacts to the OZ aquifer during operations have the potential to decrease the amount of available head in three industrial water supply wells located within the proposed project area. The three wells currently operated by Merit Energy utilize water from the OZ aquifer to stimulate oil production from wells completed in the underlying Minnelusa Formation. Two of the wells (789V and 19XX) were original Nubeth R&D wells, while a third well (22X-19) was installed into both the OZ and deeper Fox Hills Formation sandstones, including the DM aquifer. Simulations of operation and aquifer restoration indicate a maximum estimated drawdown at 789V and 19XX of 176 feet and 158 feet, respectively. Table 4.4-2 summarizes the locations of the wells both within and adjacent to the proposed project area that may experience drawdown. Figure 4.4-4 depicts the maximum estimated drawdowns at the end of uranium recovery operations and aquifer restoration along with the locations of the wells. Six wells completed in the OZ aquifer adjacent to the proposed project area are also predicted to experience drawdown during operation and aquifer restoration. The most significant estimated drawdown occurs in Wesley TW02 located in the SWSW Section 8, Township 53 North, Range 67 West, with 33.3 feet of drawdown or 42.4% of the available head. This well supplies water to a residence that is currently used by Strata as the field office for the proposed Ross ISR Project. The well also provides water to livestock. Several factors should be noted when considering this impact. First, the well is located along the Little Missouri River floodplain immediately adjacent to the no-flow boundary of the groundwater model; hence the presence of the no-flow boundary may conservatively bias the estimated drawdown. Second, water levels measured by Strata indicate the 22 feet static level to be lowest over the past year with fluctuations upward to 15 feet, again adding more conservatism to the analysis. Third, maximum estimated drawdowns in Table 4.4-2 and portrayed on Figure 4.4-4 do not necessarily occur at the end of operation/aquifer restoration and hence do not always match the drawdown contours indicated. Fourth, given the limited use by Strata field office personnel and livestock (primarily several horses), the moderate reduction in available head should not materially decrease the yield from well.

A number of factors contribute to the conservative nature of the maximum drawdowns derived from the model simulations. First, the production rates used for the operation and aquifer restoration phases assumed a higher hydraulic conductivity was present throughout the recovery areas. In fact, due to aquifer heterogeneity, production rates will vary dramatically across the project. Second, in order to simplify the modeling, operation and aquifer restoration simulations did not include injection of lixiviant or RO permeate, only an average bleed (1.25%) from recovery wells located in areas of known economic mineralization. Third, the model simulations represent one production and restoration scenario, based on results of hydrologic testing in support of the Class III Injection Permit application. Other scenarios with potentially less impact would be evaluated. These methods might include alternate ISR progression scenarios, pre-ISR aquifer conditioning, and alternate ISR operation schedules. Fourth, restoration simulations for the groundwater sweep phase did not selectively target areas identified as requiring this method of restoration. Rather, withdrawals from the aquifer were spread across the production centers uniformly at the conservatively high recovery rate. Finally, the operation and aquifer restoration simulations did not account for the potential to provide alternate sources of water to replace the Merit Energy water supply wells. As demonstrated on Table 4.4-2, significant differences in the drawdown predictions result if the wells are taken out of production two years prior to commencement of operations.

Impacts to the quantity of water in the DM aquifer during operations was not modeled. However, given the limited use of this aquifer (22X-19), limited hydraulic conductivity and yield, the probability of impacts to this system are small if not negligible.

In summary, while predicted water quantity impacts to the SM and OZ aquifers were apparent in the conservative uranium recovery and restoration simulations, impacts would be localized, short-lived and as demonstrated, potentially minimized through the Class III Injection Permit application process. Modeled drawdowns are only apparent less than 2 miles from the proposed permit boundary and are only 5% of the total available head at that location (Sophia #1A). Recovery of the OZ aquifer would be largely achieved within 10 years, even under the conservative scenario presented. Figure 4.4-5 depicts the estimated drawdowns after 10 years of recovery following aquifer restoration. At this point in time, nearly two-thirds of the wellfield area is predicted to have near full recovery to pre-operational levels with the remainder within 10 feet. Most importantly, in the event that Strata's activities prevent full use of a well, Strata commits to providing an alternate source of water of equal or better quality and quantity subject to Wyoming State water law.

4.4.2.3.5 Potential Operation Impacts to Aquifers from Deep Well Disposal

Strata proposes to utilize up to five Class I deep disposal wells within the proposed project area. A Class I UIC permit application for the injection wells was submitted to WDEQ/WQD on June 15, 2010 with a round of responses completed in October/December 2010 (refer to Addenda 4.2-A and 4.2-B in the TR). The wells will target the Cambrian-age Deadwood and Flathead Formations. These zones were selected based on their position in the stratigraphic column, permeability and porosity thickness, confinement and estimated water quality. Estimated depths to the top of the Deadwood Formation at the Ross ISR Project are 8,160 feet below ground surface and 8,560 feet below ground surface for the Flathead Formation. These proposed injection depths are below the lowermost USDW (Madison Formation) with at least 500 feet of separation between the intervals.

Structural geologic cross sections and type-logs indicate that the Deadwood/Flathead is confined immediately above by the Icebox Shale Member of the Winnipeg Group and Red River Formation, with combined thickness of approximately 416 feet. Confinement below the Deadwood/Flathead zone is provided by the granitic and metamorphic rocks of the Precambrian basement. Water quality calculations indicate that the interval contains waters with average TDS concentrations greater than 10,000 mg/L.

The potential impacts to adjacent aquifers from injection into the deep disposal wells are negligible since the intervals are confined and located at least 500 feet below the deepest USDW. Moreover, the closest wells completed in the deepest USDW (Madison Formation) are the City of Gillette wells 10 to 12 miles southeast of the proposed project area (refer to Section 4.12).

4.4.2.4 Potential Aquifer Restoration Impacts

Strata's proposed aquifer restoration program includes five processes: (1) groundwater sweep, (2) groundwater transfer, (3) RO with permeate injection, (4) groundwater recirculation, and (5) stability monitoring. These processes are discussed in more detail in Section 5.4 and in Section 6.1.2 of the TR.

Potential impacts to groundwater quality and quantity during aquifer restoration are very similar to potential impacts described in the operations sections. Aquifer restoration is the removal and/or treatment of groundwater in the exempted aquifer in order to return the groundwater quality consistent with baseline conditions, alternate standards or to a quality of use equal to or better than the uses for which the water was suitable prior to the operation (WDEQ/LQD Guideline 4 and ISR GEIS). Strata proposes to conduct aquifer restoration concurrently with operations where possible as the potential exists for the two phases to interfere with one another. While final operation and aquifer restoration schedules will be determined during development of the Class III Injection Permit application, for the purposes of this analysis, groundwater modeling efforts to evaluate impacts assumed concurrent operation and aquifer restoration to lend conservatism to the effort. Consumptive use of groundwater during the aquifer restoration phase is generally greater than during ISR operations (ISR GEIS pg. 4.3-18). However, when compared to other regional uses and natural processes the estimated maximum water consumption of the proposed Ross ISR Project can be put into context. Table 4.4-3 summarizes maximum anticipated consumptive use of water during the three primary phases of the project and includes some statistics for comparison based on publicly available data. Withdrawals of groundwater for other industrial purposes such as oil production, power generation and irrigation can easily exceed the maximum consumptive use of water estimated for the Proposed Ross ISR Project.

4.4.2.4.1 Potential Aquifer Restoration Impacts to Surficial Aquifer (SA)

The potential impacts to the surficial aquifer water quality and quantity during aquifer restoration are very similar to those addressed during operations. Leaks from pipelines, spills at the surface and shallow Class III injection well integrity issues have the potential to alter water quality and quantity in the aquifer, although the water quality in the wellfield pipelines, (particularly pipelines carrying RO permeate to the wellfield) will generally be higher during aquifer restoration than operation, so the potential impacts will generally be small and less than those potentially occurring during operation. Water management within the central plant area will continue in a similar fashion during aquifer restoration, with utilization of the lined retention ponds for temporary storage of permeate and brine pending injection. Again, engineered controls utilized during operations will prevent impacts to the system.

4.4.2.4.2 Potential Aquifer Restoration Impacts to the Water Quality of the SM, OZ and DM Aquifers

The potential impacts to water quality of the deeper, confined aquifers during aquifer restoration are similar to those discussed in Section 4.4.2.3.3. The natural conditions present that work to protect adjacent, non-exempted aquifers will continue to prevent impacts to the water quality of these systems. In addition, through monitoring, instrumentation and control along with data capture and analysis, impacts during aquifer restoration will be minimized. During restoration of the exempted aquifer, adjacent aquifers will be protected to their class of use and to applicable MCLs per EPA requirements in 40 CFR 141 and WDEQ/LQD requirements. Sufficient demonstration that restored water in the OZ will not impact adjacent aquifers will be provided to WDEQ/LQD as part of the Class III Injection Permit application and supporting wellfield data package. These might include a groundwater flow model with increased resolution compared to the regional baseline groundwater flow model already developed or development of a fate and transport model. In addition, several factors contribute to decreasing the potential for groundwater quality impacts during aquifer restoration: a) the injection and recovery flow rates are lower in restoration compared to production, b) the duration that each wellfield module will undergo aquifer restoration is typically much lower than the duration of uranium recovery operations, c) the production zone water quality will improve throughout active restoration, and d) during operations permeate will be continuously added to the lixiviant stream to maintain water quality in the exempted aquifer.

4.4.2.4.3 Potential Aquifer Restoration Impacts to the Water Quantity of the SM, OZ and DM Aquifers

Potential impacts to the water quantity of the deeper, confined aquifers during aquifer restoration were addressed in detail in Section 4.4.2.3.4. Briefly, groundwater modeling estimates of the drawdown in the SM aquifer due both to operational and aquifer restoration activities were less than 15 feet. The exempted OZ aquifer was predicted to see significant drawdowns in three wells within the proposed project area with minor drawdowns in wells within 2 miles. The conservative regional impact analysis conducted through the groundwater modeling does indicate potential impacts to the amount of available head in wells utilized for stock, domestic and industrial use. However, as discussed in Section 4.4.2.3.4, the results will be localized, short-lived and largely minimized through the mitigation measures discussed in Section 5.4. Aquifer restoration impacts to the water quantity of the SM, OZ and DM aquifers are expected to be small to moderate.

4.4.2.5 Potential Decommissioning Impacts

Following regulatory approval of restoration of the exempted portions of the OZ aquifer, decommissioning of wellfield infrastructure would commence. These activities would include removal of any downhole equipment and abandonment of all Class III injection, recovery and monitoring wells. Potential groundwater impacts associated with decommissioning are similar to the construction impacts and might include consumption of groundwater for dust suppression and revegetation efforts, spills of hydrocarbons and well abandonment (ISR GEIS).

4.4.2.5.1 Potential Decommissioning Impacts to Surficial Aquifer Water Quality

Beyond the previously discussed potential for spills and leaks, removal of the lined retention ponds and CBW may impact surficial water quality via the introduction of materials in the previously excavated areas. BMPs discussed previously and implemented and inspected under an SWPPP will be utilized to limit the potential for introduction of leaked or spilled contaminants to the surficial aquifer. Decommissioning of the water management and control features will be done systematically to ensure that water quality of the surficial aquifer is not impacted. Methodologies to verify minimization of impacts include accurate characterization of the native materials during construction, removal of all liners, leak detection and associated equipment upon radiological clearance, backfilling with materials having similar textural and compositional characteristics, and selectively breaching the CBW in order to re-establish groundwater movement through the area. Some surficial aquifer monitor wells will be retained to verify the re-saturation of previously excavated sediments and to ensure that water quality of the shallow system is not compromised.

4.4.2.5.2 Potential Decommissioning Impacts to Surficial Aquifer Water Quantity

Impacts to surficial water quantity during decommissioning will be small to non-existent. Minor use of the Oshoto Reservoir for dust/fire suppression, re-vegetation and mixing of cement for well abandonment could decrease the amount of water infiltrating to the surficial aquifer. These uses would be less than the consumptive use during operation and aquifer restoration and thus have very limited potential to impact the surficial aquifer.

4.4.2.5.3 Potential Decommissioning Impacts to the SM, OZ and DM Aquifers

Water quality and quantity impacts to the deeper, confined aquifers during decommissioning will be small. The primary mechanism for either a water quality or quantity impact is through improper plugging of the Class III injection and recovery wells. All plugging will be conducted in accordance with WDEQ/LQD Chapter 8 and 11 standards in order to prevent the movement of water from one aquifer to another. Key plugging techniques shall include placement of neat cement or bentonite grout from the bottom of the well to the surface, topping off of the plugging materials after sufficient settling time, removal of the top 2-5 feet of casing, placement of rebar or other metal in the abandoned well to facilitate well finding in the future, re-contouring and finally re-seeding the well site. A well abandonment and plugging methodology will be provided in the Class III Injection Permit application. In general, decommissioning impacts to the SM, OZ and DM aquifers are expected to be small.

4.4.2.6 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed or operated and associated impacts to groundwater quality or quantity would not occur.

Table 4.4-1. Summary of Modeled SM Aquifer Water Quantity Impacts

Well	Easting[1]	Northing[1]	Layer	Use	Drawdown Scenario #1 (ft)[2]	Drawdown Scenario #2 (ft)[2]	Amount of Available Head (ft)[3]	Maximum % Change in Available Head
KIEHL WATER WELL #2	712,381	1,474,845	4(SM)	Oil Field	1.8	2.3	48	4.8

1 Easting and northing coordinates based on Wyoming NAD 83 E coordinate system (feet).
2 Scenario #1 assumes Merit Energy water supply wells are taken out of operation 2 years prior to ISR operations. Scenario #2 assumes Merit Energy water supply wells continue to operate at the 2008-2009 average flow rates.
3 Calculated based on top of aquifer and static water level obtained from WSEO UW-6 form.

Table 4.4-2. Summary of Modeled OZ Aquifer Water Quantity Impacts

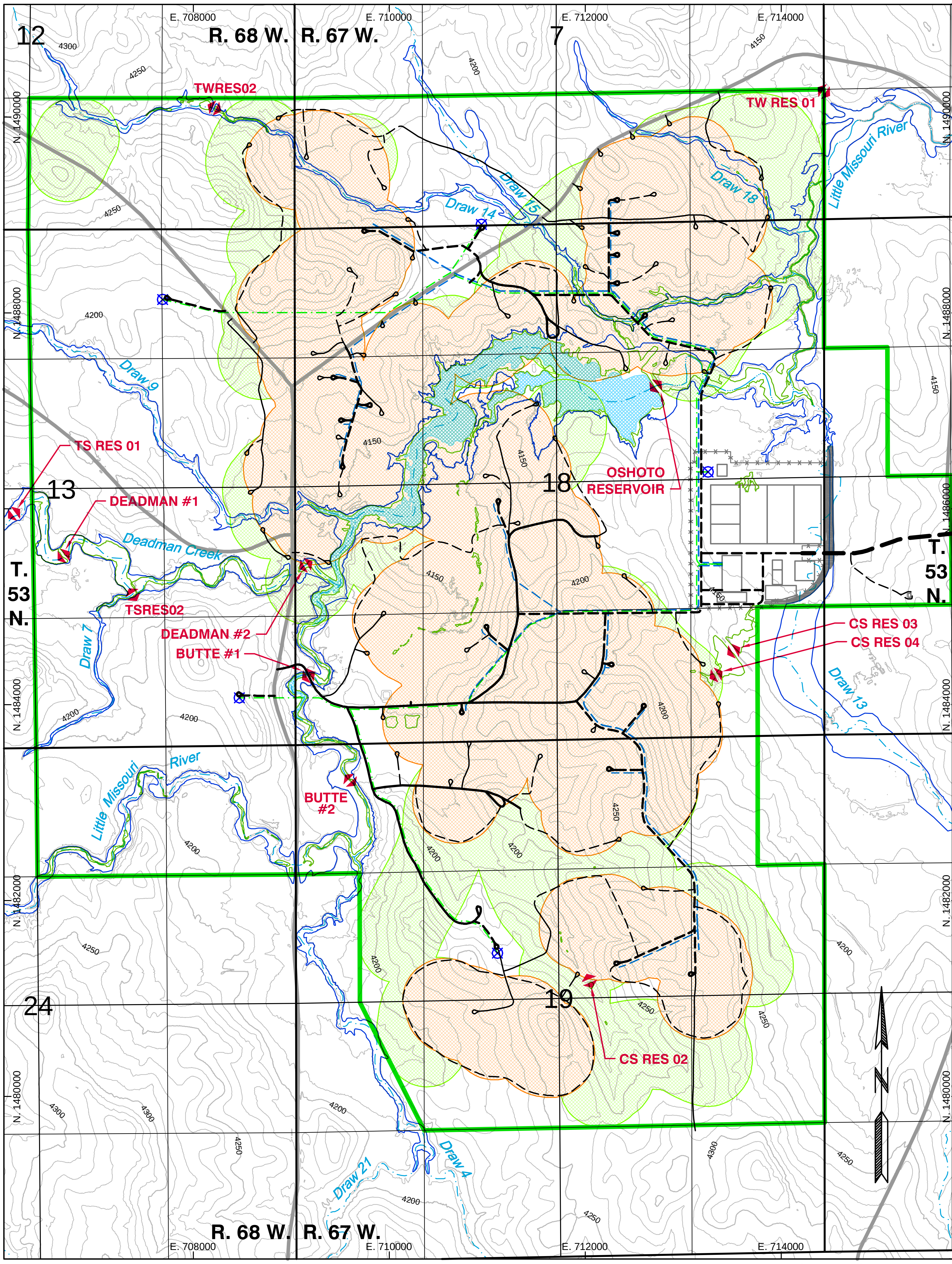
Well	Easting[1]	Northing[1]	Layer	Use	Drawdown Scenario #1 (ft)	Drawdown Scenario #2 (ft)	Amount of Available Head (ft)[3]	Maximum % Change in Available Head
CSWell01 (4)	714,963	1,483,356	6(OZ)	Domestic/ stock	5	17.3	238	7.3
SOPHIA #1A	700,456	1,484,277	6(OZ)	Oil field	14.7	26.3	526	5
KIEHL WATER WELL #2	712,381	1,474,845	4(SM) and 6 (OZ)	Oil field	1.6	3.4	182	1.9
22X-19	710,875	1,481,932	6(OZ)	Oil field	-50	110	308	35.7
19XX STATE	711,658	1,483,960	6(OZ)	Oil field	79	158	378	41.8
789V STATE	710,930	1,484,055	6(OZ)	Oil field	101	176	317	55.5
ENL Kiehl Well #1	713,378	1,473,690	6(OZ)	Oil field	3.2	5	332	1.5
WESLEY TW02 (4)	715,506	1,489,632	6(OZ)	Domestic/ stock	30.8	33.1	78	42.4
WSW#1 West Kiehl Unit	707,029	1,471,267	6(OZ)	Oil field	-0.8	1.8	270	0.7

1 Easting and northing coordinates based on Wyoming NAD 83 E coordinate system (feet).
2 Scenario #1 assumes Merit Energy water supply wells are taken out of operation 2 years prior to ISR operations. Scenario #2 assumes Merit Energy water supply wells continue to operate at the 2008-2009 average flow rates.
3 Calculated based on top of aquifer and static water level from WSEO UW-6 forms.
4 Drawdowns may be impacted by model edge effects. Results may not represent actual conditions.

Table 4.4-3. Maximum Water Consumption and Comparison to Other Regional Uses

Phase	Max. Amount Consumed (gpm)[1]	% of Total Flow	Cumulative (ac-ft/yr)	Comparison with Regional Water Consumptive Uses (ac-ft/yr)
Operation	62	0.7	100.0	100 head of beef cattle = 1.6[2]
				Average annual evaporation in Oshoto Reservoir = 62.0[3]
				Permitted capacity of Oshoto Reservoir = 172.7
Concurrent Operation and Aquifer Restoration	227	2.6	366.2	100 acres of hay = 330[2]
				Dry Fork Power Station Fox Hills withdrawal = 968[4]
				Average annual precipitation within the Ross ISR Project Area = 1,864[5]
				Average annual volume of water used for irrigation from the Little Missouri River in Wyoming = 2,000[6]
Aquifer Restoration	190	17.3	282.3	100 acres of barley = 200[2]
				Oilfield Water Flood Supply Wells within 2 miles = 231[7]
Weighted Average (all phases)	122	2.0	112.9	Average Annual Evaporation in Keyhole Reservoir = 15,000[8]
				Average annual flow of the Little Missouri River at Wyoming/Montana border = 35,000[9]
				Permitted capacity of City of Gillette Madison wells = 14,000[10]

[1] Typical brine and other 11e.(2) liquid waste disposal rate at maximum production and/or restoration flow rates. Refer to Figures 4.13-1 through 4.13-3
[2] Based on pocket water facts presented by the State of Wyoming Water Planning team: http://waterplan.state.wy.us/waterfacts.html
[3] Assuming full reservoir and 30 inches per year of net annual evaporation: http://www.wrds.uwyo.edu/sco/climateatlas/evaporation.html
[4] WSEO Estimate
[5] Assuming 13 in/yr annual precipitation and 1,721 acres in project boundary.
[6] From Wyoming Statewide Data Inventory: http://waterplan.state.wy.us/sdi/LM/LM-over.html
[7] Flow rates based on WSEO permitted capacity of 7 oilfield water flood supply wells located within and adjacent to project area.
[8] Assuming full reservoir and 30 inches per year of net annual evaporation: http://www.wrds.uwyo.edu/sco/climateatlas/evaporation.html
[9] From Wyoming Statewide Data Inventory: http://waterplan.state.wy.us/sdi/LM/LM-over.html
[10] Refer to Section 4.12



ROSS PROJECT AREA

Drawing Coordinates: WY83EF

LEGEND

- PROPOSED ROSS PERMIT BOUNDARY
- EXISTING RESERVOIR LOCATION
- EPHEMERAL STREAMS
- INTERMITTENT STREAMS
- OPEN WATER
- WETLANDS
- 100-YEAR FLOOD INUNDATION BOUNDARY
- APPROXIMATE WELLFIELD PERIMETER
- WELLFIELD PERIMETER ACCOUNTING FOR FUTURE DRILLING

FACILITIES

- PROPOSED CONVEYANCE PIPELINE
- PROPOSED DEEP DISPOSAL WELL PIPING
- EXISTING COUNTY ROAD
- PROPOSED PRIMARY ACCESS ROAD
- EXISTING SECONDARY ACCESS ROAD
- PROPOSED SECONDARY ACCESS ROAD
- EXISTING 2-TRACK ROAD
- PROPOSED TERTIARY ROAD
- PROPOSED DEEP DISPOSAL WELL

0 500 1000 2000

GRAPHIC SCALE (FEET)

STRATA ENERGY

ROSS ISR PROJECT
CROOK COUNTY, WY
P.O. BOX 2318
GILLETTE, WY 82716

REVISIONS

Date	Description

ENVIRONMENTAL REPORT
FIGURE 4.4-1

PROPOSED FACILITIES
AND SURFACE WATER FEATURES

Drawn By: MBM
Checked By: JWF
Date: 11/21/10

FILE: ROSS_ER_IMP_WTR

WWC ENGINEERING
www.wwcengineering.com

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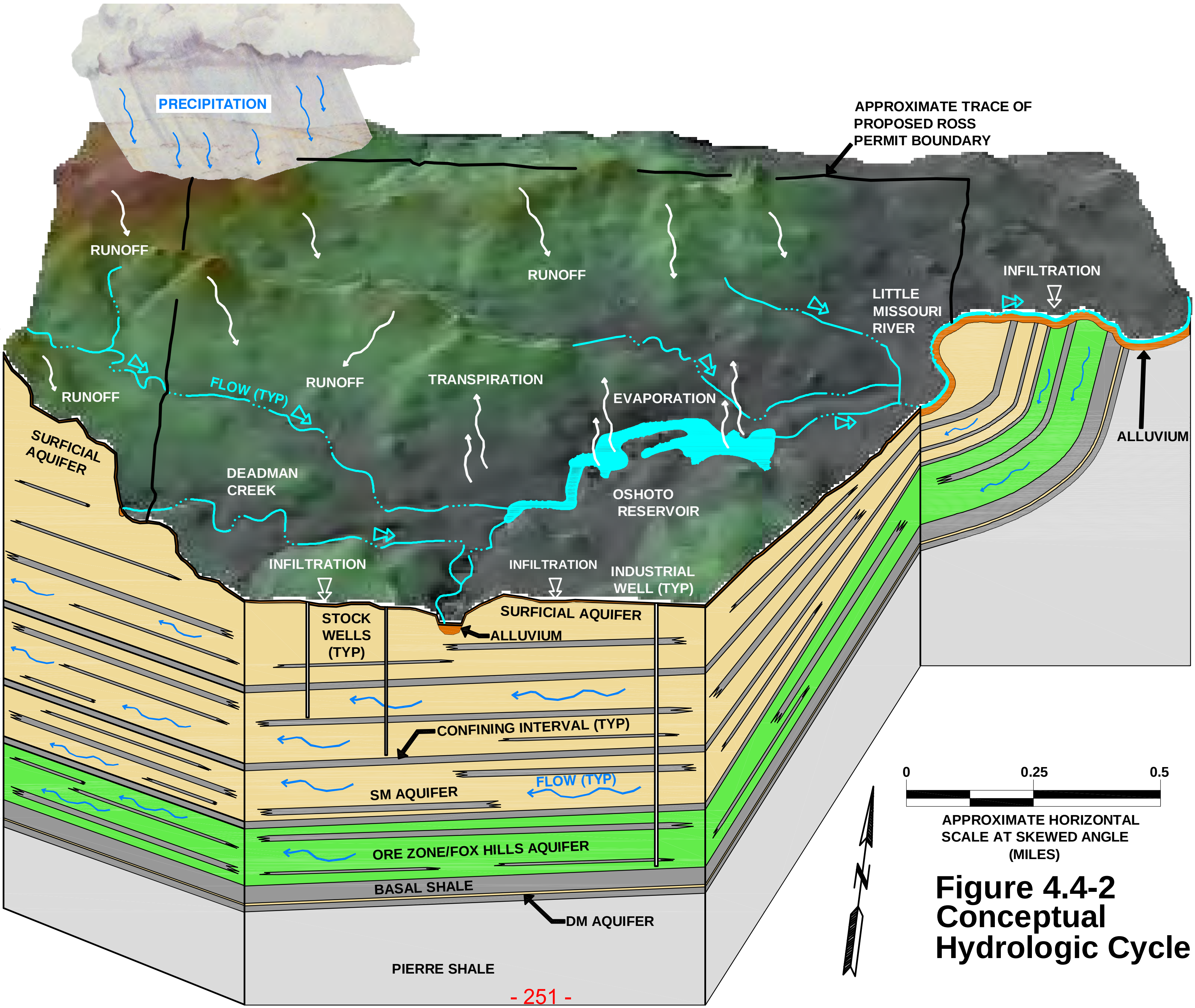

Figure 4.4-2 Conceptual Hydrologic Cycle

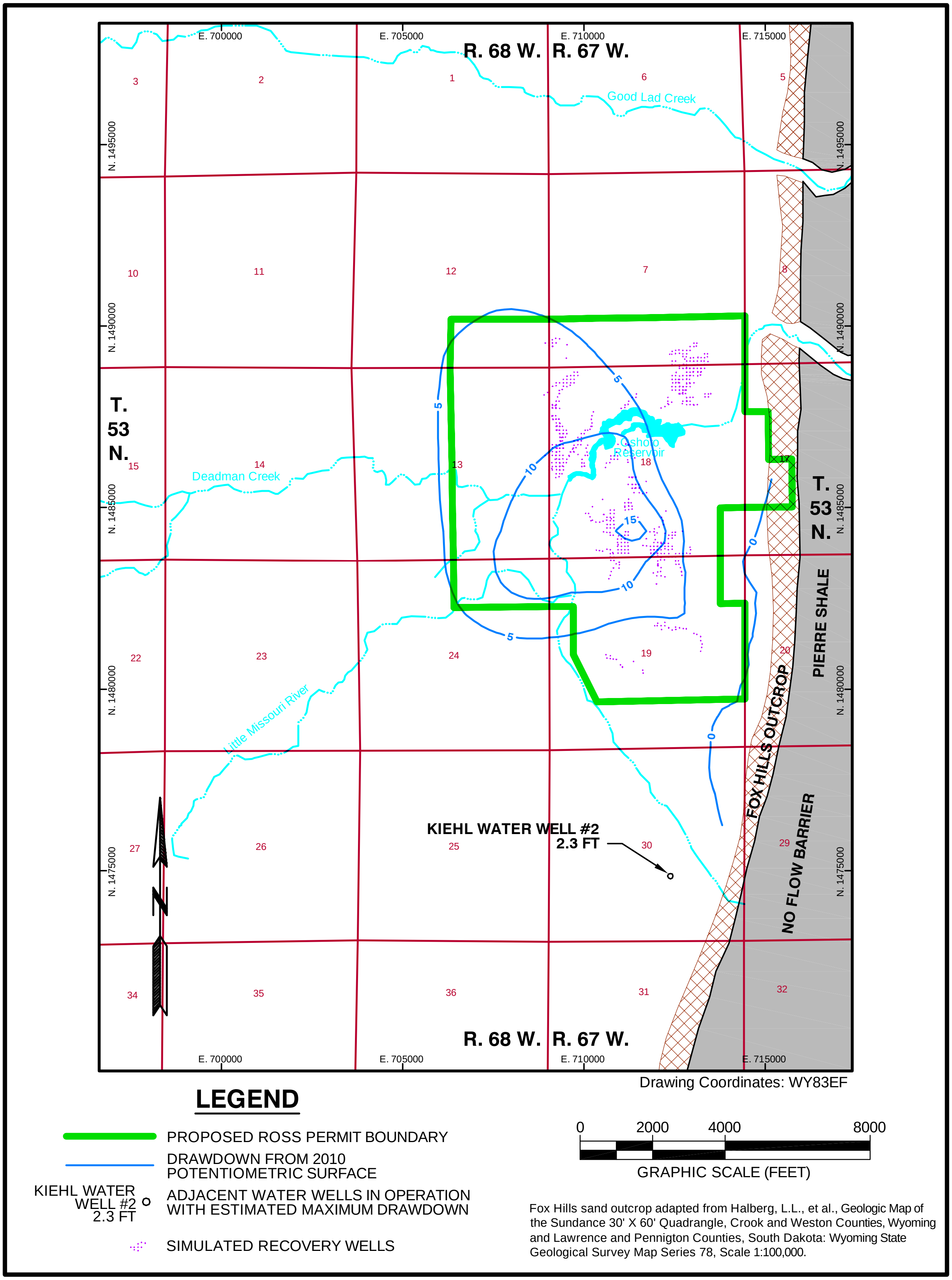

Figure 4.3-3. SM Aquifer Drawdown at End of ISR Operational and Aquifer Restoration Phases

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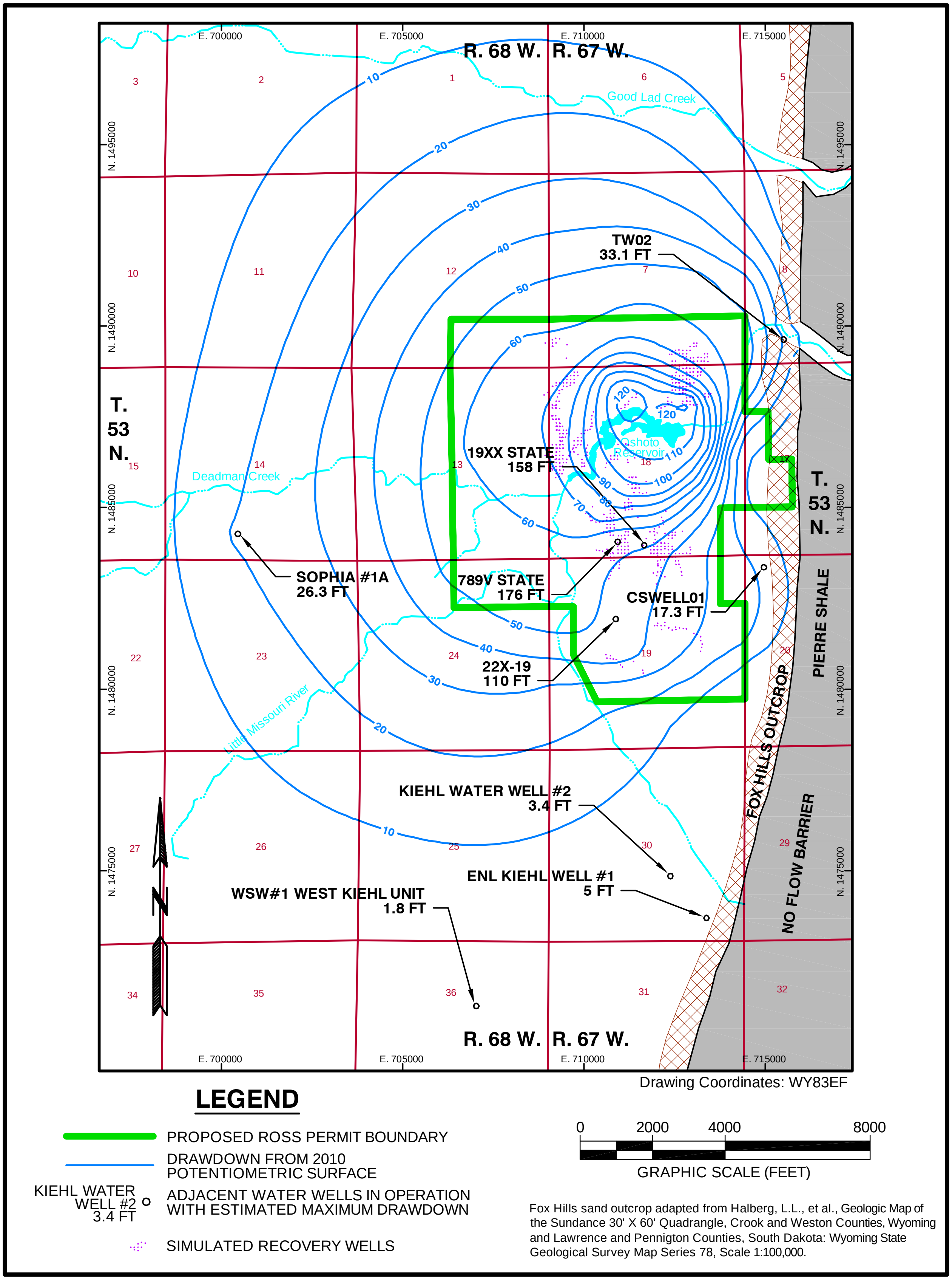


Figure 4.4-4. OZ Aquifer Drawdown at End of ISR Aquifer Restoration Phase

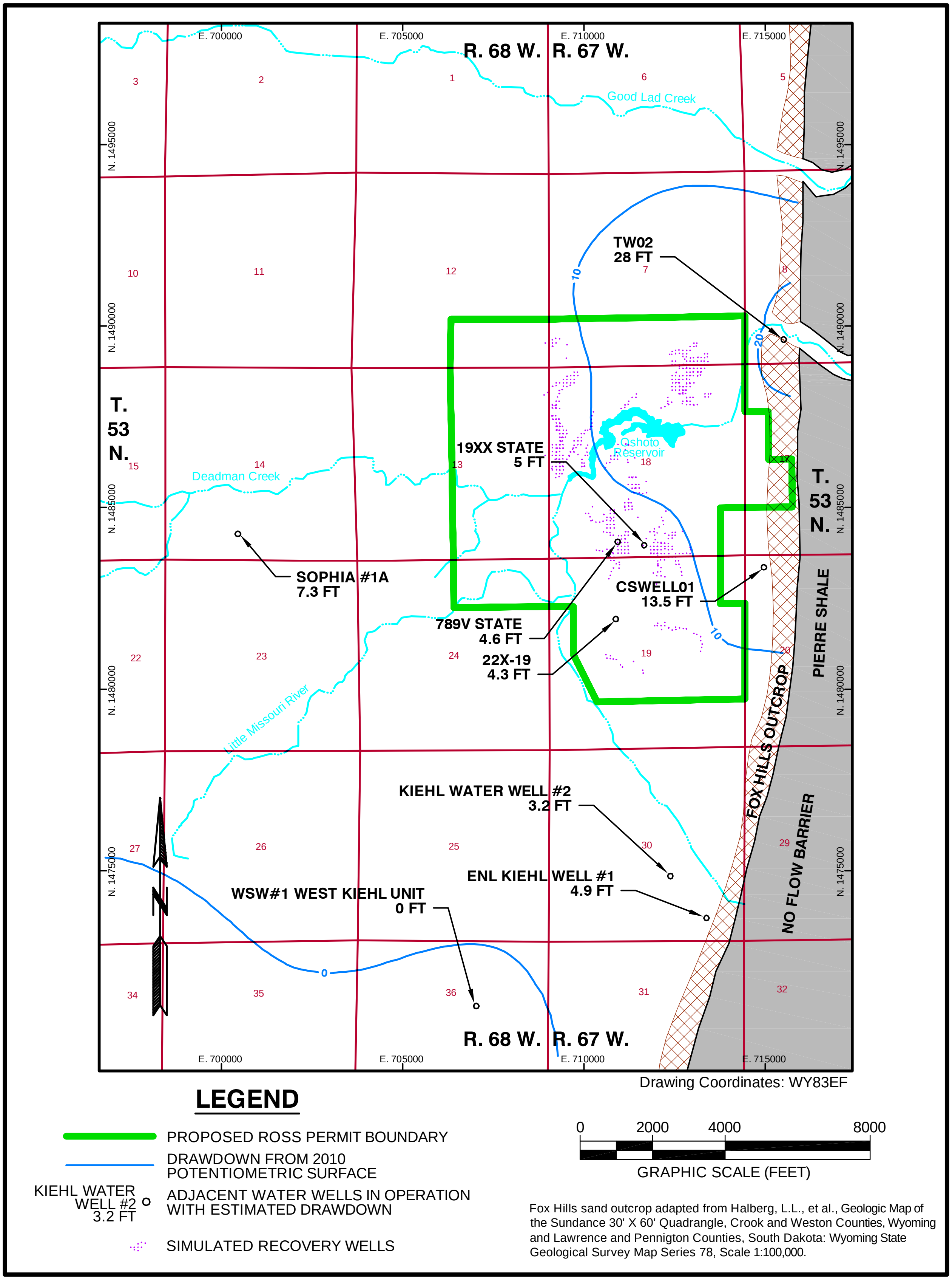


Figure 4.4-5. OZ Aquifer Drawdown after 10 Years of Recovery

4.5 Potential Ecological Resources Impacts

4.5.1 Proposed Action

The type of disturbance associated with ISR uranium recovery will not result in large expanses of habitat being dramatically transformed from its original character as in conventional mining and milling operations. Additionally, all disturbed areas will be reclaimed either at the completion of construction or during decommissioning. Impacts would also be partially mitigated by the low proportion (approximately 16%) of the total proposed project area expected to be impacted by construction of wellfield modules, processing facilities, and associated infrastructure. Once those structures are completed, the disturbance area would be reduced to only that needed to maintain the operations. Traffic will persist during operation and aquifer restoration, but will occur at a reduced and predictable level. Limited habitat disturbance also results in fewer displaced animals from existing territories into other, potentially occupied, areas, which reduces competition and stress on animals in both locations. Since there is potential for impacts to terrestrial and avian wildlife from process wastewater and sediment in the lined retention ponds, the lined retention ponds will be fenced and avian-specific deterrents will be used. A detailed description of vegetation, terrestrial wildlife, fisheries, and threatened and endangered species associated with the proposed project area is contained in Section 3.5.

Given the factors outlined above, and the limited use of the proposed project area by most vertebrate species of concern, impacts to those species from ISR operations are expected to be small as described below. Mitigation measures designed to prevent or reduce impacts to wildlife are discussed in Section 5.5.

4.5.1.1 Potential Construction Impacts

4.5.1.1.1 Terrestrial Ecology

4.5.1.1.1.1 Vegetation

Under the Proposed Action, wellfield modules and production facilities would be constructed within the nine (Upland Grassland, Sagebrush Shrubland, Pastureland, Hayland, Reservoir/Stockpond, Wetland, Disturbed Land, Cropland, and Wooded Draw) vegetation communities in the proposed project area.

Potential direct impacts include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Potential indirect impacts include the short-term and long-term increased potential for non-native species invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition or changes in vegetative density; reduction of wildlife habitat; reduction in livestock forage; and changes in visual aesthetics. An estimated 280 acres (113 ha) of the proposed project area would be affected by surface disturbance under current development plans. Potential impacts to vegetation would be highest during the construction phase when most of the surface disturbance will occur. As described in Section 3.5 of this ER, most (53%) of the proposed project area is currently covered with perennial grasses and classified as Upland Grassland. About half of the anticipated disturbance will occur on this vegetation type, primarily due to wellfield module and access road construction. Although only about 7% of the proposed project area is currently classified as Hayland, a disproportionately high amount of disturbance (approximately 20 to 30%) is anticipated on this vegetation type, primarily due to construction of the CPP and associated facilities within the central plant area.

During construction, increased soil disturbance and higher traffic volumes relative to other project phases could stimulate the introduction and spread of undesirable and invasive, non-native species within the proposed project area. Non-native species invasion and establishment has become an increasingly important result of previous and current disturbance in Wyoming. These species often out-compete desirable species, including special-status species, rendering an area less productive as a source of forage for livestock and wildlife. Additionally, sites dominated by invasive, non-native species often have a different visual character that may negatively contrast with the surrounding undisturbed vegetation. Strata will restore and re-seed much of the disturbed area within a single construction season and conduct weed control as needed to limit the spread of undesirable and invasive non-native species on disturbed areas.

No threatened or endangered vegetation species were observed within the proposed project area; therefore, no impacts are anticipated. Mitigation measures designed to prevent or reduce impacts to vegetation are discussed in Section 5.5. These include temporary and permanent revegetation of disturbed areas with seed mixtures appropriate for the affected vegetation types.

Habitat alteration, fragmentation, and loss of cover and forage are expected to occur in varying degrees as a result of the Proposed Action. Sagebrush Shrubland, the second largest vegetation type in the proposed project area (22% of the total), can be difficult and time-consuming to reestablish. Consequently, pre-construction vegetation communities (i.e., shrub-steppe) may be different than post-construction communities (i.e., grass-dominated) for several years, or possibly decades, which could alter the composition and abundance of both plant and wildlife species in the area. Reclamation or regeneration of native shrubs species could be further hindered by year-long grazing pressure. Large ungulates (wild and domestic) are attracted to the more succulent and younger plants, and often concentrate in newly seeded locations during the critical early-growth stage. Impacts to the Sagebrush Shrubland vegetation type will be minimized by minimizing surface disturbance where possible, providing a temporary seed mixture to prevent invasion of non-native species in disturbed areas, restoration of sagebrush and other shrubs on reclaimed lands, and by conducting all revegetation activities in accordance with an approved WDEQ/LQD Reclamation Plan.

4.5.1.1.1.2 Wildlife and Fisheries

As with other energy extraction industries, ISR operations have the potential to cause direct and indirect impacts on local wildlife populations. Potential impacts are short-term (until successful decommissioning is achieved) and long-term (persisting beyond successful completion of decommissioning). Indirect impacts typically affect more than a single individual and often persist longer than direct impacts. Direct, project-related impacts of ISR operations may be experienced by all wildlife species to varying degrees. Individuals may be injured or killed due to collisions with drilling and/or heavy construction equipment and related traffic. Topsoil stripping required for construction of drill pads, access roads, plant facilities, and other infrastructure may also result in injury and mortality to some wildlife species, particularly small and young burrowing species such as rodents and herptiles that have limited mobility to escape the equipment. The likelihood for impacts resulting in injury or mortality is greatest during the initial construction phase of each aspect of the proposed project, when traffic is heaviest and machinery is actively disturbing new areas. Disturbance would also be greatest during construction of facilities and supporting infrastructure, which would require more equipment and cover a larger area.

Noise, dust, and human and mechanical presence would all be considered indirect effects. These elements can cause wildlife to avoid the disturbance area within their territories and/or result in their displacement into adjoining habitats. The latter result can negatively impact both the animals leaving the affected area as well as the population of animals upon which newly displaced individuals encroach.

4.5.1.1.1.2.1 Big Game

No crucial big game habitats or migration corridors are recognized by the WGFD in the proposed project area or surrounding 1.6 kilometers (1 mile) perimeter. Big game observed in the proposed project area during the 2009-2010 wildlife surveys include pronghorn, mule deer, and white-tailed deer. During construction, when disturbance activities will be the greatest, big game could be displaced from portions of the proposed project area. Overcrowding can result in increased competition for limited resources, which could result in starvation and/or dehydration. Increased stress associated with overcrowding can also lead to physical altercations, resulting in injuries or fatalities.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance), impacts to big game as a result of the Proposed Action are expected to be small. Mitigation measures discussed in Section 5.5 will ensure that big game impacts are small. These include some or all of the following: fencing designed to permit big game passage, use of existing roads where possible, and implementation and enforcement of speed limits.

4.5.1.1.1.2.2 Other Mammals

Potential impacts to other mammals within the proposed project area would primarily involve destruction of individuals/habitat as a result of construction activities and increased public access. Overcrowding can result in increased competition for limited resources, which could result in starvation and/or dehydration. Increased stress associated with overcrowding can also lead to physical altercations, resulting in injuries or fatalities.

Two mammal species of concern (the black-tailed prairie dog and prairie vole) were observed within the proposed project area (Addendum 3.5-G). Both are Wyoming Species of Concern but neither is on the BLM list of Sensitive Species.

There are no records of prior use of the proposed project area by swift fox but, at the request of WGFD, surveys for swift fox were conducted within the proposed project area. No swift fox were observed during the 2009 or 2010 surveys.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance), impacts to other mammals as a result of the Proposed Action are expected to be small. Mitigation measures for potential impacts to other mammals would be similar to those described above for big game.

4.5.1.1.1.2.3 Upland Game Birds

Potential impacts to upland game birds within the proposed project area include: (1) nest destruction/desertions or reproductive failure as a result of proposed project activities and increased public access; and (2) mortality associated with roads.

Four upland game bird species occur within or near the proposed project area (wild turkey, sage-grouse, sharp-tailed grouse, and mourning doves) (Addendum 3.5-G). Suitable habitat (nesting, brood-rearing, and foraging) for these four species exists in the proposed project area.

As described in Section 3.5.4, there are no sage-grouse core areas or connectivity areas within or near the proposed project area. Nor were any sage-grouse broods, brood-rearing areas, or wintering areas identified during the 2010 field surveys. One sage-grouse lek (Oshoto) has been identified approximately 1.6 kilometers (1 mile) from the proposed project area. As of

2010, this lek has a WGFD occupied management status (active during at least one strutting season within the prior ten years) and an inactive annual status (no birds observed in 2010). The nearest active sage-grouse lek (Cap'n Bob) is approximately 3.5 kilometers (2.2 miles) southeast of the proposed project area. Wyoming BLM policy generally includes the following stipulations placed on mineral development activities on BLM surface or on private surface with federal minerals (BLM 2009):

- Sage-grouse leks outside core areas: surface disturbing activities or surface occupancy is prohibited or restricted on or within 0.25 mile of the perimeter of occupied or undetermined sage-grouse leks. Disruptive activity is restricted on or within 0.25 mile of the perimeter of occupied or undetermined sage-grouse leks from 6 p.m. to 8 a.m. from March 15 - May 15.
- Sage-grouse nesting/early brood-rearing habitat outside core areas: Surface disturbing and/or disruptive activities are prohibited or restricted from March 15 - June 30. This restriction is typically applied in suitable sage-grouse nesting and early brood-rearing habitat within mapped habitat important for connectivity or within 2 miles of any occupied or undetermined lek.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance), impacts to upland game birds as a result of the Proposed Action would be small.

4.5.1.1.1.2.4 Raptors

Potential impacts to raptors within the proposed project area include: (1) nest desertions or reproductive failure as a result of proposed project activities and increased public access; (2) temporary reductions in prey populations; and, (3) mortality associated with roads.

One intact raptor nest (Swainson's hawk nest SH1) was located within the proposed project area (Figure 3.5-3). Seven intact nests and one nest no longer intact were located with 1.6 km (1 mile) of the boundary. The nest within the proposed project area will not be directly disturbed, so nesting raptors would not be directly displaced by the Proposed Action, and foraging raptors could potentially avoid the disturbance area.

Six raptor species on the USFWS list of Birds of Conservation Concern (bald eagle, Swainson's hawk, ferruginous hawk, golden eagle, prairie falcon, and short-eared owl) have been observed within or near the proposed project area (Addendum 3.5-G). Swainson's and ferruginous hawks are the only species known to nest in the area. No nests will be directly impacted.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance) and the fact that no raptor nests will be directly affected, impacts to raptors as a result of the Proposed Action would be unlikely to occur.

4.5.1.1.1.2.5 Nongame/Migratory Birds

Potential impacts to nongame/migratory birds within the proposed project area include: (1) nest destruction/desertions or reproductive failure as a result of proposed project activities and increased public access; and (2) mortality associated with roads.

Fourteen nongame or migratory species on the USFWS Bird Species of Conservation Concern list could potentially occur within the proposed project area. Of the 14 bird species, 8 have been observed within or near the area (Addendum 3.5-G). Ten non raptor or nongame bird species on the BLM Sensitive Species list could potentially occur within the proposed project area. Of the 10 bird species, 4 have been observed within or near the area (Addendum 3.5-G). Thirty-two non raptor or nongame bird species on the Wyoming Species of Concern list could potentially occur within the proposed project area. Of the 32 bird species, 15 have been observed within or near the area (Addendum 3.5-G).

At the request of the WGFD, breeding bird surveys were conducted within the proposed project area. Transects were placed in four habitat types (Upland Grassland, Sagebrush Shrubland, Pastureland/Hayland, and Wetland/Reservoir). The May and June 2010 surveys revealed 27 species as discussed in Section 3.5.4.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance), impacts to nongame or migratory birds as a result of the Proposed Action would be small.

4.5.1.1.1.2.6 Reptiles, Amphibians and Fish

Potential impacts to reptiles, amphibians, and fish within the proposed project area would primarily involve destruction of individuals/habitat as a result of proposed project activities and increased public access. Sediment load from surface disturbing activities could also potentially impact aquatic habitat, although potential impacts will be greatly reduced through sediment control BMPs. Up to 2 acres of wetland habitat could be disturbed as a result of the Proposed Action; however, all wetland disturbance would be mitigated in accordance with USACE requirements.

Six amphibian call sampling sites were established within the proposed project area during summer 2010 to determine the presence of amphibian species (Addendum 3.5-G). The northern leopard frog was the only BLM reptile, amphibian, or fish sensitive species actually observed in the area. Three amphibian and five reptile Wyoming Species of Concern were observed within or near the proposed project area (Addendum 3.5-G).

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance) and the fact that aquatic habitats would be avoided during construction, impacts to reptiles, amphibians, and fish as a result of the Proposed Action would be unlikely to occur.

4.5.1.1.2 Threatened or Endangered Species

4.5.1.1.2.1 Federally Listed Species

As of July 2010 the USFWS has listed two individual wildlife species and one individual plant species for Crook County, Wyoming (USFWS 2010). The wildlife species listed are the sage-grouse (Candidate) and mountain plover (Proposed). The plant species listed is the threatened Ute ladies'-tresses (*Spiranthes diluvialis*). Threatened or endangered species surveys were conducted during November and December 2009 and January through September 2010. The sage-grouse is listed as a Candidate Species. There are no sage-grouse leks within the proposed project area. The mountain plover is a species proposed for listing as a threatened species under the Endangered Species Act. This bird was not recorded during wildlife surveys completed on this area and the proposed project area does not contain optimal habitat for this species. The potential habitat for the Ute ladies'-tresses orchid was surveyed on August 11, 12, and 13, 2010 according to approved survey methods and no orchids were found.

Due to the type of disturbance (relatively small areas disturbed and the sequential nature of the disturbance) and the fact that no threatened or endangered species were documented within or near the proposed project area, impacts to threatened or endangered species as a result of the Proposed Action would be unlikely to occur.

4.5.1.1.2.2 State Listed Species

The State of Wyoming maintains lists of wildlife Species of Special Concern (WGFD 2004 and WGFD 2010). Two mammal, 19 avian, two amphibian, and five reptile species on the Wyoming Species of Special Concern lists were observed within or near the proposed project area (Addendum 3.5-G). Thirteen of the 29 Species of Special Concern observed within or near the proposed project area were listed wholly or in part due to absence of data. As additional management information becomes available, species may be removed from these lists or other species may be added.

4.5.1.2 Potential Operation Impacts

Operation activities may directly and indirectly impact terrestrial ecology within the proposed project area. Access to the central plant area and portions of the wellfield modules will be limited by fencing. Vehicle collisions with wildlife could occur on wellfield access roads and existing roads. Since most potential terrestrial ecology impacts are caused by surface disturbance, potential impacts from operation would be much less than potential construction impacts.

During operation the soils within the proposed project area may become temporarily contaminated or altered due to unanticipated operational leaks and spills. This could potentially impact vegetation in affected areas. Any spill/leak impacts would be minimized by a spill response plan implemented by Strata and by restoring and re-seeding areas where contaminated soil has been removed.

During the operation phase noise and vehicular activity will be reduced within the proposed project area. The majority of vehicular activity will be confined to the New Haven Road, the primary access road, and the central plant area. The decreased vehicular traffic should decrease the risk of vehicular collisions and reduce noise, which would reduce disruptions to wildlife populations.

Potential impacts to terrestrial wildlife during the operation phase from process wastewater and sediment in lined retention ponds will be reduced by the fencing to be installed around the central plant area and around individual ponds. Potential impacts to avian wildlife will be reduced by using avian-specific deterrents such as bird proofing (netting) and/or aversion techniques (sound/visual hazing systems or stretch wire). BMPs, as determined at the time of construction, will be used.

4.5.1.3 Potential Aquifer Restoration Impacts

Potential ecological impacts during aquifer restoration are expected to be small, since surface disturbing activities will be very limited during aquifer restoration. Potential impacts resulting from aquifer restoration activities include vegetation and habitat alteration due to spill response and cleanup, non-native vegetation species invasion in previously disturbed areas, wildlife displacement due to noise, dust, and human/mechanical presence, and vehicle collisions with wildlife. Potential impacts are expected to be even less than those occurring during operation due to a smaller workforce and lower project-related traffic levels on roads within the proposed project area.

4.5.1.4 Potential Decommissioning Impacts

Potential ecological impacts during decommissioning will temporarily increase due to higher levels of surface disturbance, traffic, and use of heavy equipment compared to the operation and aquifer restoration project phases. Potential impacts are expected to be similar to those occurring during construction, but less than construction phase impacts due to a smaller workforce. These include short-term loss of vegetation and habitat in disturbed areas, non-native species invasion, aquatic habitat impacts from sediment loading, habitat fragmentation, wildlife displacement due to noise, dust, and human/mechanical presence, and vehicle collisions with wildlife. Potential impacts are expected to be small due to the relatively small total disturbance area (approximately 16% of the proposed project area) and mitigation measures specific to decommissioning, including habitat restoration in all areas disturbed during construction, operation, aquifer restoration, and decommissioning of the proposed Ross ISR Project.

4.5.2 No Action Alternative

Under the No Action Alternative, there would be no ISR facility construction, operation, aquifer restoration or decommissioning related to this proposed project; therefore, no land disturbance or other ISR-related activities would occur that might impact vegetation or wildlife populations.

