2.7 Hydrology

2.7.1 Surface Water

2.7.1.1 Rivers, Creeks and Drainages

The U.S. Geological Survey (USGS) maintains a hierarchical hydrologic unit code (HUC) system that divides the United States into 21 regions, 222 subregions, 352 accounting units, and 2,149 cataloging units based on surface hydrologic features, or drainages (USGS 2009a). The smallest USGS unit, the 8-digit HUC (or 4th level HUC), averages about 448,000 acres, and is usually the level referred to as a "HUC". The TCEA project site is located in the following HUC classification system (USGS 2009b):

- Region: Missouri (10)
- Subregion: White River-White (1014)
- Accounting Unit: White River [Nebraska: South Dakota] (101402)
- Cataloging Unit: Upper White River [Nebraska: South Dakota] (10140201)
- Basin: White-River-Hat Creek (**Figure 2.7-1, Table 2.7-1** [NDEQ 2010])
- Subbasin: WH1 (**Figure 2.7-2** [NDEQ 2010])

The White River Accounting Unit and Upper White River Cataloging Unit consist of an area of 9,870 and 2,810 square miles, respectively (USGS 2009b). The White River-Hat Basin, which is located in Dawes, Sioux and Sheridan counties, is comprised of a watershed area of 2,130 square miles. (NDEQ 2005)

The White River-Hat Creek Basin originates in northwestern Nebraska and heads in a northeastern pattern to a confluence with the Missouri River via the White River and the Cheyenne River (Hat Creek) in South Dakota (**Figure 2.7-1**).

The White River-Hat Basin is one of the roughest in the state, topographically. Northern tributaries in the City of Crawford area cross upland portions of the Pierre Shale, an impermeable formation. These streams are dry except for runoff flow. Southern tributaries originate in the Pine Ridge escarpment and flow primarily over forest, range, and agricultural land. These streams are ephemeral except where spring-fed. In general, stream flow in this basin is a function of surface run-off and groundwater contributions. The major land use is agriculture, with approximately 55 percent of the White River-Hat Creek Basin in rangeland or pasture and 15 percent of cropland (NDEQ 2005).

The TCEA lies within the watersheds of Bozle, Cherry, and the eastern portion of Dead Man's Creek, which are small southern tributaries to the major regional water course, the White River (**Figure 2.7-2, Figure 2.7-3**). These creeks head in the Pine Ridge south of the TCEA. From the headwaters, these creeks drain north over range and agricultural land to the White River. Contributions to flow come from springs in the Arikaree Group, snowmelt, runoff and the shallow Brule sands. The latter may receive inflow from the creek during periods of high flow. Due to the time variable nature of these water sources, discharges at various points along the

creeks may experience wide fluctuations on a month to month and yearly basis. It should be noted that all are typically dry and are more of a drainage area than a stream.

Bozle Creek drainage (south to north) is not located in TCEA permit boundary, but is located just outside the eastern permit boundary (Sections 28 and 33 T31N R52W) (**Figure 2.7-3**). Bozle Creek is typically a dry drainage in this area of the permit boundary, and remains dry throughout its course along the TCEA except for runoff flow.

Cherry Creek drainage transects the southern TCEA permit boundary (Section 29 T31N R52W) and exits the northern boundary and eventually enters the White River to the north (**Figure 2.7-3**). This creek drainage within and south of the TCEA area is dry except for runoff flow. The current drainage within the TCEA permit boundary has been modified by agricultural activities, exhibiting no defined creek bottom/sediments or banks.

Dead Man's Creek drainage does not enter the TCEA permit area, being located approximately 3,000 feet from the nearest points on the creek and the TCEA western permit boundary (**Figure 2.7-3**). Based on the topography, this area of the creek is hydraulically isolated from the TCEA permit area.

Monitoring results of the White River, Cherry Creek, and Bozle Creek are discussed in Section 2.9.

2.7.1.2 Surface Impoundments

Based on available maps and site investigations conducted by CBR, no surface water impoundments, lakes or ponds have been identified within the TCEA. Impoundments do occur within the AOR. Ice House Pond, Cherry Creek Pond and Grabel Ponds are located to the north and downgradient of the permit area and to the south of the White River. Cherry Creek Pond is located in the Cherry Creek drainage and the Grabel Ponds located to the east of Bozle Creek.(**Figure 2.7-3**). The Grabel Ponds are spring fed and discharge to Bozle Creek. Sulzbach Pond is located just outside the northwest corner of the permit boundary in an unnamed drainage. The headwaters of this unnamed drainage originates a short distance to the southwest of the permit boundary, moves across the northwest corner of the permit boundary and drains north to the White River. Just prior to this drainage entering the White River, another pond, Ice House Pond, is located within this drainage. The Grabel Ponds, Cherry Creek Pond and Ice House Pond are located on the Fort Robinson State Park. The Sulzbach Pond is located on private property.

The Sulzbach Pond is a man-made impoundment that consists of a low berm constructed across an unnamed ephemeral drainage course. The berm forms a small pond which is used for livestock watering. The Ice House and Cherry Creek Ponds are man-made impoundments formed by small earthen dams. These ponds are used principally for recreation in the Fort Robinson State Park.

Monitoring results for the Sulzbach, Grabel, Ice House and Cherry Creek Ponds are discussed in Section 2.9.

2.7.1.3 Surface Water Flow

Stream Flow

Historic monthly flow measurements, field water quality measurements and laboratory water quality data by the USGS and NDEQ for the above-referenced White River sampling points are presented in Sections 2.9

No flow measurements were attempted on Cherry Creek, Dead Man's Creek, Bozle Creek or unnamed drainages in the TCEA area due to the ephemeral nature of flow in these features.

Assessment of Flooding Potential

As shown in **Tables 2.9-14** and **2.9-15**, the average monthly stream flow of the White River at the Crawford gauge station is about 20 ft^3/sec. The highest discharge and gauge height on record between 1920 and 2004 occurred on May 10, 1991. On that date, severe thunderstorms resulted in significant rainfall, the gauge height was 16.32 feet and the stream flow exceeded 13,300 ft^3/sec (NDNR 2004). Several city facilities were damaged by floodwaters and hail, including the local golf course and fish hatchery, and the event was considered a "100 year" flood. The Rocky Mountain News (May 12, 1991) reported that mobile homes were swept away and the city water system was knocked out of service. However, it is noted that, while there are certainly historical extremes, the average gauge height on the White River at Crawford is less than 5 feet, with an average annual stream flow of 20 ft^3/sec.

An assessment of the potential for flooding or erosion that could impact the in-situ mining processing facilities and surface impoundments has been performed based on data from the Federal Emergency Management Agency (FEMA 1995). FEMA has not mapped unincorporated Dawes County south of the City of Crawford, Nebraska; however, FEMA maps are available for the City of Crawford, and an analogy can be drawn between the flooding potential in the City of Crawford and that southeast of the City of Crawford adjacent to the proposed TCEA. As shown in **Figure 2.7-4**, FEMA has classified the portion of Crawford between the D M & E Railroad (immediately west of First Street) as Zone A (i.e., an area that could be impacted by a 100-year flood) (FEMA 1995). The elevation of the White River in the Zone A classification ranges from 3,669 to 3,659 feet AMSL. The surface elevation of the railroad tracks ranges from 3,678 to 3,671 feet AMSL. These data suggest that significant flooding potential exists with a rise in the White River elevation of 9 to 12 feet above base flow conditions. This is consistent with the data from the 1991 100-year flood event, where the river elevation was approximately 11.3 feet above base gauge height (approximately 5 feet).

The proposed TCEA surface facilities are to be located in the north-west portion of Section 30 of T31N R52W, approximately 0.72 miles south of the White River, and approximately 139 feet topographically above the common river elevation. Proposed wellfields are planned for portions of Sections 28, 29, 30 and 33 of T31N R52W, and Section 25 of T31N R53W. (**Figure 2.7-3**). All of the wellfields are projected to be at least 116.6 feet above the White River elevation (**Table 2.7-2**).

There is no portion of the proposed TCEA with a reasonable potential of flooding due to flooding of the White River. Elevations of different points of the proposed TCEA permit boundary and centerpoint of the assets (i.e., wellfields, satellite facility main building and evaporation ponds)

indicate that elevations at these locations in relation to the nearest point on the White River range from 116.6 to 219.1 feet higher than the river (**Table 2.7-2**). Based on these data, the TCEA surface facilities and mine units occur outside of the 100 year flood plain, and are not considered to be in a "flood prone" area. Therefore, consistent with NUREG-1623, erosion modeling was not performed.

2.7.1.4 Surface Water Quality

NDEQ White River Sampling Program

NDEQ surface water results for the White River are presented in Section 2.9.

Crow Butte White River and Tributary Sampling Program

Water samples were collected from the White River, Cherry Creek, Bozle Creek, Sulzbach Pond, Cherry Creek Pond, Ice House Pond and Grabel Pond. Sampling location numbers assigned to all of the creeks and ponds except for the Grabel Ponds include the Bozle Creek (B-1), Cherry Creek (C-1), Sulzbach Pond (I-9), and Ice House Pond (I-10) and Cherry Creek Pond (I-11). Sampling locations are shown in **Figure 2.7-3.** The laboratory analytical results for the ponds are discussed in Sections 2.9.

2.7.2 Groundwater

This section describes the regional and local groundwater hydrology including local and regional hydraulic gradient and hydrostratigraphy, hydraulic parameters, baseline water quality conditions, and local groundwater use including well locations related to the TCEA. The discussion is based on information from investigations performed within the TCEA, data presented in previous applications/reports for the CPF license area where ISL mining is being conducted, the proposed NTEA and the geologic information presented in Section 2.6. In this regard, the hydrogeology of the TCEA is expected to be similar in many respects to that encountered in the CPF and NTEA.

The hydrostratigraphic section of interest for TCEA includes the following (presented in descending order):

- Alluvium
- Brule Formation (including the first "aquifer" in the Brule sand/clay)
- Chadron Formation (Upper Confining Unit including the Upper Chadron confining layer, Middle/Upper Chadron sand [aquifer, where present], and Middle Chadron confining layer)
- Basal Chadron Sandstone (Mining Unit)
- Pierre Shale (Lower Confining Unit)

With regard to the CPF, and particularly the NTEA and the TCEA, two groundwater sources are of interest in the City of Crawford and Crow Butte area. These are the Brule Formation sand and the Basal Chadron Sandstone. The Basal Chadron Sandstone contains the uranium mineralization in the CPF, NTEA and at the TCEA.

2.7.2.1 Groundwater Occurrence and Flow Direction

Within the Crawford Basin, the alluvium, Brule Formation, and Basal Chadron Sandstone are considered water-bearing intervals. The alluvial deposits are not typically considered a reliable water source. Sandy siltstones, overbank sheet sandstones and occasional thick channelized sandstones that occur throughout the Orella Member of the Brule Formation may be locally water-bearing units. These sandstone and siltstone units are difficult to correlate over any large distance and are discontinuous lenses, rather than laterally continuous strata. Although the Brule Formation is a local water- bearing unit, it does not always produce usable amounts of water. Despite this characteristic, the Brule Formation has historically been considered the shallowest aquifer above the Basal Chadron Sandstone aquifer and water supply wells have been completed in this unit.

Locations of all groundwater monitoring wells in the vicinity of the TCEA are shown on **Figure 2.2-4**. There are seven active monitoring wells screened in the Brule Formation (BOW 2006-1, BOW 2006-2, BOW 2006-3, BOW 2006-4, BOW 2006-5, BOW 2006-6, and BOW 2006-7). The private Miller Well (W-273) is also being utilized as a monitoring well for the Brule Formation. Ten active monitoring wells are screened in the Basal Chadron Sandstone (CPW 2006-1, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW 2006-5, COW 2006-6, COW 2006-7, UBCOW 2006-1, and UBCOW 2006-2).. Well completion reports for these monitoring wells are included in **Appendix A**. No completion report is available for W-273.

Water level measurements and water quality results for groundwater monitor wells are presented and discussed in Sections 2.9.

2.7.2.2 Groundwater Quality Data

Groundwater monitoring results and discussions are presented in Sections 2.9 and 2.10. The data are presented for the two water-bearing zones at the TCEA: the Brule Formation and the Basal Chadron Sandstone.

2.7.3 Aquifer Testing and Hydraulic Parameter Identification Information

Prior to initiation of ISL mining activities, the NDEQ UIC regulations require hydrologic testing and baseline water quality sampling. During the initial permitting and development activities within the TCEA, an aquifer pumping test was performed on April 7, 2008. The final report on pumping test activities in the TCEA (Three Crow Regional Hydrologic Testing Report – Test #7 (Petrotek 2008) is included in **Appendix E**. Testing activities and findings from pumping test activities in the TCEA are summarized below.

Prior to testing activities, CBR installed eight new monitoring wells in the Basal Chadron Sandstone (CPW 2006-2, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW-2006-5, UBCOW 2006-1, and UBCOW 2006-2) and three wells in the Brule Formation (BOW 2006-1, BOW 2006-2, and BOW 2006-3) (**Figure 2.7-5**). Well information for wells used during the 2008 pumping test is summarized in **Table 2.7-3**. CPW 2006-1 was abandoned in place due to breakage of the screen during well construction (**Appendix B**). Static water levels were collected from all eleven wells in the monitoring network on April, 21 2008 from the Brule Formation and the Basal Chadron Sandstone (6 days after completion of the pumping test), following recovery from pumping test activities. Water levels ranged from approximately 3,863 to 3,879 feet amsl in

the Brule Formation and 3,719 to 3,725 feet amsl in the Basal Chadron Sandstone (**Table 2.7-3**). The static water level at CPW 2006-2 was approximately 3,722 feet amsl, indicating that there was 108 feet of hydraulic head above the pump.

The 2008 pumping test was designed to assess the following:

- The degree of hydraulic communication between the pumping well installed in the Basal Chadron Sandstone and the surrounding Basal Chadron Sandstone monitoring wells;
- The presence or absence of hydraulic boundaries within the Basal Chadron Sandstone over the test area;
- The hydraulic characteristics of the Basal Chadron Sandstone within the test area; and
- The degree of hydraulic isolation between the Basal Chadron Sandstone and the overlying Brule Formation.

The 2008 pumping test was conducted while pumping at CPW 2006-2 at an average of 44.7 gpm for 183 hours (7.63 days). The radius of influence (ROI) was estimated to be in excess of approximately 4,600 feet. More than 113 feet of drawdown was achieved during testing and with the exception of one well, all Basal Chadron Sandstone wells monitored during the test indicated adequate drawdown of more than 2 feet, confirming hydrologic communication within the Basal Chadron Sandstone aquifer. The one exception was 1.2 feet of drawdown at COW 2006-1, which was the farthest monitoring well from the pumping well. No responses attributed to the pump testing were observed in monitoring wells installed in the Brule Formation.

Results of the 2008 pumping test indicate a mean hydraulic conductivity of 7.5 feet per day [ft/day] (ranging from 4.1 to 11.6 ft/day) or 2.65×10^{-3} centimeters per second [cm/sec], a mean transmissivity of 477 square feet per day (ft^2/day; ranging from 267 to 743 ft^2/day), and a mean permeability of approximately 2,990 millidarcies (md) based on an assumed water viscosity of 1.35 centipoises (cP) (at 50 degrees Fahrenheit) and a density of 1.0 (**Table 2.7-4**). The mean storativity was 8.8×10^{-4} (ranging from 4.8×10^{-5} to 1.6×10^{-4}) (**Table 2.7-4**). Estimated hydraulic parameters for individual well locations for the 2008 pumping test are summarized in **Table 2.7-5**. The hydrologic parameters observed at the TCEA are consistent with, although slightly higher than, the aquifer properties determined for the CPF area. No water-level changes of note were observed in any of the overlying wells during testing. The pumping test results demonstrate the following:

- All Basal Chadron Sandstone monitoring wells and the pumping well are in communication throughout the TCEA pumping test area;
- The upper and lower Basal Chadron Sandstone wells are in communication;
- The Basal Chadron Sandstone has been adequately characterized with respect to hydrogeologic conditions within the majority of the proposed TCEA test area;
- Adequate confinement exists between the Basal Chadron Sandstone and the overlying Brule Formation throughout the proposed TCEA test area; and
- The 2008 pumping testing was sufficient to proceed with UIC Class III permitting and a NRC license amendment application for the TCEA.

It should be noted that cross-sections presented in the Three Crow Regional Hydrologic Testing Report - Test #7 (Petrotek 2008) differ from cross-sections presented in this petition. Cross-sections presented in this petition are revised interpretations based on a recent extensive review of available site-specific drilling logs and published literature.

2.7.4 Hydrologic Conceptual Model for the Three Crow Expansion Area

Tables 2.6-1 and **2.6-2** present the regional and local stratigraphic columns in the vicinity of TCEA. The water-bearing units within the stratigraphic section present at the TCEA include alluvial deposits (rarely), permeable intervals in the Orella Member of the shallow Brule Formation, and the deeper confined Basal Chadron Sandstone. Sections 2.7.4.1 and 2.7.4.2 describe the upper and lower confining units and the hydrologic conditions for the water-bearing intervals present at the TCEA.

2.7.4.1 Confining Layers

Upper confinement for the Basal Chadron Sandstone within the TCEA is represented by 400 to 560 feet of smectite-rich mudstone and claystones of the Upper Chadron and Middle Chadron (**Figure 2.6-3a through Figure 2.6-3e**). Particle grain-size analyses of six core samples from the upper confining layer within the TCEA indicate all samples were either silty claystone or clayey siltstone (**Appendix C**). X-ray diffraction analyses indicate compositions of mudstone and claystone intervals of core samples from the Middle Chadron are highly similar to the Pierre Shale (e.g., predominantly mixed-layered illite/smectite or montmorillonite with quartz), which would be expected if the Pierre Shale was a source of materials for the overlying Middle Chadron (**Appendix C**). The limited lateral extent and hydraulic isolation of sandstones of the Upper/Middle Chadron within the TCEA, which range from 0 to 50 feet thick, is insignificant as a productive water-bearing zone (**Figure 2.6-5**). As a result, the Brule Formation is vertically and hydraulically isolated from the underlying aquifer proposed for exemption.

Lower confinement for the Basal Chadron Sandstone in the vicinity of the TCEA is represented by approximately 600 to 740 feet of black marine shale deposits of the Pierre Shale. Additional low permeability confining units are represented by the underlying Niobrara Formation, Carlile Shale, Greenhorn Limestone and Graneros Shale. Together with the Pierre Shale, these underlying low permeability units hydraulically isolate the Basal Chadron Sandstone from the underlying "D", "G", and "J" sandstones of the Dakota Group by more than 1,000 vertical feet (**Table 2.6-1**). The Pierre Shale is not a water-bearing unit, exhibits very low permeability, and is considered a regional aquiclude. Regional estimates of hydraulic conductivity for the Pierre Shale range from 10^{-7} to 10^{-12} cm/sec (Neuzil and Bredehoeft 1980; Neuzil et al. 1982; Neuzil et al. 1984; Neuzil 1993). The Pierre Shale has a measured vertical hydraulic conductivity in the CPF license area of less than 1×10^{-10} cm/sec (WFC 1983), which is consistent with other studies in the region. Particle grain-size analyses of two samples collected from the Pierre Shale within the TCEA (discussed in Section 2.6.1.2.3) indicate low permeability silty clay and clayey silt compositions (**Appendix C**). Regional studies also indicate there is no observed transmissivity between vertical fractures in the Pierre Shale, which appear to be short and not interconnected (Neuzil et al. 1984).

Estimates of hydraulic conductivity were developed using particle grain-size distribution data from the eight core samples collected within the Upper Chadron, Middle Chadron, and Pierre Shale. Results of the particle size distribution analyses indicate mostly silts and clays (**Appendix**

C). Hydraulic conductivity estimates were developed using the Kozeny-Carman equation, which is appropriate for sands and silts, but not for clayey soils with a high degree of plasticity. Estimated hydraulic conductivities of the four core samples collected within the Upper Chadron ranged from 3.4×10^{-5} to 8.6×10^{-6} cm/sec. Estimated hydraulic conductivities of the two core samples collected within the Middle Chadron ranged from 1.1×10^{-5} to 2.7×10^{-6} cm/sec. Estimated hydraulic conductivities for the two core samples collected within the Pierre Shale ranged from 5.1×10^{-6} to 2.7×10^{-6} cm/sec. The vertical hydraulic conductivity across the upper and lower confining layers is likely to be even lower due to vertical anisotropy. Additionally, hydraulic resistance to vertical flow is expected to be low due to the significant thickness of the upper confining zone within the TCEA, which ranges between 400 and 560 ft (**Figure 2.6-6**).

2.7.4.2 Hydrologic Conditions

A potentiometric map and cross sections of the Basal Chadron Sandstone indicate confined groundwater flow (**Figure 2.6-3a** through **Figure 2.6-3e** and **2.7-6**). Elevations of the potentiometric surface of the Basal Chadron Sandstone indicate that the recharge zone must be located above a minimum elevation 3,720 feet amsl. Confined conditions exist at the TCEA as a result of an elevated recharge zone most likely located west or northwest of the TCEA. The top of the Basal Chadron Sandstone occurs at much lower elevations within the TCEA, ranging from approximately 3,190 to 3,320 feet amsl (**Figure 2.6-8**).

In the vicinity of the TCEA, groundwater flow in the Basal Chadron Sandstone aquifer is predominantly to the east-northeast, with an average hydraulic gradient of 0.0012 ft/ft. The elevation of the Basal Chadron Sandstone within the TCEA is typically more than 500 feet below the base of the White River, which flows to the northeast less than one mile from the northwestern corner of the permit boundary (**Figures 2.7-3, 2.6-3a**, and **2.6-3c**). Regional water level information for the Basal Chadron Sandstone is currently only available in the vicinity of the current processing facility and the NTEA, but suggest a discharge point at an elevation of at least 3,700 feet amsl (or below) located east of Crawford, presumably at a location where the Basal Chadron Sandstone is exposed.

Extensive review of available data from the TCEA and vicinity strongly indicates that the extent of the Upper/Middle Chadron sandstone is limited to the southern half of the central and eastern portions of the TCEA (**Figure 2.6-3a** through **Figure 3e** and **Figure 2.6-7**). The unit is completely absent in the western, northern, and southern-most portions of the TCEA (**Figure 2.6-5**). In contrast to the NTEA, where a strong resistivity curve shift was observed across this unit, the Upper/Middle Chadron does not appear to be a highly transmissive unit at the TCEA with no apparent curve shifts that might indicate an increase in porosity or water content (**Figure 2.6-4**). Monitoring wells have not been completed in this unit as a result of the lack of recoverable water. Therefore, the unit is not considered a regional aquifer.