4.6 Potential Air Quality Impacts

4.6.1 Proposed Action

The ISR GEIS (pg. 4.2-35) classifies air quality impacts as small if the following three conditions are met for all four phases of the project.

- ♦ Gaseous emissions are within regulatory limits and requirements.
- ♦ Air quality in the region of influence is in compliance with NAAQS.
- ♦ The facility is not classified as a major source under the New Source Review or Federal Operating (Title V) permit programs.

Baseline air quality within the proposed project area is discussed in Section 3.6.2. Air quality near the proposed project area has been monitored extensively due to significant energy development. Five surface coal mines within approximately 30 miles of the proposed project area have continuously demonstrated compliance with NAAQS and WAAQS standards for PM_{10} and $PM_{2.5}$. In addition, the region has been monitored for nitrogen dioxide (NO_2) and ozone (O_3). While NO_2 concentrations have continuously remained well below the EPA standard of 0.100 ppm, ozone concentrations have been measured near the standard of 0.075 ppm, although no violations have occurred. In addition, the northern Powder River Basin is considered an ozone attainment area.

The following sections provide a discussion of potential air quality impacts including impacts associated with combustion and fugitive dust emissions. Emission results described in these sections are preliminary. A final emissions inventory for the Ross ISR Project will be completed in February 2011 to accompany the application for the WDEQ Air Quality Permit. Specific details of the preliminary emissions inventory, including equations, are provided in Addendum 4.6-A.

4.6.1.1 Potential Construction Impacts

During the construction phase of the project the greatest potential for air quality impacts stems from fugitive dust that is generated from the trucks transporting supplies to the facility and heavy equipment (cranes, bulldozers, graders, excavators, trenchers, loaders, etc.) used to construct facilities, wellfield modules and access roads. Large particles will also be released by wind blowing over disturbed areas and stockpiles. Emissions associated with land-disturbing activities and vehicle traffic during construction will be short-term and reduced through BMPs described in Section 5.6 (e.g., speed limit controls, strategically placing water loadout facilities, prompt revegetation, and use of dust inhibitors such as magnesium chloride). Fugitive dust has the potential to impact visual resources as described in Section 4.9.

Another source of potential air quality impacts during construction is combustion emissions. During construction of the wellfield, diesel emissions will be emitted from drill rigs, diesel-powered water trucks and other heavy equipment. Additional heavy equipment will be used to construct the CPP, lined retention ponds, access roads, and associated facilities. Employee vehicles and trucks transporting equipment to the site will also emit fuel combustion products.

Emissions during construction were estimated using EPA's NONROAD2008 emissions model and AP-42. Emission factors were obtained from the NONROAD2008 model for the equipment expected to be used at the Ross ISR Project, while AP-42 provided guidance for fugitive dust emissions associated with heavy construction operations, storage piles and unpaved roads. Exhaust emissions for motor vehicles and shipments traveling to and from the site were not included in the emissions inventory since engine emissions will be controlled by mandated emission controls and the contribution would be negligible compared to heavy equipment.

The preliminary emissions for total hydrocarbons (THC), NOx, CO, SO_2, and PM_{10} during the construction phase are presented in Table 4.6-1. The preliminary emissions estimate assumes that all construction will be completed during the first year, with the exception of the wellfield modules, which will continue for approximately 2 to 4 additional years, as discussed in Section 1.3 of this ER. Emissions of NO_x and CO_2 are anticipated to be the highest of the pollutants evaluated at an estimated 97.5 and 9,254 t/yr, respectively. The preliminary emissions estimates were compared to the estimated particulate and gaseous emissions for the Crownpoint, New Mexico, ISR facility presented in Table 2.7-2 of the ISR GEIS and gaseous and airborne particulates emissions presented in the Final Moore Ranch SEIS. The results of the preliminary emissions inventory were similar to those reported in the ISR GEIS, with the exception of particulate matter (PM). PM emissions associated with the Crownpoint ISR facility were 11.0 t/yr, while combustion and fugitive PM emissions for the Ross ISR Project were estimated as 177.7 t/yr. In addition, estimated combustion emissions for the Ross ISR Project were significantly higher than those estimated for the Moore Ranch Project. The differences can be attributed to the source of emission factors (AP-42 emission factors were used for the Moore Ranch Project) as well as the estimated operating hours associated with each piece of equipment.

4.6.1.2 Potential Operation Impacts

Non-Radiological Emissions

During operation, lesser amounts of fugitive dust will be generated than during construction. Sources of fugitive dust generated during operation will include trucks transporting yellowcake, vanadium, and waste materials from the site; trucks delivering chemicals, uranium-loaded IX resin and supplies to the site; work over, MIT and operation activities; and employee and contract worker vehicles traveling to and from the proposed project area on local county roads. Vehicles will utilize the primary access road from the New Haven Road and, in some cases, secondary and tertiary access roads within the proposed project area. These roads will be maintained to ensure that fugitive emissions are minimal. Mitigation measures are discussed in Section 5.6 and include dust abatement BMPs and enforcement of speed limits.

Vehicle combustion emissions will also be significantly less during operations due to less worker traffic and less shipments of chemicals and supplies to the site and yellowcake and waste from the site. During the operation phase emissions will include onsite traffic related to operations and maintenance, heavy equipment used for road maintenance within the proposed project area, employee and contractor traffic to and from the site, and heavy truck traffic delivering supplies to the site and products and waste from the site. Vehicle combustion emissions will be lower during operation than construction due to the lower number of workers and material shipments.

A summary of the preliminary emissions associated with the operation phase is provided in Table 4.6-1. The results indicate that anticipated emissions during operation are considerably lower than those anticipated during the construction phase. Since activities during operation will not vary significantly the annual estimated emissions are expected to be similar for the 4 to 8 years of operation.

Non-radiological emissions not present during construction include release of gaseous effluents such as oxygen and CO_2 from the wellfield and CPP. The primary sources of non-radiological gaseous effluents from the CPP will include CO_2 released from uranyl tricarbonate breakdown in the precipitation circuit, CO_2 and oxygen released during elution, and combustion emissions, including CO_2, from the natural gas-fired vacuum dryer(s). A summary of the anticipated annual CO_2 release from the CPP during operation is presented in Table 4.6-2. Calculations for the non-radiological emissions associated with the CPP are provided in Addendum 4.6-A.

During the operation phase there is also potential for small amounts of other non-radiological gaseous emissions, although the potential for environmental impacts from these sources is small. Potential sources of minor quantities of non-radiological gaseous emissions include small amounts of chemical vapor released from chemical storage tanks and the CPP ventilation system. These minor emissions will produce minimal environmental impacts since the emissions will be rapidly dispersed in the atmosphere.

Radiological Emissions

Radiological gaseous emissions anticipated during operation of the CPP and wellfield are described in Section 4.12 of the ER and Section 7.3 of the TR. The primary source of radiological gaseous emissions will be venting of radon-222 gas from occasional wellfield venting for sampling events, small unavoidable leaks in wellfield and IX equipment, resin transfer operations, water discharge to lined retention ponds, and maintenance of wellfield and IX equipment. Since pressurized, downflow IX columns will be used and the wellfield will be operated under pressure, the majority of radon released to the recovery solution will stay in solution and will not be released.

4.6.1.3 Potential Aquifer Restoration Impacts

Potential air quality impacts during the aquifer restoration phase will be similar to the operation phase of the project. Table 4.6-1 summarizes the combustion and fugitive emissions estimated for the aquifer restoration phase. The table shows that both combustion and fugitive emissions during aquifer restoration are anticipated be the lowest of the four phases. The decrease in emissions compared to the operation phase can be attributed to fewer employees and activities during aquifer restoration.

4.6.1.4 Potential Decommissioning Impacts

Potential impacts to air quality during the decommissioning phase will be similar to the construction phase of the project. Fugitive emissions will be generated from heavy equipment used to remove contaminated soil and grade the proposed project area, trucks transporting equipment off-site, and trucks transporting waste off-site. Combustion emissions will also be produced by these trucks as well as vehicles transporting workers to and from the site. Table 4.6-1 summarizes the estimated emissions associated with decommissioning. The results assume that CPP and associated facility decommissioning activities will occur in one year, while wellfield decommissioning will be completed over three years.

4.6.2 No Action Alternative

There would be no air quality impacts from the No Action Alternative since no wellfield or processing facility would exist.

Table 4.6-1 Preliminary Emissions Inventory for the Ross ISR Project (t/yr)

Phase	THC	NO_x	CO	SO_2	CO_2[1]	Combustion PM_{10}	Fugitive PM_{10}	Total PM_{10}
Construction	6.3	97.5	36.0	2.9	9,254	5.9	171.8	177.7
Operation	1.0	12.8	6.6	0.4	1,445	1.0	14.3	15.3
Aquifer Restoration	0.6	7.8	4.0	0.3	892	0.6	9.8	10.4
Decommissioning	1.7	21.7	10.3	1.0	3,441	2.0	85.1	87.1
Cumulative	*9.6*	*139.8*	*56.9*	*4.6*	*15,032*	*9.5*	*281.0*	*290.5*

[1] Note: Estimated for equipment only. Refer to Table 4.6-2 for process-related CO_2 emissions.

Table 4.6-2. Summary of Estimated Annual CO_2 Release from the CPP during Operation

	Annual U_3O_8 Production (lb/yr)		
Source	**750,000**	**1,500,000**	**3,000,000**
Uranyl tricarbonate breakdown in precipitation circuit	176	353	705
Elution (byproduct of sodium carbonate in eluate)	214	427	855
Product drying	282	563	1,127
Total Annual CO_2 Production (t/y):	672	1,343	2,687

4.7 Potential Noise Impacts

4.7.1 Proposed Action

Due to the remote location of the proposed project area and low number of nearby noise receptors, noise impacts are expected to be small. The following sections describe the predicted noise levels and potential noise impacts during construction, operation, aquifer restoration, and decommissioning.

As discussed in Section 3.7, there are 11 residences within the surrounding 2-mile radius of the proposed project area. Four of the residences are located within 0.3 mile of the proposed project area and would be impacted the most by increased noise. The nearest residence to the proposed project boundary is about 690 feet away, and the nearest residence to the proposed CPP is about 2,500 feet away.

Section 3.7 presents the results of noise studies conducted within and near the proposed project area. A 7-day noise study at the Strata field office, which is also one of the four nearest residences, indicated that the average noise level is about 38 dBA, including a daytime (7 a.m. to 10 p.m.) average of 39 dBA and a nighttime (10 p.m. to 7 a.m.) average of 36 dBA. Peak noise levels reached 80 to 90 dBA, due to heavy truck traffic on the nearby New Haven Road.

4.7.1.1 Potential Construction Impacts

Potential noise impacts will be greatest during construction. During construction, the number of workers commuting to the proposed project area will be highest. Peak commuter traffic coupled with the highest anticipated level of material and equipment shipments will cause the greatest increase in traffic on affected county roads. Heavy equipment operation within the proposed project area will also peak during construction of the CPP, wellfield, and associated infrastructure.

Most of the potential noise impacts to nearby receptors (residences) will be caused by increased traffic on the New Haven Road and D Road. However, a comparison between Figure 3.1-3 (nearby residences) and Figure 4.2-1 (planned roads) shows that traffic traveling between I-90 and the primary access road will only pass one of the four closest residences. Potential impacts were therefore assessed at this residence, which is designated as N-1 on Figure 3.7-2. A noise survey was conducted near this residence in February 2010. As described in Section 3.7.3.2, the maximum recorded noise level near this residence was 73.4 dBA when a bentonite truck passed by on the New Haven Road. This provides one estimate of the peak noise level associated with heavy truck traffic during construction of the proposed Ross ISR Project.

An estimate of the relative noise impacts to the N-1 residence was made using the noise data collected during the 7-day study at the Strata field office. Table 3.7-4(c) shows that the average daily duration of noise level above the 55 dBA nuisance level at the Strata field office was 62 minutes per day. The Strata field office is only 50 feet away from the New Haven Road, so it is particularly susceptible to traffic noise. By comparison, the N-1 residence is 600 feet from the New Haven Road. In order to assess baseline nuisance noise levels at this residence, the noise study data were corrected to a distance of 600 feet from the New Haven Road.

Noise from point sources diminishes by about 6 dBA for each doubling of distance according to the following relationship, where it is assumed that the noise radiation is uniform, non-directional, and freely propagating (Bell and Bell 1994):

$$L_{p,1} - L_{p,2} = 20 \log\left(\frac{r_2}{r_1}\right)$$

In this equation $L_{p,1}$ and $L_{p,2}$ are the sound pressure levels at points 1 and 2, respectively. This equation shows that doubling the distance from a point source decreases the noise level at the receptor by 6 dBA.

Using this relationship, the noise level at the N-1 residence would typically be about 22 dBA less than the noise level at the Strata field office for a noise source on the New Haven Road (based on a relative distance of 12 times further to the N-1 residence than the Strata field office). Based on the 7-day noise study results, the frequency of noise levels exceeding 77 dBA at the Strata field office averaged 34 occurrences per day. Therefore, it is estimated that the N-1 residence currently experiences nuisance noise levels exceeding 55 dBA about 30 times per day. During construction of the proposed Ross ISR Project, up to 24 one-way heavy truck trips are anticipated on the New Haven Road (Table 4.2-1). Therefore, the N-1 residence might experience an increase of about 80% in the frequency of nuisance noise levels related to traffic on the New Haven Road. The other nearby residences will experience significantly smaller traffic noise impacts, since they are not on the primary site access route.

Traffic-related noise impacts will be minimized by working with Crook County to implement additional speed limit signs on the New Haven Road and D Road and developing a speed limit policy for Strata employees and contractors traveling on county roads.

Noise originating from construction equipment will be apparent locally over the short term where construction activities are occurring. Heavy trucks, drilling rigs, and other equipment used to develop the CPP, wellfield, and associated infrastructure will generate noise within the proposed project area. Table 4.7-1 identifies typical noise levels 50 feet away from construction equipment. The table also shows estimated noise levels 690 feet away from construction equipment, or the minimum distance from the proposed project area to a nearby receptor. This table shows that construction noise levels may exceed nuisance levels (greater than 55 dBA) if heavy equipment is operated very near the proposed project boundary. Also shown on Table 4.7-1 is the estimated noise level 2,500 feet away from construction equipment, or the minimum distance from the CPP to a nearby receptor. This column shows that no nuisance noise levels at nearby receptors are anticipated due to construction activities within the central plant area. The estimated noise levels provided in Table 4.7-1 are conservatively high, since there are topographic barriers to noise propagation between most of the proposed project area and nearby residences. Furthermore, the actual distance from construction equipment to the residences will generally be much greater than the minimum distances shown depending on the location of the construction activities within the proposed project area.

The National Institute for Occupational Safety and Health (NIOSH) recommends an exposure limit for workplace noise of 85 dBA for a duration of 8 hours per day (NIOSH 1998). Exposures at and above this level are considered hazardous. Depending on the type of construction and the equipment being used, noise levels resulting from construction activities might reach or occasionally exceed 85 dBA near the source. Hearing protection will be required for workers in these areas.

Elevated noise levels associated with construction activities could affect wildlife behavior. As described in Section 4.5, noise due to construction can cause wildlife to avoid the proposed project area and potentially disrupt their breeding habits. Mitigation measures for construction-related noise impacts are discussed in Section 5.7 and may include nighttime drilling restrictions within a specified distance of residences, "first move forward" driving policies to limit backup alarms, and speed limit enforcement on access roads within the proposed project area.

4.7.1.2 Potential Operation Impacts

Noise sources specifically resulting from operation include the CPP operations, vehicle traffic related to employee travel to and from the proposed project area, material transportation and wellfield equipment, especially MIT and work over operations.

Operational noise at the CPP would be generated by pumps and other processing equipment. Except for material shipments to and from the CPP, most noise would be abated by closed buildings and would not significantly impact nearby receptors. Similarly, wellfield equipment would be contained within module buildings and well pumps would be submerged.

The major noise source during operation will be attributed to vehicles traveling to and from the proposed project area. Truck traffic associated material shipments and traffic noise related to commuting would have a small, temporary impact on nearby residences. It is estimated that there could be an increase of 108% to 114% in total daily traffic along affected portions of the New Haven Road and D Road and an increase of 133% to 178% in truck traffic. Traffic-related noise impacts will be less than those experienced during construction due to a smaller workforce and less frequent material shipments.

Within the proposed project area, the amount of heavy equipment operation will be much less than during construction and will be limited primarily to MIT and work over operations.

4.7.1.3 Potential Aquifer Restoration Impacts

Potential noise impacts during aquifer restoration will be similar to those during operation, but smaller due to a smaller anticipated workforce and less shipments.

4.7.1.4 Potential Decommissioning Impacts

Noise levels during decommissioning will be similar to those during construction. Most potential impacts to nearby receptors will occur as result of increased traffic on the New Haven Road. Most decommissioning activities will be centered around the central plant area, which is approximately 2,500 feet from the nearest residence. The previous analysis demonstrated that heavy equipment operation within the central plant area will not likely result in nuisance noise levels at nearby residences.

In the wellfield, equipment used during plugging and abandonment of recovery, injection, and monitor wells would produce the greatest source of temporary noise. Cement mixers, compressors, and pumps would be operated for short durations.

4.7.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed. Noise levels within the proposed project area would remain as described in Section 3.7, including baseline noise levels of 36 to 40 dBA occasionally elevated by heavy trucks, passenger vehicles, agricultural operations, and oil production activities.

Table 4.7-1. Noise Levels for Construction Equipment

Equipment Type	Noise Level at 50 feet[1] (dBA)	Noise Level at 690 feet[2] (dBA)	Noise Level at 2,500 feet[3] (dBA)
Heavy Truck	82-96	59-73	24-38
Bulldozer	92-109	69-86	34-51
Grader	79-93	56-70	21-35
Excavator	81-97	58-74	23-39
Crane	74-89	51-66	16-31
Concrete Mixer	75-88	52-65	17-30
Compressor	73-88	50-65	15-30
Backhoe	72-90	49-67	14-32
Front Loader	72-90	49-67	14-32
Generator	71-82	48-59	13-24
Jackhammer/Rock Drill	75-99	52-76	17-41
Pump	68-80	45-57	10-22
Drill Rig[4]	52-74	29-51	18-40

1 ISR GEIS Table 4.2-1.
2 Minimum distance between proposed project boundary and nearby residence.
3 Minimum distance between CPP and nearby residence.
4 Based on 2010 noise study described in Section 3.7 of this ER. The noise level measured 200 feet from an operating drill rig ranged from 40 to 62 dBA.

4.8 Potential Historic and Cultural Resources Impacts

4.8.1 Proposed Action

Class I and III cultural resource surveys were conducted on the proposed project area as described in Section 3.8.2 of this ER. The results are included as Addendum 3.8-A. The inventory report contains information that falls under the confidentiality requirement for archeological resources under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)). Cultural resource sites considered significant under Criterion D (see Section 3.8.2.1 for criteria), and therefore potentially eligible for listing on the NRHP, were identified. Sites also were identified that were not considered significant because they are small in areal extent, lack features, and exhibit poor integrity. Paleontological material (vertebrate remains) were also found during the cultural resource inventories. It was the opinion of the archeologist that none of the fossil bone appeared to be exposed in situ, and that the fossil bone has weathered out of the Lance Formation long ago and lacked contextual integrity.

The Proposed Action has the potential to disturb cultural resource sites, including some of the potentially eligible sites, and to temporarily limit access to cultural resource sites. Mitigation measures that will be implemented to ensure impacts to cultural resources are small are provided in Section 5.8. In general, these mitigation measures include avoidance, where practical, of NRHP sites, consultation with SHPO and, as needed, a potentially affected Tribal Historic Preservation Office (THPO). In addition, if previously unidentified cultural resources are discovered during any phase of the proposed project, work in the immediate area of the discovery will cease until a qualified archeologist evaluates the site and consults with SHPO and NRC about appropriate actions.

4.8.1.1 Potential Construction Impacts

As described in Section 4.1, construction of the proposed Ross ISR Project could disturb up to 280 acres, or about 16% of the total proposed project area (1,721 acres). The ISR GEIS (pg. 4.3-26) notes that most of the potential for adverse effects to potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological material, both direct and indirect, would likely occur during land-disturbing activities. Buried cultural features and deposits and paleontological material that are not visible on the surface during the initial cultural resources inventories could be discovered during earth-moving activities. Potential impacts will be minimized by implementing the mitigation measures discussed above and described in detail in Section 5.8, including implementing a stop-work provision should resources be encountered during construction.

Indirect impacts may also occur outside the proposed project area and related facilities and components. Visual intrusions, increased access to formerly remote or inaccessible resources, impacts to traditional cultural properties and culturally significant landscapes, as well as other ethnographically significant cultural landscapes may adversely affect these resources. As described in Section 3.8, no Native American heritage, special interest, or sacred sites have been formally identified and recorded to date by studies directly associated with the proposed project. However, Devils Tower (located approximately 11 miles (18 km) from the site) is a sacred area for several Plains Tribes (Hanson and Chirinos 1991). Although unlikely, indirect impacts to cultural resources may be unavoidable. However, these will be temporary, since the entire proposed project area will be reclaimed and restored to pre-existing land uses during decommissioning. Implementing the mitigation measures mentioned above and discussed in detail in Section 5.8 will minimize impacts to cultural resources during the construction phase of the proposed project.

4.8.1.2 Potential Operation Impacts

Direct and indirect adverse effects on potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological materials are possible during the operation phase of the proposed project. Potential impacts during operation would result primarily from maintenance and repair of existing facilities.

Potential inadvertent impacts to historic and cultural resources located within the proposed project area and other cultural landscapes that are identified before construction are expected to continue during operation. Overall, impacts to cultural and historical resources during operations would be expected to be less than those during construction, as operations are generally limited to previously disturbed areas (e.g., access roads, central plant area, and wellfield). Implementing the mitigation measures mentioned above and discussed in detail in Section 5.8 will minimize impacts to cultural resources during the operations phase of the proposed project.

4.8.1.3 Potential Aquifer Restoration Impacts

Potential impacts to potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological material are similar to those expected during operation. These would primarily result from surface disturbing activities associated with maintenance and repair of existing facilities. Implementing the mitigation measures mentioned above and discussed in detail in Section 5.8 will minimize impacts to cultural resources during the aquifer restoration phase of the proposed project.

4.8.1.4 Potential Decommissioning Impacts

Surface disturbing activities will temporarily increase during decommissioning, and the potential to impact potentially NRHP-eligible historic properties, traditional cultural properties, and paleontological material will increase accordingly during decommissioning. Most of the decommissioning activities would focus on previously disturbed areas, and therefore most of the historic, cultural, and paleontological resources would be known from investigations conducted prior to construction. Where small amounts of additional disturbance are required (e.g., to remove contaminated soil), archeological surveys would be conducted if the areas are outside of previously surveyed areas. In addition, Strata will implement a stop-work provision should previously unidentified resources be encountered during decommissioning.

4.8.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be developed and associated disturbance and potential impacts to historic and cultural resources would not occur on the portions of the proposed project area as applied for in the license application.

4.9 Potential Visual and Scenic Resources Impacts

4.9.1 Proposed Action

The Proposed Action will result in temporary, small impacts to the visual and scenic resources of the area. The nature of the impacts will be consistent with the visual resource classification of the area by the BLM. Section 3.9 describes how the proposed project area and surrounding area have been classified by BLM as Class III visual resources management areas. The management objective of VRM Class III is to partially retain the existing character of the landscape. The level of change to the characteristic landscape can be moderate. The existing landscape within the proposed project area includes rolling pastureland, cultivated cropland, industrial facilities (oil wells, pump jacks, storage tanks, etc.), fences, and transportation and utility corridors. Under the Proposed Action, the character of the existing landscape would be retained, but would be modified with noticeable but minor additional industrial facilities, utilities, and roads. The Devils Tower National Monument is the only Class II VRM area in Crook County. The proposed project area is not visible from the visitor's center or hiking trails around the monument.

Potential visual and scenic resources impacts may occur during construction, operation, aquifer restoration, and decommissioning. Most of the potential impacts will be associated with construction activities, which would be short term, and with new facilities and roads, which would be more long lasting. New facilities would introduce new elements of form, line, color and texture into the landscape. Because of the small surface footprint and low profile of ISR uranium recovery facilities, no major visual impacts would be present.

4.9.1.1 Potential Construction Impacts

Visual impacts to the proposed project area during construction would generally be short term and would result from ground clearing, grading, wellfield development, vehicular and pedestrian traffic, construction of facilities, and installation of underground and overhead utilities. Construction activities would typically occur during daylight hours, except some drilling and equipment maintenance which may occur at night.

During construction heavy equipment such as scrapers, bulldozers, backhoes, and graders may be visible from nearby vantages, especially from portions of the New Haven Road and D Road. Construction within rural areas may give the area a more industrial feel, therefore decreasing the visual appeal. However, the existing landscape already includes significant alterations from oil production facilities, roads, and utilities. Construction activities will be short term, and following completion of facility installation, temporary disturbance areas will be reclaimed to pre-construction condition.

Wellfield construction will involve the use of drill rigs, water trucks, backhoes, supply trailers, and passenger vehicles. This equipment will be temporarily concentrated at each well location A typical truck-mounted drill rig may be about 30-40 feet tall and will be the most visible piece of equipment used in wellfield construction. Once a well is completed and conditioned for use, the drill rig would be moved to a new location. Strata anticipates that up to 12 drill rigs may be operated at one time during wellfield construction. Drilling will primarily occur during daylight hours; however, it is possible drilling will continue into the night. For nighttime operation, the drill rigs would be lighted, increasing the potential visual impacts.

The wellfield modules will be phased into construction and operation, with 2 to 6 modules typically under construction at one time and up to 10 modules in operation at once. Generally there is not a large expanse of land undergoing development at one time. As described in Section 4.1, the maximum area disturbed by wellfield module construction is expected to be 40 acres at any one time. The shapes of the uranium deposits are typically irregular, and the network of pipes, wells, and power lines would not be regular in appearance, thereby reducing the visual contrast and associated impacts.

Dust generated from construction equipment may impact visual resources. Visible dust particles will be released during activities such as the mechanical disturbance of rock and soil materials, bulldozing, and vehicles traveling on gravel roads. Particles are also transported by wind blowing over the surface of bare land and stockpiles. As described in Section 5.9, dust will be minimized by wetting disturbed areas during construction, promptly restoring and re-seeding disturbed soil, and enforcing speed limits for Strata employees and contractors.

4.9.1.2 Potential Operation Impacts

Potential impacts to the visual resources during ISR uranium recovery operations will result from the presence of wellhead covers, module buildings, facility buildings, lined retention ponds, access roads, buried utilities, and power lines. Potential impacts will also result from wellfield activities such as monitor well sampling, module building inspections and MITs. Some of the facilities and wellfield activities will be visible from the county roads within and near the proposed project area including the New Haven Road and D Road.

Wellhead covers will be insulated fiberglass boxes approximately 30 to 40 inches high and 30 to 40 inches wide. The covers would present only a slight contrast with the existing landscape. Pipelines and electrical lines between the wells and module buildings will be buried and disturbed areas restored and re-seeded. Module buildings will be small metal buildings approximately 8 to 10 feet tall (wall height), 10 to 20 feet wide, and 25 to 45 feet long. TR Figure 3.1-9 depicts the module building preliminary design. A small gravel area around each module building will provide an adequate area for operations and maintenance vehicles to turn around. Oxygen storage tanks may also be located near each module building. There will be 15 to 25 module buildings within the proposed project area. Electrical distribution lines (typically overhead) will connect module buildings to existing electric distribution lines. The distribution poles will be approximately 20 to 40 feet high and wooden so that the natural color harmonizes with the landscape.

Although the processing and support facilities, such as the CPP, offices, and maintenance buildings are located in one area, they will be more noticeable to the casual observer because of their size. The CPP will be the largest structure, at approximately 200 feet wide by 370 feet long by 50 feet tall. The total plant area will occupy a space of approximately 45 acres. These facilities will be prominent in the foreground and middle ground views and will be silhouetted in the background view from public access points. Figure 1.2-6 shows the proposed locations of the central plant area, wellfield, and roads. The CPP will be located about 20 miles from the nearest highway and about ¼ mile from the nearest county road. Based on the viewshed analysis (Figure 3.9-3), 4 or less of the 11 residences located within 2 miles of the proposed project area will be able to see the tops of the highest buildings.

Trucks traveling to, from and within the proposed project area have the potential to impact visual and scenic resources during operation. MIT will be required on all wells at least every 5 years. Due to the number of injection, recovery, and monitor wells, Strata anticipates that two MIT units will operate on a regular basis. As recovery and injection wells decrease their production rates a swabbing or work over rig may be used to stimulate the wells. For testing and well stimulation a light duty truck is needed.

Operations will occur in an area where oil development operations occur today. The CPP and other structures will be noticeable from certain public vantages; however, they will not be the only prominent industrial features in the area. Solid geometric features such as storage tanks, pump jacks, maintenance buildings, power lines, and meter houses are prominent in the immediate foreground and often are noticeable in the foreground views by the casual observer.

Despite the existing visual impacts from oil development and the average scenic quality rating for the proposed project area, Strata intends to implement measures to lessen the visual impact from the project. Mitigative measures for visual and scenic resource impacts during operation are discussed in Section 5.9 and include planting trees around the central plant area, providing dust suppression on access roads and restoring and re-seeding previously disturbed areas, temporary access roads, and tertiary roads that are no longer used.

4.9.1.3 Potential Aquifer Restoration Impacts

Potential visual and scenic resources impacts during aquifer restoration will be similar to those during operations. These will include altered landscape from structures and facilities and the appearance of vehicles and dust traveling within the proposed project area and on county roads near the proposed project area. The potential impacts will be lower due to a reduced workforce and reduced frequency of wellfield operation and maintenance activities during aquifer restoration. In addition, as Strata receives regulatory approval for successful aquifer restoration within the wellfield modules, decommissioning of those modules will occur, such that the total area occupied by structures and facilities will begin to decrease during the aquifer restoration phase.

4.9.1.4 Potential Decommissioning Impacts

Visual resource impacts during decommissioning will be similar to those during construction and primarily attributed to heavy equipment operations and material and equipment transport. Areas of disturbance will be restored and re-seeded to the pre-construction condition. Site decommissioning will be done in accordance with NRC and WDEQ/LQD guidelines. At the end of decommissioning, all structures and facilities will be removed or reclaimed, and no alterations to visual and scenic resources will be left.

4.9.2 No Action Alternative

Under the No Action Alternative, the CPP, wellfield, and associated infrastructure would not be constructed. Therefore, no visual or scenic resources would be impacted.

4.10 Potential Socioeconomic Impacts

Potential socioeconomic impacts from implementing activities at the proposed Ross ISR Project could occur during all phases of the ISR facility's lifecycle. Potential socioeconomic impacts would result predominantly from direct employment at the ISR facility and the indirect demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local workforce.

The anticipated impacts as a result of the proposed construction, operation, aquifer restoration and decommissioning of the Ross ISR Project include increased pressure on the area's housing market, increased demand for services and a boost to the local economy from construction and operations worker spending, as well as county and state tax revenues from uranium and vanadium recovery operations. Increased tax revenue would have a positive effect on the local and state economy (although there is a lag between impacts and increases in tax revenue). Indirect employment related to the project could increase the number of project related workers substantially, especially during the construction phase.

The potential socioeconomic impacts from construction, operation, aquifer restoration, and decommissioning the proposed Ross ISR Project are discussed in the following sections.

4.10.1 Proposed Action

4.10.1.1 Potential Construction Impacts

Section 4.3.10.1 of the ISR GEIS discusses the potential socioeconomic impacts from construction of an ISR facility. These impacts would result from direct employment at an ISR facility and the indirect demand placed on the existing public and social services sector, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. The ISR GEIS estimates total peak employment at an ISR facility to be about 200 people, inclusive of both company and local contractor employees, depending on the timing of construction relative to the other ISR lifecycle stages. The ISR GEIS also estimates 140 indirect jobs could be created associated with the ISR facility. During construction of surface facilities and wellfields, the ISR GEIS assumes that in general local contractors (drillers, construction) would be used, as available. It was also assumed that building materials and building supplies would be purchased locally to the extent practical.

For the Ross ISR Project, the construction workforce necessary for construction of the CPP and other buildings, access roads, lined retention ponds, and general civil/site work is projected to be 115 employees, and the duration of construction is projected at 6 to 12 months. For wellfield construction, the maximum workforce is estimated at up to 85 site workers, and the duration of construction is projected at 3 to 5 years. Thus the impacts from employment for the Ross ISR Project will approximately the same as the projections in the ISR GEIS for a typical ISR project. The workforce who constructs the initial wellfield modules will overlap with the operational workforce that conducts ongoing wellfield construction as wells are depleted of mineral.

In Wyoming, the workforce frequently commutes long distances to work, sometimes from out of state. For example, Campbell County, which is partly in the Wyoming East and partly in the Nebraska - South Dakota - Wyoming Uranium Milling Region, experienced a net worker inflow during the fourth quarter of 2009 of 7,891. This was down nearly 1,000 workers from 8,792 in the fourth quarter of 2008. Crook County, which is partly within the Nebraska-South Dakota-Wyoming Region, experienced a net outflow during the fourth quarter of 2008 of 686 and a net outflow of 636 workers in 2009 (Wyoming Department of Employment 2010a). These commuting patterns were primarily for jobs related to the energy industry and indicate more jobs than workers in Campbell County and more workers than jobs in Crook County (Wyoming Workforce Development Council 2007). As described in Section 3.10, unemployment has risen throughout the region since 2007. By October 2010 there were 1,321 unemployed people in Campbell County out of a labor force of 27,823, for an unemployment rate of 4.7%. In Crook County, there were 150 unemployed persons out of a labor force of 3,573, for an unemployment rate of 4.2%. Depending on their composition and skill set, the local labor force should be able to accommodate the employee needs to construct the proposed Ross ISR Project. Thus, overall labor impacts from the construction of the Ross ISR Project and for the Wyoming East and Nebraska-South Dakota-Wyoming Uranium Milling Regions would be small.

Assuming the number of persons per household in Wyoming is about 2.5 (USCB 2008), the number of people associated with the anticipated maximum workforce could be as many as 500 (i.e., 200 workers times 2.5 persons/household). Again, depending on the skill set of the local labor force, there is sufficient local labor in Campbell and Crook counties for both construction and operation of the Ross ISR Project. Therefore, the population of the area and the demand for housing are not expected to increase significantly as a result of the Ross ISR Project. The demand for public services (schools, police, fire, emergency services) would not be expected to increase significantly with the construction and operation of an ISR facility. Since the proposed project area is in a sparsely populated portion of Crook County, there may be a need for additional standby emergency services not currently available in some parts of the region. It may be necessary to develop contingency plans and/or additional training for specialized service employees, such as EMTs, and equipment, such as ambulances and fire-fighting equipment. During pre-application meetings with Crook County officials, a primary concern for emergency services has been expressed. Strata will commit to training local emergency response personnel in the specific hazards and spill control procedures associated with ISR operations and material transport. Infrastructure (streets, waste management, utilities) for the families of a workforce of this size would not be significantly impacted since the labor from the Ross ISR Project can be supplied primarily from the local labor force.

For the type of work required, including erection of metal buildings, construction of light-duty roads, and installation of wells and associated piping, there should be ample labor supply in Crook and Campbell counties. The 200 workers required to construct the Ross ISR Project under the Proposed Action represent less than 14% of the unemployed persons in Campbell and Crook counties as of October 2010. Since the local construction industry and the CBNG industry have been particularly hard hit by the recession, it is likely that there will be sufficient unemployed workers in the local area to meet the requirements of the Ross ISR Project without the need to import workers from outside the area. The skill set of the local workforce should match well with that needed for plant and wellfield construction at the Ross ISR Project.

The equipment inside the CPP, including the IX columns, uranium and vanadium processing equipment, water treatment RO systems, and associated pumps, motors and control systems, will be largely manufactured off site and assembled by local contract labor. Therefore the influx of workers is expected to result in a small impact in Crook and Campbell counties. Because of the short duration of plant construction (about 6 to 12 months) and the small size of the workforce compared to the available labor pool in these two counties of 31,396 people, of whom 1,471 or 4.7% were unemployed as of October 2010, any impacts of worker influx will be mitigated by preferentially sourcing the labor force from the within the surrounding region.

Labor for construction will likely come from the nearest communities of Gillette (pop. ~28,700) and Moorcroft (pop. ~930). Contractors may bring in supervisory personnel from outside the region, although local contractors should be able to supply the necessary labor and equipment to construct the Ross ISR facilities. Considering the short duration of construction, small number of workers required, size of the local labor force, and abundance of workers in the area already trained at well construction, road construction, installation of pumps and piping, and erection of steel buildings, the impact of construction on the local population is expected to be small.

Construction impacts to regional income for the Ross ISR facility in the Nebraska-South Dakota-Wyoming Uranium Milling Region will also likely be small. This construction is likely to draw upon the labor force within the region before going outside the region (and state). The greatest economic benefit to the region would be to have the labor force drawn from within the region and reduce the unemployment rates of Crook and Campbell counties. Still, any impacts will be moderated by the short duration of construction.

As noted in the Final Moore Ranch SEIS (NRC 2010), rural areas in Wyoming are especially vulnerable to the boom and bust trends that have occurred in the energy sector of Wyoming. Counties and towns whose economies are centered on extractive industry do not have a diversified economy, and have suffered when the natural resources are exhausted, or when the market for the resource becomes depressed. Counties with large resource bases (like Campbell County) and larger towns such as Gillette and Casper have planning offices, a history of growth (and decline) and have built the capacity to manage change. This planning capacity coupled with historical experience in coping with change helps mitigate potential impacts through adaptation. The current recession has produced a slowdown in the State of Wyoming and in the resource-rich areas such as Campbell County, providing some temporary relief to local governments adapting to the latest boom in energy development. To the extent that project plans and information (such as changes in activity and schedule) are shared with local planners (regularly) and van/car pooling is provided and encouraged (from the larger population centers) impacts to smaller towns and places would be minimized. The potential impact to each component of the socioeconomic system is discussed below.

Demographics

Bust and boom cycles in population would continue with or without the proposed Ross ISR Project. The construction phase of the proposed project would be expected to last for approximately 3 to 5 years, overlapping with the operation phase. Within the Powder River Basin of Wyoming, workers usually choose to locate in larger population centers such as Gillette, but would also commute from towns such as Moorcroft, Pine Haven, and possibly Sundance. Given the general current global recession and the downward pressure on natural gas prices (suppressing exploration and development of CBNG projects), lower demand for electricity and therefore coal production, the recent rise in local unemployment rates (to around 5%), and the small number of workers expected during the construction phase, the impact of the Proposed Action could be small in the short term if the project were to begin under currently prevailing economic conditions.

Income

In 2006 the median per capita income was $42,538 in Campbell County and $36,752 in Crook County, compared with a State average of $40,655 and a national average of $36,714 (WDAI/EA 2010). It is expected that workers would be paid the regional rates typical of Campbell County, where a higher percentage of jobs are in the relatively higher-paying energy industry. Impacts of construction of the Ross ISR Project on local income would be relatively short-term, lasting about 3 to 5 years, and would be small, consisting primarily of temporarily providing jobs to 200 workers, many or most of whom are currently unemployed.

Housing

Changes in population and income levels drive changes in housing demand. The construction phase is expected to last approximately 3 to 5 years, with plant construction occurring prior to or concurrent with wellfield construction. The construction workforce is estimated to be 200 people, with most people coming from Campbell County which has eight times the labor force and nine times as many unemployed persons (as of October 2010) as Crook County. Most of the rest of the construction workforce would come from Crook County. Most of the construction work force is expected to be found within the existing workforce currently living in these two counties. Therefore while current housing vacancy rates are low, the construction phase should cause only a small impact on the availability of housing.

Employment Structure

Employment structure represents the resource-based extractive industries of the area. Given the existing downturn in the economy and the associated increase in unemployment, there could be a slight positive, short-term effect on unemployment in the area during the construction phase from implementing the Proposed Action. The development of an ISR project would add slightly to the economic diversity of the resource-dependent area by developing a non-carbon fuel source in an area dominated by extraction of coal, CBNG, and conventional oil and gas. The construction phase of the proposed Ross ISR Project would have a small impact on employment structure.

Local Finance

Local finance represents revenue associated with economic activity in the area (minus the cost associated with providing services for a changing population). The construction workforce would largely come from the local area and would complete construction within 3 to 5 years. Construction would therefore have a short-term small beneficial impact on the local economy through a temporary reduction of the unemployment rate (theoretically from the October 2010 figure of 4.7% to 4.0% assuming all 200 construction workers were hired from Crook and Campbell counties), increased purchases of local goods and services, as well as contributing to county and state tax revenues. Taxes derived from the value of construction equipment and use tax on purchases for the proposed Ross ISR Project would contribute to the Crook County tax base. Tax revenue would accrue to Crook County based on the value of construction equipment on the site. Typically, this equipment would be registered at the County Assessor's Office, and a discount applied to the market value (42%), then 11.5% of the adjusted value would be taxed at the local tax rate. This income would help offset any increased needs for public services, such as ambulance service and fire control. To the extent that project contractors and subcontractors register equipment as required by Wyoming Statute, the greater the benefit to the county and the more capable the county would be to manage growth through increased services.

Distribution of tax revenue could be a problem in some areas. Specifically, because of the structure of the taxing system, taxes might not accrue or be distributed to the localities proportionately to the population/public service impacts experienced by those entities. This would be the case, for example, for workers that choose to live in Campbell County. Tax revenue might accrue mainly in Crook County and to the state. Similarly, small towns experiencing increased population/public service demand might not receive a proportionate level of tax increase as sales tax accrues in the larger population centers. However, the construction period is relatively short and the construction workforce is expected to reside within the existing workforce currently living in these two counties. In general, the construction phase of the proposed Ross ISR Project would have a small impact on local finances.

Education

There is no local housing at the proposed project area. It is assumed that most of the construction workers would come from Campbell and Crook counties, primarily from the communities of Gillette, Moorcroft and possibly Sundance. The families will continue to live in these communities during the short (3 to 5-year) construction period. Therefore, the construction workforce and their families will have a small impact on the local infrastructure, schools, and public services.

Health and Social Services

Increases in population and changes in population characteristics cause changes in the demand for health and human services. However, in this case the construction period is relatively short and the construction work force is expected to be found within the existing workforce currently living in these two counties. Therefore, the impact on health and social services during the construction phase of the proposed Ross ISR Project would be small.

4.10.1.2 Potential Operation Impacts

It is projected that approximately 60 workers will be required to operate the Ross ISR project, which is within the range of 50 to 80 workers discussed in the ISR GEIS (pg. 4.4-32). Employment of operation personnel is expected to be less than that during the construction phase of the ISR facilities, and peak employment would depend on the timing and market conditions and overlap with other ISR lifecycle stages. Use of local contract workers and local building materials will diminish, because facility construction will cease and wellfield construction will drop off to the rate needed to maintain production. Revenues will be generated from federal, state, and local taxes on the facility and the uranium and vanadium produced and from sales and use taxes on goods and services purchased by the owners and employees of the plant.

Employment with a different technical expertise would be required during the operations phase, including management, health and safety, plant operations, regulatory, accounting and laboratory personnel. These people will probably be imported from outside the region, particularly during initial operations. However, it is likely that some of the workers who construct the initial wellfield modules and associated infrastructure (roads, electrical systems, and pipe networks) will hire on as operations personnel in order for the owner and employees to capitalize on the experience acquired during construction. As stated in the ISR GEIS (pg. 4.4-33), the effects on community services (e.g., education, health care, utilities, shopping, recreation) during the operations phase would be expected to be similar to the effects during construction except fewer people would be employed and the employment would be of longer duration.

The operations phase of the Ross ISR Project is expected to last for approximately 4 to 8 years, depending upon market conditions. This could be extended by 10 to 20 years or more if the Ross CPP accepts uranium-loaded IX resins from satellite facilities or water treatment entities. Individual production and injection wells will be operational for about 2 years until the ore is depleted and then will be replaced by new wells along the ore trend. The operations workforce would impact the local economy through the creation of jobs, the purchasing of local goods and services, and the increase in county and state tax revenues. Taxes derived from the value of production and equipment and sales and use tax on purchases for the proposed Ross ISR Project would also contribute to the Crook County tax base. Severance tax on the uranium extracted and State royalties on yellowcake produced from State lands would be collected at the state level and would contribute to the State of Wyoming's general fund.

Aquifer restoration will primarily occur concurrently with uranium recovery operations. However, as the reserves are ultimately depleted, the operation will transition from operation to aquifer restoration and decommissioning without concurrent operation. Labor requirements during the phase of aquifer restoration without concurrent operation will decline over time. There will no longer be a need for construction of wells and associated piping, although the CPP will continue to operate to treat the water and recirculate it through the wellfield modules until aquifer restoration is complete. It is estimated that the workforce during aquifer restoration, once all mineral recovery has ceased, will be about one-third of the normal operation staff, or about 20 people.

From a comparison of projected site-specific conditions for the operation of the Ross ISR Project with the ISR GEIS, it is clear that the socioeconomic impacts are within the range of those described in the ISR GEIS. The ISR GEIS concludes that impacts to socioeconomics during operation would be small to moderate. Therefore the site-specific socioeconomic impacts for the Ross ISR Project are expected to range from small to moderate as further illustrated below.

Demographics

The operations staff to support the proposed Ross ISR Project would be about one-third the peak number of construction staff, and a substantial number of the operations staff may come from the construction staff. With a projected plant life of 4 to 8 years or more, the operations staff would be more likely to secure permanent or long-term housing in the area compared to the construction staff. The operations phase of the proposed Ross ISR Project would require a number of specialized workers, such as management, health and safety, plant operations, regulatory, accounting and laboratory personnel. Some of these, estimated at about one-third of the operations staff, would be expected to remain through aquifer restoration and decommissioning. Some of these operations workers will likely come from outside the local area, although many of the operations personnel may come from the construction staff who will be experienced and trained in construction of wells and associated infrastructure. Even if Strata chooses to contract for some of the operations, the operations workforce will remain in the area longer than the rest of the construction staff (4 to 8 years or more) and will be more likely to take up residence and raise families in the local communities. It is estimated that up to

20% of the operations personnel, or about 12 people, will come from outside the area, and the remainder will be hired from the local labor force. Any operations personnel hired from outside the local area could theoretically result in a greater number of children and other full-time residents in the area. This increase in population could also create additional jobs to service the larger population, although the numbers of employees projected to come from outside the area are so small that this is unlikely. Considering the small operating staff (60 people) and the expectation that most of these people can be hired locally (especially considering that there are approximately 1,500 unemployed persons in the local labor force), it is concluded that the operations phase of the proposed Ross ISR Project will have a small impact on the local demographics.

Income

The average annual salary for all full-time employees would be roughly $50,000. The total annual payroll is estimated at $2,500,000 to $3,000,000. Because these salaries are consistent with current salaries in the area, and because most of the workers would be hired locally, the operations phase of the proposed Ross ISR Project would have a small impact on local income.

Housing

If the population increases due to the Ross ISR Project, there will be a corresponding increase in housing demand since the operation is expected to have a duration of 4 to 8 years or more. As noted above, a relatively small number of employees are anticipated come from outside the area (around 12). Most of the area that surrounds the proposed license area is undeveloped private and public lands, and any operations workforce hired from outside the area would most likely reside in Gillette or Moorcroft. Although not as bad as in some areas of the country, Campbell and Crook counties have been hit by the recent recession, particularly in the housing industry. As of October 1, 2010 there were 334 homes listed for sale in Gillette (National Association of Realtors 2010). As of May 13, 2010 52 of the 390 housing units were available in Moorcroft (City-Data.com 2010) Any impact from 12 employees hired from out of the area would have a minor impact on the Gillette or Moorcroft housing market, even if they all chose to live in Moorcroft. If as expected the operations employees at the Ross ISR Project came from the roles of the unemployed, their increased income could provide upward pressure on the cost of housing if these employees chose to upgrade their homes or make their existing mortgages more secure. The operations phase of the proposed Ross ISR Project would have a minor impact on the availability of housing.

<u>Employment Structure</u>

During the operations phase of the proposed Ross ISR Project new jobs would be created, such as technical and financial managers, plant operators, health and safety technicians, environmental and regulatory professionals, lab technicians, and field technicians. Employment structure represents the resource-based extractive industries of the area. Since the proposed Ross ISR Project would be considered another extractive industry, no changes to the employment structure would be expected during the operations phase; however, the overall level of employment would increase. Although the dominant industry in the area is extractive, it is centered on coal mining, CBNG production, and conventional oil and gas production. The proposed Ross ISR Project would also be an extractive industry, therefore not technically contributing to the area's economic diversity. However, depending on changing government policies regarding carbon-based energy, the development of a non-carbon industry such as uranium, even though it is still extractive, would represent a degree of economic diversification for the area. If the economy becomes more diversified, it will be better able to withstand fluctuations in one industry without going through a "bust" cycle. As discussed in Section 3.10, the State of Wyoming experienced a boom over the last several years which led to an increase in employment in the mining industry and a decrease in diversification of the state economy. The same holds true for Campbell County (WDAI/EA 2010). Crook County is less dominated by the mineral industry, and therefore may be considered more diverse. Due to the small number of employees required, constituting less than 0.2% of the labor force in Campbell and Crook counties, and the fact that most of these employees will be hired locally, the operations phase of the proposed Ross ISR Project will have a small impact on the local economy and not significantly increase the diversification of the economy from extractive industries.

<u>Local Finance</u>

Tax revenue would continue to accrue to Crook County during operations. With respect to the direct operation of the proposed Ross ISR Project, a personal property tax would be applied to the value of all equipment and property used. In addition, a state mineral severance tax would be applied to the mined uranium and vanadium, some of which would be returned to Crook County. The State also receives a royalty on minerals produced from State-owned lands. The county also imposes an ad valorem (based on value) tax on production. Crook and Campbell counties would both benefit from the increased sales tax revenue. Under Wyoming law, there is a 4% sales and use tax to which local governments may add up to a 1% general purpose option, a 1% specific purpose option (capital facilities tax), and up to a 1% optional tax for economic development purposes. The counties also have the option to impose up to a 4% excise tax on all sleeping accommodations for guests staying less than 30 days (lodging tax). Crook County at this time has imposed the 1% general purpose optional sales tax, a 1% capital facilities tax, and a 2% lodging tax. Campbell County has imposed a 1% general purpose optional tax and a 2% lodging tax.

The State's share of the sales tax revenue (69%) is distributed to the General Fund. The counties keep the remaining 31% as well as the optional sales taxes. The State severance tax rate on U_3O_8 is 4% of the sales value times an industry factor (currently 42%). The State royalty on State-owned minerals is applicable to yellowcake (U_3O_8) because uranium ore is not, per se, a salable product. The value used by the State is the Metallic and Non-Metallic Rocks and Minerals lease, and Chapter 21 of the Rules of the Wyoming Board of Land Commissioners is applicable. The current royalty rate is 2.5% on yellowcake sales at less than $20/lb, 2.75% on yellowcake sales at more than $20/lb but less than $26/lb, and 3% for yellowcake sales at $30/lb or more (Kemp 2010).

About 18% of the proposed project area of 1,723 acres is owned by the State of Wyoming. Yellowcake production from the State lands will be subject to the 3% royalty plus the 4% severance tax. During the early years of production, Strata anticipates that about half of the yellowcake will be produced from State lands. Assuming a yellowcake price of $45 per pound and an annual production rate of 750,000 pounds per year, the total annual state royalty would be $1.01 million and the severance tax would be about $530,000, for a total of $1.54 million. Considering the projected FY2010 revenues to the State of $631,600,000 and estimating that 23.3% will come from mineral taxes, the projected impact to the State from production at the Ross ISR Project will be small (refer to Section 3.10.3.3). However, the property tax on yellowcake production at the Ross ISR Project would be about $880,000 per year (assuming $45 per pound times 750,000 pounds per year times an industry factor of 42% times a 62.545 mill levy, see Table 3.10-11). Compared to total FY 2008 property taxes levied in Crook County of $10,067,332 (see Table 3.10-11), this represents an increase of about 9%, which could be considered a significant benefit. Considering that vanadium may also be sold for about $12 per pound, and assuming it is produced at a rate of 0.6 pound per pound of yellowcake, the tax revenues from production would increase by about 10% to 20%.

Education

An estimated 60 people would be required for the operation of the proposed project, of which it is estimated that about 80% would be hired locally. Thus there could be a population increase of about 30 people based on the 2005 average household size of 2.52 in Wyoming. The small number of families moving into the Crook and Campbell County school districts as a result of the proposed Ross ISR Project operations would not appreciably change school enrollment which totals about 8,000 in Campbell County and 1,100 in Crook County (Wyoming Department of Education 2010) and would therefore produce a small impact.

Health and Social Services

Changes in the size of the population and the population characteristics cause changes in demand for health and human services as previously discussed. During the operations phase of the proposed Ross ISR Project there could be an increased demand for doctors, hospitals and police to service the ISR project workers, worker families and others who migrated to the area in response to the increased demand for services. Because of the small number of employees required during operation and the expectation that most will be hired locally, the impact on health and social services will be small. Because the local area has previously experienced boom and bust cycles and is currently in a bust, it has developed the capability to manage change. Therefore, the impact from operations will be small.

4.10.1.3 Potential Aquifer Restoration Impacts

The workforce is expected to be reduced by one-half to two-thirds during aquifer restoration, so the socioeconomic impacts will be similarly small. Toward the end of the operations phase, revenues from production and severance taxes and any State royalties will decline and eventually cease. Thus the positive benefits from these revenues will cease to exist.

4.10.1.4 Potential Decommissioning Impacts

During decommissioning, a similar workforce as that required for construction will be required. As described in the ISR GEIS (pg. 4.4-33), up to 200 workers with similar skills to those required for construction are needed at a typical ISR facility. Strata anticipates that around 90 workers will be required during this project phase. Decommissioning of the central plant area, access roads, and associated infrastructure is expected to last for 12 to 18 months. However, due to phased development, decommissioning of individual wellfield modules is anticipated after regulatory approval of successful aquifer restoration. Therefore, wellfield decommissioning will likely overlap with aquifer restoration.

Decommissioning, whether done by a contractor or using operations staff after operations cease, will have similar socioeconomic impacts to those during construction.

4.10.2 No Action Alternative

No socioeconomic impacts will occur as result of the No Action Alternative, since no workers would be employed, no facilities constructed, and no uranium or vanadium produced.

4.11 Potential Environmental Justice Impacts

Because no minority or low-income populations as defined by EO 12898 were identified in the analysis area, no further analysis of environmental justice was conducted.

4.12 Potential Public and Occupational Health Impacts

4.12.1 Proposed Action

NUREG-1748 and NUREG-1569 require that the application describe public and occupational health impacts from both non-radiological and radiological sources. Strata will protect public and occupational health by complying with the Radiation Protection Standards contained in 10 CFR 20 and following the ALARA principle. The radiation safety controls and monitoring programs that will be implemented at the Ross ISR Project are discussed in Section 5.7 of the TR.

As discussed in Section 3.10, the area within an 80-km (50-mi) radius of the proposed project area includes portions of Campbell, Crook and Weston Counties in northeastern Wyoming, small portions of Powder River and Carter Counties in Montana, and very small parts of Butte and Lawrence Counties in western South Dakota. The proposed project area is located in a sparsely populated area of western Crook County, Wyoming. The nearest community is Moorcroft, Wyoming (est. 2009 population 926), about 22 miles (35 km) south of the proposed project area. The closest urban area to the proposed project area is Gillette, Wyoming (est. 2009 population 28,726), about 50 road miles (80 km) southwest of the proposed project area. Other Wyoming communities within the 50-mile radius of the proposed project area and their estimated 2009 populations include Hulett (516), Pine Haven (396) and Sundance (1,339) in Crook County, and Upton (919) in Weston County. There are two South Dakota communities just outside the 50-mi radius, Spearfish (2008 est. population 10,010) and Belle Fourche (2008 est. population 4,979). There is one unincorporated community in Montana, Alzada (est. population 200 within the zip code area) within the 50-mi radius. The population distribution for the 50-mi radius around the proposed project area is depicted in Figure 3.10-1. The figure shows the population distribution for the 16 compass sectors in concentric rings of 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70 and 80 km from the center of the proposed project area. Section 3.1.5 describes nearby residences. There are no residences within the proposed project area. Within 2 km (3.2 mi), there are 11 residences with approximately 30 current residents. The nearest residence to the proposed project boundary is about 210 m (690 ft) away, and the nearest residence to the CPP is about 762 m (2,500 ft) away. The nearest sensitive receptors are the schools in Moorcroft, about 35 km (22 mi) south of the proposed central plant location.

4.12.1.1 Potential Construction Impacts

During the construction phase of the Ross ISR Project, potential impacts to public and occupational health include: fugitive dust, combustion emissions, noise, and occupational hazards associated with construction of the wellfield, CPP, and associated facilities. Potential impacts from fugitive dust and combustion emissions are described in Section 4.6. As described in the ISR GEIS (pg. 4.2-53), fugitive dust would not likely result in any significant radiological dose as long as soils show low levels of radionuclides. Baseline radiological soil sampling and gamma surveys within the proposed project area are discussed in Section 2.9 of the TR. The soil results indicated low levels (1 – 2 pCi/g) of radium in the soil, while gamma radiation exposure rates ranged from 5.3 to 25.3 μR/hr. The highest exposure rates were concentrated to a small area in the southern section of the proposed project area, which may be attributed to previous uranium mining activities or exposed sandstone. Based on the low levels of radionuclides in soil it is not likely fugitive dust would contribute a significant radiological dose.

Section 4.7 addresses potential noise levels associated with construction equipment. Members of the public will not be exposed to potentially damaging noise levels, and a hearing conservation program for Strata employees and contractors will prevent occupational noise impacts during construction. Other potential occupational hazards will be those typical of heavy construction and drilling and will generally be the same as occupational hazards to existing oilfield workers described in Section 3.11.4 of this ER. These include common occupational injuries such as strains and sprains resulting from common incidents such as slips/trips/falls or lifting. Potential occupational injuries will be minimized by implementing worker safety procedures that conform to the Wyoming Occupational Health and Safety Act, Title 27, Labor and Employment, Chapter 11, Occupational Health and Safety and applicable OSHA standards.

4.12.1.2 Potential Operation Impacts

Operation of the Ross ISR Project has the potential for radiological and non-radiological impacts to public and occupational health. The potential for radiological and non-radiological impacts include those typical of normal operation and those associated with accidents. The following sections detail the potential impacts to workers and the public.

4.12.1.2.1 Potential Non-radiological Impacts from Normal Operations

Potential non-radiological public and occupational health impacts will be related to fugitive dust, combustion emissions, noise, permitted surface discharges and contamination of water supplies. The following sections describe these potential impacts based on the potential pathways of exposure. The receptors for non-radiological impacts include nearby residences, public schools and drinking water intakes.

4.12.1.2.1.1 Potential Exposures from Air Pathways

Non-radioactive airborne effluents at the Ross ISR Project will consist of fugitive dust from access roads and wellfield activities and vehicle combustion emissions. Fugitive dust emissions will be controlled by implementing dust control BMPs such as speed limits and dust suppressants. Additionally, vehicle combustion emissions will be lower during operation than construction since fewer workers and material shipments will be required. Air quality impacts of the Ross ISR Project are discussed in Section 4.6. Potential noise impacts during operation are addressed in Section 4.7.

4.12.1.2.1.2 Potential Exposures from Water Pathways

During operation Strata may utilize surface discharge as a disposal method for permeate, as discussed in Section 4.4 of this ER and Section 2.3.1.1 of the TR. Surface discharge of permeate would be performed under a WYPDES permit, which would be issued by WDEQ/WQD and would contain effluent limits based on 40 CFR 440 and Wyoming Water Quality Rules and Regulations that are designed to protect public health and the environment. There would be no potential public health impacts resulting from permeate discharge due to the high effluent quality and small discharge rate (typically 50 gpm or less).

Public water supply information was obtained from the 2009 Water System Survey Report from the Wyoming Water Development Commission (WWDC 2010) and additional WWDC reports. The nearest public water supply wells are 10 to 12 miles from the proposed project area (City of Gillette wells) as described below. The nearest public water supply occurs in Pine Haven, approximately 27 km (17 mi) SSE of the proposed project area. Pine Haven is served by two public water supply wells, the deepest of which is approximately 3,200 feet deep. Additional details from the WWDC (2009a) indicate that both wells are completed in the Madison Formation and that the total pumping rate is about 60,000 gpd.

The next closest public water supply is found in Hulett, approximately 30 km (19 mi) ENE from the proposed project area. Hulett is served by one public water supply well that is approximately 1,900 feet deep and is completed in the Madison Formation. The total annual water usage is approximately 4 million gallons, which equates to a typical water usage rate of about 11,000 gpd.

The Moorcroft public water supply is approximately 35 km (22 mi) south of the proposed project area. This system is currently supplied by four wells and a tap from the Gillette-Madison water pipeline discussed below. Existing water supply wells are completed in the Lance-Fox Hills Formation, but a construction project scheduled for 2010 will provide a new transmission line to a Madison well the Town of Moorcroft recently drilled about 10 miles east of Moorcroft, or about 21 miles southeast of the proposed project area (Wyoming State Loan & Investment Board 2007). Daily public water supply usage in Moorcroft is about 300,000 gpd.

The City of Gillette, though farther from the project site than the aforementioned municipalities, has a battery of ten active water supply wells some 42 miles from Gillette and 10 to 12 miles southeast of the proposed project area. The wells are located adjacent to U.S. Highway 14 about 5 miles north of the town of Pine Haven. According to a 2009 WWDC report (WWDC 2009b), the wells are completed in the Madison Formation to depths of 2,350 to 2,500 feet. The total capacity of the Madison wells is about 8,700 gpm. The Madison wells provide about 80% of the water used by the City of Gillette, with the remaining 20% coming from in-town wells completed in the Fort Union Formation. Although in-town Lance-Fox Hills Formation wells are also available to the City, their poor water quality limits their use.

The potential to impact area public water supplies as result of the proposed action is extremely remote. All public water supplies within 20 miles (32 km) are completed in the Madison Formation, which is stratigraphically far below the Lance-Fox Hills Formation targeted for ISR uranium recovery in the proposed project area (see Figure 3.3-3, Regional Stratigraphic Column, for the general location of the Madison in comparison to the Lance/Fox Hills Formation). As described in the deep disposal well application (TR Addendum 4.2-A), the depth to the top of the Madison Formation is anticipated to be approximately 7,000 feet. By comparison, the depth to the ore zone is about 250 to 660 feet within the proposed project area (see Section 3.3.2.2.4 in this ER). Between these intervals is the Pierre Shale, which is considered a regional confining unit. Furthermore, the minimum distance from the proposed project area to a public water supply well is at least 10 miles.

Rural residents of the area surrounding the proposed project area have private wells that provide drinking water for household use and livestock watering. A description of the domestic water supply wells near the proposed project area is included with the description of the baseline groundwater quality monitoring program in Section 3.4.3.3.1. Water quality impacts from normal operation of the proposed Ross ISR Project will be confined to the portions of the ore zone within the aquifer exemption boundary, and therefore there will be no public health impacts to nearby drinking water wells from normal operations.

4.12.1.2.1.3 Potential Exposures from Flora and Fauna

No non-radiological impacts to public or workers have been identified from flora and fauna pathways.

4.12.1.2.2 Potential Non-radiological Impacts from Accidents

4.12.1.2.2.1 Work Related Accidents

The number and rate of nonfatal injuries and illnesses for the Wyoming mining industry during 2008 is presented in Table 4.12-1, which was prepared using information from the Wyoming Department of Employment (2010a). As stated in Section 4.10.1.2 of this ER, the Ross ISR project expects to employ approximately 60 full-time workers during operation. Since the rates shown in Table 4.12-1 are based on numbers of injuries or illnesses per 100 full-time workers, the expected rates for the Ross ISR Project would be expected to be less than those shown in the table. Furthermore, the employees who operate the Ross ISR Project will not be exposed to the level of hazards typical of

Wyoming mining jobs, since ISR operation does not involve extensive heavy equipment operation, high walls, or many of the other hazards associated with conventional mining. The ISR facility will be more similar to a light industrial/chemical plant than a conventional surface or underground mine.

According to the U.S. Department of Labor (U.S. Department of Labor 2010), there were 3 fatalities in the Wyoming mining industry in 2009. In this case the figure includes fatalities at all establishments categorized as Mining (code 21) in the North American Industry Classification System (NAICS), including establishments not governed by MSHA rules and reporting, such as those in oil and gas extraction. The three mining-related fatalities represented 16 percent of the total occupational fatal injuries in Wyoming in 2009.

Accidents involving human safety associated with the ISR uranium recovery typically have far less severe consequences than accidents associated with underground and open-pit mining methods, and therefore the rates and numbers reflected in Table 4.12-1 should be conservatively high. In-situ uranium recovery provides a higher level of safety for employees and neighboring communities when compared to conventional mining methods or other energy-related industries. Accidents that may occur in ISR operations are generally minor when compared to accidents that typically occur in other industries. Radiological accidents that might occur would typically manifest themselves slowly and are therefore easily detected and mitigated. The remote location of the proposed project area and the low level of radioactivity associated with the process combine to decrease the potential hazard of an accident to the general public.

NRC has previously evaluated the effects of accidents at conventional uranium milling facilities in NUREG-0706 and specifically at ISR uranium facilities in NUREG/CR-6733. These analyses demonstrate, for most credible potential accidents, consequences are minor so long as effective emergency procedures and properly trained personnel are used. The proposed Ross ISR project facilities will be consistent with the operating assumptions, site features, and designs examined in the NRC analyses in NUREG/CR-6733. Strata will develop emergency management procedures to implement the recommendations contained in the NRC analyses. Training programs, discussed in Chapter 5 of the TR, will ensure that Strata personnel are adequately trained to respond to all potential emergencies.

NUREG-0706 considered the environmental effects of accidents at single and multiple uranium milling facilities. Analyses were performed on incidents involving radioactivity and these incidents were classified as trivial, small, and large. Some of the analyses in NUREG-0706 are applicable to ISR facilities, such as transportation accidents. NUREG/CR-6733 specifically addressed risks at ISR facilities and identified the "risk insights" that are discussed in the following sections.

4.12.1.2.2.2 Chemical Accidents

NUREG/CR-6733 noted that the scope of the NRC mission includes hazardous chemicals to the extent that mishaps with these chemicals could affect releases of radioactive materials. Industrial safety aspects associated with the use of hazardous chemicals at the Ross ISR Project are regulated by the Wyoming State Mine Inspector. ISR facilities utilize chemicals during the extraction process and during restoration of groundwater quality. Bulk chemicals will be stored on-site in areas at a distance from the processing facilities that will pose no significant hazard to the public or workers' health and safety. Industrial safety aspects associated with the use of chemicals will be regulated by EPA and WDEQ in addition to the State Mine Inspector.

Process-related chemicals stored on site will include some or all of the following: sulfuric acid and/or hydrochloric acid, anhydrous ammonia, ammonium sulfate, hydrogen peroxide, oxygen, carbon dioxide, sodium carbonate and sodium chloride, and sodium hydroxide. Bulk chemicals will be stored on site either in the chemical storage area adjacent to the CPP, in the CPP, or in the wellfield near module buildings. Chemicals will be stored to minimize the potential hazard to the public or to workers' health and safety. Strata will have strict standard operating procedures regarding receiving, storing, handling, and disposal of chemicals to ensure the safety of the public and workers.

<u>Sulfuric Acid</u>

Sulfuric acid will be used in the precipitation circuit of the CPP to break down the uranium complexes. The acid will be stored within the chemical storage area adjacent to the CPP in a tank(s) and piped to the point of use within the CPP. Direct skin contact could potentially occur during a spill. Sulfuric acid is extremely irritating, corrosive, and toxic to tissue. The concentration of sulfuric acid fumes that is immediately dangerous to life and health (IDLH) is 15 mg/m^3. In the risk analysis from NUREG/CR-6733, a spill of 93% sulfuric acid was not deemed a significant inhalation hazard to workers as long as normal air dilution is available from the facility ventilation system. NUREG/CR-6733 also notes that sulfuric acid reacts vigorously with ammonia, sodium carbonate, and water, all of which will be present at the proposed Ross ISR Project site. To minimize the potential for chemical reactions in the unlikely event of simultaneous tank leaks, the sulfuric acid storage tank(s) will be located away from other chemical storage tanks and away from process vessels at the chemical storage area, and the acid will be piped to an inside smaller storage tank for daily use.

The use of sulfuric acid is subject to Threshold Planning Quantities (TPQs) contained in 40 CFR Part 355, Emergency Response Plans for threshold quantities (TQs) in excess of 1,000 pounds. This is also the EPA reportable limit under CERCLA. As discussed in Section 3.2 of the TR, the storage quantity of sulfuric acid at the Ross project will exceed the TPQ. Based on the design capacity, the CPP will be subject to Emergency Response Plan requirements which will qualify for coverage under the DHS Chemical Facility Anti-Terrorism Standards. A "Top Screen" analysis for sulfuric acid will be submitted to DHS by Strata.

Anhydrous Ammonia

Anhydrous ammonia will be used at the CPP as part of the vanadium recovery circuit and, potentially, to adjust the pH of the eluate solution in the precipitation tanks. According to NUREG/CR-6733, ammonia is the chemical most frequently involved in accidents reported under the EPA Risk Management Program (RMP). Ammonia at the project will be in liquid form and will be stored outside of the CPP in the chemical storage area and piped in for use. The maximum quantity of ammonia stored at the site will be 2,500 gallons. The primary hazard associated with ammonia occurs with a piping leak where the ammonia can evaporate and can damage the human respiratory tract. The IDLH concentration of ammonia is 300 ppm. NUREG/CR-6733 identifies an ammonia leak as a significant risk factor within a plant because ventilation rates adequate to dilute ammonia fumes in a localized area to maintain concentrations below the IDLH in the event of a leak would not be feasible. An additional hazard associated with ammonia is that it reacts vigorously with sulfuric acid, which will also be present in the precipitation circuit.

The quantity of ammonia that will be stored at the site will exceed the TQ of toxic and flammable substances set forth in 40 CFR 68.130; therefore, EPA will require implementation of an RMP for the ammonia system. The goal of an RMP is to prevent accidental releases of hazardous chemicals that can cause serious harm to the public and the environment. The RMP will include items such as accident consequence analysis, standard operating procedures, emergency response procedures, documented management system, and accident prevention plans.

In addition, the project will store an amount of ammonia in excess of the screening TQ as stated in Appendix A of 6 CFR Part 27, Chemical Facility Anti-Terrorism Standards; Final Rule, by the DHS. Therefore, Strata will submit a "Top-Screen" analysis in order for the DHS to evaluate the chemical security risks associated with the Ross ISR Project.

To minimize the probability and consequences of an ammonia accident, the CPP design and operating procedures will be consistent with ANSI recommendations, which include 1) providing an excess flow valve located as close to the storage tank as possible that automatically closes if the flow rate exceeds a specific value; 2) the use of appropriate ANSI and ASME standard codes for nonrefrigerated pressure piping; and 3) provision of positive-pressure, self-contained, full-face respirators in the immediate vicinity of the ammonia piping and process operations. The ammonia piping will be placed so as to minimize the potential for impact from vehicles or other objects that might cause ruptures.

In addition to the listed regulatory programs, the Process Safety Management (PSM) of Highly Hazardous Chemicals standard contained in 29 CFR 1910.119 applies to anhydrous ammonia for TQs in excess of 10,000 pounds. In the State of Wyoming, industrial safety at ISR facilities is regulated by the Wyoming State Mine Inspector and OSHA's PSM standard does not apply. However, Strata will comply with the PSM standard during development of the ammonia system design and operating procedures.

Hydrogen Peroxide

Hydrogen peroxide will be added as a 50% H_2O_2 solution to the precipitation tanks to aid precipitation of an insoluble uranyl peroxide compound. Hydrogen peroxide is a strong oxidizer, can be very reactive and is easily decomposable. Its hazardous decomposition products include oxygen and hydrogen gas, heat, and steam. Decomposition can be caused by mechanical shock, incompatible materials including alkalis, light, ignition sources, excess heat, combustible materials, strong oxidants, rust, dust and a pH above 4.0. When sealed in strong containers, decomposition of hydrogen peroxide can cause excessive pressure to build up which may cause the container to burst explosively.

The use of hydrogen peroxide at concentrations higher than 52% is subject to the PSM standard contained in 29 CFR 1910.119 for TQs in excess of 7,500 pounds and TPQs contained in 40 CFR Part 355, Emergency Response Plans for TQs in excess of 1,000 pounds.

The hydrogen peroxide storage tank will be located in the chemical storage area outside the CPP and will be isolated from the storage areas for acids and reducing agents. The site will have storage facilities for 2,500 gallons (25,000 pounds) of 50% H_2O_2.

As noted in NUREG/CR-6733, a hydrogen peroxide piping system leak in a process building has the potential to result in localized vapor concentrations in excess of the IDLH value of 75 ppm within several minutes. A leak in a confined space has the potential to generate lethal concentrations of vapor at an even faster rate. Strata will incorporate recommendations concerning materials of construction for tanks and piping systems and the use of local ventilation with explosion-proof fans to control vapors in the event of a leak of hydrogen peroxide.

Oxygen

Oxygen at the proposed project area will be added to the injection stream upstream of the injection manifolds within the module buildings or at each well head. Oxygen will be stored as a cryogenic liquid either near the wellfield module buildings or in the chemical storage area adjacent to the CPP. Oxygen will be delivered and stored in liquid form and then conveyed to the injection point in gas form. The design and installation of the oxygen storage facility is typically performed by the oxygen supplier and meets applicable industry standards, including NFPA 55 and OSHA standards at 29 CFR 1910.104. The design and installation of underground and above-ground gaseous oxygen piping at the Ross ISR Project including material specifications, velocity restrictions, location and specifications for valves, and design specifications for metering stations and filters will be in accordance with industry standards contained in Compressed Gas Association (CGA) G4.4.

The hazards associated with oxygen storage include combustion and explosion. To reduce the risk of an accident that could potentially affect other processes or storage facilities and radiological safety, oxygen will be stored an appropriate distance from other infrastructure and storage areas. Facilities used to store oxygen at the project will conform to NFPA 55 standards.

Conveyance systems for oxygen will be clean of oil and grease because these substances will burn violently if ignited in the presence of oxygen. The proper pressure relief devices, component isolation and barriers will also be employed. Cleaning of equipment used for delivering and storage of oxygen will be done in accordance with CGA G4.1. The design and installation of the oxygen piping system will be done according to the requirements of CGA G4.4. Strata will develop procedures that implement emergency response instructions for a spill or fire involving oxygen systems.

Carbon Dioxide

Carbon dioxide may be used in the ISR process at two locations. Carbon dioxide may be used as a source of carbonate to fortify the barren lixiviant as it leaves the CPP. Carbon dioxide may also be used upstream of the IX vessels to control the lixiviant pH and increase the resin loading capacity. Carbon dioxide presents few potential hazards in its use. The main hazard is through asphyxiation if it is allowed to accumulate in a confined area. To reduce this risk of a harmful accident, carbon dioxide will be stored in the chemical storage area adjacent to the CPP in large tanks.

Bulk carbon dioxide facilities are typically located outdoors and are subject to industry design standards. Floor level ventilation and carbon dioxide monitoring at low points will be performed to protect workers from undetected leaks of carbon dioxide within the central plant.

Sodium Carbonate and Sodium Chloride

Sodium carbonate (soda ash) will be used to make up fresh elution brine and will be stored in tanks as a saturated solution in equilibrium with a bed of crystals in the storage tank. Sodium carbonate solution must be kept above 100°F (38°C) to prevent precipitation in the tank and piping. This will be accomplished by heating the water added to the tank, and continuously circulating liquid from the tank through a heat exchanger. An electric heater will be used to heat a thermal fluid to heat the exchanger. Dry sodium carbonate will be delivered by truck and will be blown into the storage tanks using air pressure. Sodium carbonate has a low risk of affecting radiological safety at the proposed project.

Sodium chloride will be used to make up fresh elution brine and will be stored in tanks as a saturated solution (approximately 26% by weight) in equilibrium with a bed of crystals in each storage tank. Dry sodium chloride will be delivered by truck and will be blown into the storage tanks using air pressure. Sodium chloride has a low risk of affecting radiological safety at the proposed project.

Sodium carbonate and sodium chloride are primarily inhalation hazards. Soda ash and carbon dioxide will be used to prepare sodium bicarbonate for injection in the wellfield. Sodium carbonate and sodium chloride are used for regeneration of ion exchange resin. Dry storage and handling systems will be designed to industry standards to control the discharge of dry material.

Sodium Hydroxide

Sodium hydroxide will be used in the precipitation circuit to raise the pH prior to precipitation with hydrogen peroxide. The sodium hydroxide system will include a storage tank and delivery pump. The storage tank will be located adjacent to the CPP building in the chemical storage area in a concrete secondary containment basin designed to contain at least 110% of the tank volume. This secondary containment basin will be separate from the containment basins for other chemical systems. The sodium hydroxide feed pump will be located inside the building, near the storage tank. Sodium hydroxide will be purchased as aqueous caustic soda, and will be pumped directly into the storage tank from the supplier's tanker trucks.

Non-Process Related Chemicals

Several non-process related chemicals will be stored at the proposed project area. These include gasoline, diesel, and propane. Due to the combustible and flammable nature of these chemicals, they will be stored outside of the plant building and away from hazardous material storage areas. Storage containers will be located above ground and with safety and environmental provisions according to federal, state and local regulations.

Domestic Sewage

Relatively small amounts of domestic effluent from an on-site wastewater disposal facility will be discharged to the environment. As described in Section 4.13, the wastewater disposal facility will discharge up to a maximum of 6,000 gpd of septic tank effluent to the subsurface in a drainfield based on the peak design flow rate during construction. Alternately, Strata might decide to design and permit a wastewater treatment system with surface discharge of treated effluent. Although the peak design effluent rate will be up to 6,000 gpd, the average rate during operation is only anticipated to be about 800 gpd. The approximate drainfield location is depicted on Figure 1.2-5. The wastewater disposal facility will be designed and constructed in accordance with WDEQ/WQD standards designed to protect public health and the environment. The drainfield, if used, will likely include monitor wells to ensure that the septic tank and drainfield adequately treat the domestic wastewater.

4.12.1.2.3 Potential Radiological Impacts from Normal Operations

Strata completed an assessment of the radiological effects of the proposed Ross ISR Project based on the types of emissions, potential pathways, and potential consequences of radiological emissions. The assessment found that the most predominant radiological emission during operation is radon-222 and its progeny. The potential planned and unplanned exposure pathways identified by Strata are illustrated in Figure 4.12-1 and include air, water and flora and fauna. As Figure 4.12-1 demonstrates, all exposure pathways, with the exception of skin absorption, are potentially important depending on the environmental media impacted and importance of a specific pathway at a given site or locale. Although the pathway involving yellowcake dryer particulate emissions is shown for completeness, it is a “de minimus” pathway since the source term is essentially zero. The following discusses potential radiological impacts for each pathway, while additional details are included in Section 7.3 of the TR.

4.12.1.2.3.1 Potential Exposures from Water Pathways

Strata will control and monitor the solutions in the ore zone to ensure that migration does not occur. This will include maintaining a hydraulic bleed beginning during initial production and continuing until stability monitoring. Additionally, the overlying and underlying aquifers will be monitored to ensure that there is no migration to surface waters or adjacent non-exempt USDWs.

Uranium recovery equipment, including the IX, precipitation, drying and packaging facilities, will be located on curbed concrete pads with secondary containment in the form of curbs, berms, and sumps to prevent any liquids from entering the environment. The secondary containment will be of sufficient size to contain 110% of the contents of the largest tank in the event of a rupture. Solutions used to wash down equipment will drain to a sump and will be pumped back into the processing circuit or to the lined retention ponds prior to injection in the disposal wells.

The primary method of waste disposal at the facility will be by deep well injection. The deep wells will be completed at a depth more than 8,000 feet and will be isolated geologically from USDWs, since the target injection depth is more than 500 feet below the lowermost USDW, the Madison Formation. The wells will be constructed under a permit from WDEQ/WQD and all requirements of the UIC program for Class I wells will be met. Addendums 4.2A and 4.2B in the TR contain the permit application and WDEQ correspondence related to the deep disposal wells, respectively.

The proposed lined retention ponds will include double liners and leak detection systems to prevent the release of liquid effluent with potentially elevated radiological constituents to water pathways. Brine, spent eluate and other 11e.(2) liquid waste will be disposed in deep disposal wells as described above and permeate will be disposed in one of five methods: surface discharge, recycling for use as plant make-up water, injection into wellfield modules in active aquifer restoration, deep disposal wells, or land application. Of these, two methods could release permeate to water pathways: surface discharge and land application. Potential public health and safety impacts resulting from the release of permeate are minimal due to the stringent effluent limits imposed on either disposal option. Permeate would only be discharged under a WYPDES permit with effluent limits established by WDEQ/WQD protective of public health and appropriate for the specific uses of the receiving stream. Land application would only occur under a permit from the WDEQ/WQD Chapter 3 construction permitting program with similar effluent limits protective of shallow groundwater.

4.12.1.2.3.2 Potential Exposures from Air Pathways

The potential for radiological exposure from air pathways will be minimized at the Ross ISR Project through the use of downflow IX columns and vacuum yellowcake dryers. As discussed in the ISR GEIS (pg. 2-24) and NUREG/CR-6733, Section 2.2.3, the heating system in the dryers is isolated from the yellowcake ensuring that the exhaust does not contain radioactive materials. Additionally, the dryer is operated under a vacuum so that leaks will cause air to flow into the chamber. Emissions in the chamber are treated using a bag filter to capture 99 percent of the yellowcake particulates and a condenser to cool and condense water vapor. Based on this technology potential radiological emissions from the Ross ISR Project will be limited to Rn-222 released from wellfields and processing facilities as stated in the ISR GEIS, Section 4.2.11.2.1 (pg. 4.2-53):

> "Radionuclides can be released to the environment during ISL facility operation. As discussed in Section 2.7.1, radon gas is emitted from ISL wellfields and processing facilities during operations and is the only radiological airborne effluent for those facilities that use vacuum dryer technology."

In addition, the uranium recovery process will be a closed circuit and exhaust from the vessels and resin transfer area will be filtered and discharged through the plant roof. The CPP will be equipped with a general area ventilation system to remove small amounts of radon-222 that may be released in areas which do not contain dedicated ventilation systems. Details of the plant ventilation system are discussed in Section 4.1 of the TR. Outside of the CPP area, radon gas may be released from well heads, header houses and lined retention ponds. These releases will have minimal impact on the public and workers since radon does not pose an outdoor health hazard. As described in GER (NMA 2007):

> "It is very important to understand that while outdoor radon contributes to levels of radon indoors, the predominant source of people's exposure to radon is from exposure to radon daughter levels inside the home primarily originating from the soils beneath the home. As the United States EPA notes people need to be occupying a structure and not just standing outdoors for its radon risk estimates to be applicable (48 Fed. Reg. 15076, 15083)."

In general, the primary sources of radon-222 gas within the proposed project area will be from occasional wellfield venting for sampling events, small unavoidable leaks in the wellfield and IX equipment, resin transfer operations, and maintenance of wellfield and IX equipment.

Source term estimates and radiological impacts on human and environmental receptors were made using MILDOS-AREA, the Argonne National Laboratory computer code (ANL 1997) recommended by NRC in NUREG-1569, Section 7.3.1.2.2. The code was designed as a primary licensing and evaluation tool to model airborne radiological effluent releases for ISR facilities, including radon-222 released from wellfields and processing facilities. The MILDOS-AREA provides the capabilities to evaluate radiation from the exposure pathways identified in Figure 4.12-1, including inhalation, ingestion of vegetables, meat and milk, and external exposure from ground shine and cloud immersion. The following describes the source term estimates and the exposure results of the MILDOS-AREA model. Dose rates comparisons to the regulatory limits are provided to demonstrate that no members of the public will be exposed to radiation levels in excess of regulatory limits set by the NRC.

<u>Source Term Estimates</u>

The five sources for potential radioactive releases at the Ross ISR Project are similar to those discussed in NUREG-1569, Appendix D. These include (1) the drilling operations at new wellfield modules, (2) uranium extraction operations at production wellfield modules, (3) unloading IX columns and water discharges to lined retention ponds and (4) restoration operations at old wellfield modules. Radon contributions from yellowcake processing were not included in the source term estimates, since the Ross ISR Project will utilize vacuum dryers for processing yellowcake. Source terms were calculated using equations presented in NUREG-1569, Appendix D and the project-specific parameters described in Table 4.12-2. The following provides a summary of the source term estimates, while Section 7.3 of the TR provides a detailed discussion including equations used. Radon release results for each source term are presented in Table 4.12-3.

Mud pits were identified as the primary source of radon potentially emitted during wellfield construction. Since Strata proposes simultaneous construction of two mine units, as described in Section 1.3, the total radon release during wellfield construction was estimated as the sum of releases from each unit. During operation, radon has potential to be released from the wellfields and the CPP. Radon releases calculated for the wellfields accounted for the leaking and venting of wellheads as well as leaking transport pipes. Within the CPP radon releases were calculated for IX column resin unloading and water discharges to lined retention ponds. The results indicate that IX column unloading contributes negligible amounts of radon to the atmosphere (less than 1 Ci/yr). Radon releases during aquifer restoration were assumed to be similar to operation, with the exception of the IX columns. Contributions from the IX columns were not included since flows through the IX columns will be significantly less than operation, resulting in fewer resin transfers.

Total Human Exposures

To ensure compliance with the annual dose limit (100 mrem/year) found in 10 CFR 20.1301, the MILDOS-AREA model in conjunction with the source term estimates were used to calculate the maximum Total Effective Dose Equivalent (TEDE) to 14 members of the public. The members of the public were identified by Strata as individuals with potential to spend at least 50 hours per year in the proposed project area. These included the following:

Residents: Five residents nearest the proposed project area were identified, including Wood, Strong, Wesley, Burch and the Oshoto Field Office. The estimated maximum duration that each resident may be exposed is 8,400 hours per year, calculated as 24 hours per day x 7 days per week x 50 weeks per year.

Ranchers: Five ranchers were modeled within the proposed project area grazing cattle, horses, and, potentially, sheep and growing hay and other dry land crops. The estimated maximum duration that a rancher will occupy the proposed project area is 100 hours per year, calculated as ten 10-hour days (e.g., for hay cutting, baling, and stacking).

Oilfield workers: Two oilfield workers were modeled attending to the existing oil production wells within the proposed project area. The estimated maximum duration that each oilfield worker will occupy the proposed project area is 175 hours per year, calculated as 0.5 hour per day x 5 days per week x 50 weeks per year for normal operations, plus 10 hours per day x 5 days per year for maintenance activities.

Couriers: Couriers will regularly deliver and pick up packages, primarily from the administration building within the central plant area. The estimated maximum duration that a courier will occupy the proposed project area is 90 hours per year, calculated as 20 minutes per day x 5 days per week x 52 weeks per year.

Vendors: Vendors such as fuel and bulk oil delivery persons will regularly travel to the proposed project area. The estimated maximum duration that a vendor would occupy the proposed project area is 260 hours per year, calculated as 1 hour per day x 5 days per week x 52 weeks per year.

In addition to the aforementioned members of the public, Strata also considered a commuter driving past the proposed project area as well as a hunter and fisherman spending time within the proposed project area. Although these members of the public may be present within the proposed project area, the dose will be negligible since the annual exposure for each is estimated as less than 25 hours.

The results, presented in Table 4.12-4, indicate that the highest annual TEDE for members of the public will occur during the operation phase. Overall, the Wesley residence is estimated to receive the highest dose (0.779 mrem/yr), which is less than 1% of the dose limit of 100 mrem/yr. Since the model only accounted for doses to adults, the MILDOS-AREA was re-modeled to assess potential doses to infants, children and teenagers. The results, presented in Table 7.3-7 of the TR, indicate that the annual dose does not vary by age group. Using the annual dose estimated for the Wesley residence, the contributions from individual pathways were evaluated. Inhalation was found to be the primary pathway (98.6%), while ingestion contributed the least.

To ensure the proposed Ross ISR Project will not negatively impact the public or workers, an additional model was completed to assess the maximum TEDE to any person standing within the proposed project area. The model utilized 287 receptors, spaced 250 meters apart within a 4-km grid centered around the CPP for an estimated duration of 2,000 hours per year. The doses are depicted as isopleths on Figure 4.12-3. The largest anticipated dose is 1.6 mrem/yr at a receptor located near the proposed CPP. Although this dose is greater than those modeled for the members of the public, it is still less than 2% of the dose limit of 100 mrem/yr.

Population Dose

The annual background dose to the population within 80 km of the proposed project area was calculated as 10,500 person-rem, based on the background radiation dose in Table 3.11-3 (2.57 mSv/yr for Wyoming) and the population in Table 3.10-2 (40,327). The TEDE to the population was estimated as 0.361 person-rem using MILDOS-AREA.

4.12.1.2.3.3 Potential Exposure from Flora and Fauna

Because of their relative mobility, some native animals, including small mammals and birds, may have contact with Rn-222 releases and associated progeny. It is possible that individual animals might have contact with higher concentrations of radionuclides than any member of the public because of potential proximity to releases. However, the mobility of biota makes it unlikely that any individual animal will receive a constant concentration for the entire year. There are no current dosimetric standards for protection of biota. However, it has been assumed by the International Commission on Radiological Protection that if humans were protected, then biota in the same exposure environment would also be protected.

U.S. Department of Energy Order 5400.5 proposed a limit of one rad per day (rad/d) for aquatic organisms (U.S. Department of Energy 2010). According to 10 CFR 834 (proposed), Subpart F, the proposed limits for terrestrial plants are one rad/d and 0.1 rad/d for terrestrial animals. Those proposed values are expected to be far higher than the doses that would be calculated to any non-human receptor; therefore, it is reasonable to expect no significant impact from exposure of biota from releases from the proposed Ross ISR Project.

4.12.1.2.4 Potential Radiological Impacts from Accidents

The following sections discuss potential accident scenarios that could have radiological impacts. Mitigation measures to reduce or eliminate these impacts are discussed in Section 5.12.2. Section 5.7 of the TR describes the radiation safety controls and monitoring programs that will be implemented at the Ross ISR Project. These programs were developed to assure that operations criteria established in NUREG/CR-6733 will be followed such that the occupational health impacts and accident risks described in that document will be applicable to the Ross ISR Project. Additional accident scenarios and details of each potential credible accident are discussed in Section 7.5 of the TR.

Tank Failure

A spill of the materials contained in the process tanks at the Ross ISR Project will present a minimal radiological risk. Process fluids will be contained in vessels and piping circuits within the CPP. The tanks will contain injection and recovery solutions, IX resin, pregnant eluate, yellowcake, and liquid waste. All tanks will be constructed of fiberglass or steel with the exception of the hydrogen peroxide storage tank, which will typically be constructed of aluminum. Instantaneous failure of a tank is unlikely. The most likely tank failure would be a small leak. In this case, the tank would be emptied to at least a level below the leaking area and repairs or replacement made as necessary. If a tank or process vessel were to have a major failure, such as a rupture, fluids would be captured in secondary containment structures (concrete berms) in the process building. As discussed in Section 7.5.1 of the TR, the containment areas will have a sump to pump the collected fluids to other process vessels, a lined retention pond, or a deep disposal well. Following fluid removal the area will be washed down and the water will be collected and disposed using a similar method.

NUREG/CR-6733 analyzed the potential impacts of a failure of a yellowcake thickener resulting in a release of 20% of the contents outside the plant structure. This postulated accident scenario was based on an event at the Irigaray ISR facility in 1994. The event in question was caused by the failure of an inadequate concrete pad supporting the thickener. The subsequent release from the building was a result of the proximity of the thickener to the plant wall. NUREG/CR-6733 concluded that, based on conservative calculations of this unlikely event, the dose to the public would be below the limits in 10 CFR 20. The calculations resulted in a dose to an unprotected worker in excess of the exposure limits from 10 CFR 20 (i.e., 5 rem). However, this dose estimate was based on a number of unlikely, conservative assumptions. The scenario made the unrealistic assumption that no efforts would be made to clean up the spill, allowing the yellowcake to dry and become transportable. The dose was based on lung clearance class Y uranium ("insoluble," therefore stays in lung a long time), which produces the highest dose estimates. This is very conservative since modern yellowcake products are quite soluble and leave the lung much more quickly than the "Y" assumed, resulting in much smaller doses. No allowance in the dose calculation was made for the use of protective equipment, including protection factors from the use of respiratory protection equipment. In the event of an accident similar to this at the Ross facility, personnel will follow spill response procedures which will require the use of personal protective equipment (PPE).

NUREG/CR-6733 also assessed the potential dose from a catastrophic spill from an IX column resulting in the release of the entire contents of the vessel and the resultant release of radon gas (Mackin et al. 2001). Based on a number of assumptions, the predicted dose was 1.3 rem in a 30-minute period to a worker in the area. Any change to the Rn-222 concentration or exposure time has a linear effect on dose. For example, if the room size is doubled or the exposure time is halved, then the dose will be halved. NUREG/CR-6733 recommended that the use of ventilation or atmosphere-supplying respirators designed to protect against gases would be sufficient to mitigate doses that unprotected personnel should evacuate spill areas near IX columns, and that ISR facilities maintain proper equipment, training, and procedures to respond to large lixiviant spills or IX column failure.

Plant Pipe Failure

The rupture of a pipe within the CPP will be easily detected by operating staff and can be quickly controlled. Spilled solution will be contained by secondary containment curbs and sumps and managed in the same fashion as for a tank failure.

Wellfield Spill/Pipeline Failure

The rupture of an injection or recovery feeder line or individual flow line in a wellfield module, or a trunkline between a wellfield module and the plant, would result in a release of injection or recovery solution which would contaminate the ground in the area of the break. Occasionally, small leaks at pipe joints and fittings may occur. Small leaks in wellfield piping typically occur in the injection system due to the higher system pressures. Until remedied, these leaks may drip injection or recovery solutions onto the underlying soil. Strata will monitor trunklines, feeder lines, and individual flow lines for changes in pressure or flow. Significant variation in these parameters will signal alarms at the CPP, which will prompt an investigation of the potential leak. These leaks seldom result in soil contamination. Following repair of a leak, Strata will require that the affected soil be surveyed for contamination and the area of the spill documented. If contamination is detected, the soil is sampled and analyzed for the appropriate radionuclides. Any contamination would be removed as appropriate.

<u>Transportation Accidents</u>

Transportation accidents are discussed in Section 4.2 in this ER and in greater detail in Section 7.5.4 of the TR. The following provides a summary of materials that may be transported to and from the Ross ISR Project and potential impacts to the public and workers.

Throughout operations the following materials may be transported to or from the Ross ISR Project:

- Shipment of 11e.(2) byproduct material
- Shipment of dried yellowcake to a conversion facility
- Shipment of vanadium to a processing facility
- Shipment of process chemicals or fuel
- Shipment of solid waste to a municipal landfill
- Shipment of hazardous waste to an appropriately licensed disposal or recycling facility
- Shipment of uranium-loaded IX resin to the Ross CPP

To minimize transportation accidents, all shipments of materials and supplies to and from the site will be transported by properly licensed and certified drivers and subject to both federal and state transportation regulations. Extensive emergency response programs will be in place along with environmental emergency response contractors for spill cleanup. Strata will provide training for local emergency personnel including firemen, police and EMTs in the hazards and emergency response procedures to ensure safe working practices in the presence of spilled materials.

Shipment of 11e.(2) Byproduct Material

Solid 11e.(2) byproduct material or unusable contaminated equipment generated during operations and decommissioning will be transported to a licensed disposal site. As discussed in Section 4.2 of this ER, Strata has evaluated potential transportation routes to four disposal sites. These include one facility in Wyoming, two in Utah, and one in Texas. The distance of these facilities from the Ross Project ranges from 235 to 1,000 miles. Before operations begin, Strata will have an agreement in place with one of these licensed disposal facilities. Shipments will be handled as LSA material and are generally made bulk in sealed roll off containers in accordance with the applicable DOT hazardous materials shipping provisions. Because of the low volume of 11e.(2) byproduct material generated, these shipments will be infrequent and average about five per year during operation and aquifer restoration, increasing to approximately 100 to 200 shipments per year during decommissioning. Potential radiological and environmental impacts in the case of an accident will generally be low due to the low level of radioactive concentration in the shipments. In addition, the solid material would be easily collected and contained in the event of an accident. Should a transportation accident result in the release of 11e.(2) byproduct material, Strata will commit to providing a post clean-up radiological survey of the affected area to verify that all contaminants have been removed.

Shipment of Dried Yellowcake

Transportation of dried yellowcake will be made in exclusive-use transportation vehicles to a licensed conversion facility, which transforms the yellowcake to uranium hexafluoride. The only currently permitted conversion facility is in Metropolis, Illinois. The proposed maximum annual yellowcake production rate for the Ross ISR Project is 3 million pounds. Based on weight limits for legal transport, each shipment will contain approximately 40,000 pounds of yellowcake, resulting in a total of about 75 shipments per year. Yellowcake will be shipped in 55 gallon steel drums; each containing a maximum of 950 pounds. Section 4.2 describes how, based on a comparison with NUREG-0706, the probability of a truck accident involving yellowcake shipment will be up to 20% annually. However, there is only about a 31% likelihood that an accident would release yellowcake, and then 30% or less of the shipment contents would likely be released. Section 4.2 also presents the potential radiological risk factors to the general public from a yellowcake release and concludes that the probability of a cancer death from a yellowcake transportation accident would be very small.

In the unlikely event that an accident involving spilled yellowcake during transportation does occur, all yellowcake and contaminated soil would be removed, processed through a uranium mill, or disposed of in an NRC licensed disposal facility. The cleanup would be directed by qualified personnel from the state radiological emergency assistance team. Should the accident be outside the state personnel's capability, the NRC will be requested to provide assistance (NRC 1980). In addition, Strata will provide a post-cleanup radiological survey to verify that all contaminants have been removed.

Shipment of Process Chemicals or Fuel

It is estimated that approximately four (4) bulk chemical, fuel, and supply deliveries will be made per working day throughout the operational life of the project. Types of deliveries will include carbon dioxide, oxygen, salt, soda ash, hydrogen peroxide, ammonia, sulfuric acid and/or hydrochloric acid, ammonium sulfate, and fuel. All packaging and shipments will be made in accordance with the applicable DOT hazardous materials shipping provisions.

Shipment of Loaded Resin to the Ross ISR Facility

The Ross ISR CPP will be designed and have the capacity to receive uranium-loaded IX resin shipments from satellite ISR facilities, including those owned and/or operated by Strata and those owned and/or operated by other ISR licensees, and from water treatment entities generating uranium-loaded IX resins that are the same or substantially similar to those generated at ISR facilities. Loaded resin will be transferred to the Ross ISR facility in tanker trailers with 500 cubic-foot capacity. Transportation of loaded resin from the satellite facility to the Ross CPP will be the responsible of the satellite facility and covered under its source and byproduct material license. Strata will assume responsibility of the loaded resin when the shipment has reached the site. An unlikely but credible accident could occur if a truck were involved in a collision which ruptured the tanker trailer. NUREG/CR-6733 has concluded after reviewing accident scenarios involving the shipment of loaded resin that consequences are likely to be lower for trucks carrying loaded resin than for trucks carrying dry yellowcake due to the fact that airborne releases from wet material would be minimal if remediated quickly. Further, as described in Section 4.2, the IX resin contains a much lower concentration of uranium than dried yellowcake, and the uranium is chemically bonded to the IX resin and is therefore less likely to spread and easier to remediate in the event of a spill. The risk of an accident within the central plant area is low due to the short distance which would be traveled and the low speed limit of roads within the central plant area. In addition, if an accident did occur, cleanup and remediation efforts are expected to be very prompt considering the proximity to trained personnel.

4.12.1.3 Potential Aquifer Restoration Impacts

Aquifer restoration activities are expected to have similar but generally smaller potential impacts to public and occupational health than during operation. During the time that aquifer restoration overlaps with operation, the quantity of permeate generated by the production and restoration RO units will be highest. Therefore, it is during concurrent aquifer restoration and operation that WYPDES discharge or land application would be most likely to be used. As described previously, potential public and occupational health impacts from permeate disposal are very small due to the high effluent quality, low water volumes, and WDEQ/WQD permit controls. The number of employees, chemical shipments, and dried yellowcake shipments will all be lower during aquifer restoration, and potential radiological and non-radiological public and occupational health impacts will also generally be lower.

4.12.1.4 Potential Decommissioning Impacts

Potential public and occupational health impacts during decommissioning are expected to be similar to those discussed in construction. There will be similar types of occupational hazards such as heavy equipment operation, and there will be an increase in the workforce, although the total number of employees and contractors is expected to be only about half of the peak construction workforce. During decommissioning there will generally not be yellowcake or vanadium shipments from the site nor a significant number of chemical shipments to the site. However, there will be a an increase in shipments of 11e.(2) byproduct material. During the 12 to 18 month decommissioning phase, a total of 200 shipments of 11e.(2) byproduct material are anticipated from affected equipment and piping, pond liners, deep disposal well equipment, and other items described in Section 4.13 of this ER. Strata will be required by the NRC to submit a decommissioning plan for review. The plan will include details on the implementation of a 10 CFR Part 20 compliant radiation safety program. The safety program will ensure that the safety of the workers and public is maintained during decommissioning.

4.12.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project would not be constructed, and potential public and occupational health impacts would not occur as result of construction, operation, aquifer restoration, or decommissioning activities.

Table 4.12-1. Number and Rate of Nonfatal Occupational Injuries and Illnesses for the Mining Industry, Wyoming, 2008

Characteristic	Mining (except oil & gas) NAICS code 212 Number (in thousands)	Rate[1]
Injuries and Illnesses		
Total Cases	0.2	2.1
Cases with days away from work, job transfer or restriction	0.1	1.3
Cases with days away from work	0.1	0.7
Cases with job transfer or restriction	0.1	0.6
Other recordable cases	0.1	0.8
Injuries		
Total cases	0.2	2.0
Illnesses		
Total cases	(2)	(2)
Illness categories		
Skin disorders	(2)	(2)
Respiratory conditions	(2)	(2)
Poisoning	(2)	(2)
Hearing loss	(2)	(2)
All other illness cases	(2)	(2)

Source: Wyoming Department of Employment 2010b

[1] Incidence rates represent the number of injuries and/or illness per 100 full-time workers (10,000 workers for illness rates) and were calculated as: (N / EH) X 200,000 (20,000,000 for illness rates) where,

N = number of injuries and/or illnesses,

EH = total hours worked by all employees during the calendar year,

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year,

20,000,000 = base for 10,000 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

(2) Data too small to be displayed

Table 4.12-2. MILDOS-AREA Input Parameters

Parameter	Abbreviation	Value	Unit	Source
Average Ore Grade		0.05%	% U_3O_8	Application
Ore Ra-226 concentration	[Ra]	143	pCi/g	2860 pCi/g per % U_3O_8, Reg Guide 3.59, NRC 1987
Mined Area	A	4.05E+5	m^2	Application
Average lixiviant flow		5,075	gpm	Application
Average restoration flow		950	gpm	Application
Operating days a year		365	days	Estimate based on planned activities
Ore formation thickness	D	2.7	meters	Application
Ore formation porosity		34	%	Application
Ore formation rock density	ρ	2.1	g/cm^3	Application
Average residence time for lixiviant		11	days	Estimate based on planned activities
Average residence time for restoration solutions		32	days	Estimate based on planned activities
Average mass of ore material in mud pits	M	225,000	g	Estimate based on planned activities
Number of mud pits generated per year	N	733	number of pits	Estimate based on planned activities
Storage time in mud pits	T	20	days	Estimate based on planned activities
Rn-222 emanating power	E	0.25	-	NUREG 1569
Resin porosity		0.35	% U_3O_8	Application
IX column volume		14,160	pCi/g	Application
Number of resin transfers per day		1.5	transfers/day	Estimate based on planned activities
Purge water release	F_p	550,000	L/day	Estimate based on planned activities
Radon venting	v	0.01	day^{-1}	NUREG 1569
Decay constant	L	0.181	day^{-1}	NUREG 1569

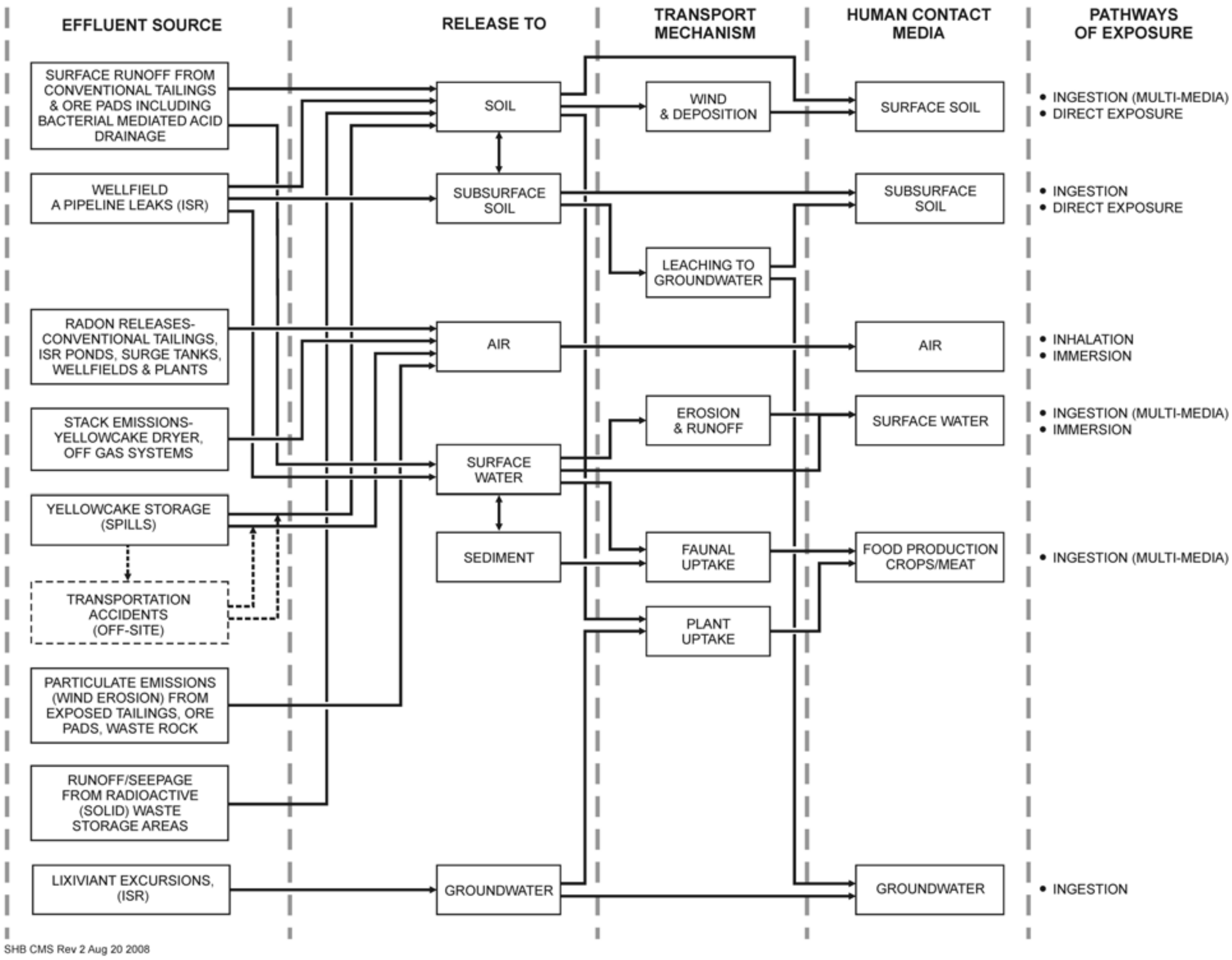
Table 4.12-3. Estimated Radon Release from the Ross ISR Project (Ci/yr)

Location	Construction	Operation	Aquifer Restoration
Mine Unit 1	0.0213	122	122
Mine Unit 2	0.0213	123	123
CPP	N/A	71.2	70.2
Total	0.0426	316.2	315.2

Table 4.12-4. Estimated Annual Dose to Members of the Public

Receptor	Estimated Exposure (hrs/yr)	Maximum TEDE (mrem/yr)		
		Construction	Operation	Aquifer Restoration
Wood residence	8,400	0.000045	0.470	0.468
Strong residence	8,400	0.000053	0.735	0.731
Wesley residence	8,400	0.000070	0.779	0.775
Burch residence	8,400	0.000013	0.090	0.089
Oshoto field office	8,400	0.000048	0.542	0.540
Rancher #1	50	0.000002	0.017	0.018
Rancher #2	100	0.000001	0.011	0.011
Rancher #3	50	0.000001	0.020	0.020
Rancher #4	100	0.000001	0.041	0.041
Rancher #5	100	0.000001	0.010	0.010
Oilfield worker #1	175	0.000005	0.049	0.049
Oilfield worker #2	175	0.000001	0.020	0.020
Courier	90	0.000001	0.049	0.049
Vendor	260	0.000004	0.548	0.542

Figure 4.12-1. Human Exposure Pathways for Potential Sources



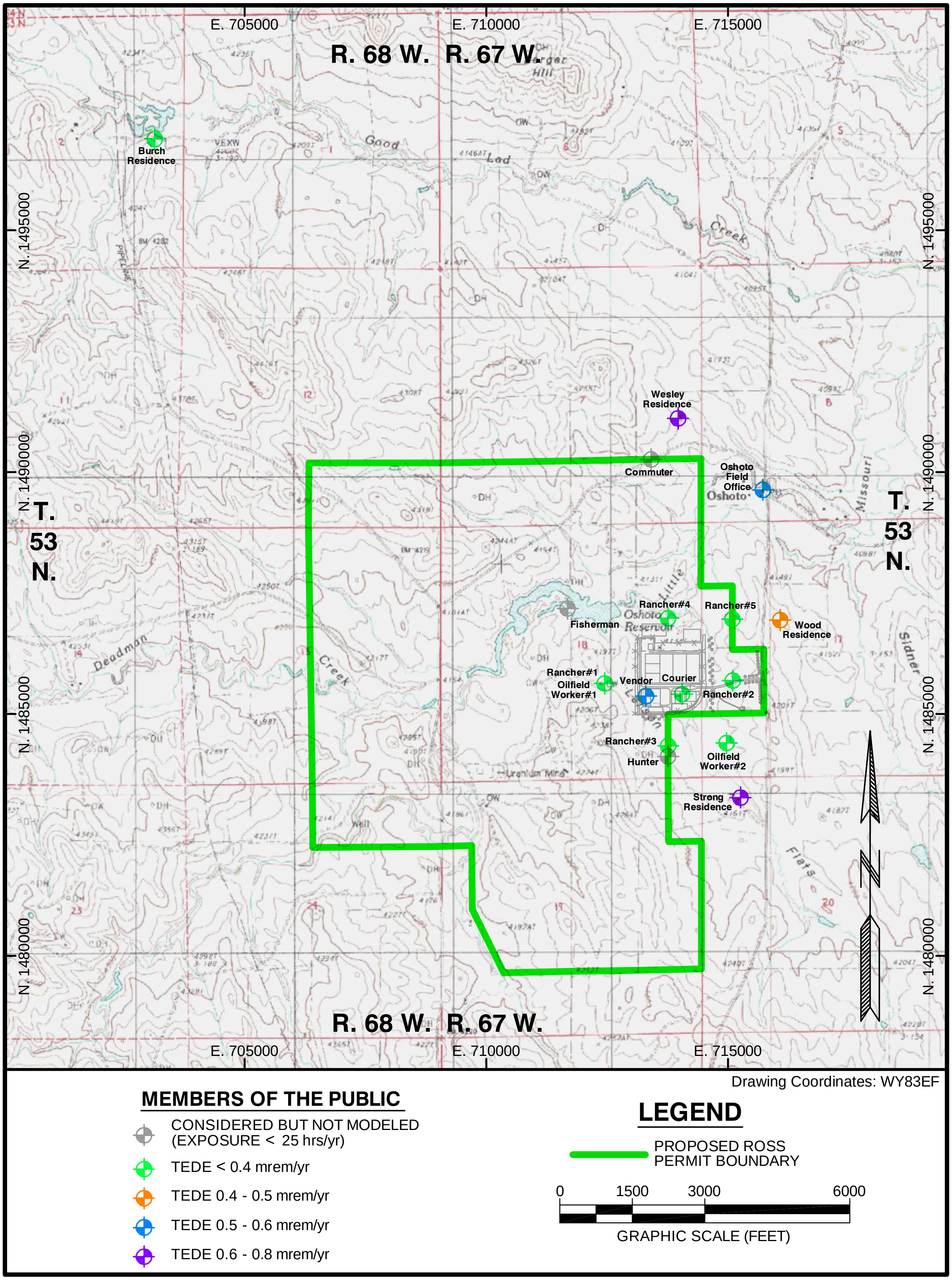


Figure 4.12-2. Maximum TEDE to Members of the Public

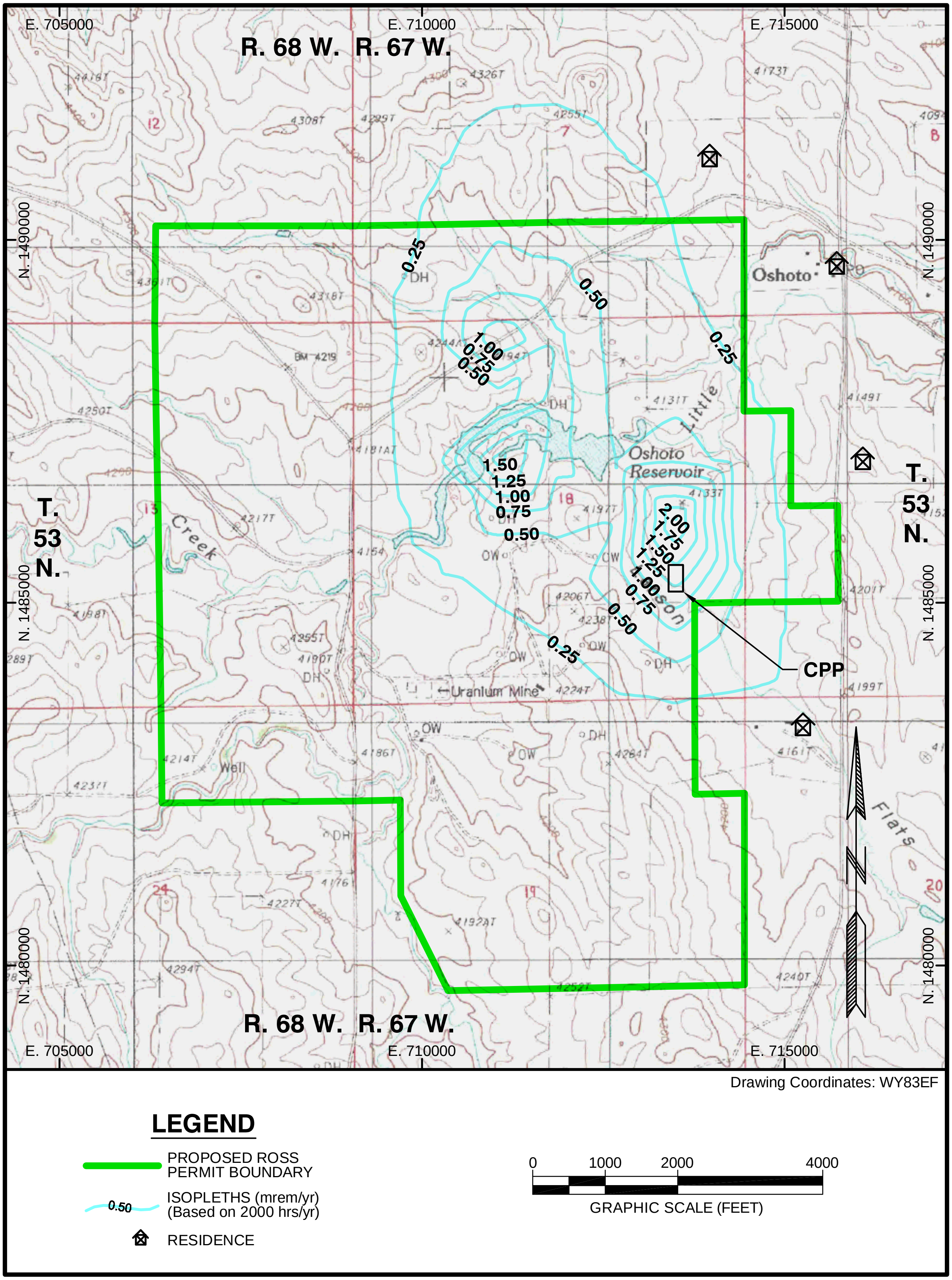


Figure 4.12-3. Isograph

4.13 Potential Waste Management Impacts

ISR uranium recovery facilities produce airborne effluents, liquid wastes, and solid wastes that must be handled and disposed of properly. Potential impacts resulting from airborne effluents are described in Section 4.6 of this ER. This section describes the anticipated quantities, proposed waste management systems, and potential impacts resulting from the management of liquid and solid waste generated under the Proposed Action and No Action Alternative.