Available regional water-level information for the Brule Formation indicates unconfined groundwater flow generally toward the White River (**Figure 2.2-4** and **Figure 2.7-7**). Within the TCEA, groundwater generally flows to the north and northeast across the entire TCEA, with an average hydraulic gradient of 0.0168 ft/ft. Though the Brule Formation is the primary groundwater supply in the vicinity of the TCEA, low production rates indicate that the discontinuous sandstone lenses of the Orella Member may not be hydraulically well-connected. Recharge to this unit likely occurs directly within the TCEA, as the unit is unconformably overlain by 0 to 30 feet of unconsolidated alluvial and colluvial deposits (depending on local

topography) and is exposed throughout the vicinity (Beins 2008). This unit is likely in direct hydraulic communication with the White River, as observed at the NTEA where groundwater elevations indicate apparent recharge in the vicinity of the White River. In that context, gaining and losing conditions along the White River are probably seasonally influenced. A sufficient number of monitoring wells will be installed in the Brule Formation between the permit boundary and the White River to monitor water quality in the event of failure of an injection well or production well, and to prevent potential communication of mining fluids with surface water (see Section 2.7.3 for a more detailed discussion). Installation of such monitoring wells is required under the Class III injection well permit. Alluvial deposits along the margins of the White River may offer limited groundwater storage depending on river levels.

The two water-bearing zones in the TCEA have distinct and differing water-level elevations (**Figure 2.6-3a** through **Figure 2.6-3e**, **Table 2.7-6**). The available water-level data suggest hydrologic isolation of the Basal Chadron Sandstone with respect to the overlying water-bearing intervals in the TCEA. This inference is further supported by the difference in geochemical groundwater characteristics between the Basal Chadron Sandstone and the Brule Formation (see Section 2.9.3.2.2) (**Tables 2.2-14** and **2.9-13**).

In summary, the following multiple lines of evidence indicate adequate hydrologic confinement of the Basal Chadron Sandstone within the TCEA.

- Results of the April 2008 aquifer pumping test demonstrate no observed drawdown in observation wells screened in overlying Brule Formation throughout the TCEA (see Section 2.7.3).
- Large differences in observed hydraulic head (86 to 196 feet) between the Brule Formation and the Basal Chadron Sandstone indicate strong vertically downward gradients and minimal risk of naturally-occurring impacts to the overlying Brule Formation (see Section 2.9.3).
- Significant historical differences exist in geochemical groundwater characteristics between the Basal Chadron Sandstone and the Brule Formation (Section 2.9.3).
- Site-specific x-ray diffraction analyses, particle grain-size distribution analyses and geophysical logging confirm the presence of a thick (up to 560 feet), laterally continuous upper confining layer consisting of low permeability mudstone and claystone, and a thick (up to 740 feet), regionally extensive lower confining layer composed of very low permeability black marine shale (see Section 2.7.5).
- Analyses of particle size distribution results suggest a maximum estimated hydraulic conductivity of 10^{-5} cm/sec for core samples from the upper confining layer and 10^{-6} cm/sec for core samples from the lower confining layer, implying that the vertical hydraulic conductivity across the upper and lower confining layers is likely to be even lower due to vertical anisotropy (see Section 2.7.5).

2.7.5 Description of the Proposed Mining Operation and Relationship to Site Geology and Hydrology

The Basal Chadron Sandstone is currently mined via ISL mining techniques in the CPF license area and represents the production zone and target of solution mining in the TCEA. Ore-grade

uranium deposits underlying the TCEA are located in the Basal Chadron Sandstone (**Figure 1.4-1**). The ore body located within the TCEA is a stacked roll-front system, which occurs at the boundary between the up-dip and oxidized part of a sandstone body and the deeper down-dip and reduced part of the sandstone body. Stratigraphic thickness of the unit within the TCEA ranges from approximately 70 to 250 feet, with an average thickness of approximately 180 feet. Depending on the presence of up to four interbedded clay units, the vertical thickness of sandstone within the Basal Chadron Sandstone can vary depending on location (**Figure 2.6-3a** through **Figure 2.6-3e**). The unit occurs at depths ranging from about 580 to 940 feet bgs within the TCEA (**Figure 2.6-3a** through **2.6-3e**). A competent upper confining layer consists of the overlying Middle Chadron and Upper Chadron, which consist predominantly of clay, claystone, and siltstone. Based on extensive exploration hole data collected to date (more than 720 drill locations), the thickness of the upper confining layers in the TCEA range from 400 to 560 feet (**Figure 2.6-3a** through **Figure 2.6-3e**). Estimated hydraulic conductivities based on particle grain-size distribution analyses for site-specific core samples collected within the upper confining layer are on the order of 10^{-5} to 10^{-6} cm/sec (see Section 2.6.1.2.2). Geophysical logs from nearby oil and gas wells indicate that the thickness of the Pierre Shale lower confining layer ranges from approximately 600 to 740 feet (see Section 2.6.1.2.3). The full thickness of the Pierre shale is not depicted in **Figure 2.6-3a** through **Figure 2.6-3e**, as the required scale would obscure stratigraphic details of the overlying White River Group. The Pierre Shale exhibits very low permeabilities on the order of 0.01 Millidarcies (md) (less than 1×10^{-10} cm/sec) (WFC 1983). Estimated hydraulic conductivities based on particle grain-size distribution analyses for core samples collected from the Pierre Shale within the TCEA are on the order of 10^{-6} cm/sec (see Section 2.6.1.2.3). Oil and gas test well logs are depicted in **Appendix D**.

Based on similar regional deposition, the TCEA ore body is expected to be similar mineraologically and geochemically to that of the current Crow Butte operation. The ore bodies in the two areas are within the same geologic unit (i.e., Basal Chadron Sandstone) and have the same mineralization source (see Section 2.6). The sites are separated by only a few miles, and the cause of mineral deposition in the two areas appears to be similar (see Section 2.6). Neither site is anticipated to be affected by any recharge or other processes that would uniquely affect each area, so the groundwater characteristics of the current Crow Butte mineralized zone are presumed representative of the TCEA. **Table 2.7-7** presents the Baseline and Restoration Values for Mine Unit 10 (additional data for MU 1-9 are presented in **Appendix L).** The values in this table are expected to be representative of the geochemical characteristics of the TCEA ore body. The TCEA ore body, the outline of which is provided on **Figure 1.4-1**, is considered a zone of distinct water quality characteristics primarily due to the presence of relatively concentrated uranium and radium in the zone when compared to the concentrations of these parameters outside of the production zone (e.g., **Table 2.2-14**).

During the course of mining the water quality is expected to change as outlined in **Table 2.7-8**. The chemicals used in the mining and recovery process will include sodium bicarbonate, an oxidizer such as oxygen, carbon dioxide, and chloride for elution. As a result, the greatest changes in water quality are expected to be in alkalinity, bicarbonate, chloride, sodium, conductivity, and total dissolved solids (TDS). Significant increases are also likely to occur in calcium concentrations as a result of IX with clays. The oxidant will cause significant increases in uranium, vanadium, and radium and minor increases in trace metals such as copper, arsenic, molybdenum and selenium. The genesis of the ore body and the facies of the host rock at TCEA are similar to that of the current Crow Butte site so it is probable the change in water quality at

the TCEA will be similar to that experienced at the current Crow Butte site. Historic restoration activities at the current Crow Butte site have demonstrated the ability to successfully restore groundwater to established restoration standards. Groundwater restoration is discussed in detail in Section 6.0.

2.7.6 References

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Table 2.7-1 White River-Hat Creek Basin Stream Segment and Use Classification [1]

Stream Segment	Segment No.	Use Classification						
		State Resource Water	Recreation	Aquatic Life	Water Supply		Aesthetics	Key Species
				Coldwater [2]	Public Drinking Water[3]	Agricultural[4]		
White River – Soldier creek to Whitney Pipe Line (Aqueduct) (Sec. 26 T31N R51W)	20000		•	B		A	•	d, e
White Clay Creek	20100		•	B		A	•	c
Squaw Creek – NE National Forest boundary (Sec. 20 T31N R51W) to White Clay Creek	20110			B		A	•	
English Creek	20111			B		A	•	
Squaw Creek – Headwaters to NE National Forest boundary (Sec. 29 T31N R51W)	20120	A	•	B		A	•	c
Unnamed Creek (Sec. 36 T31N R52W)	20130		•	B		A	•	
Bozle Creek (Sec. 9 T31N R52W)	20200			B		A	•	
Soldier Creek – Middle Fork Soldier Creek to White river	20300	A		A	•	A	•	d, e
Middle Fork Soldier Creek	20310	A		A		A	•	d, e
Soldier Creek – Headwaters to Middle Fork Soldier Creek	20400	A		A		A	•	d, e
White River – Kyle Creek (Sec. 35 T31N	30000							

Table 2.7-1 White River-Hat Creek Basin Stream Segment and Use Classification [1]

Stream Segment	Segment No.	Use Classification						
		State Resource Water	Recreation	Aquatic Life	Water Supply		Aesthetics	Key Species
				Coldwater [2]	Public Drinking Water[3]	Agricultural[4]		
R54W) to Soldier Creek		B	•	A	•	A	•	d, e
Dead Man's Creek	30100		•	B	•	A	•	c
Deep Creek (Sec. 33 T31N R 53W)	30200			B		A	•	e
Bull Creek (Sec. 6 T30N R53W)	30300			B		A	•	
Kyle Creek (Sec. 35 T31N R54W)	30400			B		A	•	
White River – Headwaters to Kyle Creek (Sec. 35 T31N R54W)	40000	B		A	•	A	•	d, e

[1] Stream segments consist only of those in close proximity to the Three Crow Expansion Area (NDEQ 2005). Note: See reference for remainder of segments.

[2] **Aquatic Life Class A**: These waters provide a habitat which supports natural reproduction of a salmonid (trout) population. These waters also are capable of maintaining year-round populations of a variety of other coldwater fish and associated vertebrate and invertebrate organisms and plants.

[2] **Aquatic Life Class B**: These are waters which provide, or could provide, a habitat capable of maintaining year-round populations of a variety of coldwater fish and associated vertebrate and invertebrate organisms and plants or which support the seasonal migration of salmonids. These waters do not support natural reproduction of salmonid populations due to limitations of flow, substrate composition, or other habitat conditions, but salmonid populations may be maintained year-round if periodically stocked.

[3] **Public Drinking Water:** These are surface waters which serve as a public drinking water supply. These waters must be treated (e.g., coagulation, sedimentation, filtration, chlorination) before the water is suitable for human consumption. After treatment, these waters are suitable for drinking water, food processing, and similar uses.

[4] **Water Supply Agricultural Class A**: These are waters used for general agricultural purposes (e.g., irrigation and livestock watering) without treatment.

c: Brook trout
d: Brown trout
e: Rainbow trout

Table 2.7-2 Differences in Elevation of Three Crow Assets and White River

Project Boundary and Facility Assets		Elevation of Nearest Point of White River	Difference in Elevation (ft)[2]	Distance of Asset from Nearest Point of White River (ft)
Individual Measurement Points[1]	Elevation (ft)			
Satellite Facility	3918.0	3779	139.0	7583
Evaporation Ponds	3912.5	3779	133.5	7249
MU1	3920.1	3779	141.1	8301
MU2	3895.6	3779	116.6	6159
MU3	3927.8	3779	148.8	7070
MU4	3987.6	3779	208.6	10131
MU5	3948.4	3760	188.4	10009
MU6	3955.5	3760	195.5	11335
MU7	3961.9	3760	201.9	11833
MU8	3951.7	3760	191.7	13619
MU9	3979.1	3760	219.1	15443
NW Corner of Permit Boundary	3924	3798.6	125.4	4365
SW Corner of Western Most Permit Boundary	4035.8	3858	177.8	7218
Center Point of North Permit Boundary	3941.6	3772.5	169.1	7133
Northeast Corner of Permit Boundary	3904.4	3761.6	142.8	10672

[1] Measurements made at center-point of satellite building, evaporation ponds, and mine units.
[2] Positive values indicate elevations of satellite facility and associated assets greater than nearest sampling point of White River.

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Table 2.7-3 Three Crow Expansion Area Summary of 2008 Three Crow Pump Test Well Information

Well	Distance to Pumping Well	Northing (ft)	Easting (ft)	Township & Range	Section	TOC Elev. (ft-amsl)	Surface Elevation (ft-amsl)	Casing Stickup (ft)	Depth Drilled (ft bgs)	Casing Depth (ft bgs)	Top Screen (ft bgs)	Bottom Screen (ft bgs)	Screen Length (ft)	Casing O.D. (in.)	04/21/08 Static Water Elevation (ft AMSL)
Basal Chadron Sandstone Pumping Well															
CPW 2006-2	0.00	492,983.11	1,068,178.21	30	T31N R52W	3,914.73	3,913.63	1.10	900	790	791	871	80	4.95	3722.26
Basal Chadron Sandstone Observation Wells															
COW 2006-1	4,601	494,341.24	1,063,782.51	25	T31N R53W	3,906.95	3,905.80	1.15	840	759	764	829	65	4.95	3724.93
COW 2006-2	2,138	494,512.66	1,066,684.93	30	T31N R52W	3,933.71	3,932.71	1.00	880	779	781	851	70	4.95	3721.50
COW 2006-3	1,155	494,006.65	1,068,713.99	30	T31N R52W	3,903.68	3,902.78	0.90	840	729	731	811	80	4.95	3718.77
COW 2006-4	2,718	490,369.75	1,068,924.73	29	T31N R52W	3,955.82	3,954.67	1.15	910	789	783	878	95	4.95	3722.61
COW 2006-5	3,877	490,191.11	1,070,868.10	29	T31N R52W	3,892.71	3,982.26	0.45	920	849	851	901	50	4.95	3721.64
UBCOW 2006-1	45	492,976.82	1,068,222.59	30	T31N R52W	3,915.06	3,913.96	1.10	760	649	654	744	90	4.95	3721.88
UBCOW 2006-2	2,711	490,371.92	1,068,906.48	29	T31N R52W	3,955.55	3,954.03	1.52	770	659	665	770	105	4.95	3721.75
Brule Formation Observation Wells															
BOW 2006-1	39	493,015.54	1,068,155.97	30	T31N R52W	3,915.50	3,914.75	0.75	170	39	45	50	5	4.95	3862.91
BOW 2006-2	2,444.00	491,217.68	1,066,488.62	30	T31N R52W	3,938.64	3,937.65	0.99	180	69	75	180	105	4.95	3878.85
BOW 2006-3	2,789	490,288.86	1,068,899.77	29	T31N R52W	3,957.36	3,956.23	1.13	200	45	45	190	145	4.95	3879.16

Table 2.7-4 Summary of Three Crow Pump Test Results vs Current Crow Butte Facility and North Trend Expansion Area

	Tests #1-#4 Existing Class III Permit Area (mean)	Test #6 North Trend 2006 (mean)	Test #7 Three Crow 2008 (mean)
Transmissivity (ft^2/day)	363	60	477
Formation Thickness (feet)	39.0	26	64
Hyd. Cond. (ft/day)	9.3	2.3	7.5
Storativity	9.7E-05	5.3E-05	8.8E-04

Table 2.7-5 Three Crow Expansion Area Summary of 2008 Three Crow Pump Test Results

Well	Distance from Pumping Well (feet)	Analytical Results	Theis Drawdown	Theis Recovery	Cooper & Jacob 'u' assumption satisfied (<0.01)	Averages
CPW 2006-2	Pumping Well	Transmissivity (ft^2/day)	NA	3.35E+02	NA	3.35E+02
		Hyd. Cond. (ft/day)	NA	5.24E+00	NA	5.24E+00
		Storativity	--	--	--	--
COW 2006-1	4,601	Transmissivity (ft^2/day)	6.38E+02	8.48E+02	NA	7.43E+02
		Hyd. Cond. (ft/day)	9.97E+00	1.32E+01	NA	1.16E+01
		Storativity	1.64E-04	--	--	1.64E-04
COW 2006-2	2,138	Transmissivity (ft^2/day)	3.67E+02	4.73E+02	NA	4.20E+02
		Hyd. Cond. (ft/day)	5.74E+00	7.39E+00	NA	6.57E+00
		Storativity	9.65E-05	--	--	9.65E-05
COW 2006-3*	1,155	Transmissivity (ft^2/day)	2.16E+02	3.22E+02	2.61E+02	2.67E+02
		Hyd. Cond. (ft/day)	3.38E+00	5.04E+00	4.08E+00	4.16E+00
		Storativity	4.83E-05	--	4.14E-05	4.49E-05
COW 2006-4	2,718	Transmissivity (ft^2/day)	3.51E+02	5.31E+02	NA	4.41E+02
		Hyd. Cond. (ft/day)	5.48E+00	8.29E+00	NA	6.89E+00
		Storativity	6.68E-05	--	--	6.68E-05
COW 2006-5	3,877	Transmissivity (ft^2/day)	4.42E+02	5.83E+02	NA	5.12E+02
		Hyd. Cond. (ft/day)	6.90E+00	9.11E+00	NA	8.01E+00
		Storativity	6.83E-05	--	--	6.83E-05

* - The 'u' assumpition limitation (<0.01) inherent to the Cooper & Jacob method was satisfied for monitor well COW 2006-3 only.

	Avg. Transmissivity (ft^2/day)	4.77E+02
	Avg. Hyd. Cond. (ft/day)	7.45E+00
Discharge Rate: 44.7 [U.S. gal/min]	Avg. Storativity	8.81E-05
Aquifer Thickness: 64 [ft]		

Table 2.7-6 Water Levels – Brule Formation and Basal Chadron Sandstone (January 2009 and 2010)

Well	1/9/2009	1/30/2009	1/22/2010 & 2/8/2010
BRULE FORMATION			
BOW 2006-1	3862.90	3863.34	3863.83
BOW 2006-2	3879.01	3879.07	3878.50
BOW 2006-3	3878.25	3878.05	3877.20
BOW 2006-4	3857.78	3857.50	3861.58
BOW 2006-5	NM	NM	3842.83
BOW 2006-6	NM	NM	3904.43
BOW 2006-7	NM	NM	3913.02
Well 273 (Miller Well)	NM	NM	3819.13
BASAL CHADRON SANDSTONE			
CPW2006-2	3,721.22	3,721.01	3,717.26
COW2006-1	3,723.94	3,723.64	3,720.36
COW2006-2	3,721.11	3,720.85	3,717.13
COW2006-3	3,720.43	3,720.22	3,716.73
COW2006-4	3,720.81	3,720.46	3,717.02
COW2006-5	3,720.26	3,720.03	3,716.46
COW2006-6	3,713.43	3,712.89	3,708.23
COW2006-7	3,711.76	3,712.20	3,707.55
UBCOW2006-1	3,720.51	3,720.36	3,716.73
UBCOW2006-2	3,720.84	3,720.61	3,716.96

Notes:

1) Groundwater elevations are in feet above mean sea level (ft-amsl).

2) Groundwater elevations for the Brule Formation and Basal Chadron Sandstone are based on depth to water measurements.

3) A single water level measurement was collected from Well 273 on 2/8/2010.

NM - not measured

Table 2.7-7 Baseline and Restoration Values for CPF Mine Unit 10

Baseline and Restoration Values for CPF Mine Unit 10	Groundwater Standard [1]	MU-10 Baseline (Primary Standard)	MU-10 Standard Deviation	MU-10 NDEQ Restoration Value
Ammonium (mg/l)	Not Listed	0.34	0.07	10
Arsenic (mg/l)	0.010	0.001	0.001	0.01
Barium (mg/l)	2	0.1	0.0	2.0
Cadmium (mg/l)	0.005	0.005	0.00--	0.005
Calcium	Not Listed	11.8	2/6	118.0
Chloride (mg/l)	250	185	14	250
Copper (mg/l)	1.3	0.01	0.01	1.3
Fluoride (mg/l)	4	0.72	0.10	4
Iron (mg/l)	0.3	0.03	0.01	0.3
Lead (mg/l)	0.015	0.001	0.0	0.015
Manganese (mg/l)	0.05	0.01	0.0	0.05
Magnesium	Not Listed	3.4	0.7	34
Mercury (mg/l)	0.002	0.001	0.0	0.002
Molybdenum (mg/l)	Reserved	1.0	0.0	1
Nickel (mg/l)	Reserved	0.05	0.0	0.15
Nitrate (mg/l)	10	0.1	0.0	10
Potassium (mg/l)	N/A	10.1	1.6	101
Radium-226 (pCi/L)	5	87.3	161.0	409.3
Selenium (mg/l)	0.05	0.003	0.002	0.05
Sodium (mg/l)	Reserved	388	12	3880
Sulfate (mg/l)	250	329	25	379
Uranium (mg/l)	0.030	0.0378	0.0351	0.108
Vanadium (mg/l)	Reserved	0.1	0.0	0.2
Zinc (mg/l)	5	0.01	0.01	5
pH (Std. Units)	6.5 - 8.5	8.51	0.19	6.5 – 8.89
Total Carbonate (mg/l)	N/A	394	15	550.5
TDS (mg/l)	500	1101	26	1127

[1] Title 118 numerical standards in effect at the time the Notice of Intent was filed with the NDEQ.

Table 2.7-8 Anticipated Changes in Water Quality During Mining

Average Ore Zone Water Quality			
Analyte	**Units**	**Pre-Mining (Well W-007)**	**Typical Water Quality During Mining at CPF**
Alkalinity, Total as CaCO3	mg/L	328	1,600
Carbonate as CO3	mg/L	0	<1.0
Bicarbonate as HCO3	mg/L	401	2,050
Calcium	mg/L	29.6	77
Chloride	mg/L	202	600
Fluoride	mg/L	1.23	0.6
Magnesium	mg/L	5.3	23
Ammonia as N	mg/L	0.74	<0.05
Nitrate+Nitrite as N	mg/L	--	0.46
Potassium	mg/L	15.0	35
Silica	mg/L	11.3	21
Sodium	mg/L	567	1,310
Sulfate	mg/L	737	900
Conductivity	umhos/cm	2,723	6,000
pH	s.u.	8.1	7.8
TDS	mg/L	1,804	4,080
Aluminum	mg/L	<0.10	<0.1
Arsenic	mg/L	<0.002	0.06
Barium	mg/L	<0.10	<0.1
Boron	mg/L	1.61	1.1
Cadmium	mg/L	<0.01	<0.005
Chromium	mg/L	<0.05	<0.05
Copper	mg/L	<0.01	0.04
Iron	mg/L	<0.05	<0.030
Lead	mg/L	<0.05	<0.05
Manganese	mg/L	0.01	0.05
Mercury	mg/L	<0.001	<0.001
Molybdenum	mg/L	<0.10	0.5
Nickel	mg/L	<0.05	<0.05
Selenium	mg/L	<0.175	0.07
Uranium	mg/L	<0.0032	44
Vanadium	mg/L	<0.10	2.5
Zinc	mg/L	<0.02	0.02
Radium 226	pCi/L	11.9	1,090

WYOMING

SOUTH DAKOTA

WH2

WH1

Sioux

Dawes

Cherry

Sheridan

Hat Creek

White River

White Clay Creek

Chadron

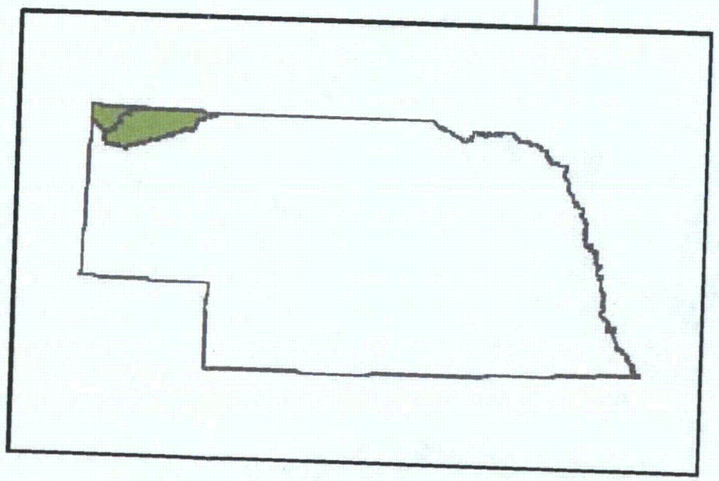
Whitney Reservoir

White

Soldier Creek

N

10 0 10 20 30 40 50 Miles



LEGEND

Proposed Three Crow Expansion Area

CROW BUTTE RESOURCES, INC.

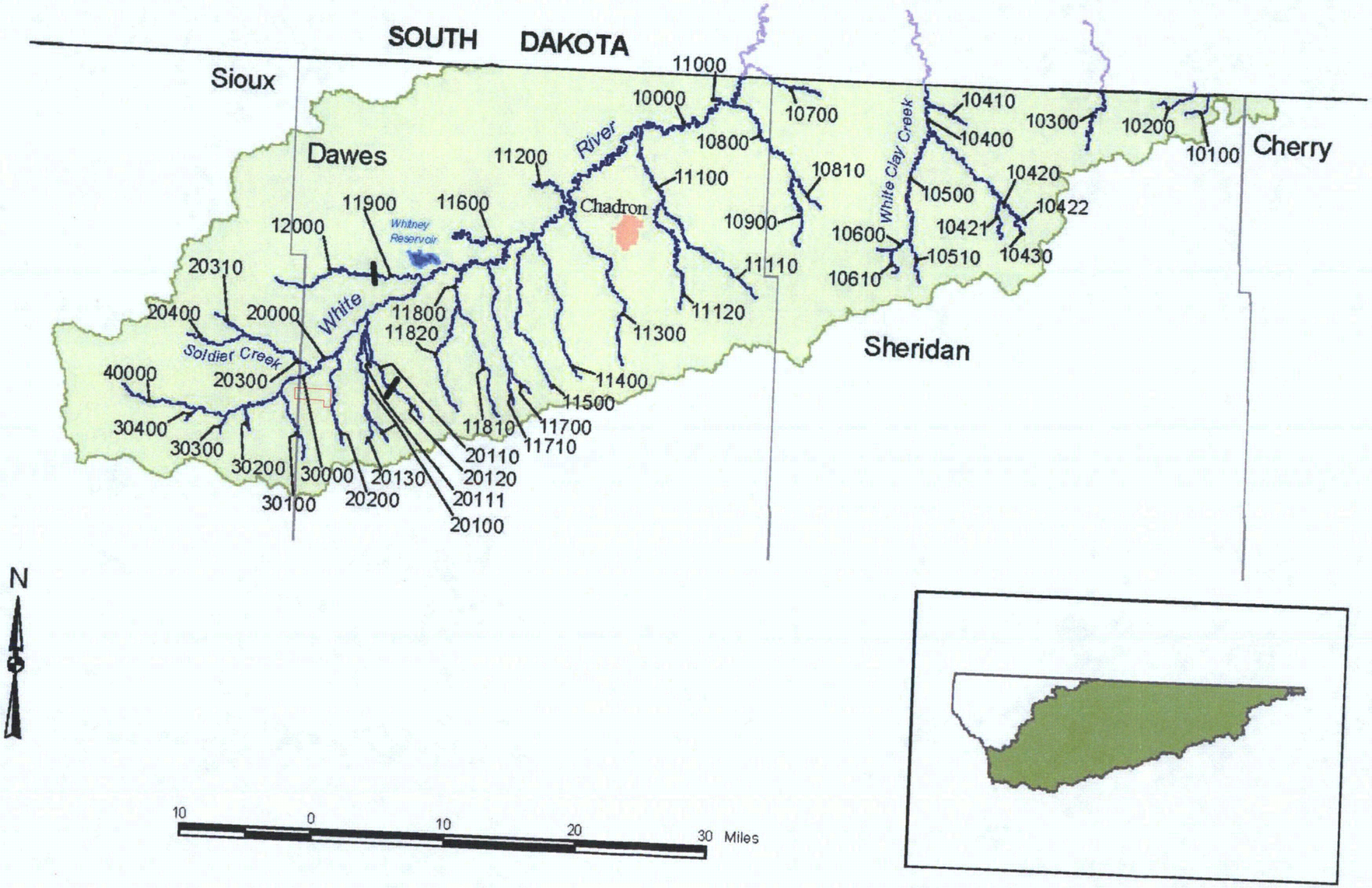
FIGURE 2.7-1
WHITE RIVER-HAT CREEK BASIN
(AND SUBBASINS)

PROJECT: CO001396.00003 MAPPED BY: MSH CHECKED BY: JC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0002_UIC\UIC_Fig_F 1-1 White River Hat Creek Basin.mxd - 5/14/2010 @ 9:15:02 AM

Subbasin WH1



LEGEND

Proposed Three Crow Expansion Area

CROW BUTTE RESOURCES, INC.

FIGURE 2.7-2
WHITE RIVER-HAT CREEK BASIN
SUBBASINS WH1

PROJECT: CO001396.00003 | MAPPED BY: MSH | CHECKED BY: JC

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Highlands Ranch, CO 80129
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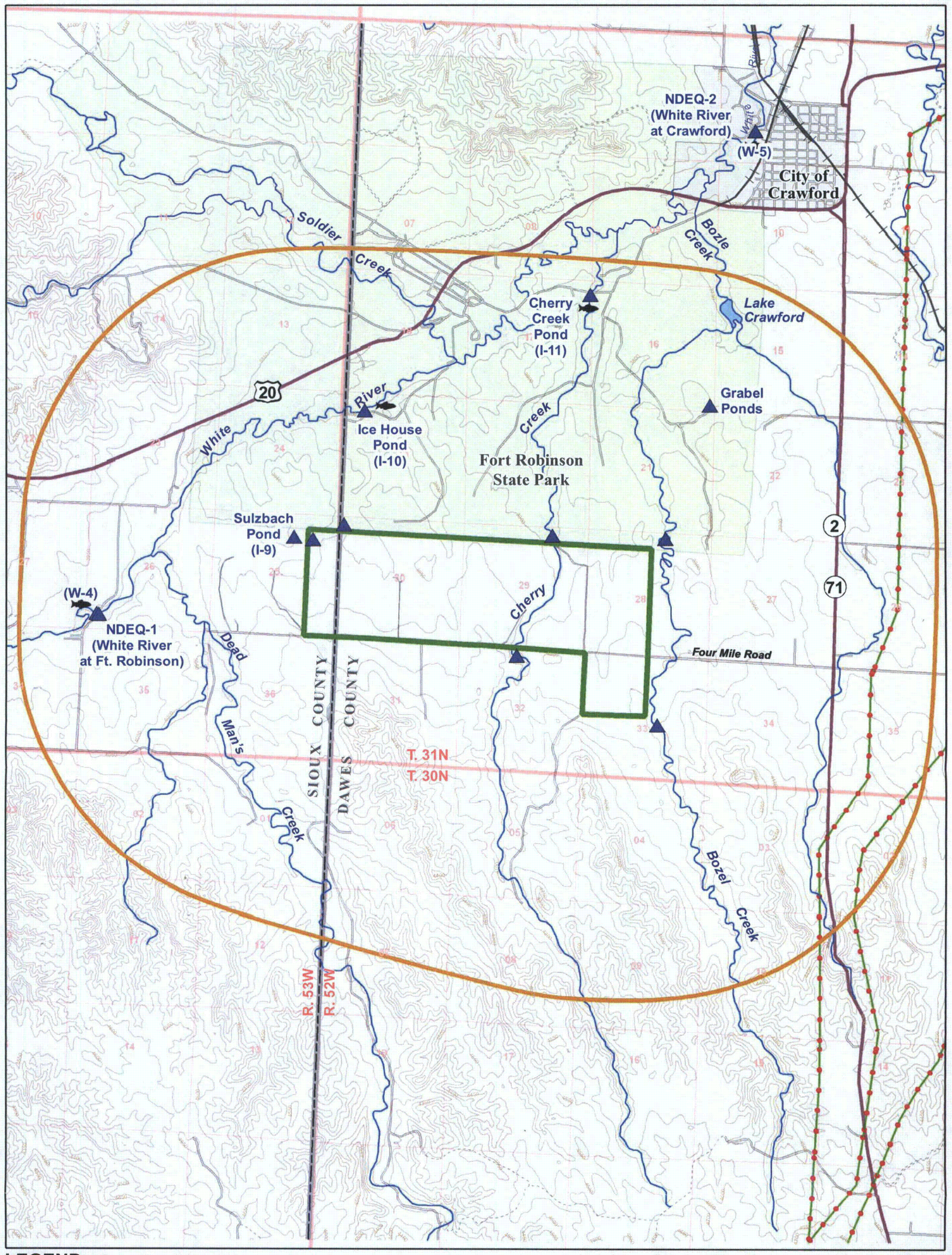
K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TRITR Fig_2_7-2_White River_Hat Creek Basin Subbasin WH1.mxd - 5/24/2010 @ 11:27:41 AM



LEGEND

- Proposed Three Crow Expansion Area and Class III Permit Boundary
- 2.25-Mile Area of Review (AOR)
- Lake
- River/Creek
- Transmission Line
- County Boundary
- Surface Water Sample Point
- Fish Sampling Location
- Elevation Contour (50-Ft Interval)
- Railroad
- Highway
- Road
- Trail

0 2,000 4,000

Scale in Feet

PROJECTION:
*NAD_1927_STATE_PLANE_*
NEBRASKA_NORTH_FIPS_2601

ALL ELEVATIONS ARE IN FT-AMSL.

N
W — E

CROW BUTTE RESOURCES, INC.

FIGURE 2.7-3
THREE CROW AREA
SURFACE WATER SAMPLING LOCATIONS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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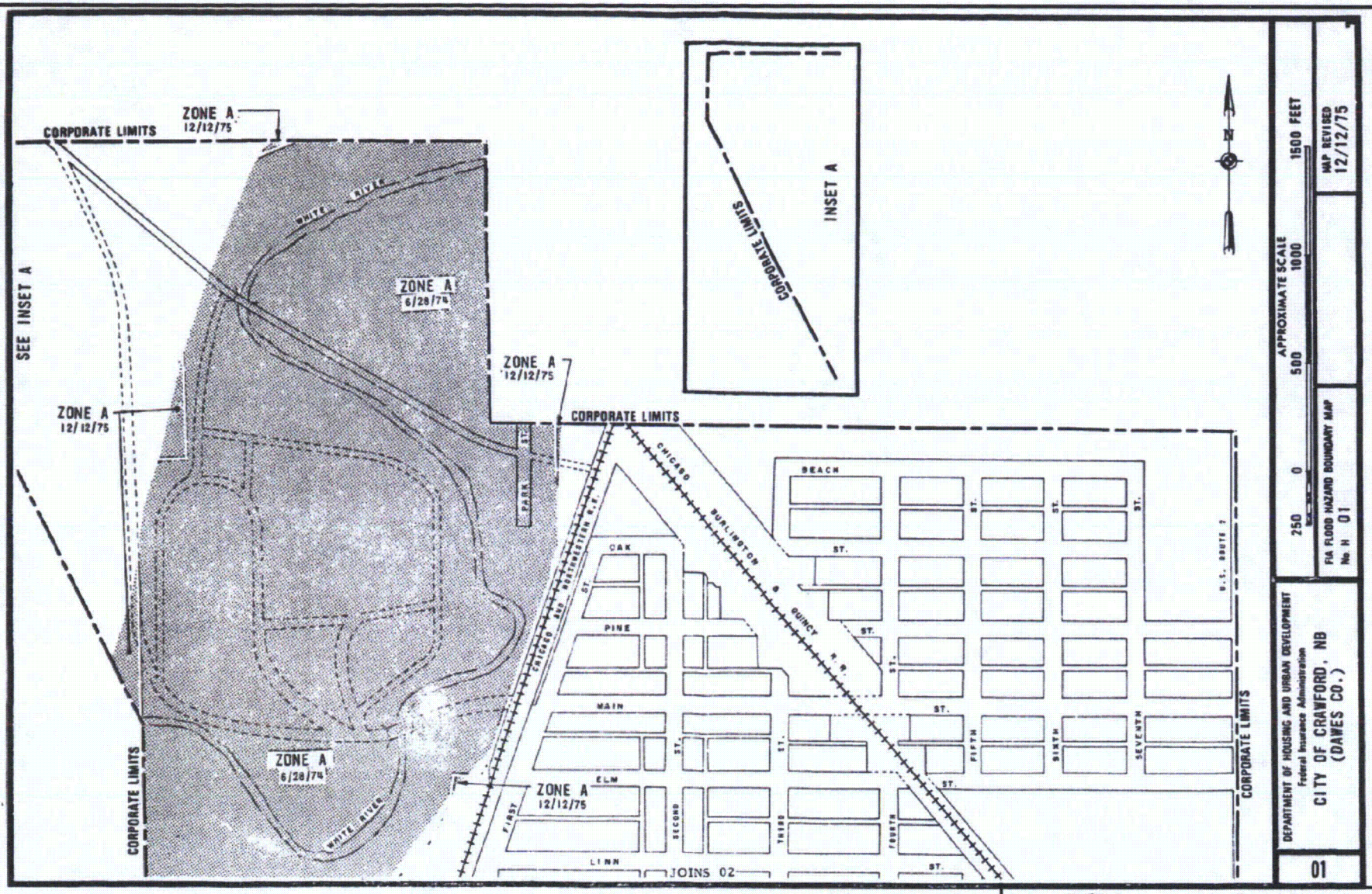
K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TRITR Fig_2_7-3 3Crow Area Surface Water Sampling.mxd - 7/6/2010 @ 11:16:16 AM



CROW BUTTE RESOURCES, INC.

FIGURE 2.7-4
FEMA FLOOD MAP

PROJECT: CO001396.00002 MAPPED BY: JC CHECKED BY: JEC

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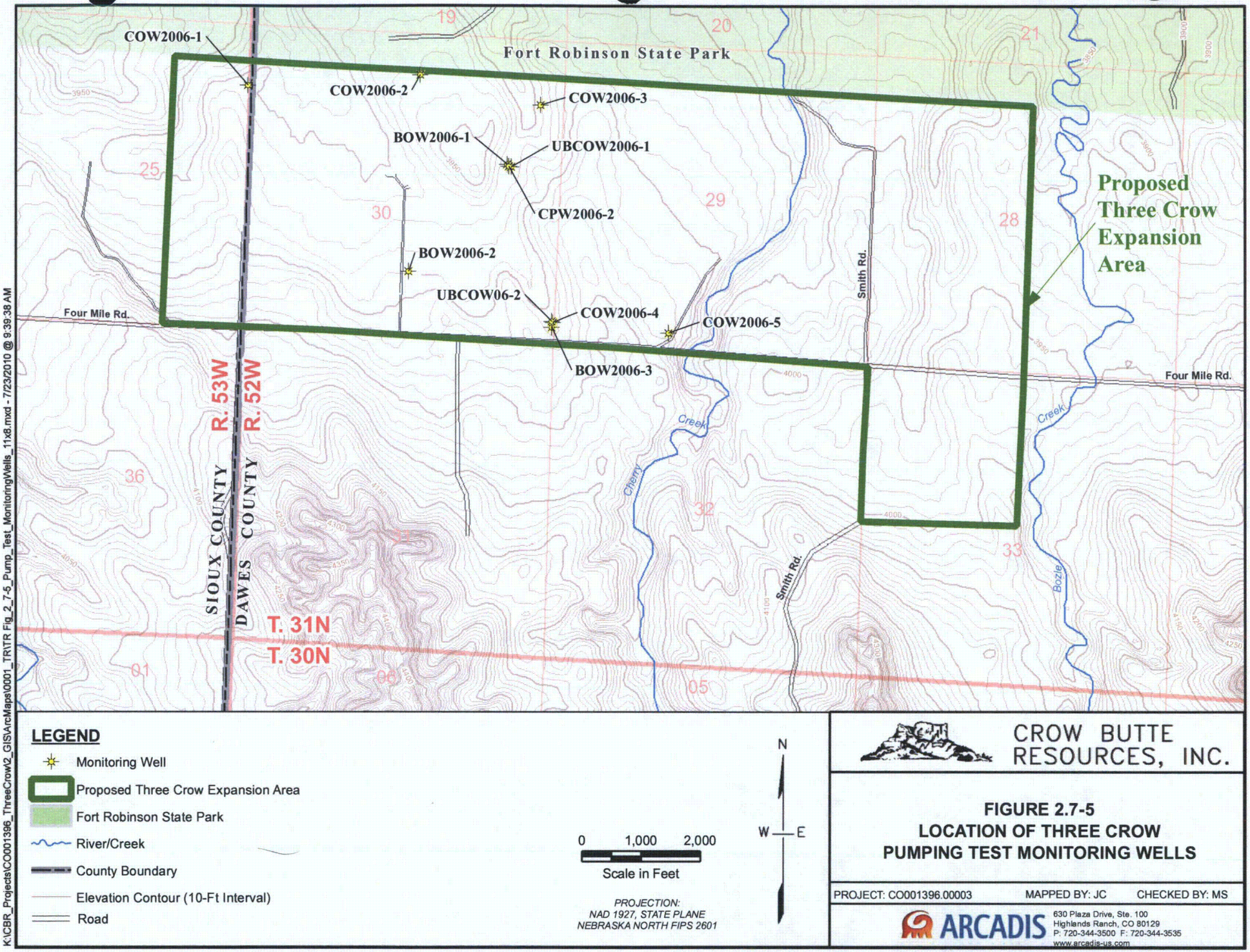
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustration\TR Fig_2_7-4 FEMA.ai @05/14/2010



LEGEND

- Monitoring Well
- Proposed Three Crow Expansion Area
- Fort Robinson State Park
- River/Creek
- County Boundary
- Elevation Contour (10-Ft Interval)
- Road

0 1,000 2,000

Scale in Feet

N

W — E

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

CROW BUTTE RESOURCES, INC.

FIGURE 2.7-5
LOCATION OF THREE CROW
PUMPING TEST MONITORING WELLS

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

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630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
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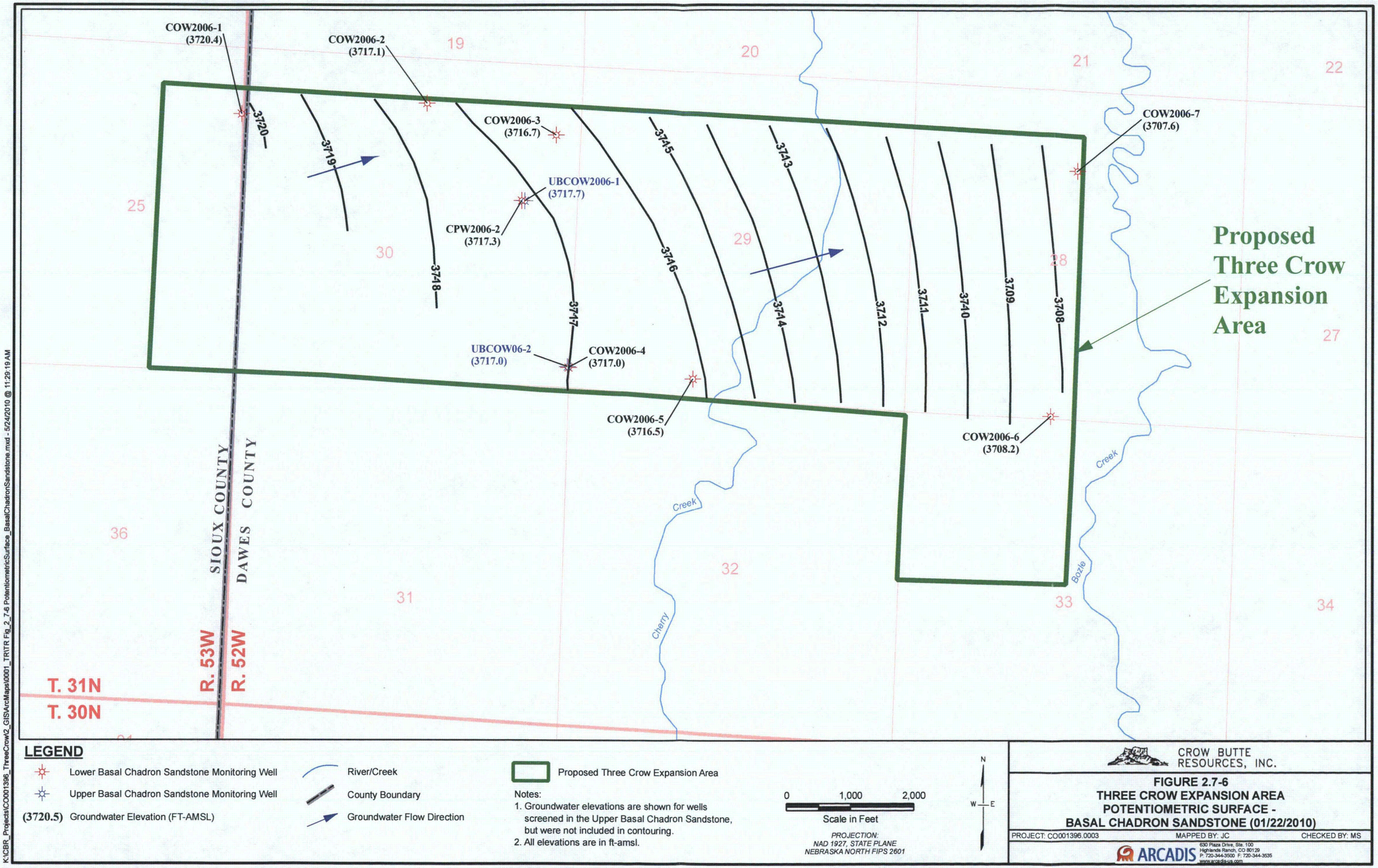

LEGEND

- Lower Basal Chadron Sandstone Monitoring Well
- Upper Basal Chadron Sandstone Monitoring Well
- (3720.5) Groundwater Elevation (FT-AMSL)
- River/Creek
- County Boundary
- Groundwater Flow Direction
- Proposed Three Crow Expansion Area

Notes:
1. Groundwater elevations are shown for wells screened in the Upper Basal Chadron Sandstone, but were not included in contouring.
2. All elevations are in ft-amsl.