4.13.1 Proposed Action

4.13.1.1 Proposed Waste Management Systems

This section describes the types and quantities of waste anticipated during construction, operation, aquifer restoration, and decommissioning of the proposed Ross ISR Project. Liquid and solid wastes are divided into two general categories: AEA-regulated waste and non-AEA-regulated waste. AEA-regulated waste includes liquids and solids meeting the definition of 11e.(2) byproduct material as defined by 10 CFR Part 40.4: "The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." AEA-regulated liquid wastes include brine, excess permeate, decontamination wastewater, spent eluate and other process liquids. AEA-regulated solid wastes include process solids (e.g., filter media), contaminated soil, and parts, equipment, debris, and PPE that cannot be decontaminated for unrestricted release including, but not limited to, pipe, fittings, and hardware (NMA 2007).

The following subsections describe the management of each waste stream anticipated under the Proposed Action. Section 4.13.1.2 describes the potential impacts during construction, operation, aquifer restoration, and decommissioning. For each waste stream, the following information is provided, as required by NUREG-1748:

- ♦ The expected quantity of waste generated during construction, operation, aquifer restoration and decommissioning
- ♦ Waste management systems designed for waste collection, storage, and disposal
- ♦ Waste disposal plan

- Waste minimization plan
- Assessment of potential impacts, including cumulative impacts

Refer to Table 4.13-1 for a summary of the anticipated solid and liquid waste stream sources, storage locations, estimated typical quantities, and disposal methods. Refer to Section 4.13.1.2 for a specific assessment of potential impacts during each project phase.

4.13.1.1.1 AEA–Regulated Waste

4.13.1.1.1.1 Brine

Brine Quantity

Brine will be generated from RO treatment of the production bleed and from RO treatment of the aquifer restoration water. Anticipated brine generation rates during operation, concurrent operation and aquifer restoration, and aquifer restoration only are provided in Figures 4.13-1 through 4.13-3, which present the anticipated water balance for the Ross ISR Project. Most of the brine will be generated during concurrent operation and aquifer restoration, when the levels of brine resulting from RO treatment of the production bleed and RO treatment of restoration fluids will be highest.

Brine Management

Brine will be routed from the production and restoration RO units in the CPP to a wastewater collection system. The wastewater collection system and lined retention ponds are described in Section 4.2 of the TR. Two retention lined ponds are planned, each including three cells. Interconnected piping will allow the transfer of liquids between cells. Ponds will include dual liners and leak detection systems. The water levels in the ponds cells will be maintained such that the total volume of liquid in any once cell can be transferred to the other two cells during maintenance or response to a leaking pond liner. In addition, freeboard will be maintained for the 100-year, 24-hour precipitation event.

Brine Disposal

Most of the brine generated by the Proposed Action will be disposed in Class I deep disposal wells. Deep well disposal was selected as the preferred method of brine disposal due to minimal potential impacts to human health and the environment compared to large evaporation ponds or off-site brine transport. Strata will construct up to five Class I deep disposal wells under a WDEQ/WQD UIC permit. As described in TR Section 4.2.3.2.1, the anticipated discharge capacity is expected to range from 35 to 80 gpm per well, or up to 400 gpm total. A comparison between the maximum anticipated disposal well capacity and the maximum brine and spent eluate disposal rate (300 gpm in Figure 4.13-2) shows that adequate disposal well capacity will be available.

The deep disposal well receiving formations will be the Cambrian-age Deadwood and Flathead Formations, both of which are at least 500 feet below the lowermost potential USDW, the Madison Formation. Deep disposal wells will be constructed according to WDEQ/WQD Class I disposal well construction standards, including surface casing from the ground surface to a distance of at least 100 feet below the base of the lowermost potential USDW. The location, depth, and construction methods for deep disposal wells will be designed to isolate liquid waste from any USDW. In order to permit the wells, Strata will demonstrate that there will be no migration of injected fluids into nearby wells or USDWs. Strata will also perform routine monitoring consisting of quantity and pressure recordation and perform internal and external MIT every 5 years. Deep disposal well permit applications and WDEQ correspondence are included as Addenda 4.2-A and 4.2-B to the TR.

Brine will be pumped to the deep disposal wells in buried pipelines as shown on Figure 1.2-6 and 1.2-7. Lined storage ponds or tanks will provide surge capacity for each disposal well.

The secondary method of brine disposal in the Proposed Action is evaporation in lined retention ponds. Lined retention ponds will be designed, constructed, and inspected in accordance with NRC Regulatory Guide 3.11 and Wyoming WDEQ/WQD rules and regulations for lined wastewater ponds with leak detection systems. Reliance solely upon evaporation ponds has been rejected because of the large surface impoundment areas that would be required, the increased environmental risk associated with storing large quantities of brine in surface impoundments and the lack of evaporation during winter. The use of evaporation in conjunction with liquid waste disposal in on-site deep disposal wells is considered to be the best alternative to dispose of these types of liquid waste.

Multiple deep disposal wells will provide operational flexibility in case one of the disposal wells becomes inoperable either for the short or long term.

Additional capacity will also be available in the lined retention ponds to completely contain an entire pond cell in the remaining cells without exceeding the freeboard capacity limits, which include space for rainfall and wave surges. In the event that a leak should develop in a pond cell, the contents of that cell will be quickly pumped to another pond cell as described in Section 4.2 of the TR.

Brine Minimization

The quantity of brine generated during operation of the Ross ISR Project will be minimized primarily by employing two stages of RO. That is, the brine from the first stage of production and restoration RO will be further treated in a second stage. This will reduce the brine quantity by an estimated 50% compared to single-phase RO treatment. Strata will further reduce the brine quantity by employing limited groundwater sweep. As described in TR Section 6.1, a limited volume of groundwater sweep is proposed to minimize consumptive use of groundwater outside of the exempted aquifer. Strata may also selectively apply groundwater sweep to specific portions of the affected wellfield module in order to maximize benefits with a minimal volume of water withdrawal and subsequent brine production.

Brine Waste Management Potential Impacts

Potential impacts from brine management include potential leaking pipes in the wastewater collection system, potential leaks from the lined retention ponds, potential spills from transportation of wellfield wastewater (e.g., resulting from well work over) to the ponds, and potential deep disposal well impacts, including potential pipeline leaks and potential groundwater impacts. These potential impacts are described with potential water resource impacts (Section 4.4) and potential soil impacts (4.3). Section 4.12 also addresses potential radiological impacts from the use of deep well injection for disposal of 11e.(2) liquid wastes.

4.13.1.1.1.2 Excess Permeate

Excess Permeate Quantity

Strata proposes to withdraw excess bleed during production, treat this production bleed through two stages of RO treatment, and inject most of the permeate into producing wellfield modules to help reduce salt buildup.

Permeate that is recycled to the wellfield is not considered a waste product and is not included in the analysis of potential waste management impacts. Figure 4.13-1 shows that a surplus of permeate is expected to be discharged into the lined retention ponds during operation without concurrent aquifer restoration. This will also likely occur during the beginning of aquifer restoration, when the first wellfield module(s) undergo groundwater sweep but when there are no wellfield modules in the RO treatment with permeate injection phase. Additional information is presented in TR Section 6.1. During concurrent operation and aquifer restoration and during aquifer restoration only, all permeate generated from production and restoration RO units is expected to be injected into wellfield modules undergoing RO treatment with permeate injection.

Excess Permeate Management

Excess permeate, when present, will be routed from the production and restoration RO units in the CPP to the lined retention ponds in buried pipelines. Note that the lined retention ponds may be used to store either permeate or brine and other 11e.(2) liquid waste at various stages. From initial operation through the beginning of aquifer restoration, Strata anticipates that three pond cells will be dedicated to permeate storage. Maximum excess permeate production will coincide with concurrent operation and groundwater sweep in the first wellfield module(s) undergoing aquifer restoration. After this time, all permeate will generally be injected into wellfield modules undergoing RO treatment with permeate injection. Therefore, it will no longer be necessary to store excess permeate in the lined retention ponds, and all lined ponds will typically be used to store brine and other 11e.(2) liquid waste.

Excess Permeate Disposal

Permeate is nearly pure, treated effluent, and as such, excess permeate will generally be put to beneficial use. Most permeate will be injected into wellfields undergoing aquifer restoration without being routed through the lined retention ponds. Excess permeate temporarily stored in the lined retention ponds will be disposed through one of the following methods:

- Recycle for plant make-up water
- Injection into wellfield modules undergoing aquifer restoration to control bleed

- Surface discharge
- Land application
- Class I disposal wells

Most excess permeate temporarily stored in the lined retention ponds will be recycled to the CPP for use as make-up water, primarily in the precipitation circuit. Excess permeate may also be used to make up fresh elution brine.

A second method of disposing excess permeate stored in the lined retention ponds will be injection into wellfield modules undergoing RO treatment with permeate injection. The lined retention ponds will provide a surplus capacity to allow Strata to supplement the permeate that circumvents the ponds during aquifer restoration.

Surface discharge of permeate would require a WYPDES permit issued by WDEQ/WQD. A WYPDES permit would include effluent limits designed to protect the receiving water in accordance with the Clean Water Act. If a WYPDES permit were obtained for permeate disposal, radium treatment might be required using barium chloride precipitation or a zeolite-based radium treatment system such as that available from Water Remediation Technology, LLC. In the latter case the treatment provider would dispose of the radium-loaded treatment media in an NRC-approved disposal facility.

During the growing season (approximately May through September), excess permeate may be disposed in a land application system. Table 4.13-2 summarizes the anticipated permeate water quality. The estimated permeate water quality is based on the anticipated ore zone water quality during operations and specific ion rejection rates of 94% to 100% as described in TR Section 6.1. Water such as this with low divalent cations (calcium and magnesium) might pose an infiltration risk to clay soils. Therefore, a land application system would likely include the application of soil or water amendments such as gypsum (calcium sulfate dihydrate). Prior to land application, the permeate might also be treated for radium reduction using the methods described above for treatment prior to WYPDES discharge.

Strata has conducted a preliminary study on the suitability of soils for land application in the proposed project area. The study indicated that suitable soils exist considering the high quality permeate that would be used. At this time, Strata is considering the use of land application. Further evaluation would be required to acquire the necessary permits. Prior to pursuing land application as a use option, Strata will provide the following for NRC and WDEQ/WQD approval:

- An irrigation plan including application system designs and flow rates,
- A site description,
- Area of review evaluation,
- Water balance demonstration,
- Geologic description,
- Hydrogeologic description,
- Water quality evaluation including a demonstration that potential doses conform to 10 CFR part 20 requirements,
- Baseline soil conditions including textural and chemical analysis for the affected areas,
- Crop description including fate of crops produced,
- Water treatment and soil amendment plans,
- Monitoring program focusing on potential impacts to irrigated soil crops, and a
- Decommissioning plan.

Strata will also work closely with WDEQ/LQD to ensure compliance with the Permit to Mine.

The final method of excess permeate disposal is injection, along with brine, in Class I deep disposal wells. Where possible, Strata will employ one of the other methods to maximize beneficial uses of the relatively high quality permeate. Since the lined retention ponds planned for temporary permeate storage have limited surface area and since they will not always be kept full, evaporation is not included as a significant permeate disposal option.

Excess Permeate Minimization

Most permeate generated from the production and restoration RO units will be injected into producing wellfield modules or wellfield modules undergoing aquifer restoration. By employing two-stage RO units, Strata will maximize permeate production and minimize brine production. Excess permeate will be minimized by recycling the permeate from the lined retention ponds to the CPP and to wellfield modules undergoing aquifer restoration.

Excess Permeate Waste Management Potential Impacts

Potential waste management impacts resulting from excess permeate recycled to the CPP are addressed with brine impacts, since most of this water will ultimately be discharged to the deep disposal wells. Potential impacts from excess permeate injection into the wellfield are addressed in Section 4.4.3. Potential impacts from surface water discharge would be small, since the water quality would need to meet WYPDES effluent limits established by WDEQ/WQD as protective of existing water uses in the receiving stream. Potential impacts from land application include altering soil chemistry, reducing the soil infiltration rate, and affecting irrigated crops. These would be addressed in a site-specific land application plan that would be submitted to NRC and WDEQ/LQD for regulatory approval prior to land application. Potential impacts from permeate disposal in deep disposal wells are addressed in Section 4.4.3.

4.13.1.1.1.3 Other 11e.(2) Liquid Waste

Other 11e.(2) liquid waste includes spent eluate, liquid from process drains in the CPP, fluids generated from work over operations on injection and recovery wells, contaminated reagents, resin transfer wash water, filter backwash water, plant wash down water, and decontamination water (e.g., employee showers). Liquid wastes generated in the CPP will be discharged into the brine ponds through the wastewater collection system, while water collected from swabbing or other work over activities on injection and recovery wells will be collected in dedicated tanks and transported to the lined retention ponds. Any water captured from leaking pipelines or equipment will also be transported to lined retention ponds in dedicated portable tanks or tanker trucks.

Other 11e.(2) liquid wastes will be managed with brine and disposed primarily through deep well injection, with lesser amounts evaporated in the lined retention ponds prior to disposal. The anticipated quantity of other liquid 11e.(2) liquid waste is shown in Table 4.13-1 and Figures 4.13-1 through 4.13-3.

4.13.1.1.1.4 Solid 11e.(2) Byproduct Material

Solid 11e.(2) Byproduct Material Quantity

Solid 11e.(2) byproduct material will be generated during all project phases except construction. During operation and aquifer restoration, Strata estimates that approximately 100 cubic yards of solid 11e.(2) byproduct material will be generated annually from the following source. This equates to about five 20-cubic yard shipments annually, which is well within the typical range of 2.5 to 15 annual shipments provided in the ISR GEIS (Table 2.8-1, pg. 2-39).

- Filtrate and spent filter media from production and restoration circuits
- General sludge, scale, etc. from maintenance operations
- Affected soil collected from spill areas
- Spent/damaged ion exchange resin
- Well solids from injection/recovery well work over operations
- Contaminated PPE

During decommissioning, up to an estimated 4,000 cubic yards of solid 11e.(2) byproduct material will be generated from the following areas. Estimated quantities generated during decommissioning are provided in the financial assurance calculations in the RAP (TR Addendum 6.1-A).

- Wellfield decommissioning, including:
  - Injection, recovery, and restoration fluid trunklines
  - Injection and recovery well feeder pipelines
  - Downhole well piping (drop pipe)
  - Manholes and sumps
  - Valves, pumps, and instrumentation and control equipment
  - Impacted soil
- Affected concrete floors, sumps, and berms in the CPP
- Equipment and piping in the CPP
- Pond sludge, pond liners, and leak detection systems
- Disposal well piping and equipment

The total quantity of solid 11e.(2) byproduct material that is expected to be generated from the Proposed Action is up to 5,000 cubic yards, based on 6 to 10 years of operation and aquifer restoration at 100 cubic yards per year and an additional 4,000 cubic yards during decommissioning.

Solid 11e.(2) Byproduct Material Management

During production and aquifer restoration, solid 11e.(2) byproduct material will be stored inside the CPP in the 11e.(2) Storage and Preparation Area. The location of this room is depicted on Figure 3.2-1 in the TR. The storage room contains space for at least two 20-cubic yard roll-off containers, with adequate additional space for 55-gallon drums and loading operations. The 11e.(2) Storage and Preparation Area will be locked and posted as restricted.

Solid 11e.(2) byproduct material will be placed inside of 55-gallon, lined drums within the 11e.(2) Storage and Preparation Area. When the drums are full, they will be sealed and moved into a 20-cubic yard roll-off container. The roll-off containers will be shipped to a licensed disposal facility. Adequate storage will be provided for at least two roll-off containers in the CPP. One or more additional 11e.(2) byproduct material storage areas may be designated outside of the CPP. These areas will be fenced, locked and posted with signs indicating they are restricted access 11e.(2) byproduct material storage areas. Large items such as contaminated equipment that cannot be stored in a roll-off container will be stored in one of the designated 11e.(2) byproduct material storage areas and covered/sealed in a manner that will prevent the spread of contamination in the 11e.(2) byproduct material storage area.

Solid 11e.(2) Byproduct Material Disposal

Sealed 20-cubic yard roll-off containers containing 11e.(2) byproduct material will be transported by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement state. Strata will develop an agreement with an off-site disposal facility prior to initiating any activity that will generate 11e.(2) byproduct material. Strata will notify NRC within 7 days if the 11e.(2) byproduct material disposal agreement is terminated and will submit a new agreement for NRC approval within 90 days of expiration or termination. Potential disposal facilities evaluated in this ER include the following. Strata might also consider the Kennecott Sweetwater Uranium Mill in the future should it become active.

- Pathfinder Mine Corporation, Shirley Basin Facility, Shirley Basin, Wyoming
- Denison Mines Corporation, White Mesa Uranium Mill, Blanding, Utah
- Energy Solutions LLC, Clive Disposal Site, Clive, Utah
- Waste Control Specialists LLC, Byproduct Material Disposal Facility, Andrews, Texas

Based on the anticipated solid 11e.(2) byproduct material generation rate of 100 cubic yards per year during operation and aquifer restoration, about 5 annual shipments of 11e.(2) byproduct material are anticipated during these project phases. During decommissioning, which is estimated to last 12-18 months, 100 to 200 shipments per year are expected.

Solid 11e.(2) Byproduct Material Minimization

The quantity of solid 11e.(2) byproduct material will be minimized through process design, decontamination, and volume reduction during decommissioning. Filter media for the production and restoration circuits will be selected based on filtration efficiency and on minimizing waste material. Where possible, equipment and building surfaces will be decontaminated and reclassified as non-hazardous material for unrestricted release. Decontamination procedures are discussed in TR Section 6.3 and may include high pressure washing, sand blasting, and acid rinsing. Strata anticipates that a grinder or chipper will be used to reduce disposal volumes of piping and other materials by 50% or more.

Solid 11e.(2) Byproduct Material Management Potential Impacts

Potential impacts solid resulting from the management and disposal of solid 11e.(2) byproduct material include potential spills, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2. In addition, Strata assessed the potential impacts on solid 11e.(2) byproduct material disposal on the capacity of the facilities potentially receiving the byproduct material. This assessment is provided below:

- Pathfinder Mines Corporation, Shirley Basin Facility: According to NRC materials license SUA-442, Amendment No. 59 (Adams Accession No. ML063480527), the Shirley Basin Facility is authorized to dispose of byproduct from ISR facilities without specific authorization from the NRC. There is a disposal limit of 10,000 cubic yards of byproduct material from generators other than ISR facilities. While there is potentially sufficient capacity to accept all of the solid 11e.(2) byproduct material from the Proposed Action at the Shirley Basin Facility, Strata might be required to find an alternate disposal facility in the event that the Shirley Basin Facility stops accepting 11e.(2) byproduct material and completes reclamation.

- Denison Mines Corporation, White Mesa Uranium Mill, Blanding, Utah: According to Utah Division of Radiation Control License UT 1900479 (Utah DEQ 2010a), disposal of byproduct material generated at licensed ISR facilities is limited to 5,000 cubic yards from a single source. Based on this limitation, Strata would be able to dispose most or all of the solid 11e.(2) byproduct material at this facility, but an agreement with an alternate facility would be needed at some point due to the uncertainty in final decommissioning volumes.
- Energy Solutions LLC, Clive Disposal Site: According to Amendment 6 to Radioactive Material License UT 2300478 (Utah DEQ 2010b), the maximum quantity of 11e.(2) byproduct material that this facility may possess at any one time is 5.5 million cubic yards. By comparison, the total estimated solid 11e.(2) byproduct material quantity from the Proposed Action (5,000 cubic yards), is less than 0.1% of this volume.
- Waste Control Specialists LLC, Byproduct Material Disposal Facility, Andrews, Texas: According to Radioactive Material License R05807 (Texas Commission on Environmental Quality 2010), this facility is licensed to accept up to 1,169,000 cubic yards of byproduct material. If all of the solid 11e.(2) byproduct material from the Proposed Action were disposed at this facility, it would occupy less than 0.5% of the permitted capacity.

4.13.1.1.2 Non-AEA-Regulated Waste

4.13.1.1.2.1 Solid Waste

Solid Waste Quantity

Solid waste will include construction debris, office trash, and decontaminated material and equipment. It will be generated during all project phases, including construction, operation, aquifer restoration, and decommissioning. Most of the solid waste will be generated during decommissioning. As described in Section 6 in the TR, Strata estimates that up to 2,000 cubic yards of solid waste will be generated during decommissioning. During the prior three project phases, only about 20 cubic yards per week (1,000 cubic yards per year) are expected.

Solid Waste Management

During construction and decommissioning, solid waste will be stored in roll-off containers in designated areas prior to shipment to a nearby landfill. During operation and aquifer restoration, solid waste will be collected daily from work areas and disposed in trash receptacles located within the restricted area but near a primary access road for convenient access for a contract waste disposal contractor.

Solid Waste Disposal

Non-hazardous solid waste will be disposed off-site in a municipal landfill permitted by WDEQ/SHWD. The nearest municipal landfills include Moorcroft (approximately 23 road miles south), Sundance (approximately 38 road miles southeast), and Gillette (approximately 52 road miles southwest).

Solid Waste Minimization

The quantity of non-hazardous solid waste will be minimized by recycling and decontaminating materials and process equipment and by using a chipper or grinder during decommissioning. Recyclable materials currently accepted at the Gillette landfill include newspaper, magazines, phone books, cardboard, aluminum and steel cans, and plastic (City of Gillette 2010).

Solid Waste Potential Impacts

The potential impact to area municipal landfills from disposing the non-hazardous solid waste generated by the Proposed Action will be small. According to Trihydro (2009), the Moorcroft Landfill currently disposes about 1,000 tons of municipal solid waste and about 600 tons of construction debris annually. By comparison, the Proposed Action is expected to generate up to 1,000 cubic yards per year during the first three project phases. Applying a typical municipal solid waste density of 100 pounds per cubic yard, this is equal to about 50 tons per year, or about 5% of the current Moorcroft disposal rate. The potential impact to landfill capacity is therefore small during construction, operation and aquifer restoration.

During decommissioning, a large quantity of construction debris will be generated. Based on the volumetric estimate of up to 2,000 cubic yards and a typical construction debris density of 2,000 pounds per cubic yard, up to about 2,000 tons of construction debris could be generated. This could have a significant impact on the capacity of the Moorcroft landfill if all of the construction debris were taken to this disposal facility. This potential impact will be minimized by coordinating with the Moorcroft landfill well in advance of decommissioning to ensure sufficient capacity will be available or by transporting solid waste generated during decommissioning to an alternate landfill.

Potential transportation impacts resulting from disposing solid waste are addressed in Section 4.2.

4.13.1.1.2.2 TENORM

TENORM (technologically enhanced naturally occurring radioactive materials) includes drilling fluids and drill cuttings from monitor wells and from the construction and development of recovery and injection wells prior to using the wells for ISR uranium recovery.

TENORM Quantity

Based on information gathered during installation of the regional baseline monitor wells for the proposed Ross ISR Project, a typical injection, recovery, or monitor well is expected to use between 3,000 and 30,000 gallons of water during drilling and well development and average around 6,000 gallons. In addition, installation of each well is expected to yield approximately 5 to 15 cubic yards of drill cuttings.

TENORM Management

TENORM drilling fluids will be stored and disposed of on-site in mud pits, which will be constructed adjacent to the drilling pad. TENORM groundwater produced during baseline activities was discharged under a temporary WYPDES permit as discussed below. It is expected that other TENORM groundwater generated during the operation and decommissioning phases will be discharged in a similar manner as long as the well is not completed in an interval which could have been affected by uranium recovery operations.

During hydrologic baseline activities, groundwater was discharged during sample collection and aquifer testing. The “native” groundwater had not been exposed to any uranium recovery processes or chemicals. The groundwater recovered during these activities was discharged to the surface in a non-erosive manner. This discharge was authorized under temporary WYPDES permit WYG720229. In accordance with the permit, the discharge was monitored for flow, TDS, TSS, pH, radium, and uranium, and the results reported to WDEQ/WQD.

Discharges under the temporary WYPDES permit occurred during water quality sampling at each of the 6 baseline well clusters, throughout July of 2010 during aquifer tests conducted at each of the baseline well clusters. Additional details regarding WYPDES discharge during regional baseline monitor well construction and sampling are found in TR Section 4.2.1.2.1.

TENORM Disposal

Mud pits containing drilling fluids and cuttings will be backfilled and graded in accordance with WDEQ/LQD regulations.

TENORM Minimization

The quantity of drilling fluids will be minimized by using the minimum quantity of water that is technically feasible for well drilling and development.

TENORM Potential Waste Management Impacts

Potential waste management impacts are primarily those associated with the surface disturbance required for mud pit construction and potential surface water impacts from discharge of “native” groundwater. Potential impacts include temporarily disturbing and changing existing land uses as described in Section 4.1, providing an increased risk for sediment transport due to soil disturbance and vegetation removal as described in Section 4.4, and potentially disturbing cultural resources as described in Section 4.8. Mitigation measures that will minimize potential impacts from TENORM waste disposal include backfilling, restoring and re-seeding mud pits, typically within a single construction season, using sediment control BMPs, avoiding construction in areas with previously identified, potentially NRHP-eligible cultural sites, and stopping work if any previously undiscovered cultural resources are encountered during construction or reclamation of mud pits.

As described by EPA (2008), "Some slight radioactivity may occur in accumulated solids in the pit bottoms." The estimated average mass of ore material in the mud pits has been included in the MILDOS-AREA source term estimates for wellfield modules as described in Section 4.12 of this ER. The radium-226 release rate from mud pits is expected to be low, and the potential impacts to public health and safety from radioactive material in the mud pits will be small. Mud pits will be included in the decommissioning gamma surveys to ensure that there are no potential long-term impacts from radioactivity in mud pits.

4.13.1.1.2.3 Hazardous Waste

Hazardous Waste Quantity

Hazardous waste generated by the Proposed Action may include small quantities of used oil from CPP equipment and wellfield vehicles, oil-contaminated soil, oily rags, used batteries, expired laboratory reagents, fluorescent lightbulbs, solvents, cleaners, and degreasers. Small amounts of hazardous waste are expected to be generated during all four project phases in similar quantities. Strata anticipates that the Ross ISR Project will be classified as a conditionally exempt small quantity generator (CESQG) by WDEQ/SHWD. As such, the project will be required to generate less than 220 pounds (100 kg) of hazardous waste in any calendar month and store less than 2,200 pounds (1,000 kg) of hazardous waste at any one time. If the facility does not meet the requirements for a CESQG, it would lose its CESQG status and be fully regulated as either a small-quantity generator (more than 100 but less than 1,000 kg hazardous waste per calendar month) or a large quantity generator (more than 1,000 kg per calendar month) (NRC 2010).

Hazardous Waste Management

Hazardous waste will be stored in secure containers inside the maintenance shop. The containers will be compatible with the materials stored, visually inspected for leaks, rust, etc. and will be labeled with contents. The maintenance shop will have a specific area that is bermed and adequately vented for hazardous waste temporary storage.

Hazardous Waste Disposal

Hazardous waste will be transported to an off-site treatment, storage and disposal facility that is licensed by WDEQ/SHWD or a nearby state to manage hazardous waste. The Campbell County Landfill, located just north of Gillette, accepts used oil and batteries for recycling and certain other hazardous waste by contract (Campbell County Public Works 2010). If needed, small quantities of used reagents or other types of hazardous waste may occasionally be transported to more distant licensed disposal facilities.

Hazardous Waste Minimization

Strata will minimize the quantity of hazardous waste generated by the Proposed Action by generally servicing vehicles and equipment at off-site facilities and by limiting laboratory reagent orders to quantities that can be consumed within the reagent shelf lives. The quantity of hazardous waste generated and stored in the proposed project area will be kept small in order to comply with CESQG requirements.

Hazardous Waste Potential Waste Management Impacts

Potential waste management impacts from hazardous waste management, storage and disposal include potential releases to surface and groundwater, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2.

4.13.1.1.2.4 Domestic Sewage

Domestic Sewage Quantity

The quantity of domestic sewage generated by the Proposed Action will vary according to the number of workers during each project phase. The peak number of workers is estimated to be 200 during construction. Using a peak WDEQ/WQD per capita domestic wastewater generation rate of 30 gallons per day (gpd) per industrial employee (Chapter 11, Wyoming Water Quality Rules and Regulations), the peak daily domestic wastewater generation rate is expected to be up to about 6,000 gpd. The average daily wastewater generation rate during operations will likely be about 800 gpd, based on the EPA (2002) domestic wastewater generation rate of 13 gpd for industrial building employees.

Domestic Sewage Management

Domestic wastewater will be collected in a gravity sewer collection system serving the office/administration building, CPP, maintenance building, and any other buildings with restrooms. Raw wastewater will be routed in gravity sewer pipes to one or more septic tanks for primary treatment.

Domestic Sewage Disposal

Domestic waste will be disposed in an on-site wastewater treatment or disposal system. The system will be designed according to WDEQ/WQD standards and will likely include one or more septic tanks for primary treatment. Septic tank effluent will either be disposed in a gravity or pressure-dosed drainfield, or Strata might decide to design and permit an enhanced treatment system. A wastewater treatment system would potentially include a recirculating geotextile or sand filter and disinfection followed by surface discharge of highly treated effluent. Based on the anticipated peak daily flow rate greater than 2,000 gpd, it is anticipated that a drainfield would be permitted as a Class V UIC facility through WDEQ/WQD. As such, WDEQ/WQD would likely require the installation of monitor wells around the drainfield with requirements for quarterly or semiannual monitoring. WDEQ/WQD would establish monitor well contaminant limits for common domestic wastewater contaminants such as chloride, nitrate, ammonia, and bacteria. A wastewater treatment system would also require point-of-compliance sampling. Typically, treated effluent would be discharged under a WYPDES permit with effluent limits established by WDEQ/WQD as protective of the receiving stream. Alternately, treated effluent could be put to beneficial use in constructed wetlands.

Every 1 to 5 years, the septic tank(s) will require sludge removal. This will be performed by a waste disposal contractor, who will pump the solids from the septic tanks into a tanker truck and transport the sludge to a nearby municipal wastewater treatment system for disposal.

Domestic Sewage Minimization

Due to the significantly higher number of construction workers relative to operating personnel, Strata will consider constructing an on-site wastewater disposal system for operating personnel and temporary holding tanks pumped by a wastewater disposal contractor for construction and decommissioning. This would reduce the amount of on-site effluent disposal.

Domestic waste will also be minimized by using modern, low-flow restroom fixtures. As required by the 1992 U.S. Energy Policy Act, fixtures installed after January 1994 must meet modern low-flow requirements (e.g., toilets with flush capacities equal or less than 1.6 gallons per flush).

Domestic Sewage Potential Impacts

Construction of the domestic wastewater system will result in soil disturbance, although the system will be constructed inside or adjacent to the central plant area, in areas likely disturbed by facility construction and utility installation. The size of the drainfield, if constructed, will depend on the design capacity, the drainfield configuration, and the site-specific percolation rate of the receiving soils. A trench-style drainfield with gravelless drainfield chambers would require about one-third acre (14,520 square feet) of surface area, assuming a moderate percolation rate of 30 minutes per inch and a peak design flow rate of around 5,000 gpd. Figure 1.2-5 depicts the preliminary drainfield location. Effluent may be pumped from the septic tank(s) to the drainfield if needed; the drainfield will not need to be located downgradient from the septic tank(s).

Potential transportation impacts related to sludge hauling would be small and are addressed in Section 4.2.

Potential groundwater impacts resulting from effluent disposal would be small and are addressed in Section 4.4. The small quantity of effluent (about 2 gpm on average) spread over a large area would have very limited potential to impact groundwater quality, considering that a properly sized and maintained septic tank will remove most of the solids and significantly reduce total suspended solids, organic carbon, and ammonia, and a drainfield will provide further treatment, including a high level of bacteria reduction. Alternately, if treated effluent were discharged to a surface water drainage, the small volume and high quality of water would have a small impact on the receiving water.

4.13.1.2 Potential Construction Impacts

During construction of the proposed Ross ISR Project, no AEA-regulated waste will be generated. Waste will be limited to relatively small quantities of solid waste (est. 20 cy/week), hazardous waste (est. <220 lb/month), and domestic sewage (est. 2,600 gpd). Most or all of the TENORM (drilling fluids and drill cuttings) will also be generated during construction. Potential impacts will result from surface disturbance during construction of waste management facilities, including lined retention ponds, deep disposal wells, deep disposal well pipelines, mud pits and the domestic wastewater system. Potential impacts include temporarily changing the land use in disturbed areas and restricting access around the fenced drainfield and central plant area (discussed in Section 4.1), impacting surface water due to sediment transport (discussed in Section 4.4), and disturbing cultural resources (discussed in Section 4.8). The area required for waste management facilities will be small, and potential surface disturbing impacts will be accordingly small. Mitigation measures include using sediment control BMPs, restoring and re-seeding disturbed areas, typically within a single construction season, avoiding construction in areas with previously identified, potentially NRHP-eligible cultural sites, and stopping work if any previously undiscovered cultural resources are encountered during construction.

Potential impacts to shallow groundwater or surface water from domestic effluent disposal are described in Section 4.4. The domestic wastewater treatment or disposal system will be designed according to WDEQ/WQD requirements designed to protect water quality in the receiving aquifer or channel. Monitor wells or effluent sampling will also likely be required to ensure no degradation of shallow groundwater or surface water quality. Potential impacts are therefore small.

Potential transportation impacts resulting from waste management are discussed in Section 4.2. During construction, only a relatively small amount of additional traffic will be required to transport solid and hazardous waste from the proposed project area to nearby landfills. The potential impacts are therefore small.

4.13.1.3 Potential Operation Impacts

During operation, non-AEA-regulated waste will be generated at similar or lesser quantities than during construction. Solid waste and hazardous waste quantities will be similar to those generated during construction, and the potential impacts will be accordingly small. The quantity of domestic sewage will likely decrease due to a smaller operating work force, and there will be little or no TENORM generated from operation activities.

AEA-regulated waste generated during operation includes solid material (including but not limited to filtrate and spent filter media, scale and sludge from equipment maintenance, contaminated soil, damaged IX resin, contaminated solids from injection/recovery well work over operations, and contaminated PPE) and liquids (excess permeate, brine, and other 11e.(2) liquid waste such as spent eluate, process drain water, contaminated reagents, filter backwash water, wash down water, and water from decontamination showers).

Permeate is nearly pure water resulting from RO treatment of the production bleed and restoration fluids, and excess permeate will generally be put to beneficial use through aquifer restoration, maintaining the salinity in producing wellfield modules, plant make-up water, land application or WYPDES discharge. The final option for excess permeate management is Class I deep well disposal. Potential impacts related to excess permeate disposal are described in Section 4.1 (potential land use impacts from land application and WYPDES discharge) and Section 4.4 (potential surface and groundwater impacts from excess permeate disposal).

Brine and other 11e.(2) liquid waste will be temporarily stored in lined retention ponds and then transported to Class I deep disposal wells in buried pipelines. Potential impacts related to disposal of these liquid wastes include potential surface and groundwater impacts from spills, leaks, or deep well disposal (discussed in Section 4.4). The potential for surface and groundwater impacts will be reduced by implementing mitigation measures including special construction measures for pipeline stream crossings, dual liners with leak detection systems for lined retention ponds, and protection of potential USDWs during deep disposal well construction and operation.

11e.(2) byproduct material not disposed in the deep disposal wells (typically solid material) will be stored in lined drums and roll-off containers in the 11e.(2) Storage and Preparation Area within the CPP. Solid 11e.(2) byproduct material will be transported in the sealed roll-off containers by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement state. Potential transportation impacts are addressed in Section 4.2 and are expected to be small due to the low traffic volume and low risk of contamination in the event of an accident involving transport of 11e.(2) byproduct material.

4.13.1.4 Potential Aquifer Restoration Impacts

Potential waste management impacts during aquifer restoration activities are similar to those anticipated during operation. The quantity of non-AEA-regulated waste will typically be lower during aquifer restoration due to a lesser workforce. The quantity of AEA-regulated material will typically be similar than during operation except for excess permeate and brine, which are both anticipated to increase during aquifer restoration.

4.13.1.5 Potential Decommissioning Impacts

Potential waste management impacts during decommissioning are anticipated to be similar to those during construction for most AEA-regulated and non-AEA-regulated wastes. Three distinctions are TENORM, which will be generated during construction but not decommissioning, solid waste, which will be generated at higher quantities during decommissioning than construction, and 11e.(2) byproduct material, which will be generated during decommissioning but not construction.

The quantity of non-AEA-regulated solid waste will increase from an estimated 20 cubic yards per week of relatively light-weight trash during construction, operation, and aquifer restoration (1,000 cubic yards per year) to 2,000 cubic yards over 12 to 18 months of dense construction debris and decontaminated piping, materials, and equipment during decommissioning. While the relatively small mass of solid waste during the previous three project phase would have minimal impact to the nearest municipal landfill (Moorcroft), the increased mass and volume during decommissioning could have a significant impact on the capacity of the Moorcroft landfill. This will be mitigated by coordinating with the landfill well in advance of decommissioning to ensure that sufficient capacity will be available or by transporting solid waste generated during decommissioning to an alternate landfill.

The quantity of 11e.(2) byproduct material requiring transport and off-site disposal will be significantly higher during decommissioning than any of the other project phases. During decommissioning, an estimated 4,000 cubic yards of solid 11e.(2) byproduct material will be generated from wellfield modules and the central plant area, including affected concrete, equipment and piping in the CPP; lined retention pond sludge, liners, and leak detection systems; and disposal well piping and equipment. There is currently sufficient capacity at each of the four potential disposal facilities evaluated in this ER.

The primary potential impacts associated with solid 11e.(2) byproduct material disposal are transportation-related impacts discussed in Section 4.2. Although the number of shipment per year will increase during decommissioning, the potential impacts are expected to be small due to the frequency of shipments (100 to 200 per year) and the low risk of contamination in the event of an accident involving transport of 11e.(2) byproduct material.

4.13.2 No Action Alternative

Under the No Action Alternative, the Ross ISR Project and associated waste management systems would not be constructed, and potential waste management impacts would not occur.

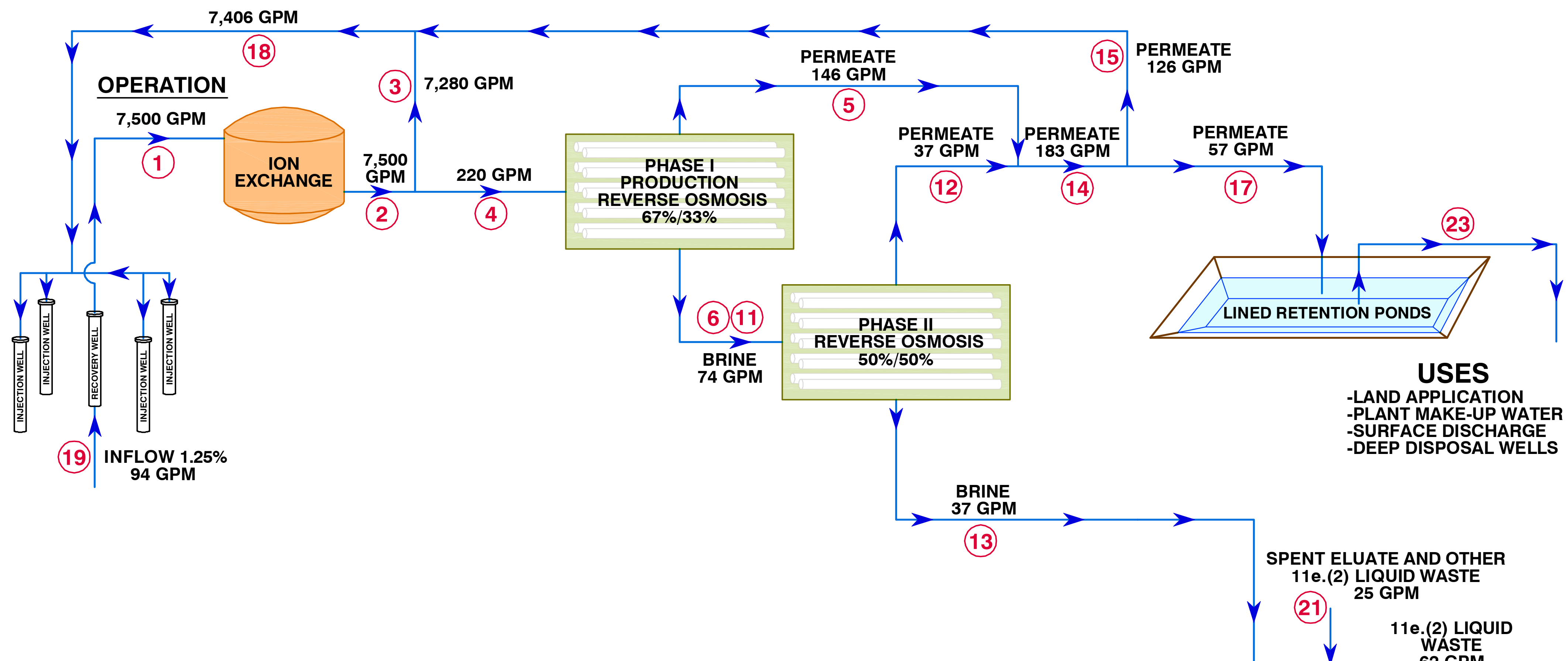
Table 4.13-1. Waste Management Systems and Anticipated Quantities

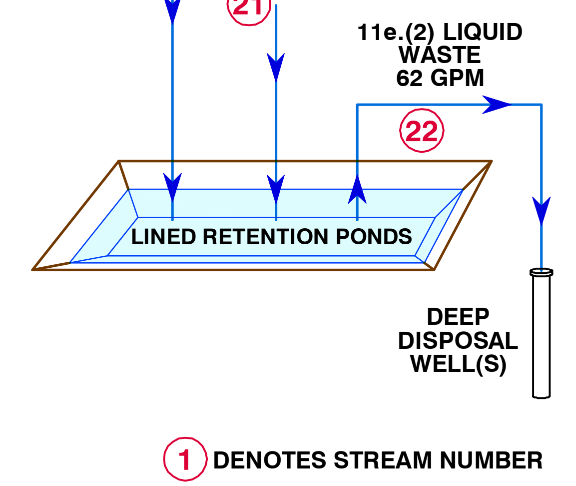
Waste Stream	Source	Storage Location	Disposal Method(s)	Estimated Typical Quantity
AEA-Regulated Waste				
Excess Permeate	Production and restoration RO circuits	Lined retention ponds	Reinjection into wellfield, CPP make-up water, surface discharge, land application, or deep disposal wells	C: 0 gpm O: 57 gpm R: 0 gpm D: 0 gpm
Brine and Other 11e.(2) Liquid Waste	Production and restoration RO circuits, CPP, well work over, spent eluate, process drains, contaminated reagents, filter backwash, wash down water, and decontamination showers	Lined retention ponds	Deep disposal wells and evaporation in lined retention ponds	C: 0 gpm O: 62 gpm R: 227 gpm D: <10 gpm
Solid 11e.(2) Byproduct Material	Filtrate and spent filter media, scale and sludge from equipment maintenance, contaminated soil, damaged IX resin, contaminated solids from injection/recovery wells, contaminated PPE and contaminated materials and equipment from decommissioning	11e.(2) Storage and Preparation area with CPP or other designated and restricted 11e.(2) storage area	Shipment to NRC or Agreement State licensed disposal facility	C: 0 cy O: 100 cy/yr R: 100 cy/yr D: 4,000 cy
Non-AEA-Regulated Waste				
TENORM	Drilling fluids and drill cuttings	Mud pits	On-site disposal in mud pits	C (per well): drilling fluid: 6,000 gal drill cuttings: 15 cy O,R,D: 0 gal 0 cy
Solid Waste	Construction debris, decontaminated materials and equipment, and general office trash	Designated waste receptacles	Shipment to municipal landfill	C: 20 cy/wk O: 20 cy/wk R: 20 cy/wk D: 2,000 cy
Hazardous Waste	Used oil, oily rags, used batteries, expired laboratory reagents, fluorescent lightbulbs, solvent, cleaners and degreasers	Designated hazardous waste storage area in maintenance shop	Shipment to WDEQ/SHWD licensed recycling or disposal facility	< 220 lb/mo (<100 kg/mo) (C,O,R,D)
Domestic Sewage	Restrooms	Septic tank(s) near CPP and office/admin building	On-site wastewater disposal or treatment system plus holding tanks/portable toilets during construction and decommissioning	C: 2,600 gpd O: 800 gpd R: 300 gpd D: 1,200 gpd

Abbreviations:
- C - Construction
- O - Operation
- R - Aquifer Restoration
- D - Decommissioning

Table 4.13-2. Anticipated Permeate Water Quality

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





Stream	Description	Flow Range (gpm)	Typical Flow Rate[1] (gpm)
1	Recovery solution from recovery wells	5000 - 7500	7500
2	Barren lixiviant from ion exchange	5000 - 7500	7500
3	Barren lixiviant to injection wells	5000 - 7500	7280
4	Phase I Recovery RO feed	0 - 560	220
5	Phase I Recovery RO permeate	0 - 380	146
6	Phase I Recovery RO brine	0 - 190	74
7	Restoration flow from restoration recovery wells	---	0
8	Phase I Restoration RO feed	---	0
9	Phase I Restoration RO permeate	---	0
10	Phase I Restoration RO brine	---	0
11	Phase II RO feed	0 - 190	74
12	Phase II RO permeate	0 - 95	37
13	Phase II RO brine	0 - 95	37
14	Total permeate	0 - 475	183
15	Permeate to injection stream	0 - 475	126
16	Permeate to restoration injection stream	---	0
17	Permeate to lined retention ponds	0 - 80	57
18	Total flow to injection stream	4900 - 7460	7406
19	Recharge to wellfield (0.5% to 2% production bleed)	25 - 150	94
20	Recharge to restoration wellfield	---	0
21	Spent eluate and other 11e.(2) liquid waste	10 - 40	25
22	Brine and other 11e.(2) liquid waste to disposal	25 - 140	62
23	Permeate to beneficial uses and disposal	0 - 80	57

[1] Typical flow rate at 7,500 gpm recovery flow, 1.25% bleed

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Date	Description

ENVIRONMENTAL REPORT
FIGURE 4.13-1

TYPICAL WATER BALANCE
DURING OPERATION ONLY

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Checked By: DEB
Date: 12/22/10

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FILE: ROSS_TR_FAC_WATER_BALANCE

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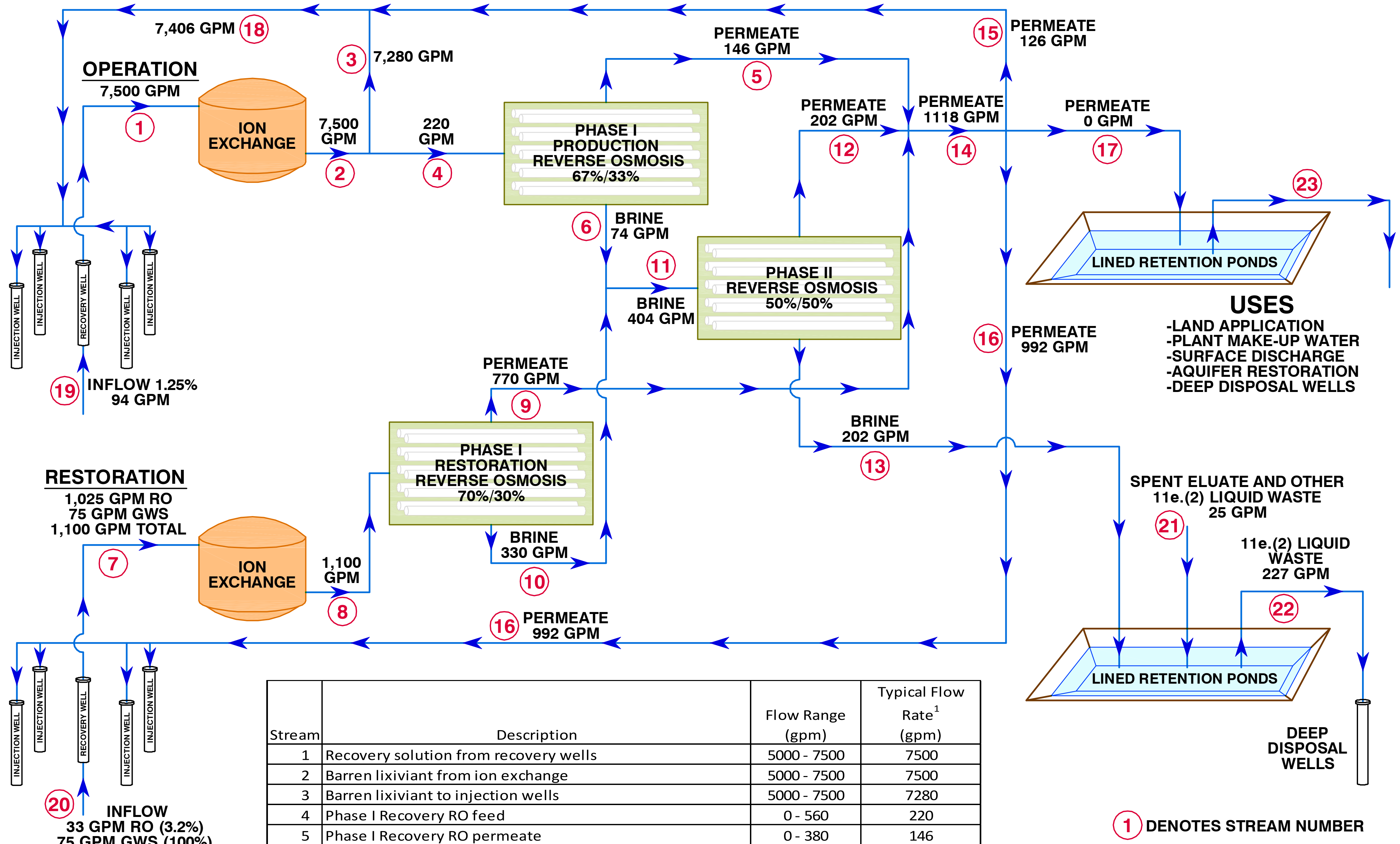