0 1,000 2,000
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 2.7-6
THREE CROW EXPANSION AREA
POTENTIOMETRIC SURFACE -
BASAL CHADRON SANDSTONE (01/22/2010)

PROJECT: CO001396.0003 MAPPED BY: JC CHECKED BY: MS

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BOW2006-5
(3842.8)

BOW2006-1
(3863.8)

BOW2006-2
(3878.5)

BOW2006-3
(3877.2)

BOW2006-4
(3861.6)

BOW2006-6
(3904.4)

BOW2006-7
(3913.0)

Well 273 (Miller Well)
(3819.10)

3850
3860
3870
3880
3890
3900
3840
3830
3820
3910

Proposed Three Crow Expansion Area

R. 53W
R. 52W

SIOUX COUNTY
DAWES COUNTY

Cherry Creek
Bozle Creek

19 20 21 25 30 29 28 36 31 32 33

LEGEND

- Brule Formation Monitoring Well
- Groundwater Potentiometric Surface (FT-AMSL)
- (3879) Groundwater Elevation (FT-AMSL)
- Groundwater Flow Direction
- River/Creek
- Elevation Contour (10-Ft Interval)
- County Boundary
- Proposed Three Crow Expansion Area

Notes:
1. Water levels at all well locations were collected on 1/22/2010, with the exception of Well 273 (Miller Well), which was collected on 2/8/10
2. All Elevations are in ft-amsl.

0 750 1,500
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 2.7-7
THREE CROW EXPANSION AREA WATER LEVEL MAP - BRULE FORMATION (01/22/10 & 02/08/10)

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

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2.8 Ecological Resources

2.8.1 Introduction

This section describes the existing ecological resources within the TCEA. The potential impacts associated with the proposed project and mitigation measures that would serve to offset such impacts are discussed in Section 7. The analysis consisted of a review of documents, databases, and reports in conjunction with biological field surveys to determine the potential impacts, if any, to special-status plant and wildlife species and their habitats in the proposed expansion area. Agency coordination has consisted of telephone conversations and written correspondence between ARCADIS biologists and U.S. Fish and Wildlife Service (USFWS) and Nebraska Game and Parks Commission (NGPC) management and staff. The purpose of these consultations and associated correspondence was to help identify biological issues and potential occurrences and distribution of special-status plants and wildlife and their habitats.

2.8.2 Regional Setting

The project area occurs at the confluence of two Nebraska eco-regions, the Western High Plains and the Northwestern Great Plains. The Western High Plains eco-region is characterized by a semi-arid to arid climate, with annual precipitation ranging from 13 to 20 inches. Higher and drier than the Central Great Plains to the east, much of the Western High Plains comprises a smooth to slightly irregular plain having a high percentage of dry-land agriculture. Potential natural vegetation is dominated by drought tolerant short-grass prairie and large areas of mixed-grass prairie in the northwest portion of the state. The Northwestern Great Plains eco-region encompasses the Missouri Plateau section of the Great Plains. It is a semiarid rolling plain of shale, siltstone, and sandstone punctuated by occasional buttes. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of this eco-region. Agriculture exists on level to rolling hills and is generally limited by erratic precipitation patterns and limited opportunities for irrigation (Chapman et al. 2001).

The Chadron State College herbarium contains 468 species from Dawes County (Wyoming Fuel Company [WFC] 1983). In addition, the Institute of Agriculture and Natural Resources lists 603 native and 123 introduced species that occur in Dawes County. During the 1982 baseline study (WFC 1983), more than 400 species of plants were collected (**Appendix J-1**).

2.8.3 Local Setting - Three Crow Expansion Area

The proposed 1,643-acre Crow Butte TCEA is located in west-central Dawes County and a very small portion of adjacent Sioux County, Nebraska, just south-southwest of the town of Crawford. The proposed TCEA is located within Sections 28, 29, 30, and 33 of Township (T) 31 North (N), Range (R) 52 West (W), and Section 25 of T31N, R53W (**Figure 2.1-1**, **Figure 2.8-1**).

2.8.4 Climate

The climate of the region is characterized by wide seasonal and day-to-day variations in temperature and precipitation. Dawes County is usually warm in the summer, with frequent spells

of hot weather and occasional cool days interspersed throughout. These changes in weather can generate thunderstorms which deliver a majority of the total annual precipitation.

Climate data was collected at the Chadron National Weather Station (NWS) (Chadron 1 NW) (latitude 42° 50' north, longitude 103° 01' west with a ground elevation of 1021 m [3350 ft] above mean sea level). The NWS site is 1.4 km (0.9 miles) west northwest of Chadron, 37 km (23 miles) east northeast of Crawford, and 35 km (22 miles) east northeast of the proposed license area. The monthly climate summary for 08/01/1894 through 02/28/2009 is presented in **Table 2.8-1** (High Plains Regional Climate Center [HPRCC] 2010). A detailed discussion of more recent meteorological data (2000 – 2009) considered representative of the permit area can be found in Section 2.5.

2.8.5 Pre-existing Baseline Data

In 1982, an ecological baseline study (WFC 1983) was conducted for the Crow Butte Resources Crow Butte Uranium Project (Radioactive Source Materials License SUA-1534). The 1982 study focused on conducting intensive studies within the principal study area, which included both the commercial study area and the five-mile adjacent area, and less intensive studies within the 50-mile outer area. Additional baseline data were collected within these three areas in 1987, 1995, 1996, 1997, and 2004 (CBR 2007). In 2005 and 2008, field observations, agency contact, and literature searches were conducted to obtain new baseline data for the TCEA.

2.8.6 Terrestrial Ecology

The information presented in this section includes a summary of the findings of the ecological baseline studies for the Crow Butte project area and expansion areas in 1982, 1987, 1995, 1996, 1997, and 2004, and the field surveys conducted for the TCEA in 2005 and 2008.

2.8.6.1 Methods

A field reconnaissance of the TCEA was conducted on December 21, 2005. Through observation, principal floral and faunal species were identified, and the composition and distribution of each distinct vegetation association was described and mapped. Further, raptor nest surveys were conducted and past ecological data compilations were confirmed during a June 9 - 12, 2008 site visit.

2.8.6.2 Existing Disturbance

Since settlement in the late 1800s, past and current human activities in and surrounding the TCEA have caused substantial alteration of mixed-grass prairie grasslands, The primary sources of surface disturbance to natural vegetation communities have resulted from agriculture, intensive grazing, haying, sand and gravel mining, road and railroad construction, and rural and urban development.

2.8.6.3 Vegetation and Land Cover Types

The vegetation/habitat classification system detailed in "*Crow Butte Uranium Project Application and Supporting Environmental Report for NRC Research and Development Source Material License*" (WFC 1983) was combined with pedestrian surveys to identify and map vegetation community types within the TCEA. The community descriptions for the Crow Butte project area

(WFC 1983) are provided below, and supplemented with additional information that is specific to the TCEA.

Seven basic vegetation communities, which generally correlate with wildlife habitat types, were identified in the TCEA: riverine, deciduous streambank forest, mixed-grass prairie, range rehabilitation, cultivated land, and structure biotope. These broad categories often represent several combinations of species composition and relative abundance, as described below. The acres of occurrence and relative distribution of these habitat types within the TCEA are presented in **Table 2.8-2**. **Figure 2.8-1** shows the distribution of the six principal habitat types within the TCEA.

Riverine

Wetlands and their associated habitats are grouped into classifications, which provide several functions and values unique to each wetland complex. Wetlands perform many important hydrologic functions, such as floodwater storage, maintaining stream flows, slowing and storing floodwaters, stabilizing streambanks, nutrient removal and uptake, and groundwater recharge.

A number of wetland classification systems have been developed, but the Cowardin et al. (1979) classification method is the most widely recognized system, and thus was used for wetland classification within the project area. Riverine habitats are defined as non-tidal and tidal-freshwater wetlands within a channel. Vegetation, when present, is predominantly non-persistent emergent plants (non-persistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both. Riverine wetlands, defined by their close associations with perennial streams, occur along stream channels and are often associated with riparian areas. These areas are also supported by groundwater drainage associated with floodplains and by periodic flooding events. Riverine wetlands are divided into categories based on the nature of the adjacent stream (e.g., upper perennial or intermittent). Riverine wetlands can be further divided based on the dominant plant life form of the physiography and composition of the substrate (e.g., unconsolidated bottom, unconsolidated shore, or streambed) and the seasonal water regime (e.g., permanently flooded, semi-permanently flooded, seasonally flooded, or temporarily flooded) (Cowardin et al. 1979).

Riverine habitats in the TCEA only include an unnamed tributary of the White River located in the NE ¼ of Section 25 T31N R53W. The Cherry Creek drainage runs through an area of mixed grass prairie of Section 29 T31N R52W. However, this drainage lacks defined bed and banks and does not support riverine habitats. A portion of Bozle Creek streambed lies outside but in close proximity to the southeastern permit boundary (Section 33 T31N R52W) supports riverine habitats. . These drainages, with the exception of Cherry Creek, have been observed to periodically contain standing water.

Deciduous Streambank Forest

Deciduous streambank forest occupies streamside sites adjacent to the White River, Dead Man's Creek, Bozle Creek, and Cherry Creek (outside of permit boundary). Eastern cottonwood (*Populus deltoides*) is the most common dominant upper canopy species in this region, including the TCEA. Other species that may be present in the canopy include green ash (*Fraxinus pennslyanica*), boxelder (*Acer negundo*), American elm (*Ulmus americana*), peachleaf willow

(*Salix amygdaloides*), narrowleaf willow (*S. exigua*), shining willow (*S. lucida*), American plum (*Prunus americana*), and chokecherry (*P. virginiana*). Understory vegetation varies widely, depending primarily upon the amount of grazing pressure. One of the more common understory species in the TCEA is Tatarian honeysuckle (*Lonicera tatarica).* Deciduous streambank forest habitats in the TCEA occur in conjunction with the riverine habitats, the locations of which are described above (**Figure 2.8-1**).

Mixed-Grass Prairie

The mixed-grass prairie vegetation community is dominated by cool- and warm-season mid-grasses, short-grasses, and sedges. Typical grass species may include blue grama (*Bouteloua gracilis*), hairy grama (*B. hirusuta*), little bluestem (*Schizachyrium scoparium*), threadleaf sedge (*Carex filifolia*), green needlegrass (*Nassella viridula*), Indian grass (*Sorghastrum nutans*), needle and thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), sand dropseed (*Sporobolus cryptandrus*), and slender wheatgrass (*Elymus trachycaulus*). Characteristic forbs may include sand sagebrush (*Artemisia filifolia*), fringed sagebrush (*A. frigida*), Nuttall's violet (*Viola nuttallii*), prickly-pear cactus (*Opuntia* spp.), and yucca (*Yucca glauca*). The mixed-grass prairie habitat type is the second most common in the TCEA, typically occurring adjacent to the buttes and drainages (**Table 2.8-2**, **Figure 2.8-1**).

Range Rehabilitation

Range rehabilitation areas are previously cultivated fields that are subjected to intensive grazing and/or seasonal haying. Species common to this habitat type are smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), intermediate wheatgrass (*Thinopyrum intermedium*), tall wheatgrass (*Thinopyrum ponticum*), and crested wheatgrass (*Agropyron cristatum*). The quality and composition of the community type varies greatly, depending upon the interval between the intensity of grazing and haying. In addition, the aspect varies from pure to sparse grass stands, to annual weed complex or bare ground.

Species composition varies within the mixed-grass prairie and the range rehabilitation communities in the TCEA. The provided descriptions of these communities are more representative of areas that are located further from roads. Weed species are especially common in both of these community types where they occur adjacent to Four Mile Road (**Figure 2.8-1**). Weed presence is particularly high in the range rehabilitation community because of the greater level of disturbance from cattle. Common weed species in the area include Russian thistle (*Salsola iberica*), common mullein (*Verbascum thapsus*), wild oats (*Avena fatua*), prickly lettuce (*Lactuca serriloa*), witchgrass (*Panicum capillare*), and cheatgrass (*Bromus tectorum*). Other species that are indicative of disturbed areas and that are found within the range rehabilitation community in the TCEA include yucca (*Yucca glauca*) and prairie sandreed (*Calamovilfa longifolia*). The 1982 study (WFC 1983) estimated that 30 percent of species and more than 50 percent of plant cover throughout the Crow Butte project area consisted of exotic species.

Cultivated

This habitat type is comprised of cultivated fields. Primary crops in the region include wheat (*Triticum* spp.), oats (*Avena* spp.), barley, corn, rye, and alfalfa (*Medicago sativa*). Cultivated

land is the most common vegetation community in the TCEA (**Table 2.8-2**, **Figure 2.8-1**), with alfalfa and wheat being the most cultivated crop.

Structure Biotopes

Structure biotopes are defined as man-made features other than cultivation, including gravel pits, buildings and farmyards, parks, cemeteries, roads, and highways and associated rights-of-way. Also included in this category are reclaimed and un-reclaimed lands. Dominant plant species growing near these biotopes may include smooth brome, cheatgrass, white sweetclover (*Melilotus alba*), yellow sweetclover (*Melilotus officinalis*), and numerous mustard (Brassicaceae family) species. Structure biotopes in the TCEA are small farmsteads with buildings. According to the 1982 baseline study, more than 400 species of plants were collected from the Crow Butte project area (WFC 1983) (**Appendix J**).

2.8.7 Mammals

During the 1982 baseline study (WFC 1983), 36 species of wild mammals were documented, and another 28 species, mostly bats, insectivores, and small rodents, were deemed likely to occur in the region (**Appendix J-2**). A summary of these findings for the Crow Butte project area is provided below, and in some cases is supplemented with additional information that is specific to the TCEA.

2.8.7.1 Big Game

Big game species that are found in suitable habitats in or adjoining the project area include pronghorn (*Antilocapra americana*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and bighorn sheep (*Ovis canadensis*) (Nordeen 2008).

Pronghorn Antelope

Pronghorn typically inhabit grasslands and semi-desert shrublands of the western and southwestern United States. This species is most abundant in short- and mixed-grass habitats and is less abundant in more xeric habitats. Home ranges for pronghorn can vary between 400 acres and 5,600 acres, according to several factors including season, habitat quality, population characteristics, and local livestock occurrence. Typically, daily movement does not exceed 6 miles. Some pronghorn make seasonal migrations between summer and winter habitats, but these migrations are often triggered by availability of succulent plants and not local weather conditions (Fitzgerald et al. 1994).

Nebraska is on the eastern fringe of the pronghorn range, and there are large areas within the range boundary where pronghorns do not occur. The highest densities of pronghorn are in the northern and southern Panhandle, primarily located in the short-grass prairies and badlands.

The baseline study (WFC 1983) identified a "Fort Robinson" population that consisted of 12 animals that ranged in and out of the Fort Robinson State Park and northward to the outskirts of the town of Crawford, using the mixed-grass habitat type. The range of this population included the portion of the Park that is immediately adjacent to the northern boundary of the TCEA (**Figure 2.1-1**). During the 2005 field reconnaissance, a herd of pronghorn were observed in the

Park, just north of Section 28 and 29 T31N R52W. Further, individuals were spotted within road adjacent pastures of the TCEA during a site visit in 2008.

The TCEA is located primarily in the Box Butte Antelope Hunting Unit (NGPC 2010a) (**Figure 2.8-2**). Antelope harvest data for the North Sioux Unit in 2002 and 2003 are 206 and 136, respectively (NGPC 2006a). The overall population trend for the pronghorn inhabiting the region has seen an overall decline in herd numbers (Hams 2004). The presumed reasons for this declining trend are low breeding success and extreme drought that has limited forage availability (Hams 2004).

Mule Deer

Mule deer occur throughout western North America from central Mexico to northern Canada. Typical habitats include short-grass and mixed-grass prairies, sagebrush and other shrublands, coniferous forests, and forested and shrubby riparian areas. In Nebraska, mule deer occur in foothills, broken hill country, prairie grasslands, and shrublands. Browse is an important component of the mule deers diet throughout the year, making up as much as 60 percent of total intake during autumn, while forbs and grasses typically make up the rest of their diet (Fitzgerald et al. 1994). This species tends to be more migratory than white-tailed deer, traveling from higher elevations in the summer to winter ranges that provide more food and cover. Fawn mortality is typically due to predation or starvation. Adult mortality often occurs from hunting, winter starvation, and automobile collisions. Typical predators may include coyotes, bobcats, golden eagles, mountain lions, bears, and domestic dogs (Fitzgerald et al. 1994).

Mule deer are distributed primarily along the foothills and escarpments, ranging outward into mixed-grass prairie and cultivated land, and occasionally along watercourses. In the mule deer distribution mapping for the Crow Butte project area, a portion of the TCEA was classified as primary mule deer range. This included the forested buttes in Sections 32, 33, and 34 of T31N R52W, and the surrounding mixed-grass prairie and cultivated habitats (WFC 1983). While Section 31 was not included in the Crow Butte project area, the buttes and surrounding area in this section are also considered primary mule deer range (**Figure 2.8-1**).

The TCEA is located in the Pine Ridge Deer Hunting Unit (NGPC 2010b) (**Figure 2.8-3**). Due to concerns with harvest of buck deer, the NGPC conducted a study (based on aged sample projected by total kill) of adult bucks 2½ years or older during the 1987, 1992, and 1997 regular firearm hunting seasons. Adult mule deer buck harvest in the Pine Ridge unit for 1987, 1992, and 1997 was 202, 446, and 385, respectively (NGPC 2006b). In 2008, the adult mule deer buck harvest for the Pine Ridge unit was 999 (NGPC 2010b). According to Hams (2004), the mule deer population in the Nebraska panhandle is stable to increasing.

White-tailed Deer

White-tailed deer occur throughout North America from the southern United States to Hudson Bay in Canada. Across much of its range, this species inhabits forests, swamps, brushy areas, and nearby open fields. In Nebraska, white-tailed deer are found throughout the state, typically concentrated in riparian woodlands, mixed shrubs riparian and associated irrigated agricultural lands, and are generally absent from dry grasslands and coniferous forests (Clark and Stromberg 1987). Their diet is diverse, capitalizing on the most nutritious plant matter available at any time.

In addition to native browse, grass, and forbs, this species would rely on agricultural crops, fruits, acorns, and other nuts. Mortality of white-tailed deer is typically related to hunting, winter starvation, collisions with automobiles, and predation. Predators may include coyotes, mountain lions, wolves, and, occasionally bears, bobcats, and eagles (Fitzgerald et al. 1994).

In the current Crow Butte project area and TCEA, white-tailed deer are more widely distributed than mule deer. Because of the high amount of cultivated land, white-tailed deer distributions may be primarily associated with riparian habitats along the White River and associated intermittent and ephemeral stream drainages. In addition, due to the overlap of the mule deer range in this part of the state, white-tailed deer may be absent from large expanses of mixed-grass prairie and shrubland habitats. Individuals were spotted within agricultural habitats throughout the expansion site during the June 2008 field surveys. In the white-tailed deer distribution mapping for the current Crow Butte project area, a portion of the TCEA was classified as primary white-tailed deer range. This included all or portions of Sections 28 and 33 T31N R52W (WFC 1983). Whitetails are the predominant deer species in eastern Nebraska, but over the past few years they have continued to extend their range, moving westward along rivers and streams.

Results of the white-tailed deer buck harvest for the Pine Ridge area were 186, 318, and 363 in 1987, 1992, and 1997, respectively (NGPC 2006b). In addition, results of the overall deer (including both white-tailed and mule deer) harvest for the Pine Ridge unit in 2002 and 2003 season was 1,732 of 2,970 tags issued, and 1,724 of 3,186 tags issued, respectively (NGPC 2006b). In 2008, the white tail adult buck harvest for the Pine Ridge unit was 1,135 (NGPC 2010b). According to the NGPC (2010b), the State deer population (including white-tailed and mule deer) is estimated to be between 300,000 and 350,000 animals.

Elk

Elk formerly ranged over much of central and western North America from the southern Canadian Provinces and Alaska south to the southern United States, and eastward into the deciduous forests. In Nebraska, this species occurs primarily in the northwestern region in a variety of habitats, including coniferous forests, meadows, short- and mixed-grass prairies, and sagebrush and other shrub lands. Similar to other members of the deer family, this species relies on a combination of browse, grasses, and forbs, depending on their availability throughout the seasons. Elk tend to be migratory, moving between summer and winter ranges. Typically, mortality is a result of predation on calves, hunting, and winter starvation. Predators may include coyotes, mountain lions, bobcats, bears, and golden eagles.

There are an estimated 1,400 elk in the State of Nebraska, with most of the range concentrated in the Pine Ridge area (NGPD 2010c). The TCEA is located in the Pine Ridge area, within the Hat Creek elk hunting unit (NGPC 2010c) (**Figure 2.8-4**). Occasionally, elk may occur within the project area as transients primarily during the period between the summer and winter range movements (Nordeen 2004).

Elk are occasionally observed in the southeastern corner of the TCEA area in the Dead Man's Creek area. This same area in the Dead Man's Creek drainage also exemplifies prime mule deer habitat (Noordeen 2008).

Bighorn Sheep

Prior to the 1900s, the Audubon bighorn sheep inhabited parts of western Nebraska including the Wildcat Hills, the Pine Ridge, along the North Platte River to eastern Lincoln County, and along the Niobrara River. It is thought that the Audubon bighorn probably became extinct in the early 1900s with its last stronghold being the South Dakota badlands (NGPC 2006d).

In 1981, the NGPC began a bighorn sheep introduction project in the Pine Ridge area. A dozen bighorns were released into a 500-acre enclosure at Fort Robinson State Park near Crawford (NGPC 2010d; WFC 1983). In December 1988, 21 sheep were released from the pen and in January 1993, the remaining 23 sheep were released. A few bighorn sheep are known to have ranged from the Fort Robinson area as far east as the Bordeaux Creek drainage southeast of Chadron, south near Belmont, west near the Gilbert-Baker Wildlife Management Area, and north into the Oglala grasslands (NGPC 2006d). In January 2005, 49 sheep from Montana were released in the Pine Ridge east of Crawford on Bighorn Wildlife Management Unit NGPC 2010d). According to March 2008 surveys conducted by NGPC, there are an estimated 140 bighorn sheep in the Pine Ridge escarpments with approximately 60 adult bighorn sheep and their current year offspring in or near the project area. The TCEA falls within the State NGPC Bighorn Sheep Hunting Unit (NGPC 2010d).

Bison

About 200 bison are impounded at the Fort Robinson State Park. The bison winter compound is located in an area that is immediately adjacent to the northern boundary of the TCEA (WFC 1983); however, they do not graze within the proposed project boundary.

2.8.7.2 Carnivores

The coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and long-tailed weasel (*Mustela frenata*) are distributed in low numbers throughout the Crow Butte project area. Coyotes occur most commonly in the grasslands, whereas red foxes occur primarily in cultivated habitat. Weasels occur in a variety of habitats in the project area (WFC 1983). The bobcat (*Lynx rufus*), badger (*Taxidea taxus*), mountain lion (*Puma concolor*), and striped skunk (*Mephitis mephitis*) may also occur in the Crow Butte project area, but less commonly. Bobcats most often occur in deciduous and coniferous woodland types, whereas badgers have been recorded in habitats near creeks. Striped skunks are seen most often in roadside situations (WFC 1983). Mountain lions occur in a variety of habitats, but prefer rougher, wooded areas (NGPC 2006e). Tracks of a single mink were observed along the White River within Fort Robinson State Park (WFC 1983). Based on the habitat descriptions and occurrence records, all of these species have the potential to occur in the TCEA, with the coyote, red fox, and long-tailed weasel having the greatest probability.

2.8.7.3 Small Mammals

The deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), meadow jumping mouse (*Zapus hudsonius*), northern pocket gopher (*Thomomys talpoides*), and meadow vole (*Microtus pennsylvanicus*) occur in the highest abundances in the Crow Butte project area. The highest densities of these small mammals occur in the deciduous forest areas, whereas the lowest densities occur in the cultivated fields. The greatest diversity of small mammals was detected in

the mixed- and short-grass community, and the lowest diversity was observed in the non-wooded riparian and lower deciduous forest areas (WFC 1983). Muskrat (*Ondatra zibethicus*) occur along watercourses, and beaver (*Castor canadensis*) occur in the White River Basin. Porcupine (*Erethizon dorsatum*), fox squirrel (Sciurus niger), white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), and eastern cottontail (*Sylvilagus floridanus*) are also expected to occur throughout the Crow Butte project area (WFC 1983). During the baseline study (WFC 1983), a small black-tailed prairie dog (*Cynomys ludovicianus*) colony was identified just north of Section 27 T31N R52W (**Figure 2.1-1**). Based on the habitat descriptions and occurrence records, all of these species have the potential to occur in the TCEA.

2.8.8 Birds

The Nebraska Ornithologists' Union (NOU) lists 447 birds (including two extinct species, passenger pigeon (*Ectopistes migratorius*) and Carolina parakeet (*Conuropsis carolinensis*)) occurring in Nebraska (NOU 2003). Johnsgard (1979) lists 430 species, including 54 apparently "accidental" (vagrant) species, and nine extinct, extirpated, or probably extirpated species. In addition, Johnsgard (1979) lists 27 "hypothetical" species, and four unsuccessfully introduced species. During the 1982 baseline study (WFC 1983), 201 species were documented in the Crow Butte project area (**Appendix J-3**).

Of the NOU 447 birds sighted in Nebraska, approximately 200 species breed in the State. The largest single component is arboreal, adapted to living in trees, woodlands, and forests, and make up approximately 45 percent of the State's total species. Aquatic and shoreline adapted species make up the second largest component, or 32 percent of the state's total avifauna (Johnsgard 1979). Species primarily associated with grasslands comprise a still smaller breeding component, or approximately 10 percent of the state's total avifauna. Bird species associated with semi-desert scrub are the least numerous.

2.8.8.1 Passerines

Passerines are anticipated to occur commonly within the cultivated fields in the Crow Butte project area, including the TCEA and include the American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), mourning dove (*Zenaida macroura*), house wren (*Troglodytes aedon*), violet-green swallow, (*Tachycineta thalassina*) and horned lark (*Eremophila alpestris*). Birds likely to be associated with the riparian and woodland habitats include pine siskin (*Carduelis pinus*), red crossbill (*Loxia curvirostra*), black-capped chickadee (*Poecile atricapillus*), rufous-sided towhee (*Pipilo erythrophthalmus*), yellow warbler (*Dendroica petechia*), and house wren (*Troglodytes aedon*).

2.8.8.2 Upland Game Birds

The range of wild turkeys now includes most major river drainages in the State and the Pine Ridge area (NGPC 2006f). Populations of turkeys in the Pine Ridge and Niobrara River valley are primarily Merriam's turkey (*Meleagris gallopavo*). The turkey is widely distributed in the Crow Butte project area, primarily along the foothills and plateaus, within ponderosa pine habitat, and along drainages (WFC 1983). During the baseline study (WFC 1983), most were observed in structure biotopes, but deciduous woodlands and coniferous woodlands were also common sites. A small proportion of these birds were found in cultivated, mixed-grass prairies, and range rehabilitation types. In proximity to the TCEA, fair numbers of turkeys may exist within the

White River basin. In addition, small, isolated populations may be found in suitable habitats outside of the White River basin.

Ring-necked pheasants (*Phasianus colchicus*) range from fairly abundant to common throughout the Crow Butte project area, with preferred habitats occurring in shelterbelts, drainages, and edges of cultivated fields. However, regional pheasant populations are subject to extreme fluctuation due primarily to the availability of suitable cover and the severity of winter weather. One pheasant was seen along Four Mile Road in the TCEA during the 2005 field reconnaissance.

Sharp-tailed grouse (Tympanuchus phasianellus) are most commonly found in short- and mixed-prairie grassland areas interspersed with serviceberry (*Amelanchier* spp.), chokecherry, and snowberry (*Symphoricarpos albus*). Shrubs and small trees play an important role in sharp-tailed grouse ecology, especially in winter when they provide both food and cover. Weed-grass types and cultivated crops (wheat and alfalfa) may be used in spring and summer. Sharp-tailed grouse may use agricultural fields by feeding on waste grain and associated insects. Sharptails are expected to occur in the mixed-grass prairie habitat in the TCEA.

2.8.8.3 Raptors

Several raptor species can occur in the Crow Butte project area, a reflection of the mixed grass and woodland habitat types and the existence of suitable nesting sites, such as tall, strong branched trees. Golden eagles (*Aquila chrysaetos)* are permanent residents of the Crow Butte area, occurring in a variety of habitats, but most often perched on cliffs and escarpments (WFC 1983). Other permanent resident raptors occurring in the cultivated fields and mixed-grass prairies of the Crow Butte project area, including the TCEA, are the red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), turkey vulture (*Cathartes aura*), and great horned owl (*Bubo virginianus*). In addition, rough-legged hawks (*Buteo lagopus*) are common winter residents of the Pine Ridge area (WFC 1983).

Within the TCEA itself, few raptors and no nests were observed during the 2008 field surveys. It should be noted that there are a few clusters of Eastern cottonwoods dispersed throughout the area that could support raptors and their nests, mostly situated near structure biotopes. More suitable habitat exists outside of the project area in riverine habitat along White River, Dead Man's Creek, Cherry Creek, and Bozle Creek. Further, there are portions of suitable nesting habitat within the ponderosa pine forests, south of the project area boundary (**Figure 2.1-1**). During the summer of 2008, pedestrian raptor nest surveys were conducted in suitable nesting habitat (i.e. forested habitat) within the project area and a 2.25 mile buffer of the project area. Great Horned Owl fledglings (8-10 weeks) were spotted in a prior year's raptor nest outside the project area alongside Dead Man's Creek, and a Red-Tail Hawk's nest was observed outside the project area alongside Cherry Creek. No nests or sign thereof were found within the project area.

2.8.8.4 Waterfowl

Waterfowl may occur throughout the region, primarily during the spring and fall migrations. However, due to the lack of wetlands and their associated habitats, the diversity and abundance of waterfowl is extremely low in the Crow Butte project area. Outside of the reaches of open water associated with the White River impoundments, wetland habitats are absent from the project area.

During the 1982 baseline surveys, 24 species of waterfowl were observed, with the mallard duck (*Anas platyrhnchos*) being the most commonly observed species (WFC 1983).

2.8.9 Reptiles and Amphibians

Of the 22 species of reptiles and amphibians recorded in Dawes and Sioux Counties (Ferraro 2004) (**Appendix J-4**), 13 were documented during the 1982 baseline investigation (WFC 1983). Documented toads and frogs included Woodhouse's toad (*Bufo woodhousii*), Great Plains toad (*Bufo cognatus*), plains spadefoot (*Spea bombifrons*), western striped chorus frog (*Pseudacris triseriata*), northern leopard frog (*Rana pipiens*), and bullfrog (*Rana catesbeiana*). The snapping turtle (*Chelydra serpentina*) and painted turtle (*Chrysemys picta*) were also observed. Snakes identified included the bullsnake (*Pituophis catenifer*), plains garter snake (*Thamnophis radix*), red-sided garter snake (*Thamnophis sirtalis*), and racer (*Coluber constrictor*). During the 2008 field observations, bullsnakes were the most commonly noticed reptile.

2.8.10 Threatened, Endangered, or Candidate Species

Several species that could potentially occur within the project area are considered "threatened or endangered" because of their recognized rarity or vulnerability to various causes of habitat loss or population decline. These designated species receive specific protection defined in the federal Endangered Species Act of 1973, as amended, and the Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. §37-430 et seq.). Other species have been designated as "candidate or sensitive" on the basis of adopted policies and expertise of state resource agencies or organizations with acknowledged expertise. A list of potentially occurring special-status species, along with specific occurrence records, was developed from an original list of target species based on records of the NGPC and the USFWS. **Table 2.8-3** summarizes the known or potential occurrence of each species within the TCEA. **Appendix J-7** provides distribution maps of these species.

2.8.10.1 Black-footed Ferret

The black-footed ferret (*Mustela nigripes*) is listed as endangered by the USFWS and NGPC, and has the potential to occur in Dawes County (**Appendix J-7**) (AGC Nebraska Chapter 2007, USFWS 2006). However, no recent confirmed populations of the black-footed ferret have been observed in the state of Nebraska. The last known specimen was an individual killed on a road near Overton in Dawson County in 1949, and no wild ferrets have been verified in Nebraska since the 1940s (NGPC 2008b). Based on this information, it can be presumed that the black-footed ferret is not expected to occur in the project area, and are not discussed further.

2.8.10.2 Black-tailed Prairie Dog

The black-tailed prairie dog (*Cynomy ludovicianus*) is one of five species of prairie dogs found in North America. It is an abundant and widely distributed species and is the only prairie dog found in Nebraska. In Nebraska, prairie dogs are found roughly in the western two-thirds of the state. It is considered a candidate for endangered status because it is a major food source for the Black-footed Ferret. When poison or other methods are used for control of this species, it also affects it natural predator, the endangered Black-footed Ferret (AGC Nebraska Chapter 2007). The USFWS announced on May 17, 2009 that it had denied a petition to reclassify three black-footed

ferret reintroduced populations in Arizona, Wyoming and South Dakota under the Endangered Species Act (USFWS 2009).

These prairie dogs inhabit areas of short and mid-grass rangeland and live in colonies or "towns" that range in size from as small as one acre to several thousand acres. It is estimated that in the late 1800s, some 700 million acres of North American rangeland were inhabited by prairie dogs. Habitat changes and extensive eradication efforts have reduced the acreage by about 90 to 95 percent from historic levels (NGPC 2008c).

There is a low to moderate density of colony potential for this prairie dog within the TCEA (**Appendix J-7**) (AGC Nebraska Chapter 2007). The cattle grazed and short grass areas coincide with the mammal's preferential habitat. Recent year's numbers in Nebraska indicate healthy and increasing populations where the mammal is not controlled (NGPC 2008c). However due to the agricultural presence, it is likely that these small mammals have been a target of grazing competition.

2.8.10.3 Eskimo Curlew

The Eskimo Curlew (*Numenius borealis*) is a relatively short, slender curlew with a slightly down curved bill. The bird's northward migrations route encompasses the eastern portion of Nebraska, but it has been reported that the curlew has migrated through the all regions of the state during the months of Marsh, April, May and June. Newly plowed fields, burned prairies and marshes are particularly attractive to migrating curlews. It feeds in the plowed fields by 8 or 9 am, and can be observed consuming grasshopper egg pods, earthworms and locusts.

In the project area, there is potential feeding habitat for the bird, but there have not been possible or confirmed sightings within the area (AGC Nebraska Chapter 2007). It is unlikely that the bird uses the area for anything but stopover habitat during migration.

The Eskimo Curlew is listed as endangered by both the Nebraska Game and Parks Commission and the U.S. Fish and Wildlife Service.

2.8.10.4 Mountain Plover

The Mountain Plover (*Charadrius montanus*) is generally considered an inhabitant of the arid short grass prairie, which is dominated by blue grama, buffalo grass and is scattered with clumps of cacti and forbs. They are very selective in choosing nest sites, preferring expansive, arid flats with very short grass and lots of bare ground, and they often nest near prairie dog communities. They primarily feed on insects, especially spiders, beetles, grasshoppers, crickets and ants. It can thrive without drinking free-standing water because sufficient water is obtained from its food (AGC Nebraska Chapter 2007).

The bird is currently being considered for listing its federal status, and it is listed as threatened in the state of Nebraska. NPGC (2008d) describes that current distribution maps are misleading, showing plovers occurring over a large range. In reality, habitat within this range is limited. Breeding strongholds are confined to small areas of native prairies in Montana and Colorado. Most of the birds winter in California, principally in the San Joaquin Valley, an area experiencing high rates of human population growth. Today the mountain plover is considered endangered in Canada, a species of special interest or concern in Montana and Oklahoma, extirpated in North

Dakota and South Dakota, on the watch list in Kansas and threatened in Nebraska. Beyond the Endangered Species Act, the Migratory Bird Treaty Act protects the mountain plover from unauthorized destruction of birds, nests and eggs. Nebraska law provides additional protection by requiring state agencies to ensure that their actions, or actions authorized or funded by them, do not jeopardize the mountain plover (NPGC 2008d).

There is potential habitat for the plover in southern Dawes and Sioux counties, and there been recent scattered observations in the neighboring Box Butte County (NPGC 2008d). It is possible that they may occur in isolated instances in the project area, but because prairie dogs are likely controlled in the area, strong plover nesting habitats are probably limited.

2.8.10.5 Swift Fox

The swift fox (*Vulpes velox*) was petitioned for listing under the Endangered Species Act in 1992. The 90-day finding from U.S. Fish and Wildlife Service concluded that a species listing may be warranted range-wide. However, the 12- month finding issued in 1995 by the U.S. Fish and Wildlife Service resulted in a "warranted, but precluded decision," concluding that the magnitude of threats to the species is low to moderate although the immediacy of threats remains imminent. Within Nebraska, the swift fox is listed as endangered under the Nongame and Endangered Species Conservation Act.

The swift fox is found in short- and mid-grass prairie habitats. It appears to prefer flat to gently rolling terrain. Swift fox feed primarily on lagomorphs, but arthropods and birds are also included in their diets. They mate between late December and February. A mating pair can bear two to five pups late March to early May, and pups emerge from the den in June. Dens are generally located along slopes or ridges that offer good views of the surrounding area (Fitzgerald et al. 1994). In a study completed in southeastern Colorado, the home range size of an adult swift fox was approximately 9.4 square kilometers at night, and their day ranges are typically much smaller (Schauster et al. 2002).

The swift fox is found in native shortgrass in northwestern Nebraska. Unlike coyotes or red fox, the swift fox uses dens in the ground the entire year. Some characteristics of swift fox dens differentiate them from other dens. Swift fox den entrances measure about 8 inches in diameter, similar to the size of a badger den. However, swift fox usually have more than one entrance, whereas badgers and most other animals have only one. Swift fox tend to spread excavated soil over a larger area than most other animals, resulting in a less prominent mound near the burrow's entrance. Dens are located on relatively flat ground away from human activity. Where coyotes are abundant, predation by coyotes is a significant source of mortality for swift fox and den availability is an important aspect of swift fox survival (Schauster et al. 2002).

Numerous natural and anthropocentric factors influence swift fox populations. Natural factors include fluctuating prey availability, interspecific competition, disease, and landscape physiography. Anthropogenic factors include habitat loss from agricultural, industrial, and urban conversion; competing land uses on remaining habitat including hydrocarbon production, military training, and grazing; and pesticide use. Of these, prey availability and habitat loss appear to have the most profound effects on swift fox populations.

Sightings of swift fox have been documented in northwestern Nebraska since the late 1970's (Godberson 2004). Most of these sightings have occurred in and around Oglala National Grasslands, primarily in large tracts of native prairie. Swift fox's have the potential to occur in the project area using rolling uplands between drainages and mixed-grass prairie habitats (**Appendix J-7**). Though, this species is sensitive to disturbance and may avoid otherwise suitable habitat in the vicinity of human disturbance.

2.8.10.6 Whooping Crane

The whooping crane (*Grus americana*) is listed as endangered by the USFWS and NGPC, with the potential to occur in Dawes County (**Appendix J-7**) (NGPC 2008b, USFWS 2006). The whooping crane is an occasional spring and fall migrant along the Platte Valley in Nebraska, which accounts for approximately 90 percent of the observations in Nebraska. The Platte Valley is located in central Nebraska, a considerable distance from the project area. Additionally, suitable habitat is lacking within the project area (e.g., rivers and streams with associated sandbars and islands, marshlands, wet meadows and croplands). The whooping crane is not expected to occur in the project area, and will not be discussed further.

2.8.10.7 Aquatic Resources

The Crow Butte project area is primarily contained within the White River basin. The White River originates on the Pine Ridge Escarpment in northwestern Nebraska. The river flows is a northeasterly direction into South Dakota, passing through boundaries of the Pine Ridge and Rosebud Sioux Indian reservations, then turns east and empties into the Missouri River near Chamberlain, South Dakota. The entire drainage basin is approximately 10,200 square miles, with 313 square miles in Dawes County, Nebraska. The White River is characterized as a larger basin with flat stream slopes that typically has high flows characterized by rapidly rising flows and gradually receding flows. The White River is primarily regulated by periods of snowmelt, direct precipitation, surface runoff, and ground water discharge from seeps and springs.

Drainages in the TCEA include: an unnamed tributary of the White River, and Cherry Creek. As of December 21, 2005, surface water was only present at the White River in Section 25 T31N R53W (**Figure 2.8-1**). Outside of these areas, the drainages within the TCEA showed no signs of water flow, lacking a defined bed and bank.

White River depth typically ranges from 0.5 to 2 meters, and width varies from about 3 to 5 meters. Cover for fish is provided by deep water, log jams, and undercut tree roots. Some riparian areas exist along the river, especially around Fort Robinson State Park. There is also limited riparian habitat in portions of the TCEA.

Within the TCEA, Cherry Creek consistently lacks a defined bed and bank. The vegetation is primarily mixed-grass prairie. Further south in central Section 5 T30N R52W, outside of the TCEA, there is evidence of occasional high water flow along this portion of Cherry Creek. A defined bed and bank is present, however, no wetland vegetation is present. As of June 12, 2008, this area was noted as dry.

In general, the aquatic habitats within the Crow Butte project area suffer from ongoing environmental stresses. Natural occurring stresses include unstable substrates and banks, low flows, and periodic high volume surface flows. Overgrazing on adjacent rangelands and riparian

areas combined with farming practices along the stream courses further compound these problems. Livestock grazing and watering add to impoverished stream conditions. These stresses are reflected in a fishery mostly consisting of non-game, tolerant species. Periodic stocking by the NGPC has created some put-and-take sport fisheries in the area, but these are not self-sustaining due to environmental factors (WFC 1983).

2.8.11 Aquatic Ecology

Aquatic ecology baseline data collections were conducted in 1982 (WFC 1983) and 1996 (Ferret Exploration of Nebraska 1987) to assess aquatic resources in the Crow Butte project area.

2.8.11.1 Fish

During the 1982 and 1996 baseline collections, fish were collected in various streams, including the White River, to document their occurrence. Fifteen species of fish were collected during these collection periods (**Appendix J-5**). Game fish collected in the White River included rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and white sucker (*Catostomus commersoni*). Minnow species collected in the White River included longnose dace (*Rhinichthys cataractae*), common shiner (*Luxilus cornutus*), fathead minnow (*Pimephales promelas*), and creek chub (*Semotilus atromaculatus*).

A regionally important put-and-take fishery exists in the White River within and around Fort Robinson State Park. However, fluctuating flows, periodic flooding, sand and silt substrates, and warm water temperatures are probably the most important factors limiting natural trout production in the White River, especially in areas of intensive agricultural and grazing (WFC 1983).

2.8.11.2 Macroinvertebrates

Macroinvertebrate density, diversity, and number of taxa for various streams, including the White River, were sampled in 1982 (WFC 1983) and 1996 (Ferret Exploration of Nebraska 1987) (**Appendix J-6**). Analyses of the samples indicated that, in general, most aquatic streams in the Crow Butte project area have stressed environments. More than 90 percent of the total abundance of all sampled areas consisted of organisms that are considered tolerant. The most abundant groups of these tolerant species were: chironomidae (34 percent); simulidae (20 percent); oligochaeta (19 percent); and ceratopogonidae (15 percent). Exceptions occurred within the upper White River, where caddisflies and mayflies dominated the riffle habitat. These two taxa typically represent less-stressed environments than the above listed organisms.

Although densities of macroinvertebrates were high at most sampling stations, diversity values were low. Healthy streams usually have diversity values between 3.0 and 4.0, but many forms of stress reduce diversity by making the environment unsuitable for some species or by giving other species a competitive advantage. The White River did not have diversity values within this range, indicating relatively lower water quality and degraded stream habitats (WFC 1983).