Stream	Description	Flow Range (gpm)	Typical Flow Rate[1] (gpm)
1	Recovery solution from recovery wells	5000 - 7500	7500
2	Barren lixiviant from ion exchange	5000 - 7500	7500
3	Barren lixiviant to injection wells	5000 - 7500	7280
4	Phase I Recovery RO feed	0 - 560	220
5	Phase I Recovery RO permeate	0 - 380	146
6	Phase I Recovery RO brine	0 - 190	74
7	Restoration flow from restoration recovery wells	300 - 1100	1100
8	Phase I Restoration RO feed	300 - 1100	1100
9	Phase I Restoration RO permeate	210 - 770	770
10	Phase I Restoration RO brine	90 - 330	330
11	Phase II RO feed	90 - 520	404
12	Phase II RO permeate	45 - 260	202
13	Phase II RO brine	45 - 260	202
14	Total permeate	255 - 1410	1118
15	Permeate to injection stream	0 - 470	126
16	Permeate to restoration injection stream	0 - 1000	992
17	Permeate to lined retention ponds	0 - 320	0
18	Total flow to injection stream	4900 - 7460	7406
19	Recharge to wellfield (0.5% to 2% production bleed)	25 - 150	94
20	Recharge to restoration wellfield	80 - 300	108
21	Spent eluate and other 11e.(2) liquid waste	10 - 40	25
22	Brine and other 11e.(2) liquid waste to disposal	90 - 300	227
23	Permeate to beneficial uses and disposal	0 - 320	0

[1] Typical flow rate at 7,500 gpm recovery flow, 1.25% bleed, 0.5 PVD groundwater sweep and 7.0 PVD RO

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Date	Description

ENVIRONMENTAL REPORT
FIGURE 4.13-2

TYPICAL WATER BALANCE DURING CONCURRENT OPERATION AND AQUIFER RESTORATION

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FILE: ROSS_TR_FAC_WATER_BALANCE

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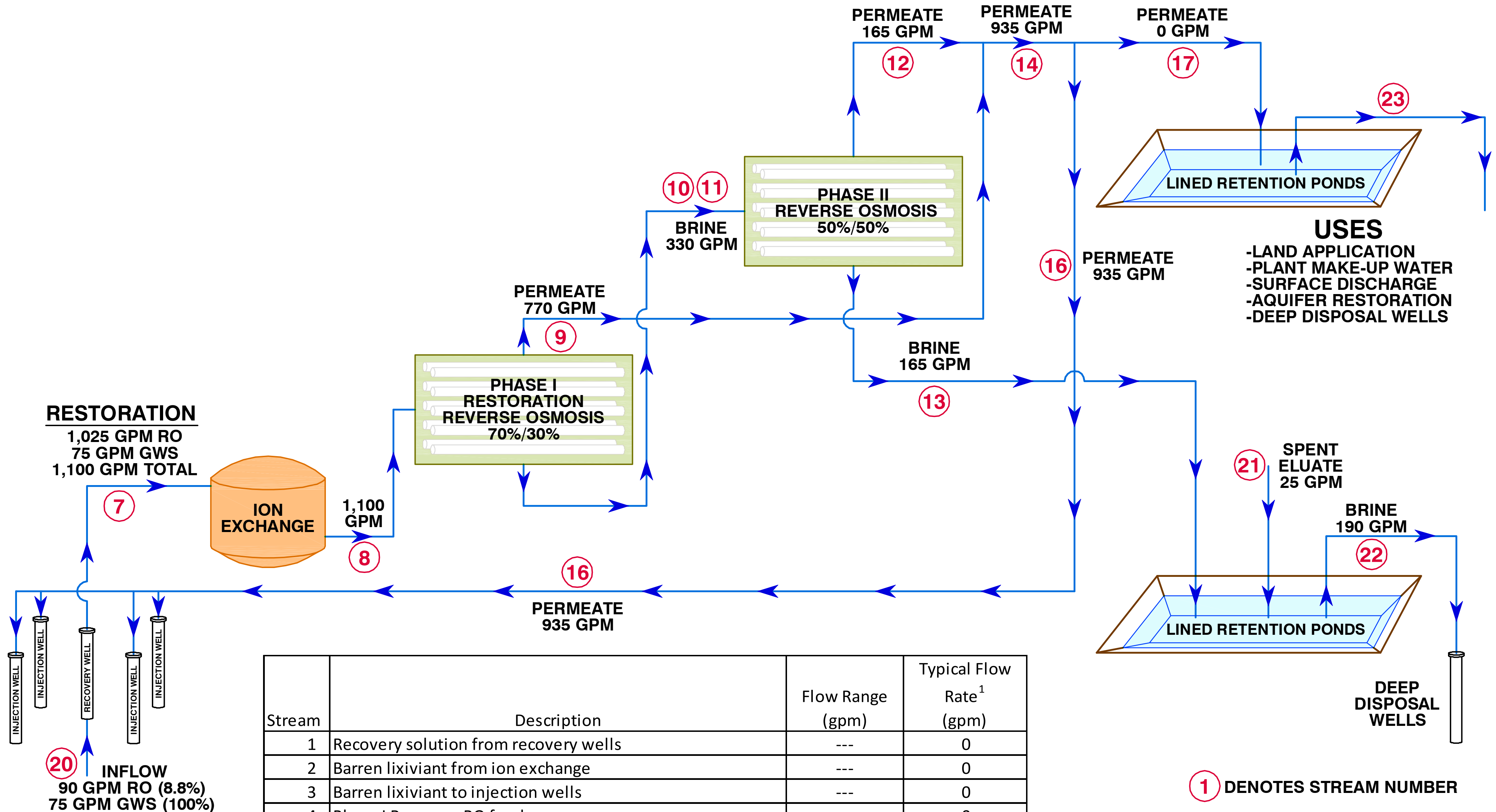

Stream	Description	Flow Range (gpm)	Typical Flow Rate[1] (gpm)
1	Recovery solution from recovery wells	---	0
2	Barren lixiviant from ion exchange	---	0
3	Barren lixiviant to injection wells	---	0
4	Phase I Recovery RO feed	---	0
5	Phase I Recovery RO permeate	---	0
6	Phase I Recovery RO brine	---	0
7	Restoration flow from restoration recovery wells	550 - 1100	1100
8	Phase I Restoration RO feed	550 - 1100	1100
9	Phase I Restoration RO permeate	385 - 770	770
10	Phase I Restoration RO brine	165 - 330	330
11	Phase II RO feed	165 - 330	330
12	Phase II RO permeate	80 - 165	165
13	Phase II RO brine	80 - 165	165
14	Total permeate	465 - 935	935
15	Permeate to injection stream	---	0
16	Permeate to restoration injection stream	465 - 935	935
17	Permeate to lined retention ponds	0 - 50	0
18	Total flow to injection stream	---	0
19	Recharge to wellfield (0.5% to 2% production bleed)	---	0
20	Recharge to restoration wellfield	80 - 170	165
21	Spent eluate and other 11e.(2) liquid waste	10 - 40	25
22	Brine and other 11e.(2) liquid waste to disposal	90 - 210	190
23	Permeate to beneficial uses and disposal	0 - 50	0

[1] Typical flow rate at 1,100 gpm restoration flow, 0.5 PVD groundwater sweep and 7.0 PVD RO

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ENVIRONMENTAL REPORT
FIGURE 4.13-3

TYPICAL WATER BALANCE
DURING AQUIFER RESTORATION ONLY

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FILE: ROSS_TR_FAC_WATER_BALANCE

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5.0 MITIGATION

The following sections describe the mitigation measures that are proposed to minimize the potential impacts described in Chapter 4. Mitigation measures are described for the Proposed Action, while no mitigation measures will be implemented for the No Action Alternative, since the proposed Ross ISR Project would not be constructed. Where possible, tangible and specific mitigation measures are provided as required by Section 5.5 of NUREG-1748. Final selection of some mitigation measures will be incorporated into the appropriate ancillary permit applications. Examples include sediment and erosion control BMPs addressed in SWPPPs reviewed and approved by WDEQ/WQD, air quality BACT reviewed and approved by WDEQ/AQD, and jurisdictional wetland mitigation measures reviewed and approved by USACE.

5.1 Mitigation of Potential Land Use Impacts

Disturbed lands within the proposed project area will be returned to their pre-existing land use (Section 3.1) and released for unrestricted use following decommissioning. As stated in Section 4.1, the surface disturbance associated with the Proposed Action will encompass approximately 280 acres, or about 16% of the proposed project area. The following summarizes Strata's proposed mitigation plan for potential land use impacts during construction, operation, aquifer restoration, and decommissioning.

5.1.1 Mitigation of Potential Construction Impacts

As described in Section 4.1, construction of the proposed Ross ISR Project has the potential to impact land use in the proposed project area through the following mechanisms:

- Changing and disturbing existing land uses,
- restricting access or establishing right-of-way access,
- affecting mineral rights,
- restricting livestock grazing areas,
- restricting recreational activities, and
- altering historic and cultural resources.

Mitigation measures to minimize potential construction impacts to land use are described below.

<u>Changing and Disturbing Existing Land Uses</u>

Strata will minimize changing and disturbing existing land uses through the following mitigation measures:

- Phased wellfield module construction to limit the total wellfield area disturbed at any one time to 40 acres or less
- Restoring and re-seeding disturbed areas promptly, typically within one construction season
- Coordinating construction efforts with the oil production company operating within the proposed project area (currently Merit Energy) to ensure that Strata causes no interruptions in oil production activities

- Using existing county roads and oilfield access roads wherever possible to minimize access road construction
- Following existing topography during access road construction to minimize cut and fill
- Minimizing secondary and tertiary access road width
- Locating access roads, pipelines, and utilities in common corridors

Access Restrictions and Establishment of Right-of-Way

Strata will minimize access restrictions and potential impacts from establishment of right-of-way through the following mitigation measures:

- Fencing less than 16% of the proposed project area at any one time. The maximum fenced area will include the central plant area and all wellfield modules. This represents about 205 acres or about 12% of the proposed project area (1,721.3 acres). Due to phased wellfield development, the actual fenced area during construction is anticipated to average less than 10% of the proposed project area.
- Coordinating construction efforts with the oil production company operating within the proposed project area (currently Merit Energy) to ensure that Strata causes no interruptions in oil production activities

Mineral Rights

The only known minerals in the proposed project area other than those proposed to be developed by Strata in the Ross ISR project are conventional oil and gas. Strata will mitigate potential impacts to mineral rights by working with the oil production company operating within the proposed project area (currently Merit Energy) to temporarily provide an alternate supply of water or alternate method of EOR that does not involve extracting water from the ore zone within the proposed project area until the portion of the ore zone aquifer affected by these water supply wells has been depleted of uranium. At that time, subject to approval by NRC and WDEQ, water removal from the ore zone for EOR could resume, restoring the prior use of this water and possibly expediting aquifer restoration by enhancing groundwater sweep and providing another water disposal option.

Livestock Grazing and Agricultural Production

Strata will mitigate potential impacts to livestock grazing and agricultural production through the following measures:

- ♦ Restoring and re-seeding disturbed areas promptly, typically within one construction season
- ♦ Fencing less than 12% of the proposed project area at any one time, including the central plant area and wellfield modules
- ♦ Establishing surface use agreements with surface owners/lessees to provide mitigation or compensation for temporary loss of areas currently used for livestock grazing or crop production
- ♦ Avoiding cultivated fields, where possible, when constructing monitor wells and other facilities

Restrictions on Recreational Activities

Strata will mitigate potential impacts to recreational activities through the following measures:

- ♦ Fencing less than 12% of the proposed project area at any one time, including the central plant area and wellfield modules, which will limit disruptions to big game migration
- ♦ Restoring and re-seeding disturbed areas promptly, typically within one construction season

Altering Historic and Cultural Resources

Strata will mitigate potential impacts to historic and cultural resources through the following measures:

- ♦ Avoiding disturbance to sites identified by the Class III inventory as potentially eligible for NRHP listing
- ♦ Consultation with SHPO and potentially affected THPOs
- ♦ Preparing and implementing a recovery plan prior to disturbance of potentially eligible sites that cannot be avoided
- ♦ Conducting pre-construction surveys to identify any previously undiscovered cultural artifacts or cultural resource sites
- ♦ Ceasing any work resulting in the discovery of previously unknown cultural artifacts until appropriate action is taken to preserve the site or recover the data

- Consulting with a professional paleontologist to evaluate the significance of any fossilized material found at the site prior to any construction within the proposed project area

5.1.2 Mitigation of Potential Operation and Aquifer Restoration Impacts

Mitigation measures that are specifically designed to address potential land use impacts during operation and aquifer restoration include the following:

- Working with the oil production company operating within the proposed project area (currently Merit Energy) to temporarily provide an alternate supply of water or alternate method of EOR that does not involve extracting water from the ore zone within the proposed project area (Refer to Section 5.4) until uranium recovery from that portion of the wellfield is completed
- Implementing cultural resources mitigation measures described above for any surface disturbance that occurs during operation or aquifer restoration
- Mitigate potential low-water crossing impacts resulting from permeate discharge (if this permeate disposal option is used) by discharging water below the Oshoto Reservoir, where the Little Missouri River is currently an intermittent stream, and by limiting the discharge rate to 50 gpm or less or an amount that is demonstrated to have little or no impact to downstream low-water crossings
- Adhering to WDEQ/WQD effluent limits for permeate land application or permeate WYPDES discharge (if either option is used) to protect receiving soils and downstream water users

5.1.3 Mitigation of Potential Decommissioning Impacts

The following sections describe the mitigation measures that will be implemented during decommissioning to ensure that there are no long-term impacts to land use within the proposed project area.

5.1.3.1 Access Road Reclamation

All primary, secondary, tertiary, and temporary access roads constructed for access to the facilities and wellfield will be removed and reclaimed unless exempted from reclamation by the request of landowners/lessees, in which case the landowners/lessees will assume responsibility for their long term maintenance and ultimate reclamation.

Prior to reclamation, any contamination which resulted from ISR facility construction or operation will be cleaned to appropriate NRC standards and the contaminated material disposed at a licensed disposal facility. All contaminated soil or gravel that is determined to be 11e.(2) byproduct material will be disposed at a licensed 11e.(2) byproduct material disposal facility, while petroleum-contaminated soil will be disposed at a WDEQ/SHWD licensed facility. Removal of roads will be accomplished by removing excess imported road surfacing material and ripping the road surface and shallow subsoil to loosen the subsoil. Culverts will be removed and pre-construction drainages re-established. The area will be graded to a contour consistent with the surrounding landscape. Topsoil will be re-spread in a uniform manner and the area revegetated.

5.1.3.2 Wellfield Decommissioning

Wellfield decommissioning will be ongoing as wellfield modules receive regulatory approval for successful aquifer restoration. Wellfield decommissioning includes the plugging and abandonment of all wells and the removal, decontamination and disposal of wellfield piping and appurtenances.

All wells no longer required for ISR uranium recovery or aquifer restoration will be plugged and abandoned in accordance with the procedures described in Addendum 2.6-B to the TR. These procedures have been prepared to comply with Wyoming Statute WS-35-11-404 and Chapter 8, Section 8 of the WDEQ/LQD Rules and Regulations. The plugging and abandonment procedures will include removing any piping, pumps, and equipment suspended in the well casing, filling the casing from the total depth to just below the ground surface with cement grout or bentonite, cutting off the surface casing below ground, and restoring and re-seeding the disturbed area.

Wellfield equipment will be removed, including injection and recovery well individual flow lines, buried electrical cable, and wellhead covers. Trunk lines, feeder lines, valve manholes, module buildings, and deep disposal well pipelines will also be removed. Strata anticipates that all downhole pipe and electrical cable, individual well flow lines, feeder lines, trunk lines, and valves will be disposed as 11e.(2) byproduct material. Mitigation measures for minimizing the quantity of 11e.(2) byproduct material during decommissioning are addressed in Section 4.13 and include using a chipper or shredder to reduce the volume of wellfield materials by 50% or more. Wherever possible, equipment will be decontaminated for release for unrestricted use, including disposal in a nearby municipal landfill or re-use in another ISR facility. Strata anticipates that this will include the module buildings. Additional information about the fate of wellfield equipment during decommissioning is presented in Section 4.2 (potential transportation impacts) and Section 4.13 (potential waste management impacts).

Following wellfield equipment removal and disposal, the affected areas will be recontoured, topsoil will be replaced, and the areas will be revegetated.

5.1.3.4 Process Buildings and Equipment Decommissioning

After aquifer restoration is complete and approved in the final wellfield module, Strata will decommission the central plant area and any remaining infrastructure, unless the CPP will continue to receive uranium-loaded IX resin from satellite ISR facilities or water treatment entities. During decommissioning of the central plant area, a radiological survey will be conducted on all process equipment. Based on the survey results, the equipment will be removed to a new location within the proposed project area for further use or storage, removed to another licensed facility for use or permanent disposal, or decontaminated to meet unrestricted use criteria for release.

Decontamination of salvageable building materials, equipment, pipe, and other materials to be released for unrestricted use will be accomplished by completing a preliminary radiological survey to determine the location and extent of the contamination and to identify any hazards. Upon completion of the decontamination processes, final alpha and, as needed, beta surveys will be performed. The release limits for alpha and beta-gamma radiation from Regulatory Guide 1.86 are as follows:

- ♦ Removable alpha contamination of 1,000 dpm/100 cm^2
- ♦ Average total alpha contamination of 5,000 dpm/100 cm^2 over an area no greater than 1 m^2
- ♦ Maximum total alpha contamination of 15,000 dpm/100 cm^2 over an area no greater than 100 cm^2
- ♦ Removable beta-gamma contamination of 1,000 dpm/100 cm^2
- ♦ Average total beta-gamma contamination of 5,000 dpm/100 cm^2 over an area no greater than 1 m^2

- Maximum total beta-gamma contamination of 15,000 dpm/100 cm^2 over an area no greater than 100 cm^2

The ALARA principle will apply to the decontamination of surfaces to reduce surface contamination to levels as far below the limits as practical. Equipment which cannot be decontaminated to these standards will be sent to an NRC or agreement state licensed facility for disposal.

Processing and water treatment equipment, including tanks, filters, IX columns, pipes, and pumps, will be prepared, including decontamination if necessary, for use at another location or dismantled and disposed of in accordance with applicable regulations. Materials contaminated with other industrial constituents will be disposed of at an appropriately licensed facility. Decontaminated and non-contaminated materials will be removed for salvage or disposed of at an appropriately licensed solid waste facility.

Structures will be decontaminated if necessary and moved to a new location, salvaged or disposed at an appropriately licensed solid waste facility. Concrete flooring, foundations, and foundation materials will be decontaminated, if necessary, broken up, and disposed of at an appropriately licensed facility. Sludge accumulating in lined retention ponds will be disposed with pond liners and leak detection systems as 11e.(2) byproduct material.

Records of equipment decontamination, distribution, disposal, and related decommissioning activities will be maintained and any necessary decontamination activities will be conducted in accordance with the operating procedures for the project. Section 4.13 contains additional information about the expected quantities of 11e.(2) byproduct material and solid waste generated from various sources during facility decommissioning.

5.1.3.5 Final Contouring

The central plant area and primary access road are the only areas that will require significant contouring during decommissioning. During decommissioning, the excess fill from the central plant area that was either used to construct the primary access road or stored in a stockpile will be hauled the short distance to the central plant area, redistributed, and compacted in place. All disturbed areas will be re-contoured as necessary to blend in with the natural terrain and consistent with the pre-construction topography. Any affected drainage channels will also be restored to pre-construction conditions during decommissioning. Pre-construction topography within the entire proposed project area was surveyed in 2010 (e.g., refer to Figure 1.2-5).

5.1.3.6 Topsoil Replacement

Suitable topsoil within the disturbed areas will be salvaged in accordance with WDEQ/LQD guidelines and conditions of the WDEQ/LQD Permit to Mine for this project. The topsoil stripping depth will vary throughout the proposed project area but is expected average 1.74 feet or less, as determined from baseline soil survey results described in Section 3.3. Additional information about topsoil stockpiling is provided in Section 5.3.

During decommissioning, topsoil will be redistributed on disturbed areas to a depth approximately equal to pre-construction conditions. As needed, the subsoil will be ripped to minimize compaction prior to revegetation. As described in Section 5.3, Strata has been employing various methods of soil reclamation according to landowner preference during regional baseline monitoring and exploratory drilling. These methods have included ripping compacted soil with the teeth of a grader, loosening compacted soil with a disc, or simply replacing topsoil and re-seeding. These techniques will continue to be refined and coordinated with WDEQ/LQD and the affected landowners.

5.1.3.7 Revegetation

Disturbed areas will be revegetated in accordance an approved WDEQ/LQD Reclamation Plan and the NRC-approved RAP. As previously discussed, topsoil stockpiles will be seeded to minimize wind and water erosion. After replacing topsoil, disturbed areas will be revegetated by seeding with a seed mix developed through discussions with WDEQ/LQD and area landowners. Seeding will be conducted by drill or broadcast methods depending upon the type of seed being planted. The WDEQ/LQD-approved Reclamation Plan will address the types and quantities of mulch and seasonal revegetation restrictions.

The extended reference area concept, as defined in WDEQ/LQD Guideline No. 2, will be used to evaluate the success of revegetation. The extended reference area means all of the undisturbed portions of a vegetation type which has experienced disturbance in any phase of the ISR process. At the end of decommissioning, quantitative vegetation data for extended reference areas representing each disturbed vegetation type will be directly compared by statistical analysis to quantitative vegetative data from reclaimed vegetation types. WDEQ/LQD requires a confidence level of 80% with no mathematical adjustments for climatic change. Qualitative comparisons between extended reference areas and reclaimed areas will also be required for each disturbed vegetation type. WDEQ/LQD will be consulted when choosing the extended reference area and when selecting the standard procedures for qualitative comparisons. Prior to release of the WDEQ/LQD reclamation bond, Strata will demonstrate revegetation success through quantitative and qualitative comparisons between external reference areas and reclaimed areas for each disturbed vegetation type.

5.2 Mitigation of Potential Transportation Impacts

The following sections present mitigation measures for potential transportation impacts. Potential transportation impacts are described in Section 4.2 and generally result from access road construction, increased traffic, and material transport.

5.2.1 Mitigation of Potential Access Road Construction Impacts

Potential impacts resulting from the construction of the primary, secondary, tertiary and temporary access roads are described in Section 4.2.1.1. Temporary, minor impacts from road construction could potentially occur to land use, soils, water resources, vegetation and wildlife, air quality, noise, historic and cultural resources, and visual and scenic resources. Mitigation measures for potential impacts from road construction to each of these resource areas are described below.

<u>Land Use</u>

Mitigation measures to minimize changing and disturbing land use include:

- ♦ Implementing a one-way in/one-way out driving approach, where sequentially developed wellfield modules will be accessed through previously developed modules. This will avoid constructing new access roads from the central plant area to remote wellfield modules
- ♦ Using existing county roads and oilfield access roads wherever possible to minimize access road construction
- ♦ Following existing topography during access road construction to minimize cut and fill
- ♦ Minimizing secondary and tertiary access road width
- ♦ Restoring and re-seeding disturbed areas promptly, typically within one construction season
- ♦ Coordinating construction efforts with the oil production company operating within the proposed project area (currently Merit Energy) to ensure that Strata causes no interruptions in oil production activities
- ♦ Locating access roads, pipelines, and utilities in common corridors

Soils

Mitigation measures to potential soil impacts include:

- Using existing county roads and oilfield access roads wherever possible to minimize access road construction
- Minimizing secondary and tertiary access road width
- Restoring and re-seeding disturbed areas promptly, typically within one construction season
- Implementing erosion control BMPs such as silt fence, sediment logs, and straw bale check dams
- Ripping compacted soil during reclamation, as necessary, and continuing to refine soil reclamation techniques developed during pre-application baseline monitoring and exploratory drilling
- Removing soil contaminated by leaks or spills and transporting the contaminated soil to a licensed disposal facility

Water Resources

Mitigation measures to potential water resources impacts, especially surface water and wetlands, include:

- Minimizing surface water crossings and, where surface water crossings are necessary (approximately 3 locations), constructing the access road perpendicular to the direction of flow to minimize disturbance
- Including culverts capable of passing the runoff resulting from the 10-year, 24-hour precipitation event in secondary access road stream channel crossings
- Using unconstructed, two-track roads across ephemeral draws and avoiding these roads during flow events
- Implementing sediment control BMPs such as silt fence, sediment logs, and straw bale check dams
- Developing and implementing a spill response plan to contain any spill that occurs during access road construction and clean up affected soil or water
- Avoiding wetlands during access road construction or, where unavoidable impacts will occur such as stream channel crossings, mitigate impacts by enhancing existing wetlands or constructing new wetlands in accordance with USACE requirements

Vegetation and Wildlife

Mitigation measures to potential ecological resources impacts include:

- ♦ Implementing dust abatement BMPs such as wetting disturbed areas and gravel access roads
- ♦ Implementing speed limits on access roads within the proposed project area and enforcement of speed limits on county roads for Strata employees and contractors
- ♦ Avoiding sensitive areas such as wetlands and reservoir habitat during access road construction

Air Quality

Mitigation measures to reduce potential air quality impacts, including vehicle emissions and dust, include:

- ♦ Minimizing disturbed areas by minimizing access road widths, utilizing existing county and oilfield roads where possible, and implementing a one-way in/one-way out policy
- ♦ Implementing dust abatement BMPs such as wetting disturbed areas and gravel access roads
- ♦ Implementing speed limits on access roads within the proposed project area and enforcement of speed limits on county roads for Strata employees and contractors

Noise

Mitigation measures to reduce potential noise impacts include:

- ♦ Implementing speed limits on access roads within the proposed project area and enforcement of speed limits on county roads for Strata employees and contractors
- ♦ Restricting access road construction activities during nighttime hours

Cultural Resources

Mitigation measures to reduce potential cultural resources impacts include:

- ♦ Avoiding construction in sites identified by the Class III inventory as potentially eligible for NRHP listing
- ♦ Consultation with SHPO and potentially affected THPOs

- ♦ Preparing and implementing a recovery plan prior to disturbance of potentially eligible sites that cannot be avoided
- ♦ Conducting pre-construction surveys to identify any previously undiscovered cultural artifacts or cultural resource sites
- ♦ Ceasing any work resulting in the discovery of previously unknown cultural artifacts until appropriate action is taken to preserve the site or recover the data
- ♦ Consulting with a professional paleontologist to evaluate the significance of fossilized material found at the site prior to any construction within the proposed project area

Visual and Scenic Resources

Mitigation measures to reduce potential visual and scenic resource impacts include:

- ♦ Constructing secondary and tertiary access roads along existing topography to minimize cut/fill and reduce the visual contrast created by straight roads
- ♦ Minimizing disturbed areas by minimizing access road widths, utilizing existing county and oilfield roads where possible, and implementing a one-way in/one-way out policy
- ♦ Implementing speed limits on access roads within the proposed project area and enforcement of speed limits on county roads for Strata employees and contractors
- ♦ Planting trees to shield access roads within the central plant area from the view of travelers on the New Haven Road

5.2.2 Mitigation of Potential Traffic Impacts

Traffic projections presented in Section 4.2 indicate that the added traffic resulting from the Proposed Action would have a small impact to traffic volumes on I-90, but could have a moderate to large impact on traffic volumes on local county roads. Traffic impacts are expected to be highest during construction, when the number of workers and shipments of materials and equipment will be highest. Potential mitigation measures for traffic impacts are described below and include:

- ♦ Working with Crook County and WYDOT to improve signage on affected portions of D Road and the New Haven Road

- Implementing a policy to enforce speed limits on county roads for Strata employees and contractors
- Performing a safety analysis of affected county roads
- Performing routine assessments of the road condition and working with Crook County to develop a maintenance agreement to address maintenance needs
- Implementing dust control BMPs such as magnesium chloride on affected portions of county roads, particularly near residences
- Investigate the potential to form a coalition with other companies operating heavy trucks on county roads (e.g., bentonite haulers) to provide additional assistance to Crook County in traffic assessment and road maintenance
- Investigate the feasibility of a park and ride system from Gillette or Moorcroft, particularly during operation when employment levels will be relatively high and worker schedules will be relatively static. Alternatives that may be considered include van pools or an employee incentive program to encourage car pooling

As described in Section 4.2, the average speed for vehicles traveling on gravel roads along the primary access route is currently 49 to 51 mph. While Strata cannot enforce speed limits for the general public, Strata can and will work with Crook County and WYDOT to provide more information about existing speed limits. Potential signage changes on county roads and on access roads within the proposed project area are shown on Figure 5.2-1. All sign placement and usage will be coordinated with Crook County and WYDOT and will meet federal standards as set forth in the 2009 Manual of Uniform Traffic Control Devices and the 2006 AASHTO Roadside Design Guide, 3rd Edition with updated Chapter 6.

Strata might also work with the county and WYDOT to lower the truck speed limit along D Road and the New Haven Road to increase safety. Portions of these roads may also be signed as "Daytime Headlight Sections" if necessary to help prevent head on collisions by increasing vehicle visibility especially in low-visibility conditions such as created by weather or dust. The primary access route can also have a safety analysis performed to determine the design speed at which every horizontal and vertical curve is constructed and appropriate warning signs may be placed at those locations to help inform unfamiliar drivers on the primary access route. Other potential roadway deficiencies may also be found during a roadway safety analysis that would be addressed to prevent accidents.

In addition to the potential measures above, Strata will develop a speed limit policy that includes employees and contract workers traveling on county roads. Strata currently has a speed limit policy for Strata employees and contractors that was developed during pre-application baseline monitoring and exploratory drilling. A similar policy will be implemented during all project phases. Reduced speeds will lower the risk of accidents, reduce roadway damage, reduce dust, and reduce potential wildlife collisions. Strata will also work with Crook County to assess county road condition before, during, and after the Proposed Action and aid in quantification of any damage to county roads to help assess maintenance needs.

Additional gravel surfacing may be required along the primary access route. Strata will work with Crook County to provide its share of necessary upgrades to the affected portions of the county road system. Strata will also assist Crook County with dust control on affected county roads, particularly near residences. Dust control would aid in providing a safer roadway and less dust-related impacts to adjacent properties. Coordinating efforts with Crook County will be defined in a County Development Plan that will be required for construction of the proposed Ross ISR Project.

5.2.3 Mitigation of Potential Accidents during Material Transport

Potential transportation impacts from accidents may occur from the following categories of material transport:

- Shipment of process chemicals and fuel from suppliers to the site
- Shipments of uranium-loaded IX resin to the site
- Shipment of yellowcake from the Ross ISR CPP to a uranium conversion facility
- Shipments of 11e.(2) byproduct material from the site to a licensed disposal facility
- Shipments of vanadium to a processing facility
- Shipments of hazardous waste from the site to a WDEQ/SHWD disposal facility

Two mitigation measures will be applicable to all material shipments, including coordination with local emergency response personnel and using appropriately licensed transporters. Strata will develop an SOP to provide ongoing training to local emergency response personnel including EMTs, firefighters, and municipal and county law enforcement personnel. For each type of material, specific information will be provided about the physical and chemical characteristics, hazards, potential exposure pathways, and spill response, containment, and cleanup procedures. Additional mitigation measures to reduce potential impacts from material shipment accidents are discussed in the following sections. The training will be ongoing and will include updates on a routine schedule or as new materials are transported to or from the site.

All material shipments will be made by appropriately licensed transporters in accordance with DOT hazardous material regulations and requirements. The Federal Hazardous Materials Transportation Law (Federal Hazmat Law), 49 U.S.C. § 5101 et seq., is the basic statute regulating hazardous materials transportation in the United States. Section 5101 states that the purpose of the Federal hazmat law is to "protect against the risks to life, property, and the environment that are inherent in the transportation of hazardous material in intrastate, interstate, and foreign commerce." Section 5103 provides that the Secretary of Transportation shall:

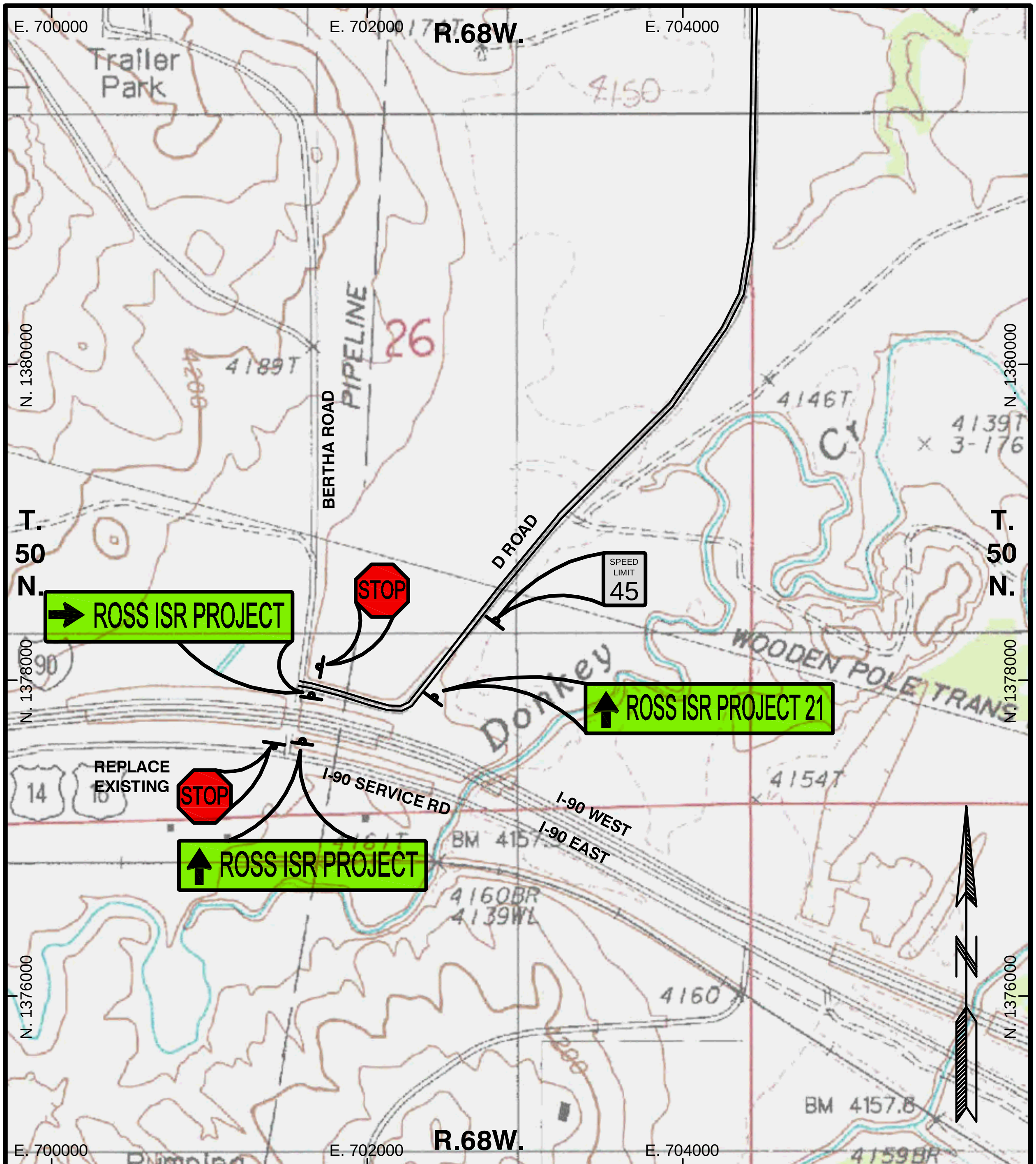
- Designate material (including an explosive, radioactive material, infectious substance, flammable or combustible liquid, solid or gas, toxic, oxidizing, or corrosive material, and compressed gas) or a group or class of material as hazardous when the Secretary determines that transporting the material in commerce in a particular amount and form may pose an unreasonable risk to health and safety or property.
- Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate, and foreign commerce.

Federal regulations applying to safe transportation of materials classed as hazardous are found at 49 CFR Parts 171-180. These hazardous materials regulations (HMR) cover the following areas:

- Hazardous materials classification (Parts 171 and 173);

- Hazard communication (Part 172, Subparts A-G);
- Packaging requirements (Parts 173, 178, 179, and 180);
- Operational rules (Parts 171, 173, 174, 175, 176 and 177);
- Training and Security (Part 172, Subparts H and I); and
- Registration (Part 171; see also Part 107, Subpart G).

A specific mitigation measure will be implemented for shipment of yellowcake, uranium-loaded IX resin from an ISR satellite owned and/or operated by Strata, or 11e.(2) byproduct material. Spill of a radioactive material as a result of a transportation-related incident will invoke activities found in the HMR regulations found at 49 CFR Part 171, Subpart B – Incident Reporting, BOE Approvals and Authorization. Among other things, these regulations require immediate notice of certain incidents, detailed incident reports, submission of examination reports, and assistance with investigations and special studies. Should an accident occur that results of a release of any of these materials to the environment, Strata will perform a post-cleanup radiological survey of the affected area to ensure that there are no long-term hazards associated with the spilled material or spill response and cleanup operations.



Note: Traffic sign specifications and placement on county roads will be coordinated with Crook County and WYDOT.

Drawing Coordinates: WY83EF

0 500 1000 2000
GRAPHIC SCALE (FEET)

Figure 5.2-1. Proposed Signing Layout (Sheet 1 of 3)

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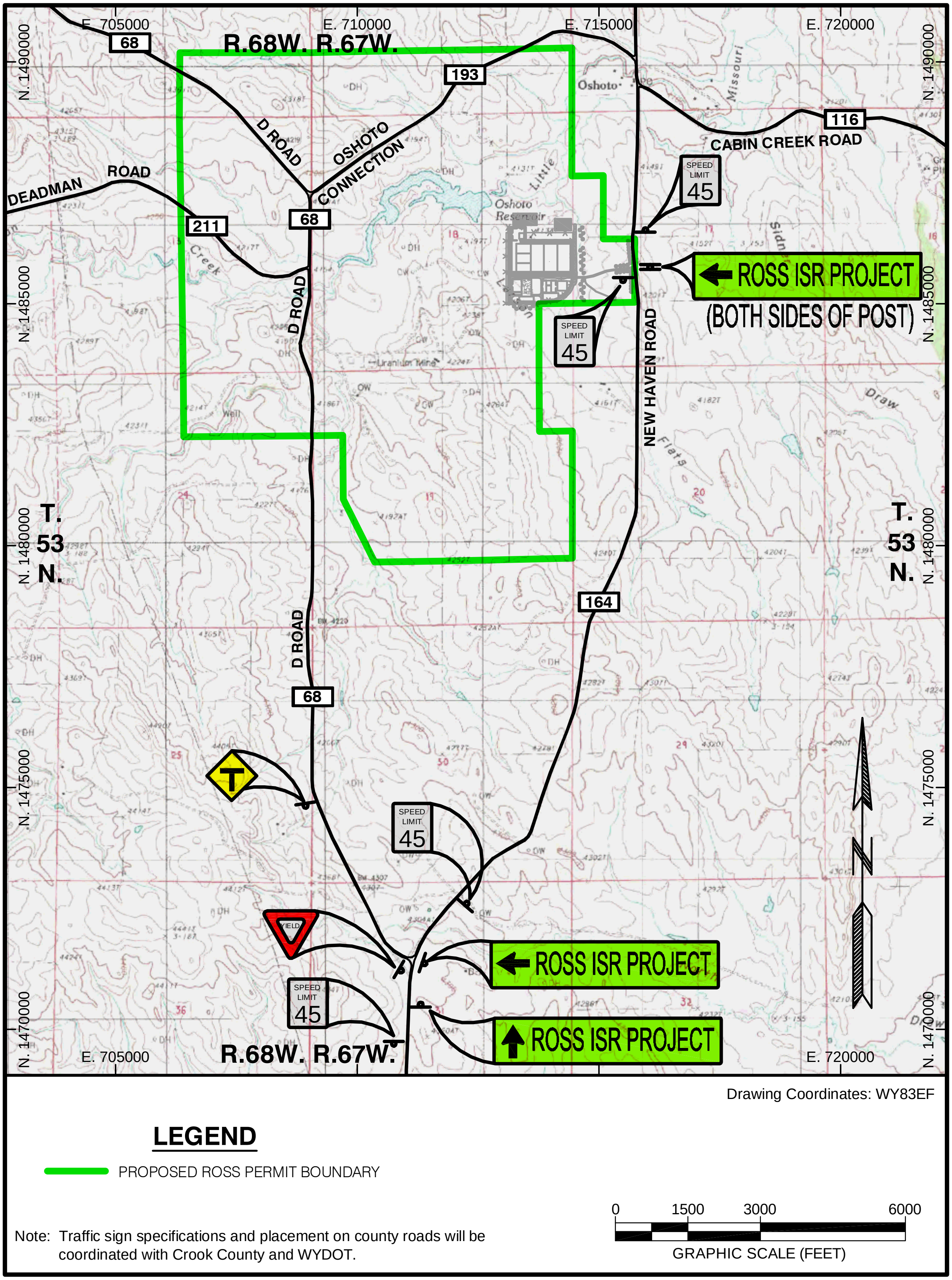
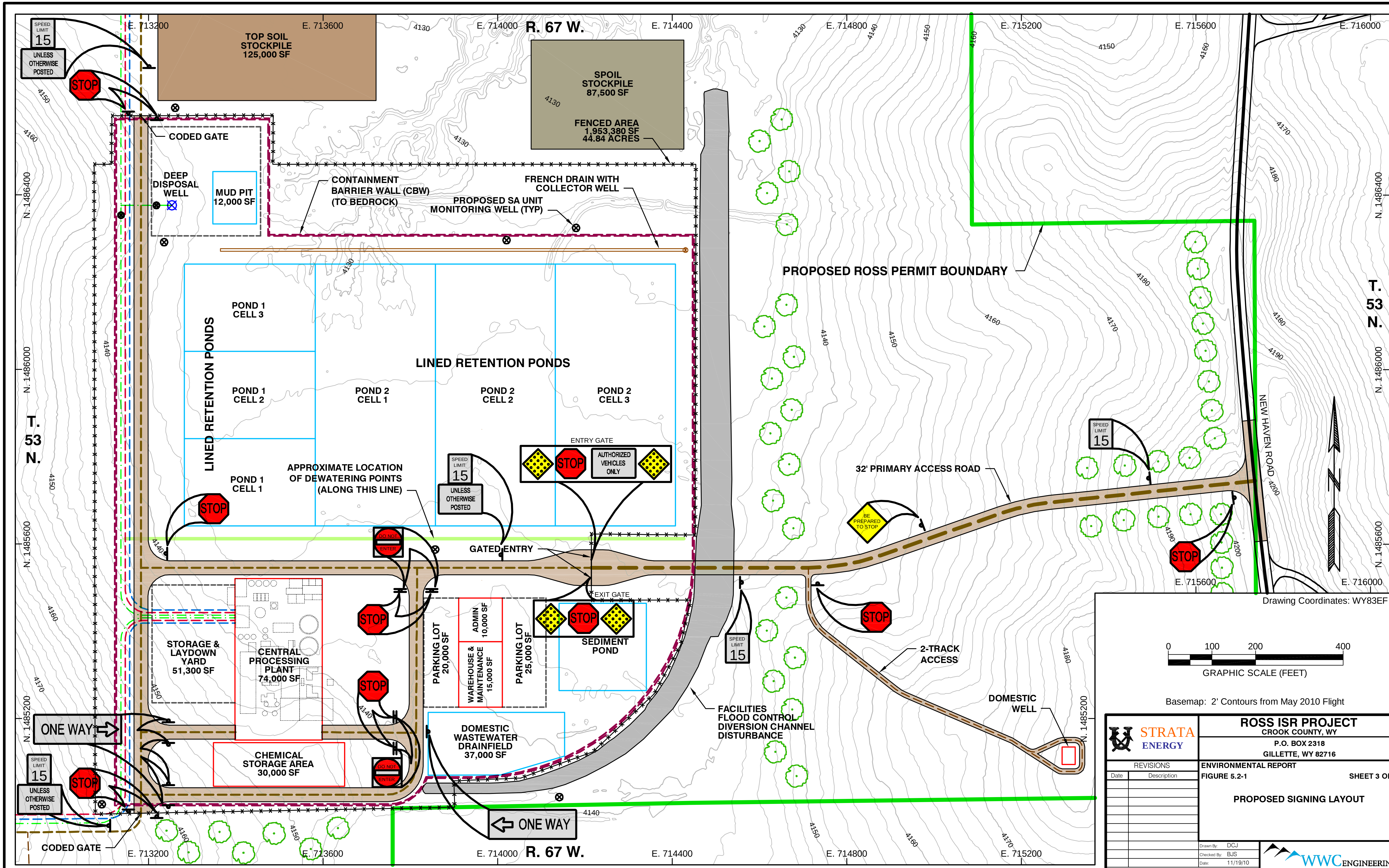


Figure 5.2-1. Proposed Signing Layout (Sheet 2 of 3)



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5.3 Mitigation of Potential Geology and Soils Impacts

5.3.1 Mitigation of Potential Geologic Impacts

The potential geologic impacts from the Proposed Action include minor disturbance of the surficial aquifer during construction of the lined retention ponds and CBW and a very low risk of hydraulic fracturing during operation of injection wells, including Class III injection wells in the ore zone and Class I deep disposal wells. Mitigation measures to minimize impacts to shallow geologic features include recontouring and restoring disturbed areas to pre-construction topography and conditions. This includes restoring pre-construction flow patterns in the surficial aquifer during decommissioning.

For Class III and Class I injection wells, the injection pressure will be maintained at a level that does not exceed the fracture gradient of the receiving formation (OZ aquifer for Class III wells and Deadwood/Flathead Formations for Class I wells).

The potential for the most credible geologic hazard, an earthquake, to impact the project will be minimized by designing buildings and structures to the 2,500-year seismic probability standards in the IBC. Only one earthquake with a magnitude greater than 2.5 has been recorded in Crook County. Nevertheless, with a limited historic record, it is nearly impossible to determine when a 2,500-year event last occurred in Crook County. Because of the uncertainty involved, and based on the fact that the new IBC uses 2,500-year events for building design, the WSGS suggests that the 2,500-year probabilistic map be used for seismic analysis in the design of critical facilities in this part of Wyoming (Case, Toner and Kirkwood 2002). This conservative approach is in the interest of public safety and will be implemented by Strata for buildings and structures at the Ross ISR Project.

Since the risk of geologic impacts from a massive Yellowstone National Park volcanic eruption is extremely remote, no special measures are proposed to mitigate potential geologic impacts from volcanoes.

5.3.2 Mitigation of Potential Soil Impacts

Mitigation measures for potential soil impacts are described in terms of the five potential impact categories presented in Section 4.3: soil loss, soil compaction, salinity, loss of soil productivity, and soil contamination.

5.3.2.1 Soil Loss Mitigation Measures

Potential soil loss impacts will be minimized by implementing BMPs related to topsoil handling, storm water control, sediment control, and wind erosion protection.

Topsoil and Subsoil Handling

Topsoil will be salvaged prior to surface disturbance activities from building sites, storage areas, pond sites, and access roads in accordance with WDEQ/LQD guidelines and conditions of the WDEQ/LQD Permit to Mine for this project. Areas to be stripped will be staked and typical earth moving equipment, such as rubber tired scrapers, will be used for stripping and stockpiling. The topsoil stripping depth will vary but is expected to average about 1.74 feet, as described in Section 3.3.

In the few areas where significant subsoil removal will occur, such as within the central plant area, subsoil will generally not be stockpiled but instead will be transported to fill areas such as pond embankments and the fill used to construct the primary access road. The quantity of excess subsoil generated from construction of the central plant area is estimated to be about 80,000 cubic yards. This material will be used to provide a slightly elevated and relatively level primary access road. During decommissioning, the subsoil will be replaced and the central plant area will be contoured to match pre-construction topography.

Several stockpiles will be used for the temporary storage of topsoil material. Stockpiles will be located on the leeward side of hills, when available, to minimize wind erosion. Topsoil stockpiles will not be located in drainage channels or other locations that could lead to a loss of material. The approximate location of the primary topsoil stockpile for the central plant area is depicted on Figure 1.2-5. Topsoil stockpiles in the wellfield will be located near access roads approximately 2,000 feet apart. All stockpile slopes will be built at 3H:1V or flatter, and stockpiles will be clearly marked with a “topsoil” label and unique ID. Traffic flow during stockpiling and re-spreading will be minimized to reduce compaction. Each topsoil stockpile will be seeded during inactive periods with an appropriate perennial seed mix to prevent wind and water erosion. A ring ditch and water collection sump will also be constructed around each topsoil stockpile to trap sediment.

During excavation of mud pits associated with well construction, exploration drilling, and delineation drilling activities, topsoil will be separated from the subsoil with a backhoe. The topsoil will be removed and placed in a separate temporary stockpile, while the subsoil is removed and deposited next to the mud pit. When the use of the mud pit is complete, usually within 30 days, the subsoil will be re-deposited in the mud pit followed by replacement of topsoil.

Pipeline and utility trench construction follows a similar procedure. The topsoil and subsoil will be stored separately, typically on opposite sides of the trench, with the topsoil being placed on top of the subsoil after the trench has been backfilled. Alternately, the topsoil may also be bladed to the side to allow for pipeline or utility installation and then bladed back after construction is complete.

Revegetation

Disturbed areas will be revegetated in accordance an approved WDEQ/LQD Reclamation Plan and the NRC-approved RAP. As previously discussed, topsoil stockpiles will be seeded to minimize wind and water erosion. After replacing topsoil, disturbed areas will be revegetated by seeding with a preselected seed mix. The seed mixture will be developed through discussions with WDEQ/LQD and area landowners. Seeding will be conducted by drill or broadcast methods depending upon the type of seed being planted. The WDEQ/LQD-approved Reclamation Plan will address the types and quantities of mulch and seasonal revegetation restrictions.

The extended reference area concept, as defined in WDEQ/LQD Guideline No. 2, will be used to evaluate the success of final revegetation and productivity. The extended reference area means all of the undisturbed portions of a vegetation type which has experienced disturbance in any phase of the ISR process. At the end of decommissioning, quantitative vegetation data for extended reference areas representing each disturbed vegetation type will be directly compared by statistical analysis to quantitative vegetative data from reclaimed vegetation types. WDEQ/LQD requires a confidence level of 80% with no mathematical adjustments for climatic change. Qualitative comparisons between extended reference areas and reclaimed areas will also be required for each disturbed vegetation type. WDEQ/LQD will be consulted when choosing the extended reference area and when selecting the standard procedures for qualitative comparisons. Prior to release of the WDEQ/LQD reclamation bond, Strata will need to demonstrate revegetation success through quantitative and qualitative comparisons between external reference areas and reclaimed areas for each disturbed vegetation type.

Storm Water Control

Potential soil loss from storm water will be minimized by implementing engineering controls to route storm water away from disturbed areas. These include but will not be limited to the following:

- ♦ Constructing a facilities flood control diversion channel (see Figure 1.2-5) to route storm water around the central plant area.
  - ◊ The channel will be designed to accommodate the 100-year, 24-hour storm event.
  - ◊ Analysis will also be done on the receiving channel to determine what mitigation measures, if any, are necessary to prevent erosion. Potential mitigation measures include an energy dissipation structure (e.g., rock riprap) at the end of the flood control diversion channel.
- ♦ Constructing a storm water control system within the central plant area consisting of the following components:
  - ◊ Sloped pavement with slot drains in areas adjacent to the CPP
  - ◊ Storm water conveyance pipes connecting the slot drains to the sediment pond
  - ◊ A sediment pond with a dual liner and leak detection system designed to contain all storm water runoff from the central plant area up to a 100-year, 24-hour storm event
  - ◊ Grading the central plant area to drain into the sediment pond
- ♦ Constructing culverts designed to pass runoff resulting from the 10-year, 24-hour precipitation event where secondary access roads cross ephemeral and intermittent stream channels.

Sediment Control

Sediment control mitigation measures will be implemented in all disturbed areas to minimize soil loss and water quality impacts from sediment transport. Mitigation measures include:

- ♦ Avoiding construction or minimizing disturbance in sensitive areas, such as next to stream channels and wetlands

- Using temporary sediment control BMPs such as silt fence, sediment logs, and straw bale check dams. Silt fence will typically be used at the toes of disturbed slopes to trap sediment. Sediment logs and straw bale check dams will typically be used in disturbed drainages to capture sediment. Refer to Figure 5.4-1 for an illustration of typical sediment control features
- Incorporating wing ditches and water collection sumps into topsoil stockpiles
- Constructing a sediment control pond within the central plant area (see discussion above) designed to capture sediment and storm water resulting from storm events up to the 100-year, 24-hour storm
- Restoring and re-seeding disturbed areas promptly, typically within one construction season

Wind Erosion Protection

Mitigation measures designed to minimize soil loss from wind erosion include:

- Wetting exposed soil during construction
- Restoring and re-seeding disturbed areas promptly, typically within one construction season

5.3.2.2 Soil Compaction Mitigation Measures

Potential soil compaction impacts will be minimized by using existing roads where possible. Three county roads traverse the proposed project area, and numerous private oilfield access roads are found throughout the proposed project area (see Figure 4.2-1). These will be used extensively by Strata during all project phases. In addition, Strata will minimize secondary access road widths and implement a one-way in/one-way out policy to access wellfield modules. Refer to Section 5.2 for more details.

Areas that undergo compaction, such as access roads, will be ripped, as needed, to a minimum depth of 2 feet during decommissioning. Strata has been employing various methods of soil reclamation during regional baseline monitoring and exploratory drilling. The methods have been selected by the affected landowners and have included ripping compacted soil with the teeth of a grader or tractor, loosening compacted soil with a disc, or simply replacing topsoil and re-seeding. These techniques will continue to be refined and coordinated with WDEQ/LQD and the affected landowners.