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Table 2.8-1 Monthly Climate Summary for Chadron 1 NW, Nebraska (251575)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec	Annual
Average Maximum Temperature (°F)	35.8	40.4	48.2	59.2	69.4	80.5	89.5	88.1	77.6	64.6	48.2	38.6	61.7
Average Minimum Temperature (°F)	11.7	15.8	23.0	33.2	43.6	53.1	60.1	58.0	47.2	35.4	23.4	14.8	34.9
Average Total Precipitation (Inches)	0.49	0.49	0.94	1.93	2.89	2.81	2.09	1.38	1.40	1.03	0.56	0.46	16.48
Average Total Snowfall (Inches)	6.6	6.4	8.9	6.0	0.8	0.0	0.0	0.0	0.3	2.3	5.6	6.7	43.6
Average Snow Depth (Inches)	2	2	1	0	0	0	0	0	0	0	1	1	1

Source: HPRCC 2010. Period of Record: 8/ 1/1894 to 2/28/2009

Table 2.8-2 Three Crow Vegetation and Land Cover Types

Habitat	Acres	Percent
Riverine	0.26	<1.0
Deciduous Streambank Forest	7.14	<1.0
Mixed-grass Prairie	578.8	35.0
Range Rehabilitation	87.7	5.0
Cultivated	945.9	58.0
Structure Biotope	23.8	2.0
Total	**1643**	**100.0**

Table 2.8-3 Federal and State Threatened, Endangered, and Candidate Species with the Potential to Occur Within the Vicinity of the Three Crow Expansion Area*

Species	Listing Status		Habitat	Critical Habitat
	Federal	State		
Black-footed Ferret (*Mustela nigripes*)	Endangered	Endangered	Closely associated with prairie dogs found in short and mid-grass prairies	None designated
Black-Tailed Prairie Dog (*Cynomys ludovicianus)*	Not Listed	Candidate for endangered status	Short and mid-grass rangeland overgrazed by livestock	None designated
Eskimo Curlew (*Numenius borealis*)	Endangered	Endangered	Migrates through NE, with newly plowed fields, burned prairies and marshes being particularly attractive to the migrating bird	None designated
Mountain Plover *(Charadrius montanus)*	Not Listed	Threatened	Arid short grass prairie, dominated by blue grama, buffalo grass that is scattered with cacti and forbs	None designated
Swift Fox (*Vulpes velox*)	Not Listed	Endangered	Large tracts of short- and mid-grass prairie habitats.	None designated
Whooping Crane (*Grus americana)*	Endangered	Endangered	Wet meadows, croplands, and marshlands	None designated

**AGC Nebraska Chapter 2007; NGPC 2008a and 2008b*

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T31N R53W
S25

T31N R52W
S30

T31N R52W
S29

T31N R52W
S28

Smith Road

Four Mile Road

T31N R53W
S36

SIOUX COUNTY

DAWES COUNTY

T31N R52W
S31

Proposed
Three Crow
Expansion
Area

Cherry Creek

T31N R52W
S32

T31N R52W
S33

Bozle Creek

LEGEND

- Drainage
- Road
- ProposedThree Crow Expansion Area

Habitat Type

- Riverine
- Deciduous Streambank Forest
- Mixed Grass Prairie
- Range Rehabilitation
- Cultivated
- Structure Biotope

0 500 1,000
Scale in Feet

N
W E

PROJECTION:
NAD_1927_STATEPLANE_NEBRASKA_NORTH_FIPS_2601
SOURCE:
AERIAL - NAIP 2006, SIOUX COUNTY & DAWES COUNTY, NEBRASKA;
HABITAT - ARCADIS FIELD SURVEY 2006

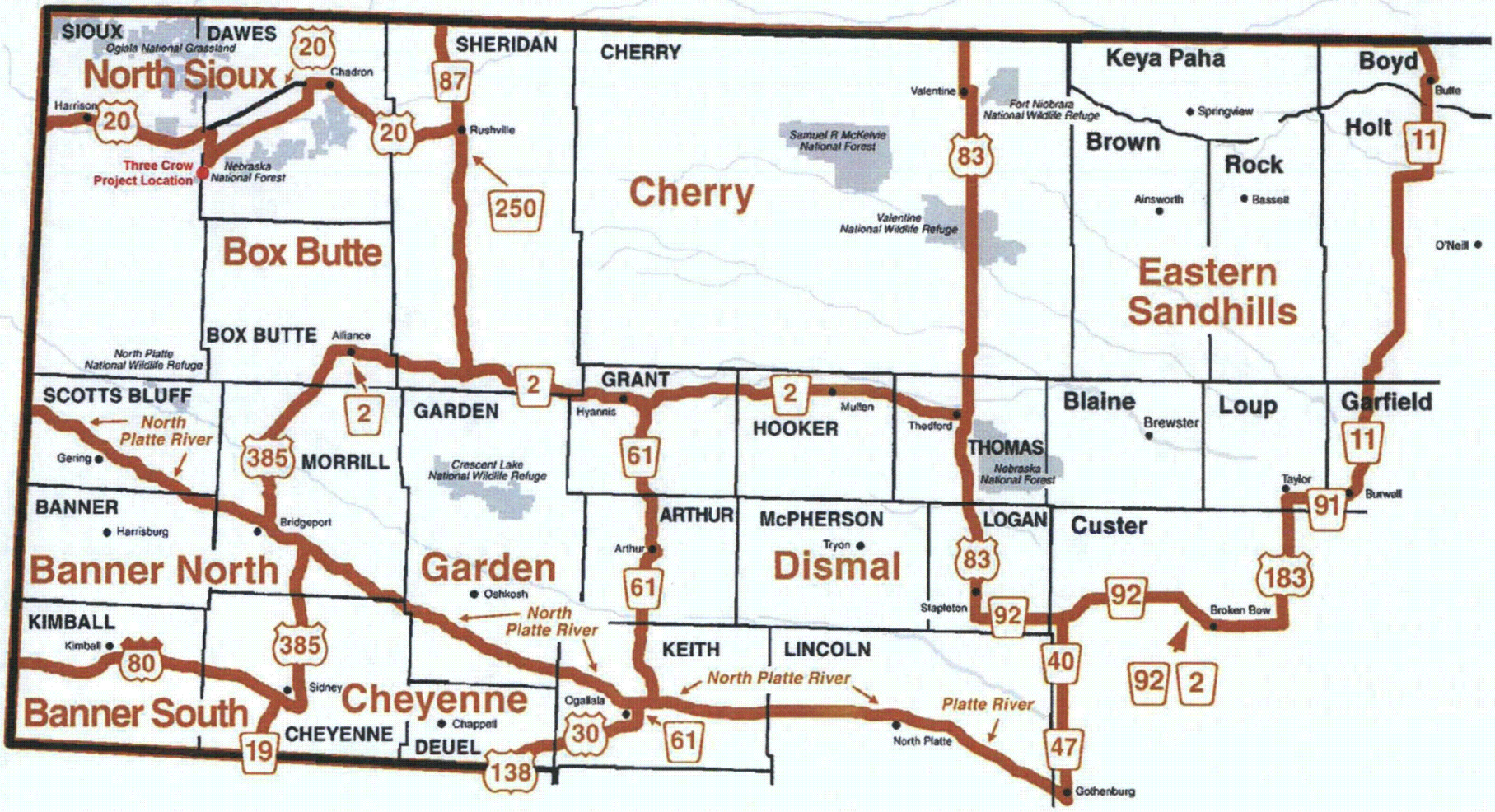
CROW BUTTE RESOURCES, INC.

FIGURE 2.8-1
THREE CROW EXPANSION AREA
HABITAT MAP

PROJECT: CO001396.00001 | MAPPED BY: JC | CHECKED BY: LW

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

\\co3fplgis-cadd\CBR_Projects\CO001396_ThreeCrowV2_GIS\ArcMaps\0001_TR\TR Fig_2_8-1_Habitat.mxd - 2/5/2010 @ 1:47:09 PM



N
W E

SOURCE: NGPC 2010a

CROW BUTTE RESOURCES, INC.

FIGURE 2.8-2
NEBRASKA
PRONGHORN HUNTING UNITS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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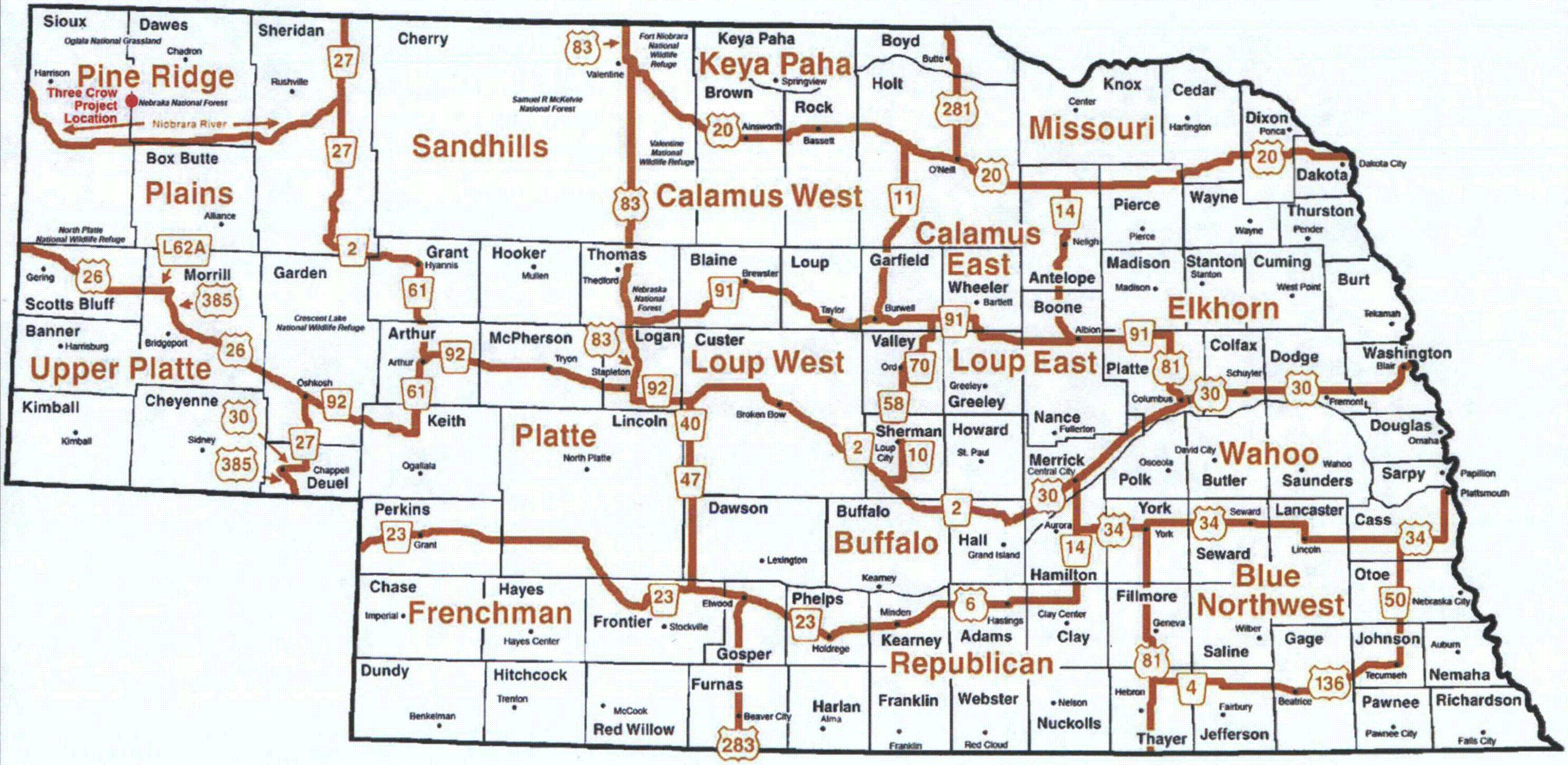
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Photoshop\TR Fig_2_8-2 NE Pronghorn Hunting Units.psd @ 01/26/2010



CROW BUTTE RESOURCES, INC.

FIGURE 2.8-3
NEBRASKA
DEER HUNTING UNITS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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Highlands Ranch, CO 80129
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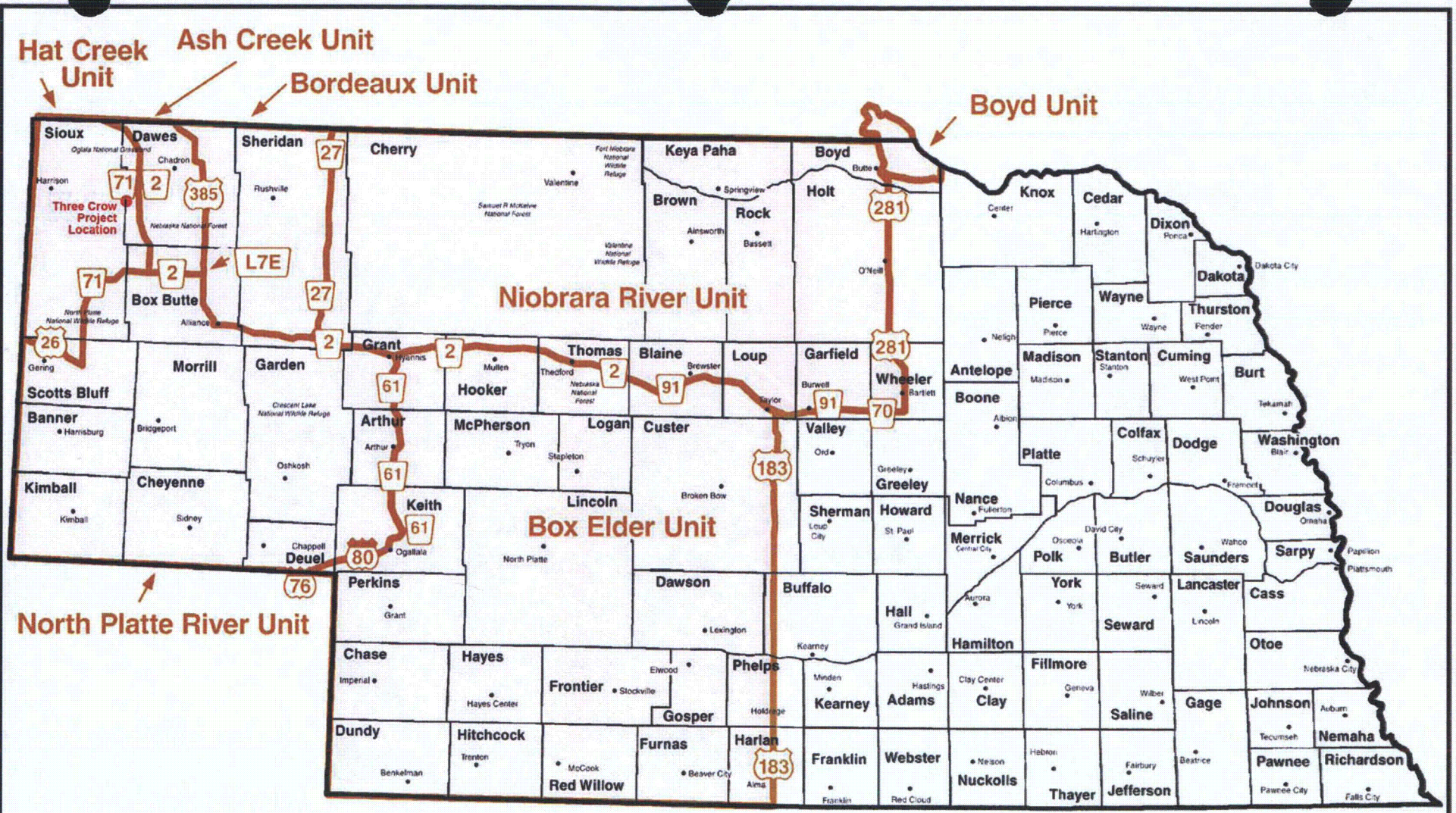
SOURCE: NGPC 2010b

K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Photoshop\TR Fig_2_8-3 NE Deer Hunting Units.psd @ 01/26/2010



SOURCE: NGPC 2010c

CROW BUTTE RESOURCES, INC.

FIGURE 2.8-4
NEBRASKA
ELK HUNTING UNITS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Photoshop\TR Fig_2_8-4 NE Elk Hunting Units.psd @ 01/26/2010

2.9 Background Radiological and Nonradiological Characteristics

2.9.1 Introduction

This section discusses the environmental sampling program that CBR implemented to assess preoperational and operational radiological background conditions in the vicinity of the TCEA. The results of this program, in contrast to the operational monitoring program implemented during satellite operations, will be used to determine the effects on the environment, if any, of the satellite facility. The operational monitoring program is discussed in Section 5.7.

The TCEA preoperational radiological monitoring was initiated in 2007. The program was designed to meet the criteria outlined in Reg. Guide 4.14 (NRC 1980). Alternatives to specific requirements of the guide were developed and implemented where appropriate. The primary basis for the alternate procedures was that Reg. Guide 4.14 was developed to address uranium "milling" operations producing yellowcake and the proposed satellite facility is a "wet" process that limits a number of concerns addressed in Reg. Guide 4.14. For example, there are limited air particulate and radon emissions due to lack of ore and overburden piles, tailings pond(s), yellowcake drier, and less disturbance area. However, the NRC advised CBR in 2009 that similar alternate approaches to the preoperational and operational monitoring (completed data collection and planned monitoring) for the proposed NTEA were unacceptable. Therefore, based on guidance from the NRC on NTEA, the TCEA preoperational and operational monitoring plans implemented in 2007 have been revised to adhere to NRC guidance.

Monitoring data collected from the first quarter of 2007 through the first quarter of 2010 are presented in this application. Following NRC approval, a revised monitoring plan will be implemented to collect 12 months of preoperational monitoring data. Once the data have been collected and analyzed, the results will be reported to the NRC.

The TCEA preoperational monitoring data collected to date indicate that the existing background concentrations of the radionuclides of interest are in the range of baseline data previously collected by CBR for the current license area.

The results of the TCEA preoperational radiological monitoring are organized by environmental media to allow ready comparison of monitoring data collected during both periods. A discussion of the scope of the monitoring program precedes the presentation of the data.

2.9.2 Baseline Air Monitoring

2.9.2.1 Selection of Air Monitoring Locations

Reg. Guide Guide 4.14 recommends that preoperational air monitoring should be conducted for air particulates, radon gas and direct radiation at three locations at or near the site boundary, one at or close to the nearest resident or occupiable structure(s) (if within 10 km of site) and one at a control or background location.

Five air monitoring locations were selected in 2010 as follows:

- Three monitor sites along the northern license boundary of the TCEA (locations TCA-1 through TCA-3). The locations were selected based on the three predominant wind roses and the site boundary.
- One monitor located at the nearest resident, which is the resident located within the TCEA license boundary in Section 29 T31N R52W.
- One monitor located to the east of the TCEA license boundary that serves as the background control location.

CBR based the sample locations for the air monitors on the anticipated satellite facility location, proposed license boundaries and predominant wind rose for the TCEA site, which was based upon the Crow Butte Project wind rose shown in Figure 2.5.-2. The local wind direction is predominantly from south-southwest direction approximately 45 percent of the time. Winds can also be from the northeast. The boundary sample locations were determined based upon this data.

The wind rose was developed from data generated at a CBR onsite MET station. The MET monitoring station on the Crow Butte site monitored temperature, precipitation, evaporation, wind speed and direction, and the standard deviation of the wind direction. The local meteorological station was operated from April 1982 through April 1984 during initial permitting for the current licensed area. From this information joint frequency data was compiled. Further information on meteorological conditions is contained in Section 2.5.

Figure 2.9-1 contains a map of the TCEA showing the monitoring locations. As noted, the air monitoring locations were designated as TCA-1, TCA-2, TCA-3 (site boundary) TCA-4 (nearest residence); TCA-5 (background control).

2.9.2.2 Air Particulate Monitoring Program

Reg. Guide 4.14 recommends that a total five particulate monitoring stations be established as discussed above in Section 2.9.2.1. Initially, CBR determined that air particulate monitoring as defined by Reg. Guide 4.14 was not appropriate for the TCEA. The basis for this was that activities at the TCEA will involve the operation of a satellite facility, which will not include drying, handling, or packaging of yellowcake. All drying and packaging operations will be performed at the CPF. Therefore, there are no operations at the satellite facility that could cause a significant release of airborne particulate radionuclides. However, CBR did conduct air particulate monitoring for four quarters in 2007 at sampling station AM-15 of the TCEA (south side of license boundary near the center of the TCEA (**Figure 2.9-2**).

The analytical results for AM-15 are depicted in **Table 2.9-1** and are compared to the background control sampler used for background for the CPF located at the northeast corner of the City of Crawford (SW quarter of SW quarter of Section 2 T31N R52 W). Uranium concentrations ranged from $<1.00\ E^{-16}$ to $8.01\ E^{-16}$ uCi/ml, radium-226 $<1.00\ E^{-16}$ to $3.02\ E^{-16}$ uCi/ml, and lead-210 $7.60\ E^{-15}$ to $3.71\ E^{-14}$.

CBR has since determined in discussions with NRC staff that since the satellite facility is considered to be a "mill" as defined by the NRC, air particulate monitoring should be conducted as required by Reg. Guide4.14. Therefore, five air particulate monitoring sites were established as

discussed in Section 2.9.1. Following NRC approval, the air monitoring will be conducted and incorporated into the operations monitoring program. One-year of quarterly data for each of the five sites will be submitted to the NRC once the data have been collected and a report prepared.

The airborne particulate samples are collected on the inlet filter of a regulated vacuum pump on a Type A/E 47 mm glass fiber filter paper. The low volume air samplers employed is the Eberline RAS-1 system that consists of a vacuum pump, an airflow regulator, a rotameter-type airflow indicator, and filter paper holder. The RAS-1 samplers are placed in protective enclosures that provided protection from the elements while allowing unimpeded sampling of the ambient air.

Clean filters are installed in the filter holder at the beginning of each sampling period. The pump flow rate is adjusted as necessary. The filter replacement schedule is determined based on the dust loading at a particular location. In general, historical operations of samplers at the CPF have shown that samplers can run for one to two weeks without a significant reduction in the flow rate due to dust loading.

At the end of the calendar quarter, the composite filter samples for each monitor are submitted to the contract laboratory for radiometric analysis using standard Chain of Custody Procedures. The filters are composited according to location. The composite samples are analyzed for the concentrations of natural uranium, radium-226, lead-210 and thorium-230.

The flow rate on the RAS-1 pumps is calibrated at six-month intervals using accepted calibration methods to ensure the accuracy of the volume of air sampled. Records of sampler calibration are available on file at the Crow Butte Uranium Project.

CBR will continue to operate all five samplers as part of the operational air particulate monitoring.

2.9.2.3 Radon Gas Monitoring Program

Reg. Guide4.14 recommends collection of radon gas samples at each of the air particulate monitoring stations (5 or more sample points). Continuous samples or at least one week per month representing about the same time of the month will be performed. Analysis is as radon gas.

Air monitoring in 2007 and 2008 involved radon gas sampling performed at quarterly intervals at air monitoring locations AM-6 (control), AM-15, AM-16, AM-17, AM-18, AM-19, AM-20 and AM-21 (**Figure 2.9-2**). Monitoring was performed using RadTrak® Type DRNF outdoor air radon detectors. RadTrak® cups contain a sensitized chip covered with a selectively permeable material allowing only the infiltration of radon. The sensitized chip records alpha disintegrations from radon daughters, allowing determination of average radon concentrations. The analysis of quarterly sampling has a sensitivity of 30 pCi/l-days. The semiannual interval was chosen to ensure that monitoring results meet the lower limit of detection (LLD) requirement of 0.2 pCi/l (2×10^{-10} µCi/ml) from Reg. Guide 4.14 and to be consistent with the semiannual intervals approved by NRC for the current operational monitoring.

Air monitoring for radon gas was performed for the TCEA for two time periods: 1/101/2007 – 7/12/2007 and 7/12/2007 – 1/11/2008. The RadTrak® detector located at AM-6 (control for CPF) was also used as the background site.

The results of the 2007 - 2008 radon sampling are presented in **Table 2.9-2.** The average values were the 1/10/2007 – 7/12/2007 sampling period were relatively constant with the exception of AM-16 which was higher than the other sites (0.8×10^{-9} µCi/ml versus 0.3×10^{-9} to 0.5×10^{-9} µCi/ml for the other sites [Note AM-19 and AM-20 were excluded due to being bad detectors). The average values for the 7/12/2007 to 1/11/2008 sampling period ranged from 0.4 to 0.9×10^{-9} µCi/ml with AM-20 being the highest at 0.9×10^{-9} µCi/ml.

With the installation of the air particulate monitors as discussed above, CBR will locate and operate radon detectors at the same locations in **Figure 2.9-1**. The detectors will be operated on a six-month basis and replaced with a new detector at that time. Detectors will no longer be operated at the other sites mentioned above, i.e., A-15, AM-16, AM-17, AM-18, AM-19, AM-20 and AM-21.

The operational monitoring sites proposed for the satellite facility will be the same as those shown in **Figure 2.9-1**. Operational monitoring of radon concentrations will continue as long as uranium recovery and restoration activities are in progress.