5.3.2.3 Soil Salinity Mitigation Measures

Soil salinity mitigation measures for land application of permeate will be addressed in a site-specific land application plan. This plan will be submitted to NRC and WDEQ/LQD for regulatory approval prior to applying any permeate to soils in the proposed project area in a land application system. The land application plan will include an analysis of baseline soil salinity and proposed soil and/or water amendments to maintain the soil infiltration rate and prevent salt buildup from insufficient leaching.

If magnesium chloride is used for access road dust control or a salt/sand mixture is used for traction on the primary access road, Strata will sample soil salinity beneath and adjacent to access roads during decommissioning. Any salt-affected soil will be removed.

5.3.2.4 Loss of Soil Productivity Mitigation Measures

Strata will implement the following mitigation measures to minimize potential loss of soil productivity:

- ♦ Segregating topsoil from subsoil during construction
- ♦ Protecting topsoil stockpiles from wind and water erosion (see Section 5.3.2.1)
- ♦ Seeding topsoil stockpiles during inactive periods with an appropriate perennial seed mix
- ♦ Redistributing topsoil and applying a permanent seed mix approved by WDEQ/LQD during decommissioning
- ♦ Comparing revegetated areas with extended reference areas using a statistical, quantitative comparison and a qualitative comparison as approved by WDEQ/LQD

5.3.2.5 Soil Contamination Mitigation Measures

Soils in the wellfield, along process fluid pipelines, and near the CPP could be contaminated by spills or leaks during the various project phases. During wellfield construction, potential soil contamination impacts from drilling fluid and drilling mud will be minimized by directing drilling fluids and muds into mud pits to control the spread of fluids. During work over operations, contaminated liquids from production and injection wells will be contained in portable tanks and transported to the lined retention ponds for disposal. Minor fuel and oil leaks will be promptly cleaned up and contaminated soil removed and disposed off-site in a land farm permitted through WDEQ/SHWD.

Soils contaminated with process fluids resulting from spills or leaks will be sampled, removed, and transported as necessary to a licensed 11e.(2) byproduct material disposal facility. Soil survey and cleanup methods are presented in TR Section 6.4. These include assessing the background uranium and radium concentrations of the soil during pre-operational monitoring, using hand-held radiological survey instrumentation and GPS-based gamma surveys to guide soil remediation efforts, removing contaminated soil and transporting it to a licensed disposal facility, performing post-cleanup analysis of uranium and radium concentrations in the soil, and comparing the concentrations to 10 CFR Part 40, Appendix A, Criterion 6(6) cleanup standards.

5.4 Mitigation of Potential Water Resources Impacts

The following sections summarize Strata's mitigation measures for potential impacts described in Section 4.4. Monitoring activities associated with the mitigation measures are discussed in Section 6.2.

5.4.1 Mitigation of Potential Surface Water Impacts

Several of the mitigation activities for surface water impacts are similar to those presented in Section 5.1, Mitigation of Potential Land Use Impacts, and Section 5.3, Mitigation of Potential Geology and Soils Impacts. In general, Strata will minimize surface water impacts by limiting soil disturbance and compaction, diverting and controlling runoff, avoiding or promptly detecting and correcting accidental spills and leaks and completing reclamation in a timely manner.

5.4.1.1 Erosion and Sedimentation

The greatest potential for erosion and sedimentation will occur during the construction and decommissioning phases of the project. To mitigate soil loss Strata will minimize the surface disturbance to soil and vegetation by using existing roads where possible, limiting secondary and tertiary road widths, and locating access roads adjacent to utility corridors. Topsoil handling and replacement, final contouring, vegetation reclamation, and road removal and reclamation are discussed in detail in Section 5.1.

Mitigation measures for erosion and sedimentation during construction will be addressed in a SWPPP prepared by Strata and reviewed by WDEQ/WQD. Prior to construction, Strata will prepare and submit to WDEQ/WQD a SWPPP along with a notice of intent for coverage under the Large Construction General WYPDES Storm Water Permit. The SWPPP will describe the nature and sequence of construction activities, identify potential sources of pollution, and describe BMPs to be used, including erosion and sediment controls (e.g., silt fence, sediment logs, straw bale check dams, etc.) and operational controls (e.g., housekeeping, signage, hydrocarbon storage, etc.). The SWPPP will be reviewed by WDEQ/WQD prior to issuing coverage under the general WYPDES permit.

Final selection of erosion and sedimentation BMPs will be performed during preparation of the SWPPP. Figure 5.4-1 depicts typical BMPs that would be implemented in disturbed areas. These include silt fence, sediment logs, and straw bale check dams. Silt fence will typically be used at the toes of disturbed slopes to trap sediment. Sediment logs and straw bale check dams will typically be used in disturbed drainages to capture sediment.

Prior to uranium recovery operations, Strata will apply to WDEQ/WQD for coverage under the Industrial General WYPDES Storm Water Permit or an individual storm water permit. As part of the application, Strata will update the existing SWPPP or prepare a new SWPPP that describes erosion and sediment controls as well as operational controls that will be used during operation to ensure that storm water discharges from the facility do not cause a violation of surface water quality standards (i.e., Chapter 1 of the Wyoming Water Quality Rules and Regulations). Qualified Strata personnel will inspect storm water BMPs semiannually or as required by the WYPDES storm water permit and maintain inspection reports on file. The SWPPP will be updated as needed, such as in response to potential problems identified during inspections or changes in operation (e.g., transition from operation to aquifer restoration). The WYPDES storm water permit will also require storm water discharge sampling and compliance with numeric effluent limits.

5.4.1.2 Flood Protection

Flood protection mitigation measures are described in TR Section 3.1.9 and summarized here. Drainage structures will be designed to route storm water runoff away from structures, roads, and lined ponds. As described previously, storm water management will be addressed in SWPPP(s) prepared in support of the construction and industrial WYPDES permits required by WDEQ/WQD for this project. One of the key features of the SWPPP(s) will be demonstrating how BMPs are designed to minimize exposure to pollutants. This will be accomplished in part through flood protection. It will also involve erosion and sediment control measures described previously and secondary containment measures described below.

Protection of equipment and facilities from large runoff events will typically be accomplished by placement on high ground out of the flood plain. When wells or other facilities must be placed within the 100-year flood inundation area, proper engineering controls will be used to ensure safety and environmental protection. The injection, recovery and monitor wells will be protected from flooding by installation of cement seals around the well casings and use of watertight well caps.

The CPP at the Ross ISR Project will be partially located in the channel of an ephemeral stream. The site is on an active dryland hay field. Historically, the ephemeral channel bisected the proposed central plant area as can be seen on the USGS quadrangle, but was since adjusted to the east in order to optimize farming and irrigation.

To minimize surface water impacts, runoff will be routed around the CPP through a facilities flood control diversion channel designed to pass runoff resulting from the 100-yr, 24-hr precipitation event. Refer to TR Section 3.1.9 for design details of the diversion channel.

5.4.1.3 Wetland Encroachment

Construction within the proposed project area has the potential to impact up to 2 acres of wetlands. Impacts to wetlands will be mitigated, as required by USACE, by enhancing existing wetlands or constructing new wetlands. Prior to disturbing any USACE-verified wetlands identified in the wetlands delineation report (refer to Section 3.4.2 and Addendum 3.4-A in this ER), Strata will apply for coverage under an appropriate USACE NWP for specific construction activities such as pipeline installation and access road stream channel crossings. As part of the application, Strata will provide a site-specific mitigation plan for project-related disturbance of jurisdictional wetlands. Depending on the nature of the anticipated wetlands disturbance, mitigation may include reestablishing temporarily disturbed wetlands in place, enhancing other existing wetlands, or constructing additional wetland areas in circumstances where disturbance will be long term. Mitigation measures will ensure that the Proposed Action does not result in a net loss of wetlands.

5.4.1.4 Spills and Leaks

There are a number of potential sources of liquid waste pollution resulting from leaks or spills. This section outlines the potential for leak or spill pollution events and describes Strata's plans to recognize, control, and safely clean up any leaks or spills. In general, the potential for liquid waste pollution will be minimized by adhering to NRC and WDEQ design criteria for ISR facilities, designing adequate spill containment and leak detection systems, training employees on how to monitor process parameters and recognize potential upset conditions before leaks or spills occur, training employees on inspection procedures for spill control BMPs in the SWPPP, frequently inspecting waste management systems and effluent control systems, and training employees in spill detection, containment and clean up procedures.

The proposed Ross ISR Project will utilize hazardous and nonhazardous chemicals throughout the life of the project. Hazardous chemicals which have the potential to affect radiological safety will be stored out of the CPP, typically in the adjacent chemical storage area, and away from areas where licensed material is stored. Hazardous chemicals will also be stored away from incompatible chemicals and away from areas populated by workers to reduce the risk of injury during an accidental release. All hazardous chemicals at the proposed project area will be handled and stored in accordance with federal, state and local regulations including the CFR, OSHA, and EPA. Secondary containment equal to 110% of the largest tank volume will be provided in all chemical storage areas. Within the chemical storage area, chemicals will either be stored in a covered area or additional secondary containment capacity will be provided to contain rainfall/runoff resulting from a 25-year, 24-hour precipitation event. Secondary containment materials will be compatible with the chemicals stored.

All areas of the plant where chemicals are handled will be provided with secondary containment. Most of the secondary containment will be provided by curbing as part of the floor of each area. Curbs will divide areas to ensure that there is no mixing of incompatible fluids. The depth of the containment curbing will be designed to contain 110% of the volume of the largest vessel in the contained area.

Each containment area inside the plant will be provided with a collection sump and the floor will be sloped to drain to the sump. Each sump will have a pump constructed of materials appropriate for the material it is designed to pump, and pumps will be of a type proper to pump the spills to a lined retention pond.

Process fluids will be contained in process vessels and pipes during operation. Instrumentation, controls, and alarms will monitor the flows, pressures and tank levels to maintain parameters within prescribed limits. If a tank or process vessel were to have a failure, such as a rupture, in the process building, all fluid would be contained in the process building. The fluid would be collected in the plant sumps and then pumped to other process vessels or a lined retention pond. After the fluids have been removed, the area would be washed down with plant water. The water would be collected in the plant sump system and pumped to a lined retention pond, thereby mitigating potential the environmental impact of the tank failure.

Spills or leaks could also occur from piping or equipment outside of the CPP and chemical storage areas. In such an event, operational controls and alarms would signal an alarm (e.g., low pipeline pressure or water in a sump), the leak or spill would be contained, and fluids would be captured and transported to the lined retention ponds for disposal with brine and process wastewater. The environmental impact of such an incident could result in some soils being contaminated, requiring controlled disposal. All areas affected by such a failure or leak would be surveyed and any contaminated soils or material would be removed and disposed in accordance with NRC and State requirements. The environmental impact of such an incident would be small with no long-term effect.

In the event of a piping failure within the CPP, low pressure sensors will trigger alarms and the pump system will shut down, preventing any further release. Any liquid waste released in the CPP or chemical storage area will be transported to the lined retention ponds for disposal.

Wellfield module buildings will be equipped with leak detection equipment which will signal alarms at the CPP. In addition, routine periodic inspections of wellfield module buildings and well heads will be conducted by Strata personnel. As described in TR Section 5.3.3, wellfield operators will visually inspect all piping and equipment within module buildings, wellheads, and valve vaults at least weekly. In the event of an environmentally significant leak, the affected soil will be surveyed for contamination and the area of the spill will be documented. If contamination is detected, the soil will be sampled and analyzed for the appropriate radionuclides. Contaminated soil will be removed and disposed in accordance with NRC and State requirements.

5.4.1.5 Surface Discharges

Potential erosion and water quality degradation impacts resulting from controlled discharge to the surface (e.g. aquifer test discharge or pipeline hydrostatic testing discharge) will be mitigated by Strata. Prior to discharging to the surface, Strata will submit an application to the WDEQ/WQD. The permit will limit flow rates and effluent concentrations based on the classification of the receiving stream. To minimize erosional impacts Strata will utilize energy dissipation devices to convey the discharge water into the receiving channel at a non-erosive velocity.

5.4.2 Mitigation of Potential Groundwater Impacts

5.4.2.1 Groundwater Quantity

Section 4.4.2 in this ER describes potential impacts to water quantity in the surficial (SA) aquifer, shallow monitoring (SM) aquifer, ore zone (OZ) aquifer, and the deep monitoring (DM) aquifer. The following sections describe mitigation measures designed to prevent or limit impacts to water quantity in the various aquifers.

5.4.2.1.1 Mitigation of Potential Groundwater Quantity Impacts in the SA, SM and DM Aquifers

Potential impacts to groundwater quality in the SA, SM, and DM aquifers are expected to be small or negligible during all project phases. For example, groundwater modeling indicates that the estimated maximum drawdown in the SM aquifer may be 5 to 15 feet inside of the proposed permit boundary. Given that the amount of available head in the SM unit ranges from 120 feet to 250 feet, a worst-case scenario (least amount of available head and maximum drawdown) results in a 12.5% decrease in the amount of head available. Mitigation measures to minimize water quantity impacts in the SM and DM aquifers include properly abandoning exploration and delineation boreholes, limiting over-penetration during drilling, employing on-site engineering/geologic supervision during well drilling and development, using proper well construction techniques, and implementing an approved MIT program. These will also limit potential water quality impacts in adjacent aquifers. Each of these is described below.

Abandoning Exploration and Delineation Boreholes

Prior to ISR uranium recovery, all exploration and delineation boreholes that can be located within the perimeter monitor well ring and beneath the central plant area will be plugged and abandoned as described in TR Addendum 2.6-B. Procedures include plugging the holes from the bottom of the hole to the surface with low hydraulic conductivity materials such as cement or heavily mixed bentonite grout.

Limiting Over-Penetration into DM Aquifer

A key characteristic of the hydrologic isolation program is limiting over-penetration during drilling programs. Both Strata and predecessors rarely drilled beyond 20 feet into the basal shale, thereby decreasing the potential for communication between the OZ aquifer and the underlying DM aquifer. Strata will use geologic data (currently existing of information from more than 2,000 exploration and delineation holes) combined with its three-dimensional resource model to accurately determine total depths and prevent over-penetration into underlying aquifers.

Drilling Supervision

Strata will employ on-site geologic/engineering oversight during any drilling project for all phases of well drilling, installation and abandonment.

Well Construction Techniques

When constructing injection, recovery, and monitor wells, Strata will employ methods approved by WDEQ/LQD and in compliance with WDEQ/LQD Chapter 11, Section 6 construction requirements for well locations, casing types and, most importantly, annular sealing techniques. Proper annular sealing methods ensure that vertical migration pathways are not created outside of the casing and inside of the borehole walls. Key characteristics of the well installation programs would include a sufficiently sized borehole diameter to provide adequate annular space for sealing materials, selection of appropriate annular seal materials such as cement with a weight of 15 pounds per gallon, displacement of the cement slurry sufficient to fill the entire annular volume from the bottom of the casing to ground surface, allowing sufficient curing time so that additional well construction work does not jeopardize the annular integrity, and selection of casing type with sufficient strength and diameter to prevent collapse and to accommodate the necessary injection pressures

Mechanical Integrity Testing Program

Strata will implement an approved MIT program for all Class III wells to ensure casing integrity. Key characteristics of the proposed MIT program include using a pressure-based testing method, a proactive testing program that targets wells displaying anomalous pressures or characteristics, retesting every 5 years and any time a well is re-entered by a drill bit or underreaming tool, maintenance of records and quarterly reporting of all wells tested along with any subsequent actions (repair or abandonment). In the unlikely event that a well fails MIT, it would either be repaired or abandoned using permit approved procedures.

5.4.2.1.2 Mitigation of Potential Groundwater Quantity Impacts in the OZ Aquifer

Sections 4.4.2.3.4 and 4.4.2.4.3 in this ER describe potential groundwater quantity impacts to the OZ aquifer within and adjacent to the proposed project area. Based on groundwater modeling results, the exempted OZ aquifer is predicted to see significant drawdowns during operation and aquifer restoration in three wells within the proposed project area and minor drawdowns in wells within 2 miles. The conservative regional impact analysis conducted through the groundwater modeling indicates potential impacts to the amount of available head in wells utilized for stock, domestic and industrial use. However, the results will be localized and short-lived. The following mitigation measures will be used to minimize potential groundwater quantity impacts in the OZ aquifer.

Merit Energy Water Supply Wells for Enhanced Oil Recovery

Strata will mitigate potential impacts to the three EOR water supply wells within the proposed project area by working with the oil production company (currently Merit Energy) to temporarily provide an alternate supply of water or alternate method of EOR that does not involve extracting water from the ore zone within the proposed project area until the portion of the ore zone aquifer affected by these water supply wells has been depleted of uranium. At that time, subject to approval by NRC and WDEQ, water removal from the ore zone for secondary oil recovery could resume, restoring the prior use of this water and possibly expediting aquifer restoration by enhancing groundwater sweep and providing another water disposal option.

Nearby Stock and Domestic Wells

Six wells completed in the OZ aquifer adjacent to the Ross ISR Project are predicted to experience drawdown during the operation and aquifer restoration phases. The most significant predicted drawdown occurs in Wesley TW02 located in the SW¼SW¼, Section 8, Township 53 North, Range 67 West with 33.3 feet of drawdown or 42.4% of the available head. This amount of drawdown could reduce the maximum potential yield of this well. Measures designed to limit or mitigate potential impacts to nearby stock and domestic wells include the following:

- ♦ Modifying wells suspected of experiencing drawdown with a sounding tube or similar device to allow periodic water level measurement
- ♦ Lowering a well pump in an affected well
- ♦ Providing an alternate water source for EOR as described above to limit cumulative impacts
- ♦ Providing an alternate source of water of equal or better quality and quantity subject to Wyoming State water law should Strata's activities prevent full use of a well

Minimizing Consumptive Use

The following mitigation measures will ensure that consumptive use of groundwater is minimized during operation and aquifer restoration:

- ♦ Designing wellfields to enable balancing
- ♦ Minimizing the production bleed through continuous adjustments to injection and recovery rates in order to keep the wellfield balanced while simultaneously limiting the amount of production bleed necessary to maintain an inward hydraulic gradient. This will also limit potential excursions, which would result in consumptive use during over-production to recover fluids outside of the ore zone
- ♦ Employing two stages of RO to treat production bleed and restoration fluids
- ♦ Treating water recovered during groundwater sweep (see discussion below)
- ♦ Employing limited groundwater sweep (see discussion below)
- ♦ Groundwater sweep may be used selectively (e.g., around the perimeter of the module) rather than throughout the entire module to maximize benefits while minimizing consumptive use of groundwater. Strata would likely use the site-specific production reservoir engineering platform (refer to TR Section 6.1.2) to aid in identification of areas to target based on potential portions of the aquifer that may have seen local imbalances during the operation phase and/or areas where local, low horizontal hydraulic

conductivity was measured during the model calibration. To some extent, the operational reservoir management platform would help predict where potential 'hot spots' might be in the wellfield area.

5.4.2.2 Groundwater Quality

Impacts to groundwater quality in the ore zone will be mitigated by groundwater restoration activities. A detailed discussion of the proposed groundwater restoration program is provided in Section 6.1 of the TR and in the RAP included as Addendum 6.1-A to the TR. This section summarizes that information.

Groundwater will be restored to the groundwater protection standards presented in 10 CFR 40, Appendix A, Criterion 5(B)(5) on a parameter-by-parameter basis using BPT. If the restoration activities are unable to achieve the background or maximum contaminant levels (whichever is greater) in Criterion 5(B)(5), Strata will submit a license amendment application request for NRC approval of ACLs.

Target restoration values (TRVs) representative of baseline water quality would be established for the entire first mine unit after sampling representative ore zone monitor wells. The TRVs will be calculated as a function of the average baseline water quality and the variability in each parameter according to statistical methods approved by NRC and WDEQ/LQD.

The proposed groundwater restoration program includes five processes:

1) Groundwater Sweep
2) Groundwater Transfer
3) RO Treatment with Permeate Injection
4) Groundwater Recirculation
5) Stability Monitoring

Groundwater Sweep

During groundwater sweep, water would be pumped from the recovery and injection wells to the CPP without reinjection into the modules undergoing groundwater sweep.

A drawback of groundwater sweep is consumptive use of groundwater, since permeate is not reinjected into a module actively undergoing groundwater sweep. WDEQ/LQD has determined that groundwater sweep with direct disposal of produced water is not considered BPT due to excessive consumption of groundwater and resultant impacts to groundwater resources (LCI 2009). Strata would invoke the following strategy to minimize consumptive use of groundwater during groundwater sweep:

- Water produced during groundwater sweep will be treated by RO, avoiding any occurrence of groundwater sweep with direct disposal of produced water.
- Whenever possible, permeate generated from one module undergoing groundwater sweep would be reinjected into another module undergoing RO treatment with permeate reinjection.
- Much of the permeate discharged into the lined retention ponds would be recycled to the CPP for make-up water.
- Groundwater sweep may be used selectively (e.g., around the perimeter of the module) rather than throughout the entire module to maximize benefits while minimizing consumptive use of groundwater.
- The total volume of water planned for groundwater sweep is much lower than that planned for RO treatment with permeate injection.
- Strata plans to employ the same groundwater model/reservoir engineering software platform used during the operation phase to guide aquifer restoration hydraulics and performance.

<u>Groundwater Transfer</u>

Groundwater transfer involves moving groundwater between one wellfield module entering restoration and another wellfield module entering production, or moving water between two areas within a single wellfield module that are in different stages of restoration (see ISR GEIS, pg. 2-27 through 2-28).

<u>RO Treatment with Permeate Injection</u>

During this phase of groundwater restoration, water would be pumped from one or more wellfield modules to the CPP for treatment. Treatment would include uranium and vanadium removal in IX columns and RO treatment to reduce dissolved constituents. Two stages of RO treatment would typically be used to maximize permeate production and minimize brine production. Additional treatment may include filtration to prevent fouling RO membranes, injection of antiscalant, pH control, and decarbonation. Permeate would be reinjected into the ore zone, while brine would be disposed of in the lined retention ponds and deep disposal wells. This phase of groundwater restoration would occur immediately following or in conjunction with groundwater sweep.

The influx of natural groundwater would be kept to a minimum by maximizing the quantity of permeate reinjected into modules undergoing RO treatment with permeate injection. This would be accomplished through two separate phases of RO treatment, which would significantly reduce the amount of brine as compared to single-pass treatment.

Groundwater Recirculation

After completion of the RO with permeate injection phase, the groundwater recirculation phase would commence. In this phase, water from the ore zone would be pumped from recovery wells and recirculated into injection wells in the same module. This recirculation would homogenize water quality within the aquifer and help reduce the risk of "hot spots," or areas of unusually high concentrations of dissolved constituents. The only treatments that would occur during recirculation are filtration and uranium/vanadium removal.

Stability Monitoring

Strata will initiate stability monitoring following restoration of a wellfield to ensure that chemical species of concern do not increase in concentration subsequent to restoration. Stability monitoring activities are described in TR Section 6.1.2.5 and summarized as follows.

Strata will evaluate the baseline water quality and recommend specific wells to be sampled during stability monitoring. These recommendations will be included in the wellfield baseline packages submitted to NRC and WDEQ/LQD prior to initiating construction of each mine unit. OZ, SM and DM monitor wells will be sampled five times spaced evenly over a 12-month period. This sampling frequency exceeds the minimum stability monitoring duration of 6 months specified in WDEQ/LQD Guideline 4. The frequency of excursion monitoring would be reduced from biweekly to quarterly during the stability monitoring phase, which is justified on the basis that active groundwater restoration will be complete and no fluids will be injected into the affected wellfield module.

Stability monitoring will include field water quality parameters and laboratory measurements of chemical constituents as shown in Table 6.1-2 of the TR. The parameter list is consistent with NUREG-1569 Table 2.7.3-1 and WDEQ/LQD Guideline 8, Appendix 1. Monitor well samples will be analyzed for all excursion parameters and static water level.

Stability monitoring results will be evaluated to determine whether there are any significant trends in chemical species of concern. The evaluation may include trend analysis, statistical variance calculations (e.g., t-test), or other common environmental statistical methods.

Criteria used to determine whether further action is required include:

1. If a constituent exhibits a statistically significant increasing trend, or
2. If a hot spot is discovered during stabilization monitoring.

Hot spots, or wells with elevated concentrations of dissolved constituents, will be identified using statistical analysis. A hot spot will generally be defined as a well with a constituent concentration greater than two standard deviations above the mean concentration for that parameter in the affected wellfield module.

If Strata identifies hot spots or increasing trends during stability monitoring, additional evaluation will be conducted to determine the potential for impact on the water quality outside of the exempted aquifer. This analysis could include extended stability monitoring or flow and transport modeling. If the evaluation reveals that groundwater outside of the exempted aquifer could potentially be affected, Strata may resume active restoration to resolve the issue. As described previously, Strata will likely use the site-specific production reservoir engineering platform (refer to TR Section 6.1.2) to aid in identification of areas to target for selective groundwater sweep during active aquifer restoration based on potential portions of the aquifer that may have seen local imbalances during the operation phase and/or areas where local, low horizontal hydraulic conductivity was measured during the model calibration. To some extent, the operational reservoir management platform would help predict where potential 'hot spots' might be in the wellfield area and to mitigate these areas with selective groundwater sweep during active aquifer restoration.

The following methods of corrective action for an excursion occurring during the restoration stability monitoring period will be instituted (not necessarily in the order given), dependent upon circumstances. Section 5.7.8 of the TR describes the excursion response procedure in more detail.

- ♦ A preliminary investigation will be completed to determine the probable cause and the area affected.
- ♦ Affected wells will be analyzed for the full suite of parameters in TR Table 6.1-2.
- ♦ An assessment will be performed to determine what actions, if any, should be taken to protect the groundwater outside the exempted aquifer. If sufficient data to make such a determination are not available, additional wells may be installed to fill in data gaps.
- ♦ If the excursion may result in degradation of groundwater outside of the exempted aquifer, a pump back or pump and treat plan will be initiated to recover the excursion. The stability monitoring period will continue but will not be considered successful until the excursion is recovered or it can be demonstrated that the remnant of the excursion will not degrade the water quality outside the exempted aquifer.
- ♦ If the excursion will not result in degradation of groundwater outside the exempted aquifer, then the stability monitoring period may continue. At the end of the successful stability monitoring period the wells affected by an excursion will be analyzed for the parameters listed in TR Table 6.1-2 to verify that groundwater outside the exempted aquifer will not be degraded.

During the groundwater restoration process, Strata will perform daily, weekly, and monthly analyses as described in TR Section 6.1.3 to track restoration progress. These analyses will be summarized, along with the restoration methods, and discussed in the Semiannual Radiological Effluent and Environmental Monitoring Report submitted to NRC. The analyses will also be submitted to WDEQ/LQD on a quarterly basis or as required by the WDEQ/LQD Permit to Mine. The final restoration report will include the results of all stability monitoring, statistical trend and hot spot analyses, and the results of any flow and transport modeling to assess potential impacts outside of the exempted aquifer. The final restoration report will be submitted to NRC and WDEQ/LQD for regulatory approval. Following NRC and WDEQ/LQD approval, plugging and abandonment of wells and final reclamation will be performed as described in TR Section 6.2.

<u>Restoration Analogs</u>

Restoration activities at Wyoming and Nebraska ISRs, including the Nubeth R&D site, have proven that the groundwater can be restored to baseline water quality or ACLs approved by NRC and WDEQ/LQD following commercial ISR uranium recovery activities. Similarities between the ore zone hydrogeologic and chemical conditions at the Ross ISR Project and Irigaray, Christensen Ranch, Smith Ranch-Highland Uranium Project, and Crow Butte indicate that aquifer restoration in the proposed project area is achievable using the methods and volumes proposed in this license application. Detailed restoration analogs are provided in TR Section 6.1.

5.4.2.2.1 Excursions

Excursions are defined as the exceedance of UCLs for two or more excursion indicators in a monitor well. To mitigate the potential for excursions Strata proposes to construct a monitor well network within and around each wellfield module. The monitor well network comprises perimeter wells and wells completed in the underlying and overlying aquifers. The function of the monitor well network will be to detect any recovery solutions that may migrate away from the production area. Ore zone monitor well spacing would be based on the aquifer characteristics determined from hydrologic modeling and aquifer testing, while the deep and shallow monitor wells will be installed on an approximate basis of one well per monitoring unit per four acres of wellfield.

Water quality samples would be collected from monitor wells on a routine basis and analyzed for excursion parameters that are designed specifically to detect recovery solution excursions. Water levels in monitor wells will also be measured in order to provide an early warning of a potential excursion and allow Strata to correct the wellfield imbalance before an actual excursion occurs. Sections 3.1, 5.7, and 6.1.2 in the TR describe how Strata will use an operation and aquifer restoration model to help prevent excursions. An increasing water level in a perimeter monitor well would indicate a flow imbalance locally within the wellfield, which could result in an excursion if not corrected. An increasing water level in an underlying or overlying monitor well would be indicative of the migration of fluid from the ore zone, possibly by an injection well casing failure. Strata's proposed monitor well network would allow corrective action to be immediately taken to locally balance the injection and recovery flows or for individual wells to be shut down as necessary.

To reduce the potential of an excursion due to an improperly abandoned exploration hole, Strata would locate and abandon all exploration drill holes that can be located within the perimeter monitor well ring and beneath the central plant area. Procedures are detailed in Addendum 2.6-B to the TR. These holes would be reentered to total depth and sealed with cement slurry or heavily mixed bentonite grout from the bottom to the ground surface.

In the event that an excursion is detected during the restoration stability monitoring period, the procedures described above would be followed.

5.4.2.2.2 Spills and Leaks

Mitigation measures for accidental spill and leaks that could potentially affect groundwater are similar to those presented in 5.4.1.4.

5.4.2.2.2.1 Wellfields and Pipelines

Within the module buildings, wellfield flows would be continuously monitored for any variations in flow or pressure that could indicate a leak in the pipelines or wells. Instrumentation would be included to automatically shut down the pumping systems in the event of a flow or pressure reading outside of acceptable operating parameters. The module buildings and valve manholes containing trunkline and feeder line valves would be equipped with leak detection devices that would activate audible and visible alarms at the CPP in the event of a leak. Wells would also undergo routine MIT to identify potential leakage.

Piping connecting the recovery and injection wells with the module buildings and connecting the module buildings with the CPP would be buried, corrosion-resistant HDPE. Piping inside the module buildings would be corrosion-resistant HDPE, PVC, or stainless steel. All piping would be rated for a maximum operating pressure greater than the proposed maximum for injection or recovery. All piping would also be hydrostatically tested for leakage prior to operation. Construction specifications for buried pipelines would include pipe bedding to provide support and prevent rocks in trench backfill from damaging the pipes. Thrust blocking would be provided at pipe bends and valves, and transient analysis would be performed to ensure that pipes are protected from rapid pressure changes resulting, for example, from the sudden closing of a valve or starting of a pump.

In the event that a significant piping failure causes a leak of injection or recovery fluids, the corresponding variation in flow or pressure would signal alarms in the module building and CPP. Automatic controls would stop operating equipment, and the operators would manually control equipment and valves to isolate and contain the leaking section of pipe. The equipment would be repaired and the leak cleaned up in accordance with Strata's Environmental Health and Safety (EHS) program.

5.4.2.2.2.2 Lined Retention Ponds

Lined retention ponds would be designed to meet the requirements of NRC Regulatory Guide 3.11 for embankment retention systems and Wyoming Water Quality Rules and Regulations, Chapter 11, for lined wastewater disposal ponds. Pond locations were selected based on topography, proximity to the CPP, access, distance from surface drainage features and nearby residences, and potential for minimizing erosion, disturbance, and water dispersion by natural features.

The lined retention ponds would include liners and leak detection systems meeting the requirements of Regulatory Guide 3.11. Each pond would be equipped with an impermeable synthetic reinforced primary liner underlain with a leak detection system. The leak detection system would consist of the transport media (clean sand on the bottom, geocomposite material on the sides, and gravel around the pipes) and the piping system. The bottom of the pond would consist of a sand layer, and the sides of the ponds would be equipped with a highly permeable, double-sided drainage geocomposite material. The sand and geocomposite material would convey any leakage that may occur through the primary synthetic liner to collection pipes, which in turn would drain to sumps. The earth bottoms of the ponds would be graded to slope toward the sides to facilitate the drainage of any leakage to the nearest collection pipe. The collection pipes would be sloped to drain to four sumps which would serve as collection points for the leak detection system. Beneath the leak detection system would be a secondary synthetic liner or a clay liner. A schematic of the pond leak detection systems is included in TR Figure 3.1-18.

Operating procedures would not allow an individual pond cell to fill to a point where overflow is considered a realistic possibility. Water levels in the ponds would be recorded daily as described in TR Section 5.3. Normally the water level would be maintained at or below the high water line, which includes not only freeboard for runoff and wave runup, but also freeboard to allow the contents of any damaged pond cell into the remaining cells within that pond. The water level would always be maintained at or below the maximum water surface elevation, which includes freeboard for direct precipitation resulting from the 100-year, 24-hour storm and wave runup.

In the event of a leak from a lined pond cell, the NRC would be notified by telephone within 48 hours of verification. Depending on the extent of the damage, water would be removed and transferred to other pond cells for temporary storage. The leak would be repaired as quickly and efficiently as possible. Strata would analyze standpipe water quality samples for leak parameters once every 7 days during the leak period and once every 7 days for at least 14 days following repairs. A written report including analytical data and descriptions of the correction actions and results of those actions would be submitted to the NRC within 30 days of initial leak notification.

5.4.2.2.3 Deep Well Disposal

Most of the brine generated by the Ross ISR Project would be disposed in Class I deep disposal wells. The wells would be constructed according to WDEQ/WQD Class I disposal well construction standards. In order to permit the wells, Strata would demonstrate that there would be no migration of injected fluids into nearby wells or USDWs. Strata would also perform routine monitoring and perform internal and external MIT in accordance with the conditions of the UIC permit.

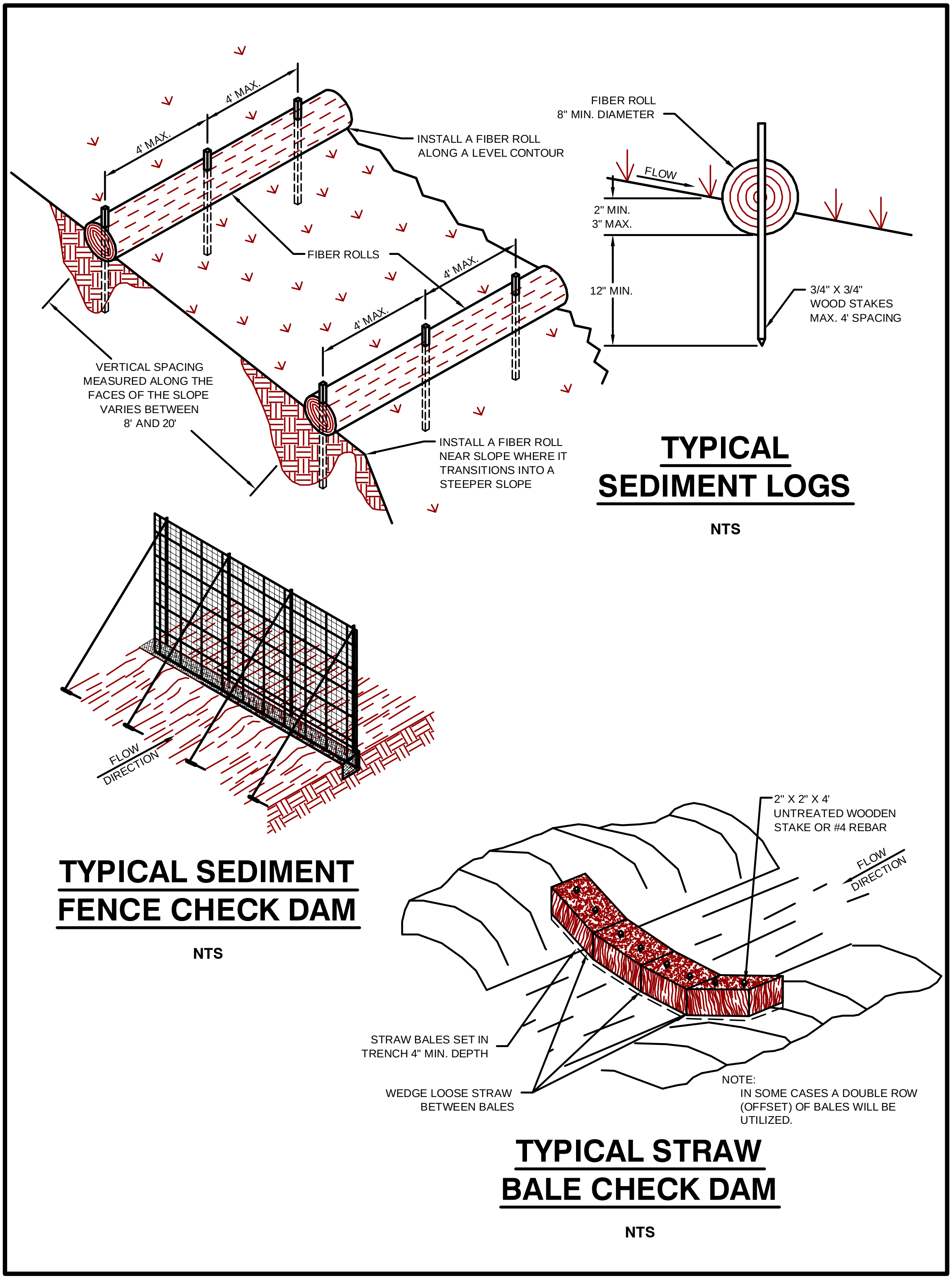

Figure 5.4-1. Sediment Control BMPs

5.5 Mitigation of Potential Ecological Resources Impacts

Primary impacts (areas of disturbance) would affect only approximately 16% of the proposed project area and are associated with the construction of wellfields, processing facilities, and associated infrastructure. Secondary impacts would extend away from the areas of primary impacts, with the area of potential effect (APE) varying according to the species of vegetation or wildlife involved. The disturbance would occur in non-contiguous mineral development areas spread across the proposed project area. Current residual (cumulative) short- and long-term disturbances to vertebrate species within the proposed project area arise from multiple sources. Those sources contributing to cumulative impacts include direct and indirect impacts from livestock grazing, hunting and recreational use, road development, conventional oil and gas development, and other forms of energy exploration and extraction operations. Those activities have occurred in the past and most are expected to continue at current levels. Energy development is expected to occur at an increased rate in the future. An increased level of energy development would likely involve increased levels of traffic, noise, dust, and infrastructure (roads, fences, power lines), which can elevate the level of cumulative disturbance in the area.

Adverse effects to the evaluated species would consist primarily of potential harassment or displacement of foraging individuals due to human and equipment disturbance and mortality or injury caused by vehicle collisions. The overall result of implementing the Proposed Action would be that individuals of some vertebrate species may be lost, but the cumulative impacts are not expected to significantly reduce the size or viability of local populations. In addition, the Proposed Action would not conflict with the current multiple-use management objectives on lands managed by BLM.

Given the limited number of vertebrate species of concern known or suspected to inhabit the area, the limited habitat disturbance associated with future ISR operations relative to the size of the proposed project area, and Strata's commitments to honor important timing and spatial limitations and continue long-term monitoring, any such residual effects from this proposed project would likely only occur on a limited basis. Construction and ISR operations have requirements for reclamation of disturbed areas as recovery of energy resources is completed. Those reclamation efforts would mitigate impacts to wildlife species and habitats.

5.5.1 Vegetation

Potential impacts to vegetation associated with the Ross ISR Project are discussed in Section 4.5. Mitigation of vegetation impacts will consist of temporary and permanent surface revegetation of disturbed areas. Revegetation practices will be conducted in accordance with WDEQ/LQD regulations and the WDEQ/LQD permit to mine. Disturbed areas will be seeded to re-establish a vegetative cover to minimize wind and water erosion and the invasion of undesired plant species. A temporary seed mix may be used in wellfields and other areas where the vegetation will be disturbed again prior to final decommissioning and final revegetation. The temporary seed mix typically consists of one or more of the native wheatgrasses (e.g., western wheatgrass, and thickspike wheatgrass). Permanent seeding is accomplished with a seed mix approved by the WDEQ/LQD. Two permanent reclamation seed mixtures (upland and pasture/hayland) would be used to re-seed disturbed areas. Suggested permanent seed mixtures are included in Table 5.5-1. Wellfield areas may be fenced as necessary to prevent livestock access, which will enhance the establishment of temporary vegetation.

5.5.2 Wildlife and Fisheries

Strata will consult with WGFD and WDEQ/LQD to determine if a sage-grouse monitoring, protection, and habitat enhancement plan is necessary for the proposed project. The plan will be formulated, if warranted. Potential impacts to terrestrial and fisheries species associated with the proposed action are discussed in Section 4.5. The potential for impacts associated with ISR construction, operation, aquifer restoration, and decommissioning activities would be reduced by the relatively small area of surface disturbance.

Given the factors outlined above, and the limited use of the proposed project area by most vertebrate species of concern, impacts to those species from the Proposed Action are expected to be minimal. Nevertheless, regulatory guidelines and requirements designed to prevent or reduce impacts to wildlife would include one or more of the following, as addressed by the various regulating and permitting agencies:

1) Fencing designed to permit big game passage (WGFD);
2) Use of existing roads when possible, and location of newly constructed roads to access more than one drill site (BLM);
3) Implementation of speed limits to minimize collisions with wildlife, especially during the breeding season;

4) Adherence to timing and spatial restrictions within specified distances of active sage-grouse leks as determined through consultation with WGFD and WDEQ/LQD;
5) If direct impacts to raptors or migratory bird species of management concern result from ISR development and operations, a Monitoring and Mitigation Plan for those species must be prepared and approved by the USFWS, including one or more of the following provisions:

    a) Relocation of active and inactive raptor nests that would be impacted by drilling, construction, or operation activities in accordance with the approved raptor monitoring and mitigation plan;
    b) Creation of raptor nests and nesting habitat through enhancement efforts such as nest platforms to mitigate other nest sites impacted by ISR operations;
    c) Obtaining appropriate permits for all removal and mitigation activities;
    d) Establishing buffer zones protecting raptor nests where necessary and restricting mine-related disturbances from encroaching within buffers around active raptor nests (from egg-laying until fledging) to prevent nest abandonment, or injury to eggs or young;
    e) Reestablishing the ground cover necessary to attract and sustain a suitable raptor prey base after drilling, construction, and future ISR uranium recovery; and
    f) Required use of raptor-safe construction for overhead power lines according to current guidelines and recommendations by the Avian Power Line Interaction Commission and/or USFWS;

6) Restoration of sagebrush and other shrubs on reclaimed lands and grading of reclamation to create swales and depressions for sagebrush obligates and their young (WDEQ/LQD);
7) Restoration of pre-drilling and pre-construction native habitats for species that nest and forage in those vegetative communities (WDEQ/LQD);
8) Restoration of diverse landforms, direct topsoil replacement, and the construction of brush piles, snags, and/or rock piles to enhance habitat for wildlife (WDEQ/LQD);
9) Restoration of habitat provided by jurisdictional wetlands (WDEQ/LQD, USACE); and
10) Reclamation of creek channels and restoration of surface water flow quantity and quality after ISR uranium recovery to approximate pre-operational conditions (WDEQ/LQD).

Another effective way to minimize impacts related to exploratory drilling in the proposed project area would be the use of a systematic drilling pattern that affects only one area at a time, working from one side of the proposed project area to another. Reclamation would be completed in the same sequence. Agency standards for reclamation would be followed. This systematic approach would allow more mobile wildlife species to relocate into adjoining, undisturbed habitat and then return following completion of reclamation in a particular area. These efforts, in conjunction with the mitigation measures outlined above, would decrease direct and indirect impacts for all wildlife species.

Table 5.5-1. Recommended Seed Mixtures

Life Form / Species	Interim Seed Mixture PLS/Ac	Upland Seed Mixture PLS/Ac	Pastureland/ Hayland Seed Mixture PLS/Ac
Perennial Cool Season Grasses			
Western Wheatgrass (Rosana)	2.5	1.5	-
Thickspike Wheatgrass (Critana)	2.5	1.5	-
Bluebunch Wheatgrass (Secar)	2.5	1.0	-
Crested Wheatgrass (Nordan)	-	-	1.5
Intermediate Wheatgrass (Rush)	-	-	1.5
Indian Ricegrass (Rimrock)	-	1.0	-
Sandberg Bluegrass (High Plains)	-	1.0	-
Smooth Brome (Carlton)	-	-	1.0
Green Needlegrass (Lodorm)	2.5	1.0	-
Perennial Warm Season Grasses			
Blue Grama (Bad River)	-	1.0	-
Buffalograss (Cody)	-	1.0	-
Prairie Sandreed (Goshen)	-	0.5	-
Shrubs			
Wyoming Big Sagebrush	-	0.5	-
Silver Sagebrush	-	0.5	-
Rubber Rabbitbrush	-	0.5	-
Subshrubs			
Winterfat	-	1.0	-
Fringed Sagewort	-	0.5	-
Perennial Forbs			
Silky Lupine	-	0.5	-
Cicer Milkvetch (Monarch)	-	0.5	1.0
Rocky Mountain Penstemon	-	0.5	-
Western Yarrow	-	1.0	-
American Vetch	-	0.5	-
Blue Flax	-	1.0	-
Alfalfa (Ladak 65)	-	-	4.0
TOTAL	10.0	16.5	9.0

Prepared by Intermountain Resources

Note: PLS = pounds live seed

5.6 Mitigation of Potential Air Quality Impacts

Potential impacts to air quality during all phases of the Proposed Action (Section 4.6) include the generation of non-radiological and radiological airborne emissions. Non-radiological emissions include fugitive dust and combustion emissions, which will be highest during construction and decommissioning, oxygen, carbon dioxide and trace chemicals released from the CPP, and oxygen and carbon dioxide released from the wellfield. Radiological emissions will be limited to radon gas released in small quantities from the wellfield, CPP, and lined retention ponds. Air quality protection measures that will be implemented at the site may include the following:

- Reduce fugitive dust emissions via standard dust control measures, including speed limits, placing dust control water loadout facilities at strategic locations along access roads within the proposed project area, use of chemical dust suppression chemicals such as magnesium chloride, and selection of road surface materials that will minimize fugitive dust.
- Reduce the potential for release of fugitive dust from construction activities by suppressing dust in disturbed areas with water and promptly revegetating disturbed areas.
- Use pressurized, downflow IX columns, pressure piping, and modern vacuum dryers to limit radon gas emissions and eliminate radiological particulate emissions.

5.7 Mitigation of Potential Noise Impacts

As a result of the remote location of the project and the low population density of the surrounding area, noise impacts are expected to be small. As discussed in Section 4.7 of this report the major noise source during the construction, operation, aquifer restoration, and decommissioning phases of the Ross ISR Project is from truck traffic. The speed limits for trucks along D Road and the New Haven Road are posted at 45 mph. Strata will set a speed limit of 15 mph on all access roads within the proposed project area. Posted signs will be located throughout the proposed project area to ensure all employees and contractors are aware of speed limits. Strata will also implement a policy that will include adherence to county road speed limits for all Strata employees and contract workers.

Other noise sources include operation of process machinery, well drilling, and heavy equipment. The process machinery such as pumps and generators will be located within the CPP, which is fully enclosed. Overhead doors may need to be opened to help ventilate the facility; however, keeping all doors closed as much as possible will help minimize the amount of noise generated.

Noise originating from the drilling equipment is apparent locally. Most of the nearby residents will have minimal effects from daytime drilling; however, people generally have a lower tolerance to noise at night. Average ambient noise levels outside during the night are around 36 dBA. The nearest residence is 690 feet from the proposed project area. As shown in Table 4.7-1 in this ER, the anticipated noise level resulting from a drill rig at this distance is 29 to 51 dBA. Most drilling activities will take place well inside the proposed permit boundary, and therefore the noise levels from drilling activities are anticipated to be well below the annoyance threshold described in Section 3.7 and 4.7 of 55 dBA. Nevertheless, Strata will coordinate drilling activities to minimize noise disturbance. Recognizing that the tolerance for noise typically decreases at night, Strata will restrict drilling to daytime hours (8 a.m. to 8 p.m.) in areas where the annoyance noise threshold could be exceeded at nearby residences.

Most of the heavy equipment will be used during the construction phase of the project. For safety, the majority of construction equipment will only be run during daylight hours. This should increase the tolerance of residents to noise from construction equipment. Most construction activities involving heavy equipment will also occur within the central plant area, which is approximately 2,500 feet from the nearest residence. Strata will also implement a ‘first move forward’ driving policy which requires drivers to park in such a way that they do not have to back up before moving forward. This policy will be followed whenever possible not only for safety purposes but also to reduce the use of backup alarms which can be potentially annoying to nearby residents. Strata will also limit noise impacts in sensitive areas by limiting use of equipment with loud engines, unrestricted exhaust systems, and engine brakes.

Any employee working at the drilling or construction site will be required to wear hearing protection. As described in Section 4.7 of this report, NIOSH recommends an exposure limit for workplace noise of 85 dBA for a duration of 8 hours per day. Several types of construction equipment such as bulldozers, excavators, and front-end loaders can reach noise levels well above 85 dBA. Strata will implement a hearing conservation program to ensure that proper PPE is worn and engineering controls are in place to protect workers from potentially damaging noise.

5.8 Mitigation of Potential Historic and Cultural Resources Impacts

Class I and III cultural resource surveys were conducted on the proposed project area as described in Section 3.8.2 of this ER. The results are included as Addendum 3.8-A. The inventory report contains information that falls under the confidentiality requirement for archeological resources under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)). Prior to any ISR-related disturbance, SHPO will be consulted to evaluate the eligibility of the cultural properties identified during the Class III surveys for inclusion in the NRHP. Cultural properties that are determined to be eligible for the NRHP will be avoided, if possible. A recovery plan will be implemented prior to disturbance of the potentially eligible sites that cannot be avoided.

None of the potentially eligible sites has been subjected to data recovery action. Therefore, all potentially eligible sites will be carried forward in the WDEQ/LQD Mine and Reclamation plans as requiring protective stipulations until a testing, mitigation, or data recovery plan is developed to address the potential impacts to the sites. Wyoming SHPO will be consulted on the development recovery plans and their implementation.

Mitigation measures that will be implemented at the project site to minimize impacts to historical and cultural resources may include the following:

- Avoidance, where practical, of NRHP sites.
- Consultation with SHPO and appropriate THPOs.
- Conduct pre-construction surveys to ensure that work will not affect important historical, cultural, and archaeological resources.
- Adhere to anticipated NRC License Conditions requiring phased identification of previously unidentified historical, cultural or archaeological resources and immediate response procedures for protecting such resources during all phases of the Proposed Action. Strata will cease any work resulting in the discovery of previously unknown cultural artifacts to ensure that no unapproved disturbance occurs. State and Federal agency personnel would be contacted, and the materials evaluated by an archaeologist or historian meeting the Secretary of Interior's Professional Qualification Standards (48 FR 22716, September 1983).
- Strata has also implemented a management control program, which states that Strata will administer a historic and cultural

resources inventory before engaging in any development activity not previously assessed by NRC. Any disturbances to be associated with such development will be completed in compliance with the National Historic Preservation Act and the Archeological Resources Protection Act.

Paleontological material (fossilized vertebrate remains) were located on the proposed project area. Therefore, prior to disturbance professional paleontologists would be consulted to evaluate the significance of the fossilized material found at the site.

5.9 Mitigation of Potential Visual and Scenic Resources Impacts

Potential impacts to the visual and scenic resources of the proposed project area are discussed in Section 4.9. The operation of the Ross ISR Project will result in more industrial activity in the area. Strata will implement mitigation measures to reduce the visual effects of the wellfields, processing facility, access roads, and drill rigs during the construction, operation, and reclamation phases.

Well head covers will be approximately 3 feet tall. Since livestock grazing will be restricted in these areas, vegetation will help conceal the well head covers. Strata will choose a neutral color for the well head covers to further screen the locations. When aquifer restoration is complete and regulatory approval is granted in specific wellfield modules, Strata will reclaim and re-seed those areas. This will help reduce the industrial look of the area.

Strata has designed the central plant area such that the CPP, offices and the maintenance building will be at one location. This will minimize the areas devoted to industrial use. The buildings will be painted a neutral color that will blend in with the existing terrain. Strata will ensure the central plant area is well maintained and reasonably free of clutter.

Strata will plant trees adjacent to the central plant area and primary access road as depicted on Figure 1.2-5 in this ER. The trees will help minimize the visibility of the facilities and traffic.

Access roads will be constructed to access the central plant area and wellfield. Roads will be aligned with the terrain and will be constructed to avoid a straight-line appearance. Although aligning the roads with topography may add slightly more disturbance, it will reduce the amount of large cuts and fills.

Construction equipment will be on site temporarily; however drill rigs may be in operation for the duration of the project. To reduce the visual impacts, Strata will minimize the amount of nighttime drilling. For the safety of the employees, large lights will be needed during nighttime drilling. To reduce the brightness of the lights, Strata will turn them away from any nearby residences. As discussed in Section 5.7, Strata will restrict the proximity of operating drill rigs to any residence at night.

Dust will likely be generated during construction activities. Truck traffic on county and local roads will also generate dust. Strata may utilize water for dust suppression using strategically placed water loadout facilities near the central plant area and wellfields. The loadout facilities would also be available for firefighting purposes. Strata may also use magnesium chloride or similar dust suppressants. Dust will also be minimized by implementing and enforcing speed limits for Strata employees and contractors traveling to the proposed project area and traveling on access roads within the proposed project area.

5.10 Mitigation of Potential Public and Occupational Health Impacts

Potential public and occupational health impacts from non-radiological and radiological sources are described in Section 4.12 as required by NUREG-1748 and NUREG-1569. Strata will minimize impacts to public and occupational health by complying with the Radiation Protection Standards contained in 10 CFR 20 and following the ALARA principle. The radiation safety controls and monitoring programs that will be implemented at the Ross ISR Project are discussed in Section 5.7 of the TR.

As discussed in Section 3.10, the proposed project area is located in a sparsely populated area of western Crook County, Wyoming. The nearest community is Moorcroft, Wyoming (est. 2009 population 926), about 22 miles (35 km) south of the proposed project area. The closest urban area to the proposed project area is Gillette, Wyoming (est. 2009 population 28,726), about 50 road miles (80 km) southwest of the proposed project area. The population distribution for the 50-mi radius around the proposed project area is depicted in Figure 3.10-1. Section 3.1.5 describes nearby residences. There are no residences within the proposed project area. Within 2 km (3.2 mi), there are 11 residences with approximately 30 current residents. The nearest residence to the proposed project boundary is about 210 m (690 ft) away, and the nearest residence to the CPP is about 762 m (2,500 ft) away. The nearest sensitive receptors are the schools in Moorcroft, about 35 km (22 mi) south of the proposed central plant location.

5.10.1 Mitigation of Potential Construction Impacts

During the construction phase of the proposed Ross ISR Project, potential impacts to public and occupational health include: fugitive dust, combustion emissions, noise, and occupational hazards associated with construction of the wellfield, CPP, and associated facilities. Potential impacts from fugitive dust and combustion emissions are described in Section 4.6. As described in the ISR GEIS (pg. 4.2-53), fugitive dust would not likely result in any significant radiological dose as long as soils show low levels of radionuclides. Impacts from fugitive dust will be mitigated by limiting the area subject to disturbance at any given time and seeding disturbed areas promptly after construction, typically within a single construction season.

Section 4.7 addresses potential noise levels associated with construction equipment. Members of the public will not be exposed to potentially damaging noise levels, and a hearing conservation program for Strata employees and contractors will mitigate effects of occupational noise during construction. Other potential occupational hazards will be those typical of construction and drilling and will generally be the same as occupational hazards to existing oilfield workers described in Section 3.11.4 of this ER. These include occupational injuries such as strains and sprains resulting from common incidents such as slips/trips/falls or lifting. Potential occupational injuries will be mitigated by implementing worker safety procedures and training programs that conform to the Wyoming Occupational Health and Safety Act, Title 27, Labor and Employment, Chapter 11, Occupational Health and Safety and applicable OSHA standards.

5.10.2 Mitigation of Potential Operation Impacts

As discussed in Section 4.12.1.2, operation of the Ross ISR Project has the potential for radiological and non-radiological impacts to public and occupational health. The potential for radiological and non-radiological impacts include those typical of normal operation and those associated with accidents.

Potential non-radiological public and occupational health impacts will be related to fugitive dust, combustion emissions, noise, permitted surface discharges and contamination of water supplies. Section 4.12 includes descriptions of these potential impacts based on the potential pathways of exposure. The receptors for non-radiological impacts include nearby residences, public schools and drinking water intakes.

Impacts from fugitive dust emissions will mitigated by implementing dust control BMPs, limiting areas that are disturbed and unreclaimed at any given time, and reclaiming disturbed areas at the first opportunity. Potential air quality impacts of the Ross ISR Project are discussed in Section 4.6. Potential noise impacts during operation are addressed in Section 4.7.

There would be no potential public health impacts resulting from any permeate discharge due to the high effluent quality (see Section 4.4 of this ER and Section 2.3.1.1 of the TR) and small discharge rate (typically 50 gpm or less).

Section 4.12.1.2.2 describes the potential for non-radiological impacts from accidents during operation at the Ross ISR Project. Accidents involving human safety associated with ISR uranium extraction typically have far less severe consequences than accidents associated with underground and open-pit mining methods. Accidents that may occur in ISR operations are generally minor when compared to accidents that typically occur in other industries. Radiological accidents that might occur would typically manifest themselves slowly and are therefore easily detected and mitigated. The remote location of the proposed project area and the low level of radioactivity associated with the process combine to decrease the potential hazard of an accident to the general public.

NRC has previously evaluated the effects of accidents at conventional uranium milling facilities in NUREG-0706 and at ISR uranium facilities in NUREG/CR-6733. These analyses demonstrate, for most credible potential accidents, consequences are minor so long as effective emergency procedures and properly trained personnel are used. The proposed Ross ISR project facilities will be consistent with the operating assumptions, site features, and designs examined in the NRC analyses in NUREG/CR-6733. Strata will mitigate the effects of accidents by implementing and enforcing emergency management procedures following the recommendations contained in the NRC analyses. Training programs, discussed in Chapter 5 of the TR, will ensure that Strata personnel are adequately trained to respond to all potential emergencies.

NUREG/CR-6733 noted that the scope of the NRC mission includes hazardous chemicals to the extent that mishaps with these chemicals could affect releases of radioactive materials. Strata will mitigate the effects of chemical spills by adopting and enforcing standard operating procedures regarding receiving, storing, handling, and disposal of chemicals to ensure the safety of the public and workers. An RMP for the ammonia system will be implemented and will include items such as accident consequence analysis, standard operating procedures, emergency response procedures, documented management system, and accident prevention plans. Also, Strata will submit a “Top-Screen” analysis in order for the DHS to evaluate the chemical security risks associated with the Ross ISR Project.

To mitigate consequences of an ammonia accident, the CPP design and operating procedures will be consistent with ANSI recommendations, which include 1) providing an excess flow valve located as close to the storage tank as possible that automatically closes if the flow rate exceeds a specific value; 2) the use of appropriate ANSI and ASME standard codes for nonrefrigerated pressure piping; and 3) provision of positive-pressure, self-contained, full-face respirators in the immediate vicinity of the ammonia piping and process operations. The ammonia piping will be placed so as to minimize the potential for impact from vehicles or other objects that might cause ruptures. Although industrial safety at ISR facilities is regulated by the Wyoming State Mine Inspector and OSHA's PSM standard does not apply, Strata will comply with the PSM standard during development of the ammonia system design and operating procedures.

Strata will mitigate potential effects of a spill or leak of hydrogen peroxide by incorporating recommendations concerning materials of construction for tanks and piping systems and the use of local ventilation with explosion-proof fans to control vapors in the event of a leak of hydrogen peroxide.

To mitigate hazards associated with storage and handling of oxygen on site, Strata will design and install underground and above-ground gaseous oxygen piping in accordance with industry standards contained in CGA G4.4 concerning material specifications, velocity restrictions, location and specifications for valves, and design specifications for metering stations and filters. To mitigate the risk of an accident that could potentially affect other processes or storage facilities and radiological safety, oxygen will be stored an appropriate distance from other infrastructure and storage areas in facilities that conform to standards detailed in NFPA 55. Strata will develop procedures that implement emergency response instructions for a spill or fire involving oxygen systems.

To mitigate the potential for accidents involving storage and use of gasoline, diesel, and propane, they will be stored outside of the plant building and away from hazardous material storage areas. Storage containers will be located above ground and with safety and environmental provisions according to federal, state and local regulations.

Strata completed an assessment of the radiological effects of the proposed Ross ISR Project based on the types of emissions, potential pathways, and potential consequences of radiological emissions (see Section 4.12 in this ER). The following discusses mitigation of potential radiological impacts for each pathway; additional details are found in Section 7.3 of the TR.

To reduce and mitigate potential exposures from water pathways, Strata will control and monitor the solutions in the ore zone to ensure that migration does not occur. This will include maintaining a hydraulic bleed and monitoring the overlying, underlying, and adjacent non-exempt aquifers for excursions.

Most uranium recovery equipment, including the IX, precipitation, drying and packaging facilities, will be located on curbed concrete pads with secondary containment of sufficient size to contain the contents of the largest tank in the event of a rupture. While most process equipment will include secondary containment such as curbs and sumps designed to contain and isolate the contents of the specific equipment, general secondary containment will be provided for all equipment within the CPP in the form of a stem wall incorporated into the building foundation. The stem wall will extend upward from the CPP foundation and will be designed to ensure that no process fluid or chemical is allowed to reach the surrounding environment. Additional details are found in TR Section 3.2.9.2. Solutions used to wash down equipment will be captured and pumped back into the processing circuit or to lined retention ponds prior to injection in the deep disposal wells.

The potential for radiological exposure from air pathways will be minimized at the Ross ISR Project through the use of downflow IX columns and vacuum yellowcake dryers. By employing this technology, radon gas emissions from wellfields and processing facilities will be the only radiological airborne effluent (see ISR GEIS, pg. 4.2-53). The uranium recovery process will be a closed circuit with exhaust vented outside the plant building through the roof. The CPP will have ventilation systems to remove small amounts of radon-222 that may be released during solution spills, filter changes, IX resin transfer and maintenance activities. Radon gas released from well heads, module buildings and lined retention ponds will have minimal impact on the public and workers since radon does not pose an outdoor health hazard.

Mitigation measures to reduce or eliminate impacts from potential accident scenarios that could have radiological impacts are discussed in Section 5.12.2. Section 5.7 of the TR describes the radiation safety controls and monitoring programs that will be implemented at the Ross ISR Project. These programs were developed to assure that operations criteria established in NUREG/CR-6733 will be followed such that the occupational health impacts and accident risks described in that document will be applicable to the Ross ISR Project. Additional details of each potential credible accident are discussed in Section 7.5 of the TR.

A spill of the materials contained in the process vessels and chemical storage tanks at the Ross ISR Project will present a minimal radiological risk. All tanks will be constructed of fiberglass or steel with the exception of the hydrogen peroxide storage tank, which will typically be constructed of aluminum. Instantaneous failure of a tank is unlikely. The most likely tank failure would be a small leak. In this case, the tank would be emptied to at least a level below the leaking area and repairs or replacement made as necessary. If a tank or process vessel were to have a major failure, such as a rupture, all fluid would be captured in secondary containment structures (concrete curbs or stem wall) in the CPP. The containment areas will have a sump to pump the collected fluids to other process vessels, a lined retention pond, or a deep disposal well. Following fluid removal the area will be washed down and the water will be collected and disposed using a similar method.

The potential failure of a yellowcake thickener resulting in a release of contents outside the plant structure will be mitigated by designing foundations to support the maximum weight of the equipment and by having all personnel follow spill response procedures which will require the use of PPE.

To mitigate potential effects from a spill from an IX column resulting in the release of the contents of the vessel and the resultant release of radon, Strata will provide employees and train them in the use of respirators, evacuate unprotected personnel from spill areas near IX columns, and maintain proper equipment, training, and procedures to respond to large lixiviant spills or IX column failure.

The rupture of an injection or recovery line in a wellfield module, or a trunkline between a wellfield module and the plant, would result in a release of injection or recovery solution which would contaminate the ground in the area of the break. Occasionally, leaks at pipe joints and fittings in the module buildings or at the wellheads may occur. These leaks seldom result in soil contamination. To mitigate any adverse effects, following repair of a leak, Strata will require that the affected soil be surveyed for contamination and the area of the spill documented. If contamination is detected, the soil will be sampled and analyzed for the appropriate radionuclides and any contamination would be removed as appropriate.

Potential transportation accidents are discussed in Section 4.2 in this ER and in greater detail in Section 7.5.4 of the TR. Mitigation of effects from transportation accidents are discussed in Section 5.12. To mitigate the effects of any transportation accidents, extensive emergency response programs will be in place along with environmental emergency response contractors for spill cleanup. Strata will provide training for local emergency personnel including firemen, police and EMTs in the hazards and emergency response procedures to ensure safe working practices in the presence of spilled materials.

In the unlikely event that an accident involving spilled yellowcake during transportation does occur, all yellowcake and contaminated soil would be removed, processed through a uranium mill, or disposed of in an NRC licensed disposal facility. The cleanup would be directed by qualified personnel from the state radiological emergency assistance team. Should the accident be outside the state personnel's capability, the NRC will be requested to provide assistance (NRC 1980). In addition, Strata will provide a post-cleanup radiological survey to verify that all contaminants have been removed.

Solid 11e.(2) byproduct material or unusable contaminated equipment generated during operations and decommissioning will be transported to a licensed disposal site. Potential radiological and environmental impacts in the case of an accident will be small due to the low level of radioactive concentration in the shipments. To mitigate any adverse effects, the solid material would be collected and contained in the event of an accident. Should a transportation accident result in the release of 11e.(2) byproduct material, Strata will provide a post clean-up radiological survey of the affected area to verify that all contaminants have been removed.

Transportation of dried yellowcake will be made in exclusive-use transportation vehicles to a licensed conversion facility. Yellowcake will be shipped in 55 gallon steel drums, each containing a maximum of 950 pounds. Section 4.2 describes how, based on a comparison with NUREG-0706, the probability of a truck accident involving yellowcake shipment will be up to 20% annually. There is only about a 31% likelihood that an accident would release yellowcake, and then 30% or less of the shipment contents would likely be released. Section 4.2 also presents the potential radiological risk factors to the general public from a yellowcake release and concludes that the probability of a cancer death from a yellowcake transportation accident would be very small.

If loaded resin is brought to the Ross ISR CPP from Strata satellite facilities or other locations, it will be transported to the Ross ISR facility in tanker trailers with 500 cubic-foot capacities. Transportation of loaded resin from the satellite facility to the Ross CPP will be the responsibility of the satellite facility and covered under its source and byproduct material license. Strata will assume responsibility of the loaded resin when the shipment has reached the site. An unlikely but credible accident could occur if a truck were involved in a collision which ruptured the tanker trailer. NUREG/CR-6733 has concluded that consequences are likely to be lower for trucks carrying loaded resin than for trucks carrying dry yellowcake because airborne releases from wet material would be minimal if remediated quickly. Further, as described in Section 4.2, the IX resin contains a much lower concentration of uranium than dried yellowcake, and the uranium is chemically bonded to the IX resin and is therefore less likely to spread and easier to remediate in the event of a spill. The risk of an accident within the central plant area is low due to the short distance which would be traveled and the low speed limit of roads within the central plant area. In addition, if an accident did occur, cleanup and remediation efforts are expected to be very prompt considering the proximity to trained personnel.

5.10.3 Mitigation of Potential Aquifer Restoration Impacts

Aquifer restoration activities will have similar but even smaller potential impacts to public and occupational health than operation activities. The times when aquifer restoration overlaps with operation is when the highest rates of RO permeate are generated. It is during concurrent aquifer restoration and operation that WYPDES discharge or land application would most likely be used. Potential public and occupational health impacts from permeate discharge or land disposal would be small and would be mitigated by producing high-quality, low-volume effluent that meets all WDEQ/WQD effluent limits.

Potential public and occupational health impacts during decommissioning would be similar to those during construction. There will be similar types of occupational hazards such as equipment operation, and there will be an increase in the workforce, although the total number of employees and contractors would be only about half of the peak construction workforce. There will generally not be yellowcake or vanadium shipments from the site, a significantly reduced number of chemical shipments to the site, and an increase in shipments of 11e.(2) byproduct material. Strata will be required by the NRC to submit a decommissioning plan for review. The plan will include details on the implementation of a 10 CFR Part 20 compliant radiation safety program. The safety program will ensure that the safety of the workers and public is maintained and that any residual impacts are mitigated during decommissioning.

5.11 Mitigation of Potential Waste Management Impacts

Section 4.13 describes the anticipated quantities, proposed waste management systems, and potential impacts resulting from the management of liquid and solid waste generated under the Proposed Action and No Action Alternative. This section describes measures that will be taken by Strata to mitigate any adverse waste management impacts that might result from the Ross ISR Project.

Brine will be generated from RO treatment of the production bleed and aquifer restoration water. Most of the brine will be generated during concurrent operation and aquifer restoration, when the levels of brine resulting from RO treatment of the production bleed and RO treatment of restoration fluids will be highest. Brine will be routed from the production and restoration RO units in the CPP to a wastewater collection system as described in Section 4.2 of the TR. Two lined retention ponds are planned, each including three cells. Most of the brine and other 11e.(2) liquid waste generated by the Proposed Action will be disposed in Class I deep disposal wells. Deep well disposal was selected as the preferred method of brine disposal due to minimal potential impacts to human health and the environment compared to more and larger evaporation ponds or off-site brine transport.

The secondary method of brine disposal in the Proposed Action is evaporation in lined retention ponds. Lined retention ponds will be designed, constructed, and inspected in accordance with NRC Regulatory Guide 3.11 and Wyoming WDEQ/WQD rules and regulations for lined wastewater ponds with leak detection systems. Reliance solely upon evaporation ponds has been rejected because of the large surface impoundment areas that would be required, the increased environmental risk associated with storing large quantities of brine in surface impoundments and the lack of evaporation during winter. The residue from evaporation would require disposal as an 11e.(2) byproduct. The use of evaporation in conjunction with liquid waste disposal in on-site deep disposal wells is considered to be the best alternative to dispose of these types of liquid waste.

Potential impacts of brine disposal by deep well injection or evaporation are small, and any slight adverse effects will be mitigated by reducing the amount of brine produced. This will be done primarily by employing two stages of RO. The brine from the first stage of production and restoration RO will be further treated in a second stage. This will reduce the brine quantity by an estimated 50% compared to single-phase RO treatment. Strata will further reduce the brine quantity by employing limited groundwater sweep. As described in TR Section 6.1, a limited volume of groundwater sweep is proposed to minimize consumptive use of groundwater coming from outside of the exempted aquifer, thereby mitigating the effects of water withdrawal from the ore zone aquifer. Any effects of leaks or spills from the brine management system will be mitigated by early detection and response to correct the leak, prevent future leaks, and proper disposal of any affected soils.

Most of the permeate from the RO units will be injected into producing wellfield modules to help reduce the buildup of dissolved constituents or into wellfield modules undergoing RO treatment with permeate injection as part of aquifer restoration. Figure 4.13-1 shows that excess permeate is expected to be discharged into the lined retention ponds during operation without concurrent aquifer restoration. This will also likely occur during the beginning of aquifer restoration, when the first wellfield module(s) undergo groundwater sweep but when there are no wellfield modules in the RO treatment with permeate injection phase. Additional information is presented in TR Section 6.1. During concurrent operation and aquifer restoration and during aquifer restoration only, all permeate generated from production and restoration RO units is expected to be injected into wellfield modules undergoing RO treatment with permeate injection.

Excess permeate, when present, will be routed from the RO units in the CPP to the lined retention ponds in buried pipelines. The lined retention ponds may be used to store either excess permeate, brine or other 11e.(2) liquid waste at various stages. Strata anticipates that three pond cells will be initially dedicated to permeate storage. Maximum permeate production will coincide with concurrent operation and groundwater sweep in the first wellfield module(s) undergoing aquifer restoration. After this time, all permeate will generally be injected into wellfield modules undergoing RO treatment with permeate injection. Therefore, it will no longer be necessary to store permeate in the lined retention ponds, and all lined ponds will typically be used to store brine and other 11e.(2) liquid waste.

Permeate will be good-quality water and will generally be put to beneficial use. Most will be injected into wellfields undergoing aquifer restoration without being routed through the lined retention ponds. Excess permeate temporarily stored in the lined retention ponds will be disposed through one of the following methods:

- ♦ Recycle for plant make-up water
- ♦ Injection into wellfield modules undergoing aquifer restoration to control bleed
- ♦ Surface discharge under WYPDES permit
- ♦ Land application (May – September)
- ♦ Class I disposal wells

Any potential impacts from permeate management and disposal will be mitigated by minimizing the amount of permeate produced. Most permeate will be recycled into producing wellfield modules or wellfield modules undergoing aquifer restoration. By employing two-stage RO units, Strata will maximize permeate production and minimize brine production. Excess permeate will be minimized by recycling the permeate from the lined retention ponds to the CPP and to wellfield modules undergoing aquifer restoration.

Potential impacts from surface water discharge would be small and could be beneficial because the discharged water would be available for beneficial uses such as water for livestock and wildlife. The discharged water would be of good quality since it would need to meet WYPDES effluent limits. Surface discharge would also help recharge potentially impacted aquifers that subcrop under the Little Missouri River.

Solid 11e.(2) byproduct material will be generated during all project phases except construction. The 11e.(2) byproduct material will be transported by an appropriately licensed transporter to a disposal facility licensed by NRC or an agreement state. Potential impacts resulting from the management and disposal of 11e.(2) byproduct material include potential spills, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2.

The primary method of mitigating any potential impacts from disposal of 11e.(2) byproduct material will be to minimize the amount of this material through process design, decontamination, and volume reduction during decommissioning. Filter media for the production and restoration circuits will be selected based on filtration efficiency and on minimizing waste material. Where possible, equipment and building surfaces will be decontaminated and reclassified as non-hazardous material for unrestricted release.

Decontamination procedures are discussed in TR Section 6.3 and may include high pressure washing, sand blasting, and acid rinsing. Strata anticipates that a grinder or chipper will be used to reduce disposal volumes of piping and other materials by 50% or more.

Non-AEA-regulated solid waste will include construction debris, office trash, and decontaminated material and equipment. It will be generated during all project phases, including construction, operation, aquifer restoration, and decommissioning. Most of the solid waste will be generated during decommissioning as described in Section 4.13 of this ER.

Non-hazardous solid waste will be disposed off-site in a municipal landfill permitted by WDEQ/SHWD. The nearest municipal landfills include Moorcroft (approximately 23 road miles south), Sundance (approximately 38 road miles southeast), and Gillette (approximately 52 road miles southwest).

The primary method of minimizing any potential impacts from solid waste disposal will be to minimize the amount of waste produced by recycling and decontaminating materials and process equipment and by using a chipper or grinder during decommissioning. Recyclable materials that will be taken to an approved municipal landfill include newspaper, magazines, phone books, cardboard, aluminum and steel cans, and plastic.

Significant quantities of construction debris could be generated during decommissioning. The potential impact of this on the Moorcroft landfill will be mitigated by coordinating with the Moorcroft landfill staff well in advance of decommissioning to ensure sufficient capacity will be available or by transporting solid waste generated during decommissioning to an alternate landfill.

Quantity estimates and management plans for TENORM are described in Section 4.13.1.1.2.2. Mud pits containing drilling fluids and cuttings will be backfilled and graded in accordance with WDEQ/LQD regulations. It is expected that TENORM groundwater generated during the operation and decommissioning phases will be discharged under a temporary WYPDES permit as long as the well is not completed in an interval which could have been affected by uranium recovery operations. Mitigation measures for WYPDES discharge are discussed in Section 5.4.1 and include erosion control BMPs and energy dissipation devices. To mitigate any impacts from these disposal methods, the quantity of drilling fluids will be minimized by using the minimum quantity of water that is technically feasible for well drilling and development. Other mitigation measures that will minimize potential impacts from TENORM waste disposal include backfilling, restoring and re-seeding mud pits, typically within a single construction season, using sediment control BMPs, avoiding construction in areas with previously identified, potentially NRHP-eligible cultural sites, and stopping work if any previously undiscovered cultural resources are encountered during construction or reclamation of mud pits. Mud pits will be included in the decommissioning gamma surveys to ensure that there are no potential long-term impacts from radioactivity in mud pits.

Small amounts of hazardous waste are expected to be generated during all four project phases in similar quantities (see Section 4.13.1.1.1.5.3). In order to maintain classification as a CESQG by WDEQ/SHWD, the project will be required to generate less than 220 pounds (100 kg) of hazardous waste in any calendar month and store less than 2,200 pounds (1,000 kg) of hazardous waste at any one time.

Hazardous waste will be transported to an off-site facility that is licensed by WDEQ/SHWD or a nearby State to manage hazardous waste. The Campbell County Landfill, located just north of Gillette, accepts used oil and batteries for recycling and certain other hazardous waste by contract (Campbell County Public Works 2010). If needed, small quantities of used reagents or other types of hazardous waste may occasionally be transported to more distant licensed disposal facilities.

Potential impacts from hazardous waste management, storage and disposal include potential releases to surface and groundwater, addressed in Section 4.4, and potential transportation impacts, addressed in Section 4.2.

Strata will mitigate any potential impacts from hazardous waste management by minimizing the quantity of hazardous waste generated. This will be done by generally servicing vehicles and equipment at off-site facilities and by limiting laboratory reagent orders to quantities that can be consumed within the reagent shelf lives. The quantity of hazardous waste generated and stored in the proposed project area will be kept small enough to comply with CESQG requirements.

Domestic wastewater management is described in Section 4.13.1.1.1.5.4. Sewage will be collected in a gravity sewer collection system serving the office/administration building, CPP, maintenance building, and any other buildings with restrooms. The wastewater will be disposed of in a conventional septic tank – leach field system designed according to WDEQ/WQD standards.

Construction of the domestic wastewater collection, treatment, and disposal system will result in soil disturbance, much of which will also be disturbed by facility construction and utility installation.

Potential transportation impacts related to sludge hauling, which would occur every few years, would be small and are addressed in Section 4.2.

Potential groundwater impacts resulting from effluent disposal would be small and are addressed in Section 4.4. The small quantity of effluent (about 2 gpm on average) spread over a large area would have very limited potential to impact groundwater quality, considering that a properly sized and maintained septic tank will remove most of the solids and significantly reduce total suspended solids, organic carbon, and ammonia, and a drainfield will provide further treatment, including bacteria reduction.

Impacts of sewage disposal will be mitigated primarily by minimizing the amount of waste produced. Due to the significantly larger number of construction workers relative to operating personnel, Strata will consider constructing an on-site wastewater disposal system for operating personnel and temporary holding tanks pumped by a wastewater disposal contractor for construction and decommissioning. This would reduce the amount of on-site effluent disposal and would eliminate the need to design the sewage disposal system for the short-term construction workforce. Domestic waste will also be minimized by using modern, low-flow restroom fixtures.

The amount of surface disturbance required for construction of the soil absorption system will be reduced by utilizing a trench-style drainfield with gravelless drainfield chambers.

5.12 References

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6.0 ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

This section describes Strata's proposed environmental measurement and monitoring programs for the proposed Ross ISR Project, including radiological monitoring, physiochemical monitoring, ecological monitoring, and historic and cultural resources monitoring. These monitoring programs will be used to measure and address the potential impacts addressed in Chapter 4 and the mitigation measures described in Chapter 5. These efforts will ensure the protection of worker health and safety as well as the protection of the public and environment.

6.1 Radiological Monitoring

This section describes Strata's proposed radiological monitoring program for the Ross ISR Project during plant operations. The purpose of the program is to ensure the health and safety of the public and workers by characterizing and evaluating the radiological environment and identifying principal radiation pathways. The program is in many ways a continuation of the pre-operational baseline monitoring program, described in Section 2.9 of the TR. This program includes similar media, sampling locations, methods and procedures and therefore pertinent subsections and figures are referenced below as applicable.

This operational radiological monitoring program is based on the recommendations of NRC Regulatory Guides 4.14 (NRC 1980), 4.15 (NRC 1979) and 8.37 (NRC 1993) to meet the requirements of 10 CFR 20 and 10 CFR 40. Additionally, all monitoring will be conducted in accordance with accepted scientific protocols and guidance, which have been incorporated into Standard Operating Procedures (SOPs). A copy of Strata SOPs are contained in Addendum 2.9-A of the TR. A summary of the major elements of the radiological program is presented in Table 6.1-1.

6.1.1 Radiation Monitoring

6.1.1.1 Ambient Monitoring

The operational airborne radiation monitoring program will utilize the air particulate sites established for the pre-operational baseline monitoring program, discussed in Section 2.9.2.3 of the TR. Baseline monitoring and MILDOS-AREA modeling confirmed that the monitoring locations, depicted in Figure 2.9-24 of the TR, are consistent with Regulatory Guide 8.30. Additionally, the monitoring stations meet the recommendations of Regulatory Guide 4.14, which states that:

> "Air particulate samples should be collected at (1) a minimum of three locations at or near the site boundary, (2) the residence or occupiable structure within 10 kilometers of the site with the highest predicted airborne radionuclide concentration, (3) at least one residence or occupiable structure where predicted doses exceed 5 percent of the standards in 40 CFR Part 190, and (4) a remote location representing background conditions."

Strata will utilize F&J Specialty Products Models DF-40L-BL-AC and LV-1D samplers. Filters will be collected from each air-sampling unit on a weekly basis (or more often as required by dust loading) and analyzed for uranium, radium-226, thorium-230 and lead-210.

Strata will co-locate radon detectors and thermoluminescent dosimeters (TLDs) with the air particulate samplers as well as other areas of interest including the nearest residences, CPP, lined retention ponds, and wellfields. Strata will utilize Landauer high sensitivity environmental radon Trak-Etch detectors and environmental low level TLDs. The results will be used to assess quarterly radon concentrations and gamma exposure rates at each of the sites.

6.1.1.2 In-Plant Monitoring

Although exposure to uranium particulates with the CPP area is expected be low due to use of vacuum dryers, the potential for exposure does exist. Therefore, Strata proposes to monitor air within the plant as discussed in Section 5.7.3 of the TR. Air particulate stations, depicted in Figure 5.7-6 of the TR, will be situated throughout the CPP. Samples will be collected on a monthly basis in accordance with Regulatory Guide 8.25. In addition, breathing zone sampling may be implemented when workers are at high exposure risk. The results will be used to assess employee exposure to airborne radioactivity.

Strata will also monitor the CPP area for radon-222 and its progeny, as described in Section 5.7.3.2 of the TR. Initial sampling will determine specific monitoring locations and frequency such that areas exceeding 10% of the regulatory limit or 0.03 working levels (WL) above background will be monitored monthly, while all other areas will be monitored quarterly. In the event that a radon-222 progeny sample exceeds 0.08 WL an investigation will be conducted. Samples will then be taken weekly at this location until four consecutive samples show levels below 0.08 WL. Additional samples will be taken in areas where there is an upset condition, maintenance, or operational change that could result in the release of radon or before a radiation work permit can be issued for work in confined spaces likely to contain radon.

6.1.2 External Radiation Exposure Monitoring

In addition to the airborne radiation monitoring program, Strata will also have an external radiation monitoring program to ensure the safety of workers and the public. The program is discussed in detail in Section 5.7.2 of the TR and will include general area surveys and personnel dosimetry.

Strata will conduct gamma surveys of the process area on a monthly basis (minimum). The surveys will be performed in areas where workers may be exposed to elevated gamma levels, including the IX columns, and elution tanks, resin transfer system, RO units and other areas where 11e.(2) byproduct material is accumulated and stored and yellowcake precipitation, thickening, drying/packaging and storage areas. The surveys will be conducted by a trained radiation safety technician in accordance with standard operating procedures as defined in the project Radiation Safety Manual. The surveys will utilize a handheld meter with a range between 100 µR/hr and 50 mR per hour.

Beta surveys of specific operations involving direct handling of aged yellowcake will be conducted per the recommendations of Regulatory Guide 8.30. The surveys will be performed near the surface of the material to assess beta exposure to workers' hands and skin during handling of the material. The surveys will be conducted with a Ludlum 43-1-1 alpha–beta phoswich scintillation probe or equivalent. Since Strata will utilize modern ISR technology it is highly unlikely that workers will be exposed to beta.

Strata will also utilize area and personal monitoring devices such as thermoluminescent dosimeters (TLDs) or optical synchrotron radiation monitors (OSRs). The area monitoring devices will be located in areas where initial surveys indicated high potential for gamma exposure as well as non-process areas such as offices, change rooms and lunchroom. The dosimeters will be exchanged on a quarterly basis or more frequently based on survey results at the discretion of the Radiation Safety Officer (RSO). All regular plant workers will be provided with personal dosimeters to wear while onsite. Dosimeters will be exchanged on a quarterly basis and results will be used to assess individual deep dose equivalent (DDE) for determining total effective dose equivalent (TEDE).

6.1.3 Soils and Sediment Monitoring

During operations, Strata will conduct soil and sediment sampling on an annual basis. Soil samples will be collected at the six air particulate stations, while sediment samples will be collected at the surface water monitoring stations and Oshoto Reservoir as discussed in Section 3.4.1. All samples will be collected to a depth of 60 inches for consistency with the baseline soil sampling surveys described in Section 3.3.5. Following the recommendations of Regulatory Guide 4.14, the samples will be analyzed for uranium, radium-226, lead-210 and gross alpha. In addition, sediment samples will be analyzed for thorium-230. Sediment collected during a runoff event in the pump samplers, installed at the surface water monitoring stations between April and October, will be analyzed for radiological constituents.

6.1.4 Vegetation, Food, and Fish Monitoring

Monitoring for vegetation, food and fish will be based on the results of the MILDOS-AREA model and final NRC approval of the operational monitoring program. As stated in Regulatory Guide 4.14, "where a significant pathway to man is identified in individual licensing cases, vegetation, food and fish samples should collected." In the event that monitoring is required, sample collection will be conducted similar to the pre-operational baseline monitoring described in Section 2.9 of the TR and will meet the recommendations of Regulatory Guide 4.14.

6.1.5 Water Resource Monitoring

Strata will employ a detailed water sampling program during operations to identify any potential impacts to water resources of the area. The operational water monitoring program will include evaluation of groundwater on a regional basis, groundwater within the permit or licensed area, and surface water on a regional and site specific basis. The following presents the radiological monitoring component of the program, while Section 6.2 describes the physiochemical monitoring including excursions and aquifer restoration.

6.1.5.1 Surface Water Monitoring

During operations, Strata will monitor the surface water monitoring stations and reservoirs established during the pre-operational baseline monitoring. Details of the sites are described in Section 3.4.1 and depicted on Figure 3.4-7. These sites meet the recommendations of Regulatory Guide 4.14. Grab samples from each site will be collected on a quarterly basis and analyzed for dissolved and suspended uranium, radium-226, thorium-230, lead-210 and polonium-210. Additionally, the three surface water stations will be equipped with pump samplers from April through October. The samplers will continuously monitor flow rates and automatically collect a sample in the event of significant runoff.

6.1.5.2 Groundwater Monitoring

Strata will conduct monitoring of both groundwater monitor wells and private water supply wells as part of the operational monitoring program. Monitor wells will be located up-gradient and down-gradient from the CPP, while private well sampling will include wells within 3.3 km (2 mi) of the proposed project area, as discussed in NUREG-1569. Section 3.4.3 provides a summary of the private wells sampled during pre-operational baseline monitoring. These wells, depicted in Figure 3.4-33, will be monitored monthly the first year and quarterly thereafter with consent of the landowner. Samples will be analyzed for dissolved uranium, radium-226, thorium-230, lead-210 and polonium-210 with results reported to landowners.

Table 6.1-1. Summary of the Major Elements of the Operational Environmental Monitoring Program

Program Element	Location	Radionuclides Analyzed	Sampling Frequency	Number of Sampling Locations
Groundwater – Monitor Wells	Up-gradient and down-gradient from CPP	Dissolved uranium, Ra-226, Th-230, PB-210, Po-210, gross alpha, gross beta	Monthly first year, quarterly thereafter	3 or more down-gradient; at least up-gradient control sample
Groundwater – Existing Water Supply Wells	Private wells within 3.3 km (2 mi) of project area similar to pre-operational baseline monitoring (Section 3.4.3 and Figure 3.4-33)	Dissolved and suspended uranium, Ra-226, Th-230, Pb-210, Po-210, gross alpha, gross beta	Quarterly	29
Surface Water	Surface waters passing through project area and reservoirs subject to runoff similar to pre-operational baseline monitoring (Section 3.4.3 and Figure 3.4-7)	Dissolved and suspended uranium, Ra-226, Th-230, Pb-210, Po-210, gross alpha, gross beta	Quarterly (as available)	3 surface water monitoring stations and 11 reservoirs within project area
Particulates in Air[1]	Locations with the highest predicted concentrations, nearest residences and control location similar to pre-operational baseline monitoring (TR Section 2.9 and TR Figure 2.9-24)	Total uranium, Th-230, Ra-226, Pb-210	Continuous-Composites of weekly filters analyzed quarterly	5 or more
Radon in Air	Particulate in air locations and other areas of interest similar to pre-operational baseline monitoring (TR Section 2.9, TR Figure 2.9-26)	Rn-222	Continuous via Track-Etch units – quarterly exchange and analysis of units	5 or more
Soil (Surface and Sub-surface)	Particulate in air locations and other locations with the highest predicted concentrations similar to pre-operational baseline monitoring (TR Section 2.9, TR Figure 2.9-27)	Total uranium, Ra-226, Pb -210, gross alpha	Annually	5 or more
Sediment	Surface waters passing through project area and reservoirs subject to runoff similar to pre-operational baseline monitoring (Section 3.4.3 and Figure 3.4-7)	Total uranium, Ra-226, Pb -210, gross alpha	Annually (as available)	3 surface water monitoring stations and 11 reservoirs within project area
Direct Radiation	Particulate in air locations and other areas of interest similar to pre-operational baseline monitoring (TR Section 2.9, TR Figure 2.9-26)	Continuous via TLD	Quarterly	5 or more

Table 6.1-1. Summary of the Major Elements of the Operational Environmental Monitoring Program (Continued)

Program Element	Location	Radionuclides Analyzed	Sampling Frequency	Number of Sampling Locations
Vegetation(2)	Animal grazing areas and other locations with the highest predicted concentrations similar to pre-operational baseline monitoring (TR Section 2.9, TR Figure 2.9-26)	Ra-226 and Pb-210	Three times during grazing season	Grazing vegetation representing 3 different sectors that have the highest predicted concentrations of radionuclides
Animal Tissue	Livestock (cattle) raised within 3 km of the site and fish from Oshoto Reservoir similar to pre-operational baseline monitoring (TR Section 2.9, TR Figure 2.9-26)	Ra-226 and Pb-210	Once during site decommissioning and prior to license termination	3 samples of beef 1 fish sample (composite to meet laboratory MDL)

(1) Location of air particulate samplers used during the preoperational baseline monitoring will be re-evaluated for operational monitoring based on results of the pre-operational meteorological monitoring program (TR Section 2.5) and the results of the MILDOS-AREA analysis (TR Section 7.3) to insure at least 3 locations are selected representing 3 different sectors that have the highest predicted concentrations of radionuclides

(2) In accordance with the provisions of NRC Regulatory Guide 4.14, Footnote (o) to Table 2: "*vegetation and forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway…*" defined as a pathway which would expose an individual to a dose in excess of 5% of the applicable radiation protection standard. This pathway was evaluated by MILDOS-AREA and is discussed further in TR Section 7.3.

6.2 Physiochemical Monitoring

The following sections provide an overview of Strata's proposed physiochemical monitoring program, including baseline and operational monitoring. In general the monitoring program will establish baseline conditions for operation, aquifer restoration and decommissioning and identify unintended or unexpected events (excursions or leaks/spills).

The monitoring program described below is based on potential impacts presented in Chapter 4 and mitigation measures described in Chapter 5. Additionally, the physiochemical monitoring will be completed in conjunction with radiological monitoring activities discussed in Section 6.1.

6.2.1 Baseline Monitoring

Pre-operational baseline physiochemical monitoring was completed by Strata in 2009 and 2010. Chapter 3, Affected Environment, presents the sampling locations utilized by Strata and provides a summary of the monitoring results for surface water, groundwater, air quality and meteorology. Following submittal of the application Strata will continue monitoring efforts. The following details the baseline physiochemical monitoring that will continue prior to the construction and operation of the proposed Ross ISR Project.

6.2.1.1 Surface Water Monitoring

Strata will continue to monitor reservoirs within the proposed project area on a quarterly basis. Additionally, the three surface water monitoring stations established during pre-operational baseline monitoring will be operated continuously between April and October. The locations of the reservoir and surface water monitoring stations are depicted on Figure 3.4-7. The surface water monitoring stations are equipped with pressure transducers, a data-logging system and pump samplers activated by runoff events. Water quality samples will be analyzed for constituents listed in Table 3.4-11, or a shortened list if previous results indicate low or undetectable results for some parameters.

6.2.1.2 Existing Water Supply Well Monitoring

Existing water supply wells located within 2 kilometers (1.6 miles) of the proposed project area will continue to be monitored on a quarterly basis, subject to landowner consent. Samples will be analyzed for constituents listed in Table 3.4-11, or a shortened list if previous results indicate low or undetectable results for some parameters. The landowners will be provided with results. If during the course of groundwater model development for specific wellfield modules, impacts to adjacent water supply wells are predicted, Strata may install pressure transducers in the well(s) in order to monitor any changes in water level during operation or aquifer restoration.

6.2.1.3 Air Quality Monitoring

Strata will submit a Chapter 6, New Source Construction, permit application to the WDEQ/AQD in March 2011. The operational air quality monitoring at the Ross ISR Project will meet all permit requirements.

6.2.1.4 Meteorological Monitoring

Strata will continue to operate the meteorological monitoring station established in January 2010 as part of the pre-operational baseline monitoring program. The location of the MET station is depicted on Figure 2.9-24 of the TR. The MET station will continue to collect continuous measurements of wind speed, wind direction, temperature, relative humidity, precipitation, and evaporation.

6.2.2 Physiochemical Monitoring during Construction

6.2.2.1 Groundwater Monitoring

At the onset of construction of the proposed Ross ISR Project, Strata will implement a groundwater monitoring program to determine UCLs for identifying excursions and to define the aquifer restoration goals. The proposed monitoring program will follow WDEQ/LQD guidelines with one baseline well cluster for every four (4) wellfield acres, subject to regulatory approval. Each cluster will include three wells targeting the DM (lower aquifer), OZ (ore zone) and SM (shallow aquifer) zones, with approximately 24 baseline clusters proposed for the Ross ISR Project. Each of the wellfield baseline wells will be equipped with dedicated submersible pumps and a sounding tube (wells completed in the ore zone may not include sounding tubes since these wells may be used as recovery wells). They may also be equipped with pressure transducers.

The regional baseline monitoring network wells (DM, OZ and SM), discussed in Section 3.4, may be used as wellfield baseline wells depending on proximity to wellfield modules. Wells that are not used will be plugged and abandoned according the procedures described in Addendum 2.6-B in the TR, including plugging each well from the total depth to the top with cement or bentonite grout in accordance with WDEQ/LQD requirements. Strata plans to utilize all of the SA (surficial aquifer) wells included in the regional baseline monitoring network for continued baseline monitoring on a quarterly basis throughout the life of the project. Additionally, the wells may be sampled at an increased frequency in the event of an accidental leak or spill.

In addition to the baseline cluster wells, perimeter monitor wells will be installed around each wellfield module to detect horizontal excursions. The perimeter wells will be located in a ring 400 to 600 feet from the production wellfield modules. The perimeter wells will also be spaced 400 to 600 feet apart. Similar to the baseline cluster wells, the perimeters wells will be equipped with dedicated pumps and sounding tubes and may also be equipped with pressure transducers.

During wellfield characterization at least four (4) samples will be collected from all monitor wells in the overlying and underlying aquifers, all perimeter monitor wells, and from baseline recovery wells. At least 2 weeks will separate each sample. The first and second sample events will include analyses for all WDEQ/LQD Guideline 8, Appendix 1, Parts III and IV and NUREG-1569, Table 2.7.3-1 parameters as shown in Table 6.2-1. The third and fourth sampling events may be analyzed for a reduced list of parameters as defined by the results of the previous sample events and pre-operational baseline efforts. Results from the samples will be averaged arithmetically to obtain an average baseline value, as well as a maximum value for determination of UCLs for excursion detection. Additionally, the baseline data from recovery wells will be used to calculate TRVs for restoration as described in Section 6.1 of the TR and Addendum 6.1-A of the TR.

Mechanical Integrity Testing and Aquifer Tests

Strata will complete MIT on all wells, including monitor wells. The tests will be completed immediately following construction and wells will be retested every five years. Additionally MIT will be completed on wells that are re-entered with drilling bit or underream tool or suspected of damage. Strata will complete

MIT by first placing packers directly above the screen interval and near the top of casing. The well will then be pressurized with water to the test pressure (maximum allowable injection pressure plus a safety factor of 25%). The well will pass the test if pressure does not deviate greater than 10 percent over 10 minutes. Additional MIT details are described in Section 3.1.2.3 of the TR.

Aquifer tests will also be completed by Strata to ensure hydrologic isolation of each overlying and underlying aquifer and communication between perimeter wells and the ore zone. Additionally, the test data will be used to further refine the groundwater model. All wellfield aquifer testing will be completed after the exploration and delineation boreholes have been abandoned and filled with cement from bottom to top and MIT have been completed.

6.2.3 Physiochemical Monitoring during Operation

6.2.3.1 Surface Water Monitoring

During operation, surface water monitoring will include collecting grab samples from the 11 reservoirs sampled during pre-operational baseline monitoring within or near the proposed project area (see Section 3.4.1) Parameters will include those shown on Table 6.2-1 or a reduced list of parameters as defined by the results of the previous sample events and pre-operational baseline efforts. In addition, the three surface water stations established during pre-operational baseline monitoring will continue to be operated continuously from April through October. Surface water monitoring during operations will also be performed on any surface water features that might be impacted due to a spill or pipeline leak. Results from samples collected in response to a leak or spill will be reported to NRC and WDEQ/LQD.

Surface Discharges

Strata will permit all discharges to surface water through the WDEQ WYPDES program. Monitoring will be completed in accordance with permit requirements and samples will be analyzed for constituents identified in the permit. WYPDES permits will include a temporary WYPDES permit for well testing and construction water, one or more stormwater WYPDES permits, and, potentially, a WYPDES permit to discharge permeate during operation and aquifer restoration.

6.2.3.2 Existing Water Supply Well Monitoring

Existing water supply wells within the proposed project area and within 2 km (1.6 mi) surrounding the proposed project area will be monitored quarterly throughout the life of the ISR facility. The results will be reported to landowners and submitted to NRC and WDEQ/LQD on a quarterly basis. Parameters will include those shown on Table 6.2-1 or a reduced list of parameters as defined by the results of the previous sample events and pre-application baseline efforts.

6.2.3.3 Groundwater Monitoring

6.2.3.3.1 Excursion Monitoring and Upper Control Limits

During operation and aquifer restoration monitor wells (DM, SM and perimeter) will be sampled on a biweekly basis to detect potential excursions. Pressure transducers may also be used to provide early warning of potential excursions.

Excursion indicators and UCLs will be established for each wellfield based on water quality data collected during the baseline groundwater monitoring program, as previously discussed. Strata proposes to use chloride, conductivity and total alkalinity as excursion indicators in the SM and perimeter monitor wells. Baseline monitoring indicates that the DM zone has naturally high chloride concentrations; therefore, Strata anticipates using sulfate in place of chloride as an indicator of potential downward vertical excursions. UCLs will typically be set at 20% above the maximum baseline concentration for each excursion indicator. For excursion indicators with a low baseline average, the UCL may be determined by adding 15 mg/L to the baseline average if the resulting value is greater than the baseline mean plus 5 standard deviations. Additional details about the selection of UCL parameters and UCL calculations are presented in Section 5.7.8.2 of the TR.

6.2.3.3.2 Corrective Actions

An excursion will be defined as two excursion indicators in any monitor well exceeding UCL values, or one UCL exceeded by 20 percent. The first corrective action will be to resample the well within 48 hours. If the second sample does not exceed any UCLs a third sample will be collected within 48 hours. If the third sample does not indicate an exceedance of a UCL the first sample is considered in error. If the second or third sample verifies an exceedance the well is placed on excursion status. Strata will contact the NRC Project Manager within 24 hours of verification and written notice will be mailed within 7 days. Additionally, a written report will be submitted to the NRC within 60 days of the excursion and will include the excursion event, corrective action and results. In the event the well is on excursion status when the report is submitted, Strata will include a schedule detailing future corrective actions and reports. If an excursion is not corrected within 60 days of confirmation, injection of lixiviant into the wellfield may be terminated until the excursion is controlled, or an increase to the financial assurance arrangement will be provided in an amount that is agreeable to the NRC and that would cover the expected full cost of correcting and cleaning up the excursion. Additional information about corrective actions Strata will employ is discussed in Section 5.7.8.2 of the TR.

<u>6.2.3.3.3 Aquifer Restoration Monitoring</u>

Monitoring associated with aquifer restoration will be completed in two phases: active restoration and stability monitoring. During active restoration Strata will monitor the recovery wells in the affected wellfield monthly. The results will be compared to TRVs and used to assess the progress of restoration and identify potential hot spots. Active restoration will continue until monitored constituents meet TRVs and Strata has received approval from NRC and WDEQ/LQD.

Stability monitoring will consist of five rounds of sampling over a 12-month period for the recovery wells. The initial sample event will be completed at the end of active restoration and additional events will be spaced 3 months apart. Samples will be analyzed for physical/field water quality parameters and laboratory measurements of chemical constituents as shown in Table 6.2-1. During stability monitoring Strata will reduce the frequency of excursion monitoring from biweekly to quarterly. Additional details of Strata's proposed aquifer restoration plan are presented in Section 6.1 and Addendum 6.1-A of the TR.

6.2.3.4 Shallow Groundwater Monitoring within Central Plant Area

Due to the potential for contamination of the SA unit in the central plant area, Strata will install SA monitoring wells and piezometers within the central plant area. The SA monitoring wells will be equipped with data logging pressure transducers to monitor water levels both inside and outside of the containment barrier wall. Samples will be collected from the wells on a monthly basis and analyzed for constituents listed in Table 6.2-1. In addition, Strata will also collect samples from the dewatering French drain on a monthly basis.

6.2.3.5 Lined Retention Pond Leak Detection Monitoring

The lined retention ponds will be equipped with leak detection systems. In addition to the leak detection system Strata will employ routine inspections of the ponds, as discussed in Section 5.3.2 of the TR. These include examination of the freeboard, condition of the pond inlet and outlet structures, inspection of the embankment and liners, and assessment of leak detection systems. The routine inspections will be completed in accordance with NRC Regulatory Guide 3.11 by trained employees with tasks completed on a daily, monthly and annual basis. All inspection records will be retained until final decommissioning.

The leak detection system alarm will be triggered when water reaches the riser pipes that drain the collection piping system. In the event the alarm is triggered Strata will collect a sample of the water in the riser pipe. The sample will be analyzed to determine if the water quality is similar to the contents of the pond. If the sample verifies the water is from the pond, the contents of the pond will be transferred to other pond cells or to one of the deep disposal wells. Strata will complete a thorough inspection and leak test to determine the location of the leak. Additionally, Strata will notify the NRC by telephone within 48 hours of verification. A written report including analytical data and descriptions of the corrective actions and results of those actions will be submitted to the NRC within 30 days of initial leak notification.

6.2.3.6 Meteorological Monitoring

Strata will continue to operate the meteorological monitoring station established during pre-operational baseline monitoring. Results will be used in conjunction with the airborne radiological monitoring.

Table 6.2-1. Post-Restoration Stability Monitoring Parameters

Physical and Field Water Quality Parameters		
Static water level	Electrical conductivity, field	Temperature
pH, field		
General Water Quality Parameters		
pH, lab	Ammonia	Alkalinity
Electrical conductivity, lab	Nitrate-nitrite	
Total dissolved solids		
Major Ions		
Calcium		Bicarbonate
Magnesium		Carbonate
Potassium		Chloride
Sodium		Sulfate
Radiological		
Gross alpha		Radium 226, dissolved
Gross beta		Radium 228, dissolved
Trace and Minor Elements		
Arsenic, dissolved	Fluoride	Molybdenum, dissolved
Barium, dissolved	Iron, dissolved	Nickel, dissolved
Boron, dissolved	Iron, total	Selenium, dissolved
Cadmium, dissolved	Lead, dissolved	Uranium, dissolved
Chromium, dissolved	Manganese, total	Vanadium, dissolved
Copper, dissolved	Mercury, dissolved	Zinc, dissolved

6.3 Ecological Monitoring

6.3.1 Vegetation

Strata commissioned baseline vegetation sampling for the proposed Ross ISR Project using methods approved by WDEQ/LQD. Vegetation community type mapping was initiated in late 2009 using NAIP photography, with actual surveys conducted through September 2010.

Strata will commence site reclamation activities, including D&D of the CPP, wellfield modules, module buildings, piping, and the surrounding land areas with the ultimate goal of releasing the proposed project area for unrestricted (i.e., any) potential use. Disturbed areas will be reclaimed in compliance with applicable regulations following the completion of construction activities or during decommissioning. A detailed reclamation plan is found in Chapter 6 and Addendum 6.1-A of the TR.

The extended reference area concept, as defined in WDEQ/LQD Guideline No. 2, will be used to evaluate the success of revegetation. The extended reference area means all of the undisturbed portions of a vegetation type which has experienced disturbance in any phase of the ISR process. At the end of decommissioning, quantitative vegetation data for extended reference areas representing each disturbed vegetation type will be directly compared by statistical analysis to quantitative vegetative data from reclaimed vegetation types. WDEQ/LQD requires a confidence level of 80% with no mathematical adjustments for climatic change. Qualitative comparisons between extended reference areas and reclaimed areas will also be required for each disturbed vegetation type. WDEQ/LQD will be consulted when choosing the extended reference area and when selecting the standard procedures for qualitative comparisons. Prior to release of the WDEQ/LQD reclamation bond, Strata will demonstrate revegetation success through quantitative and qualitative comparisons between external reference areas and reclaimed areas for each disturbed vegetation type. Monitoring of revegetated areas prior to final WDEQ/LQD reclamation bond release will be conducted using a schedule approved by WDEQ/LQD. The minimum bond release period recommended by WDEQ/LQD for non-coal mines (which includes ISR uranium recovery facilities) is 5 years. Visual assessments of reclamation will be conducted to evaluate vegetation establishment prior to the final monitoring required for WDEQ/LQD reclamation bond release.

6.3.2 Wildlife

Strata commissioned pre-operational baseline monitoring for a variety of wildlife species for the proposed Ross ISR Project. Monitoring was initiated in November 2009 and continued through October 2010. Those efforts will transition to annual monitoring once ISR operations are permitted, which will continue through the life of the project. Annual wildlife monitoring surveys should follow the same regimen as other ISR operations in the region to maximize comparisons among survey results and impact assessments. At a minimum, those surveys typically include the following, as modified for site-specific habitats:

1. Early spring surveys for, and monitoring of, sage-grouse leks within one mile of the license/permit area, new and/or occupied raptor territories and/or nests and T&E and BLM sensitive species on and within the license/permit area;
2. Late spring and summer surveys for raptor production at occupied nests, and opportunistic observations of all wildlife species, including T&E and BLM sensitive species, and other species of management concern; and
3. Other surveys as required by regulating agencies.

No crucial big game habitats or migration corridors are recognized by the WGFD in the proposed project area or surrounding 1.6 kilometers (1 mile) perimeter. Crucial range is defined as any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain and reproduce itself at a certain level. Due to the lack of crucial big game habitats, WGFD did not require big game surveys during pre-operational baseline monitoring (refer to Section 3.5.4.2.1 and Addendum 3.5-I in this ER). Long-term monitoring requirements for big game are not anticipated. A similar approach has been applied to other baseline projects (uranium, coal, bentonite, and gold) in Wyoming, and is the current policy for annual monitoring at surface mines in the region.

All aspects of a regular and/or periodic monitoring program would be developed according to current agency protocols and guidelines. Those considerations would apply to field surveys and equipment; data collection, analysis, reporting, and storage procedures; agency consultations and collaborations; permitting requirements; and any other relevant components.

6.4 Quality Assurance Program

Strata will establish a quality assurance (QA) program at the facility consistent with the recommendations contained in NRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment (RG 4.15). The purpose of the program is to ensure that all radiological and non-radiological measurements that support the radiological monitoring program are reasonable, valid and of a defined quality. These programs are needed to identify deficiencies in the sampling and measurement processes and report them to those responsible for these operations so that licensees may take corrective action and to obtain some measure of confidence in the results of the monitoring programs to assure the regulatory agencies and the public that the results are valid.

The QA program will contain the following:

- Formal delineation of organization structure and management responsibilities, responsibility for both review/approval of written procedures and monitoring data/reports is provided;
- Minimum qualifications and training programs for individuals performing radiological monitoring and those individuals associated with the QA program;
- Written procedures for QA activities, these procedures include activities involving sample analysis, calibration of instrumentation, calculation techniques, data evaluation, and data reporting;
- Quality control (QC) in the laboratory, procedures cover statistical data evaluation, instrument calibration, duplicate sample programs and spike sample programs, outside laboratory QA/QC programs are included; and
- Provisions for periodic management audits to verify that the QA program is effectively implemented, to verify compliance with applicable rules, regulations, and license requirements, and to protect employees by maintaining effluent releases and exposures ALARA.

QA procedures, as described in RG 4.14, Sections 3 will be defined for the following programs:

- External Radiation Exposure Monitoring Program

- Airborne Radiation Monitoring Program
- Bioassay Program
- Contamination Control Program
- Airborne Effluent and Environmental Monitoring Program
- Groundwater and Surface Water Monitoring Program

Additionally, QA recommendations contained in RG 4.14 and RG 8.22 will be incorporated in the environmental monitoring and bioassay programs, respectively. In general, the QC requirements for a specific activity will be incorporated into the SOP for that activity

The QA program will be audited periodically. The audits will be conducted by individuals qualified in radiochemistry and monitoring techniques. However, the auditors will not have direct responsibilities in the areas being audited. An example of an appropriate auditor is an outside consultant. The results of the audits will be documented and provided to the NRC and made available to members of management with authority to enact any changes needed (i.e., RSO, Mine Manager, etc.).