2.9.2.4 Quality of Air Measurements

The accuracy of monitoring data is critical to ensure that the preoperational air monitoring program precisely reflects air quality. Reg. Guide 4.14 specifies the following lower limits of detection (LLD):

Radionuclide	Recommended LLD µCi/ml	Actual LLD µCi/ml
Natural Uranium	1×10^{-16}	1×10^{-16}
Radium-226	1×10^{-16}	1×10^{-16}
Thorium-230	1×10^{-16}	1×10^{-16}
Radon-222	2×10^{-10}	2×10^{-10}
Lead-210	2×10^{-15}	2×10^{-15}

Note that Landauer does not provide the LLD on the analytical report. The LLD for Radtrak® detectors is a function of the exposure time and the area of the cup that is analyzed by Landauer.

2.9.3 Baseline Groundwater Monitoring

CBR will operate evaporation ponds at the proposed satellite facility to manage liquid wastewater streams generated during operations and restoration. A groundwater monitoring program will be carried out to monitor groundwater downgradient of the evaporation ponds that is consistent with the monitoring requirements of Reg. Guide 4.14. CBR will install two monitor wells hydrologically down gradient, and one well up gradient of the proposed evaporation ponds. These upgradient and downgradient monitor wells will be installed during the operational phase once the exact locations of the ponds and other assets have been finalized. In addition, other groundwater monitoring activities will supplement this proposed monitoring:

- The evaporation ponds will have a leak detection system to assure there is no migration beyond the liners.

- The evaporation ponds will be located within the monitor well ring for MUs 1-3 to detect migration of any process fluids from the production areas.
- CBR will also monitor selected wells within 0.5 mile of the license boundary (see discussions below).

This overall monitoring program is sufficient for monitoring groundwater conditions associated with the operation of the evaporation ponds.

2.9.3.1 Private Water Supply Wells

This section will discuss the results of the radiological and nonradiological analyses for private water supply wells within the TCEA and vicinity. Other information on the selected wells including formation, depth, and usage is shown in **Appendix F**.

Radiological Analyses

A summary of groundwater radiological quality data collected in 2007, 2008 and 2009 in the TCEA and vicinity for private water supply wells is presented in **Table 2.9-3**. All private wells in the vicinity of the AOR are completed in the Brule Formation. Additional summary data for radium-226 and natural uranium as compared to other CBR Brule Formation and Basal Chadron Sandstone Formation monitor wells are presented in **Table 2.9-4**. Four of the private wells that were monitored are located within the TCEA permit boundary (Wells 270, 272, 273, and 277) and the remaining wells (Wells 269, 274, 275, 313, and 314) are located less than 0.5 mile from the permit boundary (**Figure 2.9-3**). The wells were chosen based on proximity to the proposed mining operation, use, and distribution throughout the expansion area. For operational monitoring, wells 269, 274, 275, 312 and 314 will be monitored. Well 313 has been replaced with Well 312 since Well 313 and 314 are located close together, so additional data are only needed for one of these wells. Well 312 will allow for more representative sampling of the area north of the TCEA permit boundary.

Table 2.9-5 contains individual well results of the analyses for radionuclides for all private wells sampled for the TCEA during 2007, 2008, and 2009. Results are for concentrations of lead 210, polonium 210, radium-226, thorium 230 and natural uranium. As shown for all parameters in the data summary of **Table 2.9-3**, approximately 59% of the samples were less than the reporting limit, with approximately 41% at or greater than the reporting limit. Natural uranium was the only parameter with all values greater than the reporting limit. Lead-210 had the greater number of values at or less than the reporting limit (98%), followed by thorium-230 (89%) and ra-226 (87%) concentrations.

The results of the analyses indicate concentrations of the radionuclides are within the expected ranges for naturally occurring background in the area. The concentration of uranium in the wells completed in the Brule Formation within the NTEA ranged from <0.0003 to 0.05 mg/l, as compared to the private wells in the TCEA (0.008 – 0.0272 mg/l). The concentration of dissolved radium-226 in these same NTEA wells ranged from <0.2 to 1.3 x 10^{-9} µCi/ml, as compared to 0.006 to 0.5 pCi/L for the TCEA, with the majority of the wells below the detection level.

Nonradiological Analysis

The nonradiological analytical results for 2007 – 2008 for the private wells are presented in **Table 2.9-6**, **2.9-7**, **2.9-8**, and **2.9-9**. The analytical results for these tables are summarized in **Table 2.9-4.** Concentrations of the parameters for the private wells versus CBR monitor wells completed in the Brule Formation are comparable. The difference between the wells completed in the Brule Formation versus the CBR monitor wells completed in the Basal Chadron Sandstone is clearly shown in **Table 2.9-4**. Major differences are discussed below in Section 2.9.3.2. Similar trends in relative concentrations were observed in water quality sampling at the NTEA for these water-bearing units.

2.9.3.2 CBR Groundwater Monitor Wells

Locations of all groundwater monitoring wells in the vicinity of the TCEA are shown on **Figure 2.9-3.** There are seven active monitoring wells screened in the Brule Formation (BOW 2006-1, BOW 2006-2, BOW 2006-3, BOW 2006-4, BOW 2006-5, BOW 2006-6, and BOW 2006-7). The Miller Well (W-273) is also being utilized as a monitoring well for the Brule Formation. Ten active monitoring wells are screened in the Basal Chadron Sandstone (CPW 2006-1, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW 2006-5, COW 2006-6, COW 2006-7, UBCOW 2006-1, and UBCOW 2006-2) (**Figure 2.9-3**). Well completion reports for these monitoring wells are included in **Appendix A**. No completion report is available for W-273. Individual well Laboratory Analytical Reports and QA/QC Summary Reports received from the contract analytical laboratory for radiological and nonradiological parameters are presented in **Appendix H.**

Water Level Measurements

Water-level measurement events for the Brule Formation were conducted at four monitoring wells (BOW 2006-1, BOW 2006-2, BOW 2006-3, and BOW 2006-4) during two water level measurement events in January 2009 and at seven monitoring wells and W-273 in January 2010 (**Table 2.9-10**). The static water level for wells screened in the Brule Formation in the vicinity of the TCEA typically ranges from 30 to 80 feet bgs. Water levels measured during the January 2010 ranged from approximately 3,819 to 3,913 feet amsl (**Figure 2.9-4**). Groundwater flow in the Brule Formation is directed to the north and northeast across the entire TCEA. Groundwater elevations for all events indicate groundwater flow is convergent with the White River. The average hydraulic gradient within the TCEA is 0.0168 ft/ft. Regional water level information for the Brule Formation is currently only available in the vicinity of the CPF.

Water-level measurement events for the Basal Chadron Sandstone were conducted at all ten monitoring wells (CPW 2006-2, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW 2006-5, COW 2006-6, COW 2006-7, UBCOW 2006-1, and UBCOW 2006-2) during three water level measurement events during the months of January 2009 and January 2010 (**Table 2.9-10**). The static water level for wells screened in the Basal Chadron Sandstone in the vicinity of the TCEA typically ranges from 180 to 270 feet bgs. Groundwater elevations from the more recent January 2010 measurement event are shown on **Figure 2.9-5**. Water levels ranged from approximately 3,707 to 3,720 feet amsl. Groundwater flow is directed predominantly toward the east-northeast across the entire TCEA (**Figure 2.9-5**). The average hydraulic gradient within the TCEA is 0.0012 ft/ft. Regional water level information for the Basal Chadron Sandstone is currently only available in the vicinity of the CPF.

Strong vertically downward gradients exist at all locations within the TCEA, indicating minimal, if any, risk for potential impacts to the Brule Formation from the underlying Basal Chadron Sandstone under natural conditions (**Figures 2.6-3a** through **2.6-3e**). Observed head differences between the two water-bearing zones at three well pairs (BOW 2006-5 and COW 2006-1, BOW 2006-1 and CPW 2006-2, and BOW 2006-3 and COW 2006-4) ranged from approximately 86 to 196 feet during the January 2010 measurement event. Head differences between well pairs screened in the upper and lower Basal Chadron Sandstone (UBCOW 2006-1 and CPW 2006-2, UBCOW 2006-2 and COW 2006-4) were less than 1.0 feet for all water level measurement events, indicating favorable hydraulic communication between the two intervals.

Available groundwater data for both the Brule Formation and Basal Chadron Sandstone at the TCEA do not indicate any documented flow rate variations or recharge issues that would impact groundwater quality as a result of ISL mining operations in the Basal Chadron Sandstone. There are no surface-water ponds within the TCEA permit boundary and only limited stream flow. The Brule Formation, while considered an overlying aquifer, is not an extensive or exceptionally productive system. The available monitoring data do not indicate any seasonality or pumping effects by domestic wells within this zone.

2.9.3.3 Groundwater Quality Data

Groundwater quality within the White River drainage generally is poor (Engberg and Spalding 1978). Groundwater obtained from the Basal Chadron Sandstone aquifer has a strong sulfur odor as a result of localized reducing conditions associated with the ore body (**Figure 2.9-6**). A summary of groundwater quality data collected in 2007, 2008 and 2009 to establish background conditions in the vicinity of the TCEA is presented in **Table 2.9-4**. The data are presented for the two water-bearing zones at the TCEA: the Brule Formation and the Basal Chadron Sandstone. Four of the private wells that are monitored are located within the TCEA permit boundary (Wells 270, 272, 273, and 277) and the remaining wells (Wells 269, 274, 275, 313, and 314) are located less than 0.5 mile from the permit boundary (**Figure 2.9-3**). Well 313 will be replaced by Well 312 for future monitoring of private water supply wells. Well 313 and 314 are located close together, so additional data are only needed from one of these wells. Well 312 will allow for more representative sampling of the area north of the permit boundary.

Radiological

Tables 2.9-11 and **2.9-12** report the detailed radiological results of three bi-weekly sampling events for Brule Formation and Basal Chadron Sandstone monitoring wells within the TCEA. The bi-weekly sampling events were conducted for dissolved radiological parameters at all of the Brule Formation monitoring wells (BOW 2006-1, BOW 2006-2, BOW 2006-3, BOW 2006-4, BOW 2006-5, BOW 2006-6, and BOW 2006-7) in November 2008 through February 2009 and at ten Basal Chadron Sandstone monitoring wells (CPW 2006-2, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW 2006-5, COW 2006-6, COW 2006-7, UBCOW 2006-1, and UBCOW 2006-2) between December 2008 and February 2009. Analyses were also conducted for three bi-weekly samples for suspended radiological parameters (lead-210, polonium-210, radium-226, and thorium-230) for Brule wells BOW 2006-5, BOW 2006-7, BOW 2006 and Well 273 from November through December 2009.

A summary of the radiological analyses for uranium and radium-226 ranges for the individual well results for **Table 2.9-11** and **2.9-12** is presented in **Table 2.9-4**. Uranium concentrations in

the Brule Formation for private wells and monitoring wells ranged from 0.008 to 0.0272 mg/L and from 0.0032 to 0.0264 mg/L, respectively. Uranium concentrations in the Basal Chadron Sandstone ranged from 0.0004 to 0.0385 mg/L. Dissolved radium-226 concentrations for private wells and monitor wells in the Brule Formation ranged from 0.006 to 0.500 mg/L and 0.065 to 0.41 pCi/L, respectively. Dissolved radium concentrations in the Basal Chadron Sandstone ranged from 0.23 to 181 pCi/L. Suspended radium-226 concentrations in the Brule formation for wells Bow 2006-5, BOW 2006-6, BOW-2007 and Well 273 ranged from 0.04 to 0.20 pCi/l.

Nonradiological

Tables 2.9-13 reports the detailed nonradiological results of three bi-weekly sampling events for the Brule Formation and Basal Chadron Sandstone monitoring wells within the TCEA, which were included in the range of concentrations reported on **Table 2.9-4**. The bi-weekly sampling events were conducted at four Brule Formation monitoring wells (BOW 2006-1, BOW 2006-2, BOW 2006-3, BOW 2006-4, BOW 2006-5, BOW 2006-6, and BOW 2006-7) in November 2008 through February 2009 and at ten Basal Chadron Sandstone monitoring wells (CPW 2006-2, COW 2006-1, COW 2006-2, COW 2006-3, COW 2006-4, COW 2006-5, COW 2006-6, COW 2006-7, UBCOW 2006-1, and UBCOW 2006-2) between December 2008 and February 2009. TDS concentrations for the Brule Formation ranged from 237 to 327 mg/L, whereas TDS for the Basal Chadron Sandstone ranged from 980 to 1,300 mg/L. Alkalinity for the Brule Formation was detected up to 172 mg/L, while alkalinity in the Basal Chadron Sandstone was consistently detected above 300 mg/L. Conductivity for the Brule Formation was detected up to 466 • mhos/cm, while conductivity for the Basal Chadron Sandstone was detected above 1,690 • mhos/L at all sampling locations. Major ion concentrations (i.e., alkalinity (total as $CaCO_3$), carbonate (as CO_3), bicarbonate (as HCO_3), calcium, chloride, fluoride, magnesium, ammonia nitrogen as N, nitrate plus nitrite as N, potassium, silicia, sodium and sulfate),for the Brule Formation ranged from 527 to 589 mg/L, while concentrations for the Basal Chadron Sandstone ranged from 1,547 to 1,967 mg/L. Similar trends in relative concentrations were observed in water quality sampling at the NTEA for these two water-bearing zones.

In general, concentrations of TDS, specific conductance and major ions in the Basal Chadron Sandstone appear to be an order of magnitude larger than observed in the Brule Formation at the TCEA. To date, water quality sampling indicates that the Brule Formation and the Basal Chadron Sandstone have unique geochemical signatures within the TCEA.

2.9.3.4 Quality of Groundwater Measurements

The accuracy of monitoring data is critical to ensure that the water monitoring program precisely reflects water quality.

In addition to recommending the use of approved analytical methods for water quality measurements (contained in 40 CFR 136), the NRC also specifies analytical quality requirements in Reg. Guide 4.14 for the following lower limits of detection (LLD) in water:

Radionuclide	Recommended LLD µCi/ml	Actual LLD µCi/ml
Natural Uranium	2×10^{-10}	2×10^{-10}
Thorium-230	2×10^{-10}	2×10^{-10}
Radium-226	2×10^{-10}	2×10^{-10}
Polonium-210	1×10^{-9}	1×10^{-9}
Lead-210	1×10^{-9}	1×10^{-9}

2.9.4 Baseline Surface Water Monitoring

Surface water sampling in Reg. Guide 4.14 calls for sampling of surface water passing through the project site or offsite surface waters that may be subject to drainage from potentially contaminated areas or that could be affected by a tailings impoundment failure. Grab samples are to be collected on a monthly basis with samples analyzed for suspended and dissolved natural uranium, radium-226 and thorium-230.

Surface water sampling in Reg. Guide 4.14 also requires samples from each large onsite body of water or offsite impoundments that may be subject to direct surface drainage from potentially contaminated areas that could be affected by a tails impoundment failure. Grab samples are to be collected on a quarterly basis with samples analyzed for suspended and dissolved natural uranium, radium-226 and thorium-230. Semiannually, samples should be analyzed for suspended and dissolved lead-210 and polonium-210.

There is one unnamed drainage and Cherry Creek that pass through the project site. Bozle Creek does not pass through the project site, but does pass in close proximity to the eastern license boundary (**Figure 2.9-7**). These ephemeral drainages enter the White River, with the later being subject to sampling. Sampling for the White River and ephemeral drainages are discussed in Section 2.9.4.2.

There are no current onsite surface impoundments. Since there will be no tailing impoundments, sampling for the TCEA is conducted at offsite downgradient surface impoundments that may be subject to direct surface drainage from surface contaminated areas associated with the satellite facilities, evaporation ponds and other wellfield activities. Surface impoundments are discussed in Section 2.9.4.2.

Available historical flow and water quality data collected by state and federal agencies on the White River in the vicinity of the TCEA was summarized. These data are discussed in Section 2.9.4.1.

2.9.4.1 State and Federal Agency Monitoring Programs

Table 2.9-14 shows the mean monthly discharge of the White River as compared to the mean monthly precipitation over several years. These extended data show that a general correlation can be made between the direct precipitation and discharge. Higher flows are recorded in spring and early summer with lowest flow rates in late summer to early fall, reflecting seasonal changes related to precipitation.

Table 2.9-15 provides mean monthly discharge information for the White River at Crawford for 1999 through September, 2007 (NDNR 2010). The average flows from 1999 through 2006

(complete 12 months each of measurements) ranged from 16.7 to 21.9 ft^3/sec with an average of 20.3 ft^3/sec. These data for the White River at Crawford are comparable to the stream flow data shown in **Table 2.9-14** (average flow of 20.2 ft^3/sec).

NDEQ White River Ambient Stream Monitoring Program

The NDEQ has collected flow and water quality data for a number of years from the White River at the following NDEQ sampling stations: Ft. Robinson (SW1WHITE325), Crawford (WH1WHITE208) and Chadron (WH1WHITE105). Descriptions of these sampling points are shown in **Table 2.9-16**. With the exception of the Chadron sampling station, sampling locations in the Three Crow area (White River at Crawford and White River at Fort Robinson) are shown in **Figure 2.9-7**. The Chadron sampling station is located 2.5 miles east of the City of Chadron on Hwy 20, then 10 miles north/northeast on Slim Buttes Road to the White River. The sampling program is a component of the NDEQ statewide ambient streams monitoring program. Flow and water quality data for three sampling points in these areas were provided to CBR on January 09, 2010 (Lund J. 2010).

Field Measurements

Data was provided for the years 2001 through 2009 for field measurements, including flow data. Field measurements (temperature, dissolved oxygen, pH, conductivity, and field turbidity) were collected using a Hydro-Lab Quanta with Turbidity & Eureka Multi-Parameter Meter. Lab turbidity measurements were made with a Hach turbidity meter.

Table 2.9-17 provides the annual summaries for the flow measurements at the three sampling stations. Detailed measurements are shown in **Appendix I**. Flow measurements for the White River at Crawford (20.6 ft3/sec) are similar to the measurements reported by the NDNR and USGS above. Average flows at the White River at Crawford were consistently higher than the White River at Chadron for the years 2003 through 2009. This can be associated with evaporation and water consumption for local use in this stretch of the river.

The results of additional field measurements (water temperature, dissolved oxygen, pH, conductivity and turbidity) are present in **Table 2.9-18**. In general, as the White River flows downstream, it becomes cooler, dissolved oxygen concentrations and pH decrease, and conductivity and turbidity increase. Likewise, dissolved oxygen may decrease due to increased amounts of nutrients and organic matter downstream and thus, increased biological activity, or as a result of decreased flow rates and relative water stagnation.

Laboratory Analyses

Water quality samples were collected at the locations listed in **Table 2.9-16.** The results of the laboratory nonradiological water quality analyses are presented in **Tables 2.9-19, 2.9-20** and **2.9-21.** More detailed results are shown in **Appendix I**.

Data presented for most analytes in these tables demonstrate strong increasing concentration trends from upstream to downstream, including calcium, chloride, magnesium, total suspended solids (TSS), sodium, total Kjeldahl nitrogen (TKN), and phosphorous. Although TKN increases downstream, concentrations of nitrate (nitrite + nitrate as nitrogen) tend to decrease downstream

for unknown reasons. Ammonia concentrations do not show any notable year-to-year trends. Downstream increases of TSS and ionic (calcium, chloride, magnesium, and sodium) concentrations are likely sources of the above-noted turbidity and conductivity trends, respectively. These trends are likely associated with increased amounts of agricultural runoff between the Cities of Crawford and Chadron.

2.9.4.2 Crow Butte White River, Tributary and Surface Impoundment Sampling Program

The baseline surface water monitoring planned requires water samples for water quality analyses from the White River and associated tributaries and surface impoundments in the area of the TCEA, including Cherry Creek, Bozle Creek, an unnamed drainage, Sulzbach Pond, Cherry Creek Pond, Ice House Pond and Grabel Ponds. However, Cherry Creek, Bozle Creek, and other drainages in the area of the TCEA are designated as ephemeral with intermittent flow. During the baseline sampling program, there has not been a sufficient amount of flow to allow for the collection of water samples. Therefore, water samples were only collected from the surface impoundments and the White River. In lieu of water samples for these ephemeral drainages, sediment samples were collected (see Section 2.9.7).

Sampling location numbers assigned to all of the creeks and ponds except for the Grabel Ponds include the Bozle Creek (B-1), Cherry Creek (C-1), Sulzbach Pond (I-9), and Ice House Pond (I-10) and Cherry Creek Pond (I-11). Sampling locations are shown in **Figure 2.9-7.** Monthly samples are currently being collected at two points on the White River (upstream and downstream of the TCEA).

Water samples have been collected from Cherry Creek, Bozle Creek, Sulzbach Pond, Cherry Creek Pond, Ice House Pond and Grabel Pond. Monthly samples are currently being collected at two points on the White River (upstream and downstream of the TCEA). Sampling location numbers assigned to all of the creeks and ponds except for the Grabel Ponds include the Bozle Creek (B-1), Cherry Creek (C-1), Sulzbach Pond (I-9), Ice House Pond (I-10), Cherry Creek Pond (I-11) and White River (w-4 and W-5). Sampling locations are shown in **Figure 2-9-7.**

CBR did not perform flow measurements on the White River, opting to use historical USGS and NDEQ flow data discussed above. No flow measurements were attempted on Cherry Creek, Dead Man's Creek, Bozle Creek or unnamed drainages in the TCEA area due to the seasonal nature of flows in these features.

The analytical results for radiological and nonradiological parameters for the Ice House Pond, Cherry Creek Pond, Grabel ponds and Sulzbach Pond are presented in **Tables 2.9-22** and **2.9-23**, respectively.

Radiological Analyses

The radiological laboratory analytical results for the Ice House Pond, Grabel Ponds, Cherry Creek Pond and the Sulzbach Pond are presented in **Table 2.9-22.** Water samples were collected the second through the fourth quarters of 2007, first through the fourth quarter of 2008 and first quarter of 2009. Radiological analytical results are for the dissolved fractions of lead-210, polonium-210, radium-226, and thorium-220 as activity (pCi/l). Uranium was analyzed as mass (mg/l).

The radiological analytical results were at levels that would be expected for background concentrations of the area. Uranium levels varied from 0.0029 to 0.0185 mg/l, radium--226 levels were primarily below the reporting limit with three samples of 0.2, 0.2 and 0.3 pCi/l in the second quarter of 2008. lead-210 and thorium-230 levels were below the reporting limit for each analysis, Po-210 results varied from below the reporting limit to a maximum of 0.8 pCi/l.

Nonradiological Analyses

The nonradiological analytical results presented in **Table 2.9-23** were for quarterly samples collected in the third quarter of 207 and quarters 2, 3 and 4 for 2008. Overall, the concentrations of the measured parameters were similar over the sampling period with some isolated variations. One noted exception was for the third quarter of 2007 when a number of parameters for the Cherry Creek Pond were substantially higher than for the other ponds, e.g., alkalinity, bicarbonate as HCO_3, ammonia nitrogen as N, sodium, conductivity, total dissolved solids, iron, and manganese.