6.5 Historic and Cultural Resources Monitoring

Should unanticipated cultural resources be uncovered during construction, operation, aquifer restoration, or decommissioning of the proposed Ross ISR Project, an Unanticipated Discovery Plan will be implemented by the Site Supervisor. The plan will be prepared prior to license approval, and will outline the process of notification, evaluation, and actions to be taken should unanticipated cultural resources be found during the development of the facility.

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7.0 COST-BENEFIT ANALYSIS

7.1 General

Demand for uranium to fuel nuclear power plants is set to grow rapidly as the nuclear industry expands. The world's appetite for energy is expanding at a fast pace, driven largely by modernization of the developing nations. At the same time as total energy demand is growing, there is a growing impetus to reduce the burning of carbon-based fuels.

Currently, nuclear energy provides 6% of the world's total energy supply, including 15% of the world's electricity. Some countries rely heavily on the nuclear industry; in the United States, nearly 20% of the electricity is produced from nuclear power and in France it is 78% (U.S. Energy Information Administration 2010a).

There are now over 430 reactors operating worldwide and 56 more are presently under construction. Plants now in the planning stages number 136 units in 26 countries – mainly in China and India. China, to reduce its reliance on coal, is expected to further expand its nuclear industry and could see more than 100 nuclear power plants. The country has plans to stockpile uranium to avert supply shortages. In North America, existing nuclear reactors are being expanded (although at a slower rate due to the recession and permitting delays) and licenses are being extended. The U.S. stimulus plan has dedicated funding to provide loan guarantees for new plants.

New generation reactors are more efficient than older units, and that will moderate the growth in demand. Nevertheless, over the coming years, usage of uranium as a fuel for nuclear power plants is forecast to grow at a fast pace. At present, annual global usage of uranium is around 150 million pounds.

For the first half of 2010, U.S. uranium concentrate production totaled 1,931,186 pounds U_3O_8. This amount is 4% higher than the 1,862,796 pounds produced during the first half of 2009 (U.S. Energy Information Administration 2010b). During the second quarter 2010, U.S. uranium concentrate was produced at four U.S. uranium concentrate processing facilities. Of these, three (Alta Mesa, Crow Butte and Smith Ranch-Highland) are ISR facilities and the fourth (White Mesa) is a conventional mill.

The general need for production of uranium is assumed in the operation of nuclear power reactors. In reactor licensing evaluations, the benefits of the energy produced are weighed against environmental costs, including a prorated share of the environmental costs of the uranium fuel cycle. The incremental impacts of typical mining and milling operations required for the fuel cycle are justified in terms of the benefits of energy generation to the society in general. However, the specific site-related benefits and costs of an individual fuel-cycle facility such as the Ross ISR Project must be reasonable as compared to that typical operation.

Strata has evaluated the costs and the benefits associated with uranium production in order to formulate the Ross ISR Project. Historically, a company operated a pilot project and considered operating a full-scale ISR uranium recovery facility within the proposed project area, but the price of uranium declined to where the costs outweighed the benefits at that time. More recently, due to the increased demand for uranium, associated price increase, and improved and tested technologies, Strata believes the benefits now outweigh the costs. Although the specific amount of yellowcake produced will depend on the market price and the cost of production, Strata anticipates producing about 750,000 pounds of uranium per year. If market conditions remain positive, preliminary plans are to produce about 0.6 pound of vanadium for each pound of yellowcake produced. Early analyses suggest that the vanadium can be produced with relatively little additional capital investment and operating costs. Based on current information and projections, the anticipated life of the Project is 8 to 12 years. Current demand/supply projections indicate that the price should remain sufficiently high to support the Ross ISR Project over that time frame. With appropriate regulatory approval, the CPP could process loaded resins from other ISR sites in the region, even after the ISR operation in the original license area is complete.

7.2 Potential Economic Benefits

Monetary benefits will accrue to the community from the presence of the Ross ISR Project, such as local expenditures of operating funds and the federal, state and local taxes paid by the owner of the project. Against these monetary benefits are any potential monetary costs to the communities involved, such as would occur if the project required new or expanded schools and other community services.

It is not possible to precisely quantify all the economic benefits and costs of the project for any one community because many of the benefits, such as tax revenues, depend upon prevailing market prices which are subject to change due to unpredictable economic and political factors. This section discusses the potential economic impacts of the Proposed Action and compares these impacts to the No Action Alternative.

Since the operation of the Nubeth pilot project in the 1970's, ISR production methods have been improved to minimize costs. The primary recovery method for uranium is now ISR rather than conventional surface or underground mining. ISR has lower operating costs and also reduces exposure of radioactive materials to the atmosphere. While some alternatives to the project have been considered, including facility locations and plant capacity, the overall capital costs and the operating costs per unit of production do not differ substantially with the choice of alternatives.

7.2.1 Tax Revenues

Section 4.10 of this ER summarizes the tax revenues from the Ross ISR Project. Future tax revenues are dependent on uranium prices which cannot be forecast with any accuracy; however, these taxes are also somewhat dependent on the number of pounds of uranium produced by Strata. To the extent that uranium prices remain approximately at current levels (spot market price was $46.50 per pound U_30_8 in mid-October 2010 when this benefit-cost analysis was done and had risen to about $60 per pound by mid-December 2010), the Ross ISR Project can produce significant tax revenues for Crook County and the State of Wyoming. In order to provide an estimate of the tax revenues that might be generated by the Ross ISR Project, the following conservative assumptions were made:

- Production: 750,000 pounds U_30_8 for a period of 10 years;
- Sale price: $45 per pound for purposes of illustration;
- 18% of total production will be from State lands and therefore subject to State mineral royalty payments;
- All mineral production will be in Crook County, and the mill levy will remain constant at 62.545 mills; and
- The production facilities and property will have an assessed valuation of $50 million.

Table 7.2-1 summarizes the major tax revenue stream for the Ross ISR Project based on the assumptions listed above. Severance taxes and royalties will accrue to the State and will be distributed among the State and local agencies in accordance with established procedures, while the gross products and property taxes will be assessed and collected by Crook County.

The severance and gross products taxes and State royalties are sensitive to the price of U_30_8 and are likely to vary over the life of the project. These taxes will end when production ends. Property taxes should remain relatively constant over the mine life and will continue after production is completed throughout the wellfield restoration until the facilities are removed and the area is reclaimed.

It is possible that vanadium will also be produced at the Ross ISR Project. Preliminary analyses suggest that 0.6 pound of V_2O_5 could be produced for every pound of U_3O_8 produced with relatively little additional investment in capital or operating costs. The current price of vanadium is about $12.00 to $13.00 per pound (Global Infomine, October 2010). Assuming the vanadium production is taxed similarly to yellowcake, and that prevailing prices hold steady, the possible benefits from severance taxes, royalties and gross products taxes shown in Table 7.2-1 could be understated by as much as 10 to 20%).

Income taxes are not considered in this analysis because there is no state income tax in Wyoming, income taxes are difficult to estimate because they are based on operating profits which are variable and hard to predict, and they accrue to the federal government and do not represent a direct benefit to the local or regional economy.

7.2.2 Employment

7.2.2.1 Construction Employment

As described in Section 4.10, the Ross ISR Project is expected to employ about 200 people during construction, and the duration of construction is expected to last from 6 months (for the CPP) to 36 months (for the initial, fully operational wellfield modules). These employees are expected to come from the local labor force, since the total number of jobs is small relative to the number of unemployed workers in the local labor force and the required skill set fits well with skills and experience of the local labor force (light construction and wellfield installation).

Salaries for the construction workers are expected to be about $50,000 per year, which is higher than the current average per capita income in Crook County but is representative of prevailing wages in the mining sector (see Section 4.10). This will be beneficial by reducing the local unemployment rate for the duration of construction, and some of the workers will likely stay on through the operational phase. Assuming an average of around 125 workers during a 2-year construction period, and a per-capita wage of $50,000, the total annual payroll during construction would be about $6,250,000. This represents "new" money injected into the local economy. Payroll taxes would amount to around $500,000 per year.

This level of employment is significant to the local economies. As described in Section 4.10, there were 1,321 unemployed people in Campbell County and 150 in Crook County in October 2010, representing unemployment rates of 4.7% and 4.2%, respectively. The peak employment of 200 persons during construction could reduce the local unemployment rate to about 4.0%.

7.2.2.2 Operating Employment

As stated in Section 4.10.1.2, about 60 employees would be required to operate the Ross ISR facility. It is estimated that about 80% of these will come from the local labor force, with many staying on after construction of the facility is completed. Assuming the same per capita income as the construction work force, the annual payroll during the 4- to 8-year operating life of the facility would be about $3 million, with payroll taxes amounting to around $250,000 per year.

The employment level would be reduced by about two-thirds after uranium recovery operations are completed and the only remaining activities are wellfield restoration and surface reclamation/decommissioning. Payroll and payroll taxes would decrease accordingly. If market conditions are favorable and additional reserves are identified, the life of the facility as well as the tax and payroll benefits could be extended.

7.3 Potential Benefits of the No Action Alternative

Under the No Action Alternative, the production and property taxes identified above would not be realized by the State and local governments. The uranium ore would remain in the ground and thus could be developed at a later date, but consideration of that alternative is not within the scope of this analysis.

The employment, and associated personal income and payroll taxes identified in the previous section, would not occur under the No Action Alternative. It is possible that other jobs will be created in the region, but that speculation is not within the scope of this report. The lands on which the Ross ISR Project would be created have historically been used for rangeland agriculture, limited hunting, and limited oil and gas development. No other potential uses for this property have been identified to date, so it is considered likely that these historic uses will continue to prevail of the Ross ISR Project is not constructed.

7.4 Potential External Costs of the Project

7.4.1 Housing

As explained in Section 4.10, the available housing resources in Crook and Campbell counties are expected to be adequate to support the needs of the Ross ISR Project during facility construction and operation. Considering the recent economic recession and the decline in housing cost and demand, and the fact that the workforce will primarily come from the local labor force, the Ross ISR Project is not expected to create a housing crunch.

7.4.2 Noise and Congestion

Strata projects an increase in the noise and congestion in the immediate area of the Ross CPP and wellfield during construction of the facility. This will include heavy truck and equipment traffic and access to the jobsite by construction workers. These impacts will be most noticeable to residents in the immediate vicinity of the facility and will be temporary. As described in Section 3.10, the project vicinity is sparsely populated and the nearest residence is about 0.5 mile away from the proposed CPP. As described in Section 3.7, ambient noise levels in the proposed project area are low, consisting mostly of wind and trucks, primarily hauling bentonite along the local county roads. During construction, truck traffic on these roads will increase but will be similar in intensity to historic noise sources. During operation, little noise will emanate from the CPP, which will be enclosed. Noise during operation will be associated primarily with the well drilling activities and ongoing installation of utility lines and pipelines to and from the wellfield.

Dust from construction activities will be controlled using standard dust suppression techniques used in the construction industry.

7.4.3 Local Services

Strata plans to actively recruit and train local residents for positions at the project. As stated in Section 4.10, it is expected that the majority of construction and operating positions at the Ross ISR Project will be filled with local hires. As a result of using the local workforce, the impact on local services, including schools and medical facilities, should be small. In many cases these services (e.g., schools) are underutilized due to population trends in the area. As noted in Section 3.10.3.6, due to the remoteness of the site, Strata will maintain on staff personnel and equipment necessary to provide emergency services to deal with environmental, safety and health emergencies during construction and operation, including during restoration and reclamation of the site. Thus, these services will not represent a cost to local governments.

7.4.4 Potential Aesthetic Costs

Section 3.9 of this ER describes the existing visual resources of the proposed project area and surrounding area. Landscapes within the visual resource study area are characterized by a gently rolling topography and large, open expanses of upland grassland, pasture/hayland, and sagebrush shrubland. Intermittent streams are fed by ephemeral drainages which seasonally drain the adjacent uplands. Water features include the Little Missouri River and some minor tributaries, the Oshoto Reservoir and several small stock reservoirs. There are also areas of altered landscape within the study area, including 10 nearby residences, oil production facilities (oil well pump jacks, pipeline and utility rights of way, aboveground tanks, and access roads), transportation facilities (public and private roads, road signage, power and utility transportation lines), agricultural activities (fences, livestock, stock tanks, and cultivated fields), and environmental monitoring installations. The visible surface structures proposed for the Ross ISR Project include pre-engineered steel buildings housing the CPP, office/lab facilities and a warehouse; chemical storage vessels; wellhead covers, several small module buildings, and electrical distribution lines. The project will use existing and new roads to access each wellfield module. Because of the relatively flat to rolling topography, construction of roads, buildings and drill pads will require only minor amounts of earthwork, with little or no cuts or fills. Project development would alter the physical setting and visual quality of portions of the landscape, which would affect the overall landscape to some degree, as viewed from sensitive viewing areas. The proposed facilities would introduce new elements into the landscape and would alter the existing form, line, color, and texture, which characterize the existing landscape. The project would primarily affect rangelands.

In foreground-middleground views, the CPP, module buildings, wellhead covers, and water storage ponds would be the most obvious features of development. Access roads would be visible as light-tan exposed soils in geometrically-shaped areas with straight, linear edges that provide some textural and color contrasts with the surrounding rangeland. The CPP buildings, module buildings, and wellhead covers would be painted to resemble the colors of the surrounding soil and vegetation cover. These facilities would be visible from local county roads, but would be subordinate to the rural landscape. During construction of the wellfield modules and during operations as depleted wells are replaced with new wells in unmined areas, the most visible structures from any distance away will be the masts on the drill rigs. From beginning of construction through completion of the operational phase there could be as many as 12 drill rigs operating simultaneously. Due to the rolling topography, these may or may not be visible from a distance depending upon whether the rig or the viewer is in an area of high or low relief.

The electric distribution line poles would be an estimated 20 feet tall, and would be located throughout the proposed project area to provide power to module buildings and deep disposal wells. The distribution lines are similar in appearance to those typical of the rural landscape, but would occur at a higher density than on adjacent lands. The lines would be obvious to viewers at the viewing areas, but would not change the rural character of the existing landscape.

Following completion of each well, the mud pits would be regraded and the land around the well will be graded to conform to existing topography and seeded to approved species. Wellhead covers would be difficult to discern in the landscape from any sensitive viewing area. The form and textural contrast would be very weak because the relatively low profile (3 to 4 feet high) and small size of the facilities would disappear into the surrounding textures of soil and vegetation. Generally, color contrasts are most likely to be visible in foreground-middleground distance zone; however, the wellhead covers would be painted an earthtone color that would harmonize with the surrounding vegetation and soil colors. Therefore, contrast of line, form, texture, and color would be low. The facilities would not be noticeable to the casual observer. Wellhead covers would be visually subordinate to the landscape in foreground-middleground distance zone.

Any decreases in aesthetics at the proposed project area, such as increased noise, will be minimal due to the remoteness of the area, the nature of ISR operations, improved technologies, and required reclamation. In addition, the activities at the Ross ISR Project, such as well installation, are similar to the activities associated with other extractive industries in the region (e.g., oil and gas drilling).

7.4.5 Land Access Restrictions

Property owners of land located within the wellfield and plant boundaries will lose access and free use of these areas during operation, aquifer restoration, and decommissioning. The areas impacted are all used for agricultural purposes and the owners will lose the ability to use the areas for production purposes. Offsetting these land use restrictions are the surface lease, damage payments and production royalties to the landowners.

Interference with other uses of the proposed project 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 proposed project area is anticipated. As another example, hunting will be restricted at the proposed project area during production and reclamation to reduce safety concerns; but in the long term, hunting access may be improved due to road construction. To ensure that future users of the proposed project area are aware of the presence of abandoned wells, a deed notice of the mine unit locations will be required.

7.4.6 Most Affected Population

The expected impacts from the proposed Ross ISR Project would represent a totally new land use within what is currently a basically rural area with some limited recreation and oil and gas development. This represents a change for the few residents of the area, and the impacts of change, like those of noise, are based in part on the perception and attitude of the individual being affected. For the most part, the financial impact from operation of the Ross ISR Project would be positive for Crook County and the residents who would be directly or indirectly employed by the operation. With this project Strata could provide much-needed and well-compensated employment opportunities for the local population. Strata would adopt a policy of purchasing goods and services locally to the extent possible, in order to maximize the positive economic impact on a county facing economic challenges. Production tax collections and particularly the increase in local property taxes paid on the facilities and the production of uranium would have a significant economic impact on local government-provided services.

Offsetting these positive impacts to the local population are increases in noise, congestion, and aesthetic impacts for residents in and adjacent to the proposed Ross ISR Project. Residents with property in the proposed project area are land owners that would have financial arrangements with Strata and will benefit economically from the presence of the facility. Residents of nearby ranches will receive no direct financial benefits from the project.

7.4.7 Health and Environmental Costs

Strata proposes the Ross ISR Project will provide the societal benefits described in Section 7.2 while 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 to hydrogeology,
- use of groundwater,
- depletion of uranium and vanadium 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 proposed project area, which are summarized in various parts of Section 3 of this ER. Potential impacts to these resources are described in Section 4 of this ER. The resources will be reclaimed to support the approved post-project land uses of livestock, wildlife grazing, and oil and gas production, which are the same as the pre-project land uses, 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 TR. Because ISR operations are conducted in a series of wellfield modules, which are installed, produced, and reclaimed sequentially, only portions of the proposed project area will be disturbed at a given time.

Inherent to the Proposed Action, the uranium and vanadium will be depleted. However, the uranium mineral will provide a source of fuel for producing nuclear energy. Currently, the nation and the public are strongly 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 host rock associated with uranium will be reduced. This will improve the health of humans and the environment that may otherwise be exposed to the ores.

Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 94% of the domestic vanadium consumption in 2009. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid. Net import reliance was 100% of vanadium consumption in the U.S. from 2005 through 2009 (USGS 2010).

Groundwater will serve as a tool to recover uranium. Groundwater will be pumped from the recovery 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 recovery wells; treated at the CPP for removal of uranium and vanadium; and circulated through this system again and again. Ultimately, the majority of the water will be treated to remove dissolved constituents 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. The vanadium will be recovered along with the uranium and, if commercially feasible, recovered in a separate circuit for sale. The current price of vanadium is about $12.00 to $13.00/lb (Global Infomine

2010), so the additional capital and operating costs necessary to remove vanadium from the water during the ISR project must be relatively small in order to prove commercially viable.

Various types of wastes will be produced from the Project. These wastes may be categorized as AEA-regulated wastes and non-AEA-regulated wastes. Materials will be decontaminated or treated to reduce the volume of waste. AEA-regulated waste will be removed from the proposed project area and disposed at an NRC-licensed facility or will be disposed of in a UIC Class I well or evaporation pond, depending on the type of waste, in accordance with current NRC regulations. All other wastes will also be disposed of according to applicable local, state, and federal regulations.

Exposures to radioactive materials were estimated using results from the radiation survey and the MILDOS-AREA model. Estimated public exposure to radioactive materials is negligible due to the remote location of the proposed project 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.

7.5 Potential Internal Costs of the Project

Internal costs impact Strata 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.

The estimated internal costs are provided in Table 7.5-1.

The estimated decommissioning costs for the Ross ISR Project will be included in the annual financial assurance update submitted to WDEQ and the NRC for approval prior to construction activities. Each year, the cost estimate will be reviewed by the regulatory authorities based on total remaining aquifer restoration and decommissioning work, and adjustments will be made as necessary.

7.6 Benefit Cost Summary

The benefit-cost summary for a fuel-cycle facility such as the Ross ISR Project involves comparing the societal benefit of a constant U_3O_8 supply, which will be used to provide energy, against possible local environmental costs, for some of which there may be no directly related compensation. For this project, there are basically three of these potentially uncompensated environmental costs:

- groundwater impact;
- radiological impact; and
- disturbance of the land.

The groundwater impact is considered to be temporary in nature, as aquifer restoration activities will restore the groundwater to pre-construction use suitability. The successful restoration of groundwater during the Nubeth R&D project demonstrated that the restoration process can meet this criterion successfully.

The radiological impacts of the proposed project are small, with all AEA-regulated wastes being transported and disposed of off-site. Radiological impacts to air and water are also expected to be small.

The disturbance of the land for an ISR facility is quite small, both in terms of total area disturbed and magnitude of topographic changes, especially when compared with conventional surface mining techniques. All of the disturbed land will be reclaimed after the project is decommissioned and will become available and suitable for pre-construction uses.

In addition to the specific, tangible benefits, the Ross ISR Project will also provide more diverse benefits. Regional recreation may be enhanced following the reclamation of the disturbed area, because of improved access and the reclamation of the disturbed area to support wildlife and livestock grazing. Due to the remoteness and small population of the area 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 area.

The Ross ISR Project will support a domestic source of energy and environment-friendly practices. 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. Uranium production varies as a function of market conditions, which are affected by political and economic factors. After a decade of falling worldwide production of uranium prior to 1993, production has generally risen and now meets 76% of the demand for uranium for power generation. An increasing portion of uranium, now 36%, is produced by ISR (World Nuclear Association 2010). The U.S. produced about 2.9% of the world's uranium in 2009. Today's reactor fuel requirements are met from primary supply (direct mine output - 78% in 2009) and secondary sources: commercial stockpiles, nuclear weapons stockpiles, recycled plutonium and uranium from reprocessing used fuel, and some from re-enrichment of depleted uranium tails (left over from original enrichment). The Ross ISR Project, once in full-scale production, will add 750,000 pounds of U_30_8 per year to the market. This could increase to 3 million pounds through processing uranium-loaded IX resin. With appropriate regulatory approval, the processing facilities could accept loaded resins from other ISR sites in the region, even after the ISR operation is complete in the proposed project area.

7.7 Summary

In considering the energy value of the U_3O_8 produced to U.S. energy needs, the economic benefit to Crook County, the minimal radiological impacts, minimal disturbance of land, and technical feasibility of mitigating all other impacts, it is believed that the overall benefit cost balance for the proposed Ross ISR Project is favorable, and that issuing a license for the proposed project is the appropriate regulatory action.

Table 7.2-1. Estimated Major Tax Revenues from the Ross ISR Project

Description	Tax Revenues Average Per Year	 Over 10 Years Production
Severance taxes	$500,000	$5,000,000
State royalties	$180,000	$1,800,000
Gross products taxes	$900,000	$9,000,000
Property taxes	$350,000	$3,500,000
Total	$1,930,000	$19,300,000

Table 7.5-1. Estimated Internal Project Costs

Item	Present Worth (1,000 $US)
Obtain right to mine (claims, surface access and permits)	13,000
Facility construction[1]	40,000
Operation and maintenance	74,000
Groundwater restoration[2]	5,100
Decommissioning (including decontamination) [2]	3,500
Surface reclamation[2]	1,100
Total	136,700

[1] Due to sequential development of modules, some of the facility construction costs are distributed throughout the life of the project rather than concentrated at the beginning

[2] Includes plant area facilities and Mine Unit 1, complete restoration, reclamation and decontamination costs as estimated in Chapter 6, Section 5 of the TR and Addendum 6.1-A (RAP)

7.8 References

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8.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Chapter 1 of the Environmental Report outlines the operation plans for the Ross ISR Project and explains the purpose and need for the Proposed Action. Chapter 2 describes alternatives considered in the formulation of the Proposed Action. The baseline environment of the proposed Ross ISR Project and the surrounding area is described in Chapter 3. Chapter 4 describes the potential environmental impacts, both adverse and positive, of the Proposed Action. Chapter 5 discusses Strata's plans to mitigate most potential environmental impacts. Chapter 6 describes the monitoring program that will be carried out by Strata, and Chapter 7 presents a discussion of the benefits and costs of the project. This section presents a brief summary of the environmental consequences of the Proposed Action. Chapter 2, Section 2.3 compares the environmental consequences of the Proposed Action, No Action Alternative, and reasonable alternatives considered but eliminated from further analysis. These include: alternate wellfield layout (Section 2.1.3.1), conventional mining/milling, including heap leaching (Section 2.1.3.2), alternate CPP locations (Section 2.1.3.3), alternate lixiviants (Section 2.1.3.4), alternate waste management (Section 2.1.3.5), uranium processing alternatives (2.1.3.6) alternate CPP size (Section 2.1.3.7), and recovery of arsenic and selenium (Section 2.1.3.8). These alternatives are not currently nor expected to be economically preferable to the Proposed Action and have much more severe environmental consequences. Therefore, these alternatives were not examined in detail in this Environmental Report.

Due to the benign nature of ISR uranium recovery methods and the lack of unique environmental resources in the area, the potential environmental impacts of the Ross ISR Project are minor. Because of the relatively short duration of the project (approximately 8 to 12 years from construction through decommissioning), all environmental impacts are short-term. The only irreversible and irretrievable commitment of resources for project construction, operation, aquifer restoration, and decommissioning are the chemicals used in the mineral recovery process (none of which are scarce), the fuel required to operate equipment and transport employees to and from the project, and the power consumed by the process (to run pumps and motors and to dry the yellowcake). The power that will be generated by the uranium produced will far exceed the power required in the process of dissolving the uranium from the groundwater and recovering it from the solution. After the short-term use of the proposed project area to recover dissolved uranium and vanadium from the groundwater, the project area will be restored to its pre-construction condition and will support all pre-construction uses of the land for the foreseeable future. Because of the remoteness of the site, the small magnitude of potential environmental consequences, and the small number of employees required relative to the local labor force, none of the environmental consequences of the project are cumulative with any other ongoing projects in the area.

This section summarizes the relatively few environmental impacts that cannot be avoided. These impacts are small, but they will alter the environment of the project area for a short period of time. The unavoidable impacts of the proposed construction, operation, aquifer restoration and decommissioning of the Ross ISR Project are summarized in Table 8-1.

Table 8-1. Summary of Environmental Consequences

Potential Impact	Alternative	Potential Impacts
Potential Land Surface Impacts	Proposed Action	Surface disturbance on about 280 acres, or about 16% of proposed project area. Disturbance will range from short term for construction of well pads and utility corridors that will be reclaimed after construction to long term for roads, buildings, parking areas, and ponds that will remain until final D&D. All disturbance will be reclaimed to be suitable for pre-construction uses after aquifer restoration and D&D.
	No Action	None
	Alternative Wellfield Layout	Not analyzed in detail, but surface disturbance would be similar in severity and of longer duration than Proposed Action.
	Conventional Mining/Milling including Heap Leaching	Open-pit mining could disturb up to five times as much area for pit, ramps, and material stockpiling and would create permanent topographic changes. Conventional milling requires crushing of ore and disposal of tailings, creating long-term or permanent 11e.(2) byproduct material disposal area.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Disposal in evaporation ponds would require considerably more long-term surface disturbance due to evaporative surface required. Residue left after evaporation would be 11e.(2) byproduct material that would require disposal in an appropriately licensed facility.
	Uranium Processing Alternatives	Use of single-stage rather than two-stage RO treatment of bleed and restoration solutions would create twice as much brine as Proposed Action, requiring larger storage ponds - much larger ponds if evaporation is selected for waste water disposal. Reducing RO treatment of water recovered during aquifer restoration would increase surface area required for water storage and may increase the duration of the project due to longer time to achieve aquifer restoration.
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	**Alternative**	**Potential Impacts**
Potential Land Use Impacts	Proposed Action	Restricted access on up to 1,721.3 acres for 8-12 years (construction through decommissioning) which will have small impacts on livestock grazing and hunting.
	No Action	None
	Alternative Wellfield Layout	Not analyzed in detail, but land use restrictions would be similar in severity and of longer duration than Proposed Action.
	Conventional Mining/Milling including Heap Leaching	Area used for pit, ramps, haul roads, overburden stockpiles and topsoil stockpiles would be unavailable for any other uses for the duration of the operation, including decommissioning. Tailings piles would be a permanent restricted-use area.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Larger area required for water retention ponds would be unavailable for any other uses during project duration.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Transportation Impacts	Proposed Action	Approximately 30 acres will be disturbed for life of project to construct access roads. Traffic will increase on local public roads, peaking during construction. Chemicals being hauled to the site and products being hauled away, including small quantities of 11e.(2) byproduct material, pose small risk of spill during project life. Some roads might remain after decommissioning if they support the post-decommissioning land use and are desired by the surface owner.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit mine would most likely require relocation of local roads to accommodate pits, overburden stockpiles, and tailings impoundments. Conventional mining methods would require more employees with accompanying traffic on local roads.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action, possibly for longer duration since aquifer restoration could require more time.
	Alternate Waste Management	Same as Proposed Action
	Uranium Processing Alternatives	Use of single-stage RO treatment would require more area used for ponds than Proposed Action.
	Alternate Size of CPP	A smaller CPP would require fewer people and less materials to construct. If uranium-loaded IX resin were not processed, there would be no shipments of resin and fewer shipments of chemicals and yellowcake.
	Arsenic and Selenium Recovery	Similar to proposed action, with slightly more equipment, chemical, and product shipments.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Geology and Soils Impacts	Proposed Action	No significant impacts on geology. About 280 acres will be stripped of topsoil for construction of facilities. Topsoil will be stockpiled and protected from erosion until it is replaced during reclamation. After topsoil is replaced and revegetated, the land will support the pre-construction uses of livestock grazing and limited hunting.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit mining would be much more radical in terms of impacts on geology and soils. All the materials from the surface through the ore zone would be removed. Overburden would be stockpiled during mining and replaced in the pit after mining as a relatively homogeneous mixture of the original, stratified overburden.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action, although project duration could be extended if alternative lixiviants require more time for aquifer restoration.
	Alternate Waste Management	More area for retention/evaporation ponds would require more topsoil removal and stockpiling, which would last for the life of the operation.
	Uranium Processing Alternatives	Use of single-stage RO treatment would require more area used for ponds (hence, topsoil removal) than Proposed Action.
	Alternate Size of CPP	Similar to Proposed Action. There would be slightly less soil disturbance for a smaller CPP.
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Surface Water Impacts	Proposed Action	Small risk of increased sediment load to ephemeral stream channels due to surface disturbance. Small risk of spill of chemicals or fuels during project life. Small potential for impacting surface water if excess permeate is managed through WYPDES discharge or land application. Risks minimized by applying BMPs.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit mining would alter the surface drainage network, including requirement to divert surface water around the pit and stockpile area and restore all affected streams after mining. Larger disturbed area would present larger risk of sediment contributions to surface waters. Large amount of groundwater to be treated and discharged for either open-pit or underground mine would impact drainages which normally see only ephemeral flow events.
	Alternate CPP Location	Similar to Proposed Action, depending on CPP proximity to surface water.
	Use of Alternate Lixiviants	Increased potential risk to surface water associated with potential spill of acid or ammonia-based lixiviant compared to sodium-bicarbonate based lixiviant.
	Alternate Waste Management	Larger ponds would pose greater risk of spill to surface waters and disturb more acreage, presenting more risk of increased sediment load to streams.
	Uranium Processing Alternatives	Larger ponds would pose greater risk of spill to surface waters and disturb more acreage, presenting more risk of increased sediment load to streams. Little or no excess permeate would be generated if groundwater sweep solutions were not treated by RO. Potential surface water impacts from WYPDES discharge or land application of permeate would therefore be avoided.
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Groundwater Impacts	Proposed Action	Small risk that adjacent aquifers could be contaminated by excursion of recovery solution and would require cleanup. Small risk that shallow groundwater could be contaminated by leaks or spills. Small net withdrawal of water from the ore zone aquifer during operation to contain fluids. Some of the water withdrawn will be evaporated in ponds or disposed by deep well injection and thus represents a consumptive use. Water consumed will be replaced by natural recharge over time.
	No Action	None
	Alternative Wellfield Layout	Repeated recompletion of wells and potential well integrity problems would add to duration of operation and aquifer restoration.
	Conventional Mining/Milling including Heap Leaching	Open-pit and underground mining would drastically alter the hydrogeology of the area. All discrete aquifers from the surface to the bottom of the ore zone would be exposed in the pit, requiring water management, dewatering, treatment and disposal, and possibly creating safety hazards from highwall failures or cave-ins. Changes to aquifers would be permanent. Groundwater removed to allow conventional mining would have to be discharged, affecting streamflow patterns.
	Alternate CPP Location	Similar to Proposed Action, depending on CPP proximity to shallow groundwater.
	Use of Alternate Lixiviants	Same as Proposed Action, possibly with longer duration due to extended time for aquifer restoration.
	Alternate Waste Management	Same as Proposed Action
	Uranium Processing Alternatives	Use of single-stage RO or not treating groundwater sweep recovery solutions with RO would increase net amount of groundwater withdrawn from ore zone aquifer.
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Similar to Proposed Action, except that aquifer restoration could require less time if selenium is recovered during operations.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Ecological Impacts	Proposed Action	No threatened or endangered species will be impacted. No critical game habitat will be impacted. Small, temporary loss of habitat for some species will occur for life of project. BMPs will limit waterfowl and other wildlife access to lined retention ponds.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Much more surface disturbance, which will represent loss of habitat for life of project. Large quantities of water to be treated and discharged or stored in ponds would alter habitat for life of project.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Similar to Proposed Action, possibly for longer duration if aquifer restoration occurs more slowly.
	Alternate Waste Management	More terrestrial habitat lost due to need for larger impoundments.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Air Quality Impacts	Proposed Action	Slight increases in fugitive dust will occur, mostly during construction. Fugitive dust will increase over baseline levels for life of project due to increased traffic over local road system. No violation of air quality standards will result. Combustion and greenhouse gas emissions are estimated and will be relatively low. Greenhouse gas emissions will be offset by the power generated from the recovered uranium.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit mining would expose much more disturbed surface to potential wind and water erosion and fugitive dust. Earthmoving equipment would increase emissions of greenhouse gases. Tailings piles and ponds and heap leach pads would increase risk of airborne contaminants, including radioactive materials.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Similar to Proposed Action, possibly for longer duration if alternative lixiviants require more time for aquifer restoration.
	Alternate Waste Management	More surface disturbance caused by need to construct larger ponds would increase emissions of fugitive dust.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action. While there would be slightly fewer combustion emissions and greenhouse gas emissions if uranium-loaded IX resin were not received and processed, there would also be less carbon-offsetting power generated by the recovered uranium.
	Arsenic and Selenium Recovery	Similar to Proposed Action. Combustion emissions would be slightly higher due to increased material shipments.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Noise Impacts	Proposed Action	Noise will increase over ambient levels, which are 35 to 45 dBA, over life of project, mostly from construction equipment and vehicles. Nearest residence could experience short-term noise above the 55-dBA "annoyance" threshold if construction occurs near the license boundary at its shortest distance from the residence.
	No Action	None
	Alternative Wellfield Layout	Similar to Proposed Action. Slight reduction in noise levels due to the installation of fewer injection and recovery wells would be offset by added noise due to recompletion and additional MIT.
	Conventional Mining/Milling including Heap Leaching	Open-pit mining would entail use of much more heavy equipment, a primary source of noise.
	Alternate CPP Location	Similar to Proposed Action, although local effects could vary depending upon location with respect to existing roads and residences.
	Use of Alternate Lixiviants	Similar to Proposed Action, possibly for longer duration if alternative lixiviants require more time for aquifer restoration.
	Alternate Waste Management	The need to construct larger ponds would increase severity and/or duration of noise from earthmoving equipment.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action, with slightly fewer material shipments for a smaller CPP.
	Arsenic and Selenium Recovery	Similar to Proposed Action, with slightly more material shipments.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Historical and Cultural Impacts	Proposed Action	Impacts will be small, since sites eligible for NRHP will be avoided, a phased process will be used to identify previously undiscovered cultural resources and a stop-work provision will be provided if any cultural resources are discovered during construction.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Same as Proposed Action, except that increased surface disturbance increases the risk that historical or cultural resources will be impacted if they are not noticed during construction.
	Alternate CPP Location	Similar to Proposed Action, although potential impacts could vary according to location with respect to historical and cultural resources.
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Similar to Proposed Action, except that additional surface disturbance caused by larger ponds increases risk that unknown historical or cultural resources will be impacted.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	**Alternative**	**Potential Impacts**
Potential Visual/Scenic Impacts	Proposed Action	Slight visual impacts will occur from new structures and construction equipment but will maintain consistency with BLM visual resource classification of the area.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit mine would create a significant visual impact, with large stockpiles and a large tailings impoundment that would be present for the life of the operation.
	Alternate CPP Location	Similar to Proposed Action. Potential impacts would depend on location relative to residences and roads.
	Use of Alternate Lixiviants	Same as Proposed Action, possibly for longer duration if alternative lixiviants prolonged the aquifer restoration phase.
	Alternate Waste Management	More and larger impoundments than required under the Proposed Action would have localized visual impacts.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action. Potential impacts would be slightly less with smaller central plant area.
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Socioeconomic Impacts	Proposed Action	Most of the workforce is projected to come from the local area so there will be minimal impact on housing and local services. Project could employ up to 14% of the currently unemployed workforce in Campbell and Crook counties during construction, with employment declining during operation and decommissioning. Project would have slight, positive benefit to the State on severance tax, royalty, and sales and use tax collections and moderate benefits to Crook County on property and production taxes. Remoteness of the site might indicate slight need for increased emergency services (fire and ambulance service).
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Conventional mining and milling would require more employees than ISR recovery, and underground mining would likely require more employees than open-pit mining for the same amount of yellowcake produced per year. Local labor force might still be able to supply most of the employees, but would not be experienced in underground mining. Revenues to the State, which are based on production, would be similar to Proposed Action, but Crook County revenues from property taxes would be more due to additional equipment required for conventional mining.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action, possibly for longer duration if alternative lixiviants prolong aquifer restoration. The aquifer restoration phase has no revenues from mineral production and would require fewer employees than the operation phase, so impacts of extended aquifer restoration would be slight.
	Alternate Waste Management	Same as Proposed Action, possibly with extended construction period due to need to construct more and/or larger impoundments.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Fewer employees would be required to construct and operate a smaller CPP, and less tax revenue would be generated.
	Arsenic and Selenium Recovery	Similar to Proposed Action with slightly more revenue to Crook County due to higher property and production taxes.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Nonradiological Health Impacts	Proposed Action	Slight risk of public exposure through chemical leaks and spills will be mitigated by employing BMPs.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Open-pit and underground mining have risk of more accidents and more severe accidents than ISR recovery operations. Safety hazards from conventional mining at the Ross site would be compounded by the depth of the ore zone (average nearly 500 feet) and weakly cemented, saturated sands in the ore zone and shallower aquifers, which would create risk of highwall and roof failures.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Similar to Proposed Action; acid or ammonia-based lixiviant would introduce additional nonradiological health risks.
	Alternate Waste Management	Same as Proposed Action
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action, since the same types of chemicals would be stored and used.
	Arsenic and Selenium Recovery	Similar to Proposed Action; arsenic and selenium processing would introduce additional nonradiological health risks.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Radiological Health Impacts	Proposed Action	Modeling shows no impact to the public.
	No Action	None
	Alternative Wellfield Layout	None
	Conventional Mining/Milling including Heap Leaching	Conventional mining, particularly underground, presents more risk of exposure to radiation than ISR recovery. Tailings from conventional milling or heap leaching would constitute 11e.(2) byproduct material that would be a permanent feature of the landscape.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Same as Proposed Action
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action; potential impacts could be reduced slightly with smaller CPP and lined retention ponds.
	Arsenic and Selenium Recovery	Same as Proposed Action

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Waste Management Impacts	Proposed Action	Slight risk of exposure to public by transporting wastes to approved disposal site. Risk will be minimized by employing BMPs.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Conventional mining and milling creates considerably more waste than ISR, including tailings, which would be 11e.(2) byproduct material, and residue (salts and minerals) left over from treatment of the large amount of water that would be produced to allow access by open pits or underground tunnels.
	Alternate CPP Location	Same as Proposed Action
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Use of evaporation to dispose of liquid wastes would leave a residue of solids that would require disposal in a licensed facility as 11e.(2) byproduct material. If that facility were off site, there would be additional impacts from hauling the material to the disposal site. If that facility were created on site, it would be a permanent impact on the site.
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Similar to Proposed Action; potential impacts would be slightly reduced if a smaller CPP were constructed.
	Arsenic and Selenium Recovery	Similar to Proposed Action; slightly more waste could be generated during selenium and/or arsenic processing.

Table 8-1. Summary of Environmental Consequences (Continued)

Potential Impact	Alternative	Potential Impacts
Potential Mineral Resource Recovery Impacts	Proposed Action	Applicant will coordinate with oil producer on the property to assure that the operation does not interfere with oil recovery. No other minerals will be impacted.
	No Action	None
	Alternative Wellfield Layout	Same as Proposed Action
	Conventional Mining/Milling including Heap Leaching	Any existing oil wells would represent a conflict with development of an open-pit mine and would have to be plugged and abandoned.
	Alternate CPP Location	Similar to Proposed Action; potential impacts would depend on proximity to mineral resource development.
	Use of Alternate Lixiviants	Same as Proposed Action
	Alternate Waste Management	Same as Proposed Action
	Uranium Processing Alternatives	Same as Proposed Action
	Alternate Size of CPP	Same as Proposed Action
	Arsenic and Selenium Recovery	Same as Proposed Action

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9.0 LIST OF PREPARERS.. 9-1

9.0 LIST OF PREPARERS

In support of the Ross ISR Project, the individuals and organizations listed below contributed to the preparation of this Environmental Report as well as the Technical Report and Permit to Mine Application.

Strata Energy, Inc.
406 W. 4th St.
Gillette, WY 82716
(307) 686-4066

Tony Simpson	Chief Operating Officer
Alf Gillman	Corporate Geologist
Joe Syphers	Project Geologist
Al Berglund	Project Development Consultant

WWC Engineering
1849 Terra Avenue
Sheridan, WY 82801
(307) 672-0761

Michael Evers, P.G.	President/Energy and Environmental Manager
Benjamin Schiffer, P.G	Senior Geologist/Project Manager
Doyl M. Fritz, P.E.	Senior Technical Advisor
Tom Crump, P.E.	Branch Manager
Dale Brown, P.E.	Mining Manager
Kenneth Collier, P.G.	Senior Geologist
Jack Fritz, P.E.	Senior Engineer
John Berry, C.W.B.	Senior Biologist
Mike Wolf, P.G.	Senior Geologist
Wade Filkins, P.E.	Engineer
Ray Moores, P.E.	Engineer
Ben Weaver, P.E.	Engineer
Clint Andersen	Engineer
Sarah Moss	Engineer
Beth Kelly	Engineer
Rod Fuller	Environmental Technician
Jason Rogers	Environmental Technician
Mal McGill	CADD Designer
Robert Muller	CADD Manager
Dave Johnson	CADD Designer
Rodney Ventling	GIS Designer
Heidi Robinson	Administrative Secretary
Leanne Danner	Secretary
Chad Flanagan	Information Technologies

Lyntek, Inc.
1550 Dover Street
Lakewood, CO 80215
(303) 623-8365

John I. Kyle, P.E.	Vice President
Douglas Maxwell, P.E.	Project Manager
Breanna Alexander	Metallurgist

SENES Consultants Limited
8310 South Valley Hwy, Suite 300
Englewood, CO 80112
(303) 524-1519

Steven Brown, CHP	Certified Health Physicist
Lisa Manglass	Health Physicist

Thompson & Pugsley, PLLC
1225 19th Street, NW
Suite 300
Washington, DC 20036
(202) 496-0780

Anthony Thompson, Esq.	Partner
Christopher Pugsley, Esq.	Partner

BKS Environmental
P.O. Box 3467
Gillette, WY 82717
(307) 686-0800

Brenda Schladweiler, Ph.D.	President
Katie Wilson	Gillette Operations Manager/Soils Technician
Jacob Mulinix	Soil Scientist

Petrotek Engineering Corporation
10288 West Chatfield Ave., Suite 201
Littleton, CO 80127
(303) 290-9414

Ken Cooper, M.S., P.E.	Senior Engineer
Hal Demuth, M.S.	Senior Engineer/Project Manager
Errol Lawrence, M.S., P.G.	Senior Hydrogeologist
Wes Janes	
Aaron Payne	

GCM Services
1003 S. Montana
Butte, MT 59702
(406) 723-4387

David Ferguson	Principle Investigator

IML Air Science
555 Absaraka Street
Sheridan, WY 82801
(307) 674-7506

Ronn Smith, P.E.	Senior Engineer
Shane Hansen	Meteorologist

IML Laboratory
1633 & 1673 Terra Avenue
Sheridan, WY 82801
(307) 8945

Tom Patten	Laboratory Manager
Wade Nieuwsma	Assistant Laboratory Manager
Michelle LaGory	Quality Assurance Manager
Christopher Johnston	Soil Scientist
Lacey Ketron	Project Manager
Karen Secor	Soil Laboratory Supervisor
Jim Yocum	Radionuclide Program Manager

Intermountain Resources
P.O. Box 1589
Laramie, WY 82073
(307) 745-3803

Jim Orpet	President
Rusty Tait	Vice-President

PB Communications & Strategic Solutions
P.O. Box 293
Ranchester, WY 82839
(307) 751-3789

Melissa Butcher	Managing Partner

Timberline Land & Mineral Co.
27 Pine Lane
Sheridan, WY 82801
(307) 752-5738

Niles Veal	President

Fitzimmons, LLC
2201 Cabin Court
Gillette, WY 82718
(307) 686-3158

John L. Kennedy	Principal
Teri M. Storey	Landman

Tetra Tech Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525
(970) 223-9600

H. Robert Meyer, Ph.D.	Principal

GLOSSARY

11e.(2) byproduct material: The tailings or wastes produced by extracting or concentrating uranium or thorium from any ore processed primarily for its source material content. Also byproduct material.

Barber Amendment Area: An area, approximately 15 miles south of the proposed project within the Lance District, that is currently being evaluated by Strata as an ISR Satellite to the Ross ISR Project. Wellfields and an IX Plant would provide loaded resins to the Ross CPP. Mineralization occurs in similar Lance Formation sandstones, confined by thick shales as those present at the proposed project area.

Bleed: A solution drawn to adjust production or to restore groundwater by removing more fluids from the production zone than are injected, causing fresh groundwater to flow into the production area and minimizing the potential movement of lixiviant out of the wellfield.

Brine: Water with concentrated dissolved solids generated from the production and restoration reverse osmosis units.

Buffer area: Area extending a specified distance outside the proposed project area for analyzing baseline conditions and potential impacts. The distance from the proposed project area varies by resource.

Byproduct material: See 11e.(2) byproduct material.

Central plant area: The fenced area that will include the central processing plant, storage facilities, office/warehouse facilities, lined ponds, and other piping and equipment. The central plant area is proposed in portions of the NESE and SENE of Section 18, Township 53 North, Range 67 West.

Containment barrier wall: A highly impermeable, *in-situ* mixture of soil and bentonite that will form a continuous contaminant containment barrier around the central plant area. Also soil-bentonite slurry wall.

Deadwood/Flathead Formations: The Cambrian aged sandstones targeted at the Ross ISR Project for disposal of liquid waste. The Deadwood/Flathead formations are below the Madison Formation (lowermost USDW) and hydraulically isolated by the Englewood Shale Formation.

Deep monitoring zone (DM): The first water-bearing interval that lies stratigraphically below the uranium ore-bearing sands in the Upper Fox Hills Formation, and the target completion interval for the deep monitor wells. Also described as "BFS" horizon in the Lower Fox Hills Formation.

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

Excursion: The exceedance of upper control limits for two or more excursion indicators in a monitor well.

Facilities flood control diversion channel: A constructed earthen channel designed to route all surface water flow, up to and including the 100-year, 24-hour storm event, around the facilities in the central plant area.

Feeder line: A buried pipeline conveying lixiviant from a trunk line to an individual module building or recovery solution from an individual module building to a trunk line.

Flare: The undetected spread of recovery solutions between the wellfield and perimeter monitoring wells of the production zone. Flare is also a proportionality factor that estimates the amount of aquifer water outside of the pore volume that has been affected by lixiviant flow during the recovery phase. The flare is usually expressed as a horizontal and vertical hydraulic conductivity of an aquifer material.

Hydraulic anomaly: A water level deviation from historic trends as measured in perimeter, deep or shallow monitor wells indicating a local wellfield imbalance or a compromised confining unit. A precursor to a potential excursion where no geochemical abstractions have been measured.

Individual flow line: A buried pipeline conveying lixiviant or recovery solution from a module building to an individual injection well or recovery solution from an individual recovery well to a module building.

Injection well: A well or conduit through which lixiviant is introduced into the subsurface.

Intermittent stream: A stream or part of a stream where the channel bottom is below the local water table for some part of the year, but is not a perennial stream.

ISR GEIS: Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities, NUREG-1910.

ISR Satellite: An ISR/resin operation that transports its loaded resin to a CPP operated by the same company/licensee. As such, the ISR/resin operation is a "satellite" of the CPP.

Lance District: Uranium ore-bearing area along the west side of Crook County in northeastern Wyoming. The proposed project area encompasses approximately 2.7 square miles within the Lance District, which includes approximately 56 square miles of total surface area. Geologic conditions supporting uranium mineralization and hydrogeologic continuity are consistent throughout the 56 square miles.

Lined retention pond: A retention pond with a leak detection system used to temporarily store either permeate or brine and other wastewater, including spent eluate, liquid from process drains in the central processing plant, fluids generated from work over operations on injection and recovery wells, contaminated reagents, resin transfer wash water, filter backwash water, plant wash down water, and decontamination water.

Lixiviant: A leachate solution composed of native groundwater and chemicals (such as sodium carbonate/bicarbonate, ammonia, or sulfuric acid) added by the ISR facility operator. In the ISR process, the lixiviant is pumped underground for the purpose of mobilizing (dissolving) uranium from a uranium ore body.

Lower confining unit: A low-permeability, stratigraphic horizon below the ore zone composed of dark gray to black shale, claystone and mudstone. Also described as the "BFH" horizon in the Lower Fox Hills Formation.

Madison Formation: Mississippian limestone confined aquifer used by regional municipalities in public drinking water supplies.

Mine unit: A collection of wellfield modules permitted simultaneously through WDEQ/LQD.

Module: A module building and associated injection and recovery wells, individual flow lines, and feeder lines. Strata anticipates that 15 to 25 modules will be developed within the proposed Ross ISR Project.

Module building: A building containing manifolds, pumps, flow control valves, and sample points for controlling and monitoring lixiviant flowing to injection wells and recovery solutions from recovery wells within a wellfield module. Typically referred to as a header house at ISR facilities.

Monitor well: A well constructed or utilized to measure static water levels and/or to obtain liquid, solid, or gaseous analytical samples or other physical data that would be used for controlling the operation or to indicate potential circumstances that could affect the environment.

Nubeth: A joint venture formed between Nuclear Dynamics Inc., and Bethlehem Steel Corporation.

Ore zone (OZ): The targeted uranium ore-bearing sands in the Upper Fox Hills/Lower Lance formations, and the target completion interval for the ore zone and perimeter monitor wells. Also described as "FH" and "LT" stratigraphic horizons in the Upper Fox Hills and Lower Lance formations.

Perennial stream: A stream or part of a stream that flows continually during all of the calendar year as the result of a groundwater discharge or surface runoff.

Permeate: Nearly pure water generated from the production and restoration reverse osmosis units.

Permit boundary: The boundary of the proposed project area.

Pierre Shale: A geologic formation or series in the Upper Cretaceous which occurs east of the Rocky Mountains in the Great Plains, from North Dakota to New Mexico. A known regional confining interval between Late Cretaceous sediments and older sediments of the Early Cretaceous/Paleozoic Era.

Pore volume: A term used to define an indirect measurement of a unit volume of aquifer affected by ISR recovery or restoration. This report distinguished between the *in situ* pore volume and the pore volume displacement (see below).

Pore volume displacement: The unit volume of aquifer displaced during ISR uranium recovery and aquifer restoration. Pore volume displacement is calculated as completion thickness x area x porosity x flare, where the thickness is the average completion thickness for recovery and injection wells, area is the surficial area of injection and recovery well patterns, porosity is the collective open spaces of the formation, and flare is defined above.

Primary access road: An access road to provide access to the central plant area from the New Haven Road (County Road 164). The primary access road will include significant cut and fill and gravel surfacing and will be constructed for long-term use.

Production zone: See ore zone.

Proposed Action: The Proposed Action involves construction, operation, aquifer restoration, and decommissioning of an ISR uranium recovery facility in the proposed project area.

Proposed project area: The area proposed for construction, operation, aquifer restoration, and decommissioning of an ISR uranium recovery facility. For the Ross ISR Project, the proposed project area encompasses 1,721.3 acres in portions of Sections 7, 17, 18, and 19, Township 53 North, Range 67 West, and portions of Sections 12, 13, and 24, Township 53 North, Range 68 West.

Recovery solution: Any material which flows or moves, whether semi-solid, liquid, sludge, gas or other form of state, used to dissolve, leach, gasify or extract a mineral.

Recovery well: A well or conduit through which a recovery fluid, mineral, or product is produced from the subsurface. If a well is used for both injection and recovery, it is considered an injection well until the operator has adequately demonstrated that the well has been converted to use(s) other than injection.

Secondary access road: A road constructed within the proposed project area that provides access to wellfield module buildings and deep disposal wells with limited cut and fill construction. Also a graveled access road within the central plant area. These roads are used for long-term traffic and may be surfaced with small sized aggregate or other appropriate material.

Shallow monitoring zone (SM): The first water-bearing interval that lies stratigraphically above the targeted uranium ore-bearing sands in the Upper Fox Hills/Lower Lance formations, and the target completion interval for the shallow monitor wells. Also described as "LM", "LL", and "LK" stratigraphic horizons in the Lance Formation.

Soil-bentonite slurry wall: See containment barrier wall.

Staging and storage area: Areas used to store non-radioactive equipment (cement, bentonite, piping, vehicles, trailers, etc.) during short-term construction activity (typically less than 6 months).

Study area: Area including the proposed project area and a buffer area extending a specified distance outside the proposed project area for analyzing baseline conditions and potential impacts. The distance from the proposed project area varies by resource.

Surficial aquifer (SA): Water-bearing fluvial sandstones of the upper-most Lance Formation and recent alluvium/colluvium. Also described as "LB" and "LA" stratigraphic horizons in the Upper Lance Formation.

Temporary access road: A road used within the proposed project area for temporary access to drilling sites, wellfields in development, or ancillary areas assisting wellfield development. Temporary access roads are temporary in nature (generally in use 2-6 months) and consist of designated two-track trails where the land surface is not typically modified to accommodate the road.

Tertiary access road: A road used within the proposed project area for access to monitor wells, injection wells, and recovery wells. Tertiary access roads are used for limited travel and consist of designated two-track trails where the land surface is not modified to accommodate the road. They are used until they are no longer needed to access the desired location within the wellfield.

Trunk line: A buried pipeline conveying lixiviant from the central processing plant to feeder lines or recovery solution from a feeder line to the central processing plant.

Upper confining unit: A low-permeability, stratigraphic horizon above the ore zone composed of mudstone and claystone. Also described as the "LC" horizon in the Lance Formation.

Wellfield: The area of an ISR operation that encompasses the array of injection, recovery (or production) and monitoring wells and interconnected piping employed in the ISR recovery process.

Wellfield area: The surface area overlying the injection and recovery zones. This area may be all or a portion of the entire area proposed for the injection and production of recovery fluid throughout the life of the mine.

Wellfield pattern area: The surface area overlying the injection and recovery wells and interconnected piping (excludes wellfield area between injection/recovery wells and perimeter monitor well ring).