The continuance of the preoperational baseline monitoring plan for surface water will include quarterly sampling of Cherry Creek Pond, Ice House Pond, Sulzbach Pond and Grabel Pond(s), which will be analyzed quarterly for suspended and dissolved natural uranium, radium-226 and thorium-230. Semiannually, samples will be analyzed for suspended and dissolved lead-210 and polonium-210. For the White River (sample points W-4 and W-5) and the ephemeral streams if sufficient flow is available (i.e., Cherry Creek, Bozle Creek and unnamed drainage), sampling will occur monthly. The samples will be analyzed for suspended and dissolved natural uranium, radium-226 and thorium-230. Semiannually, samples will be analyzed for suspended and dissolved lead-210 and polonium-210.

2.9.4.3 Quality of Surface Water Measurements

The accuracy of monitoring data is critical to ensure that the water monitoring program precisely reflects water quality.

In addition to recommending the use of approved analytical methods for water quality measurements (contained in 40 CFR 136), the NRC also specifies analytical quality requirements in Reg. Guide 4.14 for the following lower limits of detection (LLD) in water:

Radionuclide	Recommended LLD µCi/ml	Actual LLD µCi/ml
Natural Uranium	2×10^{-10}	2×10^{-10}
Thorium-230	2×10^{-10}	2×10^{-10}
Radium-226	2×10^{-10}	2×10^{-10}
Polonium-210	1×10^{-9}	1×10^{-9}
Lead-210	1×10^{-9}	1×10^{-9}

2.9.5 Baseline Vegetation, Food and Fish Monitoring

2.9.5.1 Vegetation

Reg. Guide 4.14 recommends sampling of grazing areas near the site in different sectors that will have the highest predicted air particulate concentrations during the milling operations. CBR selected three vegetation sampling locations located on the northern site boundary. These sampling sites were selected due to being located downwind of the satellite facility in the three predominant wind direction sectors (winds predominantly from south-southwest direction. The site boundary adjoins the Ft. Robinson State Park, so sampling was restricted to the area near the permit boundary.

CBR conducted vegetation sampling at three locations along the northern boundary of the TCEA in 2009. These composite vegetation samples were obtained three times during the grazing season and analyzed for natural uranium, thorium-230, radium-226, lead-210, and polonium-210.The sample locations were based on being downwind of the three predominant wind roses at the site boundary (**Figure 2.9-2**). The results of analyses for 2009 are presented in **Table 2.9-24**. The vegetation samples were composite samples of the vegetation present in proportion to occurrence. Concentrations for natural uranium ranged from 1.10 E^{-5} to 4.8 E^{-6} µCi/kg. Concentrations for radium-226 ranged from 8.4 E^{-6} to 2.2 E^{-5} µCi/kg. Concentrations for thorium-230 ranged from <2.7 E^{-6} to 3.6 E^{-5} µCi/kg. Concentrations for lead-210 ranged from 3.1 E^{-4} to 7.0 E^{-4} µCi/kg. Concentrations for polonium-210 ranged from 5.6 E^{-6} to 7.5 E^{-5} µCi/kg. In 2007,

These results are similar to historical baseline vegetation monitoring performed in the current CBR project area.

As part of the continuing preoperational radiological monitoring program, additional vegetation samples will be collected during the grazing season at the designated sampling locations (**Figure 2.9-8**). A minimum of three samples will be collected three times during the grazing season. These samples will be analyzed for the concentrations of natural uranium, thorium-230, radium-226, lead-210 and polonium-210.

Grass samples will be collected in accordance with the Safety, Health, Environment and Quality Management System (SHEQMS) Volume VI *Environmental Manual* (CBR 2010).

2.9.5.2 Quality of Vegetation Measurements

The accuracy of monitoring data is critical to ensure that the vegetation monitoring program precisely reflects radionuclide concentrations. Reg. Guide 4.14 specifies the following lower limits of detection (LLD):

Radionuclide	Recommended LLD µCi/kg (wet)	Actual LLD µCi/kg (wet)
Natural Uranium	2×10^{-7}	6.9×10^{-8}
Thorium-230	2×10^{-7}	6.9×10^{-8}
Radium-226	5×10^{-8}	6.9×10^{-8}
Polonium-210	1×10^{-6}	3.5×10^{-7}
Lead-210	1×10^{-6}	3.5×10^{-7}

Note that all recommended LLDs were met with the exception of radium-226. The actual LLD of 6.9×10^{-8} was slightly above the recommended LLD of 5×10^{-8}. The recommended LLD was not met due to inadequate sample size. However, all measured radium-226 values were well above the recommended LLD and the error estimate was at or near the 10% of the reported value recommended by NRC.

2.9.5.3 Food

Crops

Reg. Guide 4.14 recommends that crops, livestock, etc. raised within three kilometers (km) (~1.86 miles) of the mill site be sampled at the time of harvest or slaughter. The NRC has indicated that other food sources should be explored for sampling, such as private gardens in the area (e.g., sampling a variety of available garden plants). Grab samples should be analyzed for natural uranium, radium-226, thorium-230, lead-210, and polonium-210. Livestock should include a variety of animals present in the area, including cattle, sheep, pigs, fowl, etc.

The preoperational baseline plan will provide for a survey of a three km area around the centerpoint of the satellite facility as to the availability of crops, livestock, fowl and other applicable sources for sampling. This would determine the types of crops grown in the area, number and types of livestock, availability of gardens, etc.

As shown on **Figure 2.9-8**, the land to the north of the TCEA is downwind of the predominant wind directions from the TCEA. This land is part of the Ft. Robinson State Park and is for recreation and grazing. There are no croplands within three km of the TCEA to the north of the TCEA (downwind of predominant wind direction). As seen in **Figure 2.9-8**, crops do exist within the TCEA license boundary, but once construction commences, cultivation will cease. There are croplands just to the east, south and west of the license boundary. As part of the preoperational monitoring plan, CBR will survey these available croplands and seek landowner approval to sample crops during the harvest periods. At the current time, wheat seems to be the main crop being grown in the area of the TCEA.

A survey within the three km radius of the satellite facility will also be made for the presence of private gardens, with the priority on locating such gardens downwind from the TCEA in the predominant wind direction. CBR will seek approval from the garden owner to be able to collect samples from at least three garden items being grown. Sampling of available gardens would involve sampling of leafy tissues and fruits, etc.

Vegetation samples will be collected in accordance with the SHEQMS Volume VI *Environmental Manual* (CBR 2010).

Livestock

At the current time, the only livestock known to be raised within three km radius of the satellite facility are cattle and bison. CBR will survey the area for the presence of these and other livestock, and when found, will seek approval from the owner(s) to collect samples at the time of slaughter. Efforts will be made to collect samples prior to start of construction to be able to compare to samples collected during operations.

Sampling of livestock would involve sampling and analysis of tissues such as bone, muscle, liver and kidney for each species (e.g., cattle and bison). Sampling targets would be identified and an agreement made with the owner as to a sampling program acceptable to both parties.

Samples for crops and livestock will be obtained at the time of harvest or slaughter. Samples would be analyzed for natural uranium, radium-226, thorium-230, lead-210, and polonium-210.

Fish

Reg. Guide 4.14 requires that fish be collected, if available, from lakes, streams in the project site area that may be subject to seepage or direct surface runoff from potentially contaminated areas or that could be affected by a tailings impoundment failure. Fish should be collected and sampled and analyzed semiannually for natural uranium, radium-226, thorium-230, lead-210 and polonium-210.

The CBR preoperational monitor plan will provide for collection of fish samples from the White River (at or near sample points W-4 and W-5), Ice House Pond (I-10) and Cherry Creek Pond (I-11) (**Figure 2.9-7**). It is highly unlikely the ephemeral streams (i.e., Cherry Creek, unnamed drainage, and Bozle Creek) will have ever sufficient flow to sustain fish populations. Therefore sampling is not planned for these drainages.

If feasible, two target species will be collected at each collection point, one being a predator species and the other either a forage or bottom-feeder species. This of course will depend on the success of the collection efforts. Specimens from different families may include Catostomidae (suckers), Centrarchidae (sunfish, bass and crappie), Cyprinidae (minnows, shiners, chubs and daces) and Salmonidae (rainbow, brown and brook trout).

Where feasible (e.g., fish size and tissue quantity), separate tissues will be collected from specimens for radionuclide analysis. Tissues will consist of bone, liver and muscle. The levels of uranium-series radionuclides in fish tissue are generally highest in bone, followed by skin, liver, gonad and muscle (Swanson, S.M. 1985, Elsenbud, M. 1987). For smaller fish, such as minnows, whole body radionuclide analysis will be conducted. Radionuclide uptake has been reported to not vary with fish age, size or sex (Swanson, S.M. 1985). Analyses will be performed for natural uranium, radium-226, thorium-230, lead-210 and polonium-210.

Any sampling method used will be consistent with procedures of the U.S. Geological Survey (USGS 1993). Seining will be the preferred option.

2.9.6 Baseline Soil Monitoring

Reg. Guide 4.14 recommends soil samples be collected as follows:

- Up to 40 samples surface soil samples would be collected at 300-meter intervals to a distance of 1500 meters in each of eight directions from the center of the milling area. Surface soil samples would be collected to a depth of 5 cm using consistent sampling methods. Sampling would be conducted once prior to construction and repeated for locations disturbed by excavation, leveling or contouring. All samples would be analyzed for Ra-226, and 10% of the samples analyzed for natural uranium, thorium-230 and lead-210.

- Five or more surface soil samples (to a depth of 5 cm) would be collected at the same locations used for air particulate samples. Samples would be collected once prior to construction. Samples would be analyzed for natural uranium, radium-226, thorium-230 and lead-210.
- Five subsurface samples collected at the center point location and ar distances of 750 meters in each of four directions. Subsurface soil samples would be collected to a depth of one meter and divided into three equal sections for analysis. Samples would be collected once prior to construction and repeated for locations disturbed by construction. All samples would be analyzed for Ra-226 and one set of the samples analyzed for natural uranium, thorium-230, and lead-210.

In 2008, CBR collected surface soil samples once from designated sampling locations and analyzed for natural uranium, radium-226, lead-210, and thorium-230. Soil samples were collected from the top 5 centimeters of soil. Samples were collected at sampling points AM-15, AM-16, AM-17, AM-18, AM-19, AM-20 and AM-21 (**Figure 2.9-2**).

Vegetative roots, rocks and other debris were removed from the soil samples. The samples were sent to Energy Laboratories in Casper, Wyoming for analysis. The results of analysis of the soil samples are presented in **Table 2.9-25**. Radium-226 soil concentrations ranged from 0.5 to 0.7 pCi/g, natural uranium soil concentrations ranged from 0.4 to 0.6 pCi/g, lead-210 soil concentrations ranged from 0.3 to 0.6 pCi/g and thorium-230 soil concentrations ranged from 0.2 to 0.4 pCi/g.

As part of the preoperational radiological monitoring program, additional surface soil samples will also be collected at the five air monitoring locations.

In addition, to the extent feasible, soil samples will be collected at 300 meter intervals to a distance of 1500 meters in each of 8 directions from the centerpoint of the satellite facility. The location of the satellite facility and size and shape of the license boundary requires a modification to Reg. Guide 4.14 as for sampling points. In addition to the sampling points based on the centerpoint of the satellite facility, additional transects will be made across the TCEA area to collect samples in areas of proposed wellfields (**Figure 2.9-9**). Sampling distances for some sampling points on transects from centerpoint of satellite facility were modified to obtain a more representative sampling of the project area, e.g., proposed wellfield locations.

Surface soil samples to a depth of 5 cm will be collected at 300-meter intervals to a distance of 1500 meters (where feasible) along established transects. Any areas disturbed by excavation, leveling or contouring would be resampled. All surface samples (5 cm) will be analyzed for radium-226 and 10% of the samples for natural uranium, thorium-230, and lead-210. Surface soils samples at each air monitoring station will be analyzed for natural uranium, radium-226, thorium-230 and lead-210. All surface soil sampling will occur once prior to construction and repeated for any locations disturbed by excavation, leveling or contouring. For subsurface samples, once prior to construction and repeated for any locations disturbed by construction.

Subsurface samples will be collected at the satellite facility center reference location and at a distance of 750 meters (alternate distances in some cases as explained above) in each of 8 directions, as shown in **Figure 2.9-9**. Samples were collected in 8 directions as opposed to 4 to accommodate the shape and size of the license boundary to collect representative samples.

Additional subsurface samples will be collected along the additional transects discussed above. Any areas disturbed by construction will be resampled. Subsurface soil profile samples would be collected to a depth of one meter. Samples would be divided into three equal sections for analysis. All subsurface samples would be analyzed for Ra-226 and ones set of samples for Natural Uranium, Th-230, and Pb-210.

Soil samples will be collected in accordance with the SHEQMS Volume VI *Environmental Manual* (CBR 2010).

2.9.6.1 Quality of Soil Measurements

The accuracy of monitoring data is critical to ensure that the soil monitoring program precisely reflects radionuclide concentrations. Reg. Guide 4.14 specifies the following lower limits of detection (LLD):

Radionuclide	Recommended LLD µCi/g	Actual LLD µCi/g
Natural Uranium	2×10^{-7}	2×10^{-8}
Radium-226	2×10^{-7}	2×10^{-8}
Thorium-230	2×10^{-7}	2×10^{-8}
Pb-210 (dry)	2×10^{-7}	2×10^{-8}

2.9.7 Baseline Sediment Sampling

Sediments of lakes, reservoirs, and flowing bodies of surface water may become contaminated as a result of direct liquid discharges, wet surface deposition, or from runoffs associated with contaminated soils. Because of various chemically and physically binding interactions with radionuclides, sediments serve as integrating media that are important to environmental monitoring.

Reg. Guide 4.14 recommends that sediment samples be collected from sediments of surface water passing through the project site or offsite surface waters that may be subject to to drainage from potentially contaminated areas or that could be affected by evaporation pond failure. Samples are to be collected once following spring runoff and late summer following a period of extended low flow. Samples are to be analyzed for natural uranium, radium-226, thorium-230, and lead-210.There were one unnamed drainage and Cherry Creek that flow though the project site. Bozle Creek does not flow through the project site, but does flow in close proximity to the eastern license boundary (**Figure 2.9-7**). These ephemeral drainages flow into the White River, with the later being subject to sampling. Sampling for the White River and ephemeral drainages are discussed in Section 2.9.4.2.

Sediment sampling in Reg. Guide 4.14 also requires samples from each large onsite body of water or offsite impoundments that may be subject to direct surface drainage from potentially contaminated areas that could be affected by a tailings impoundment failure. One sample is to be collected prior to construction and analyzed for natural uranium, radium-226, thorium-230 and lead-210. There are no onsite surface impoundments. Since there is no tailings impoundment, sampling was conducted on offsite downgradient surface impoundments that may be subject to direct surface drainage from surface contaminated areas associated with the satellite facilities,

evaporation ponds and other wellfield activities. Surface impoundments are discussed in section 2.9.4.2.

Sediments in Cherry Creek Pond, Ice House Pond, Grabel Ponds and Sulzbach Pond have been sampled twice as part of the preoperational monitoring program. Sampling was done in the fourth and third quarters of 2007 and 2008, respectively. Samples were analyzed for dissolved lead-210, radium-226, polonium-210, thorium-230 and natural uranium. The analytical results are shown in **Table 2.9-26** and sampling locations in **Figure 2.9-7.** Radium-226 sediment concentrations ranged from 0.2 – 1.0 pCi/g, lead-210 from 0.6 – 4.1 pCi/g, polonium-210 0.6 to 1.3 pci/g, thorium-230 <0.09 – 0.7 pCi/g and natural uranium 1.4 – 22 pCi/g. Thorium-230 was not analyzed for in the 12/19/2007 sampling event.

The preoperational monitoring program will be expanded to include additional sampling and analysis for Cherry Creek Pond, Ice House Pond, Grabel Ponds and the Sulzbach Pond. These ponds will be sampled once prior to construction and analyzed for natural uranium, radium-226, thorium-230, and lead-210.

In, addition, an unnamed drainage and Cherry Creek will be sampled up and downstream of the drainages passing through the site. Bozle Creek does not flow through the project site, but the drainage is in close proximity to the license boundary so that it may be subject to direct runoff from potentially contaminated areas (i.e., wellfields). Bozle Creek will be sampled at a point upstream of the southern license boundary and downstream of the northern license boundary. The White River will be sampled at upstream and downstream locations (sample points W-5 and W-5) (**Figure 2.9-7**), so that the ephemeral streams crossing or in close proximity to the TCEA will flow into the river between these sampling points.

These drainages and the White River will be sampled twice, once following spring runoff and late summer following period of extended low flow. Samples will be analyzed for natural uranium, radium-226, thorium-230, and lead-210.

Sediment samples will be collected in accordance with the SHEQMS Volume VI *Environmental Manual* (CBR 2010).

2.9.7.1 Quality of Sediment Measurements

The accuracy of monitoring data is critical to ensure that the sediment monitoring program precisely reflects radionuclide concentrations. Reg. Guide 4.14 specifies the following lower limits of detection (LLD):

Radionuclide	Recommended LLD µCi/g	Actual LLD µCi/g
Natural Uranium	2×10^{-7}	2×10^{-8} (1996 samples) 1×10^{-8} (2004 samples) 2×10^{-7} (2006 samples)
Thorium-230	2×10^{-7}	2×10^{-8}
Radium-226	2×10^{-7}	2×10^{-8} (1996 samples) 2×10^{-7} (2004 and 2006 samples)
Lead-210	2×10^{-7}	1×10^{-7} (1996 samples) 1×10^{-6} (2004 samples) 2×10^{-7} (2006 samples)

2.9.8 Baseline Direct Radiation Monitoring

Reg. Guide4.14 recommends direct radiation measurements be collected at 150-meter intervals to a distance in each of 8 directions from the centerpoint of the milling area or at a point equidistant from the milling area and tailings disposal area. Since there is no milling or tailings disposal area, CBR used the satellite facility as the centerpoint. Samples are to be collected once prior to construction and repeated for areas disturbed by site preparation or construction. Gamma exposure rate is to be derived, using passive integrating device such as a thermoluminescent detector (TLD), pressurized ionization chamber, or a properly calibrated portable survey instrument.

The preoperational baseline radiation monitoring program includes routine monitoring of direct radiation levels at the air monitoring stations.

Gamma measures were made in 2007 and 2008 using two different types of detectors: environmental thermoluminescence detector and environmental optically stimulated luminescence detector.

Environmental Thermoluminescence Detector (TLD)

Gamma readings were taken at specific sampling locations at TCEA (i.e., AM-15, AM-16, AM-17, AM-18, AM-19, AM-20, and AM-21). In addition, background samples were reported for the background sampling location point AM-26 used for the CPF site (SW quarter of SW quarter of Section 2 T31N R52 W). This monitor site is located at the southeast corner of the City of Crawford. Quarterly measurements were made from January 2007 to Januay 2008. The results are presented in **Table 2.9-27**.

The TLDs were placed at sample locations depicted in **Figure 2.9-2**. The average gamma exposure rates were relative constant, ranging from 3 to 10 mrem/qtr (**Table 2.9-27**). Monitoring was conducted by placing the TLDs provided by Thermo Nutech on a quarterly basis at the monitoring locations. Lithium fluoride chips were used and housed in rugged containers to provide protection from the weather. The containers or monitors were placed at the predetermined monitoring locations approximately one meter above ground level. They were exchanged with new monitors on a quarterly basis and the exposed monitors were returned to the vendor for processing. These devices provide an integrated exposure for the period between annealing and processing. The results were reported in mrem per week.

Environmental Optically Stimulated Luminescence Detector (OSLD)

In 2008, OSLDs were placed the sampling locations shown in **Figure 2.9-2** for gamma measurements. The OSLDs are the most advanced technology available for measuring radiation exposure, including being accurate within ±1 Mrem, while in contrast, TLD and film badges require 10 Mrem to begin reporting (Landauer 2010). These detectors, unlike TLD or film badges, provide accurate dose readings, even when exposed to extreme temperatures, moisture, or when tampered with or dropped. The vendor no longer supplies TLDs, replacing these with the OSLDs. Therefore, OSLDs will be used for future gamma exposure measurements requiring continuous integrating devices.

The OSLDs were used for gamma measurements from January 2008 to July 2008 to compare to TLD measurements at the same locations in 2007. Monitoring was conducted by placing the OSLDs provided by Landauer on a quarterly basis at the monitoring locations. The monitors were placed at the predetermined monitoring locations approximately one meter above ground level. They were exchanged with new monitors on a quarterly basis and the exposed monitors were returned to the vendor for processing. These devices provide an integrated exposure for the period between annealing and processing.

The results are shown in **Table 2.9-27**. Gamma exposure rates ranged from 2.7 to 13.4 mrem/qtr. These measurements were consistent with the TLD background measurements of 3 to 10 mrem/qtr in 2007 and 2008. The average background gamma level in the Western Great Plains have been reported to be 0.014 mR/hr (NRC 1979), which corresponds well to the results obtained with the TLD and OSLD gamma monitors

Additional preoperational monitoring will be carried out and include the following:

1. Gamma readings will be made at 150 meter intervals in each of 8 directions from the center of the satellite facility and along additional established transects as discussed in Section 2.9.2 (air particulate monitoring). Sampling locations are shown in **Figure 2.9-9**. The gamma exposure rate will be determined using a properly calibrated portable survey instrument.
2. OSLDs will be placed at each of the air monitoring stations, with quarterly changes. Sample locations are shown in **Figure 2.9-9**.

The preoperational direct gamma radiation program was designed to meet the guidance provided in Reg. Guide 4.14. NRC guidance recommends a combination of direct gamma radiation measurements and exposure measurements made with integrating devices (i.e., thermoluminescent detectors or TLDs) during preoperational monitoring. Direct measurements are made in areas where process facilities will be located during site characterization.

In addition to the environmental gamma monitors, NRC recommends that the background gamma radiation in the area of the facility be measured with a scintillometer. As per Reg. Guide 4.14, CBR will perform preoperational gamma radiation measurements at 150-meter intervals as discussed above (**Figure 2.9-9**). Note that some alternate sampling locations will be utilized as discussed in Section 2.9.6. These measurements will be made once prior to construction, and repeated for area disturbed by site preparation or construction. The type of survey instrument and

procedures would be as described below for measurements previously conducted at the proposed satellite facility.

2.9.9 Preoperational Baseline Monitoring Program Summary

The TCEA preoperational baseline monitoring program discussed in this section is summarized in **Table 2.9-28**.

2.9.10 References

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Table 2.9-1 Airborne Particulate Concentrations for Three Crow Expansion Area

Location	Radionuclide	Date	Concentration uCi/ml	Error Estimate uCi/ml	LLD uCi/ml
First Quarter 2007					
AM-6 (Background)	Uranium	01/0207 – 04/02/07	$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$1.22\ E^{-14}$	$7.60\ E^{-16}$	$2.00\ E^{-15}$
AM-15	Uranium	01/10/07 – 04/10/07	$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$1.04\ E^{-14}$	$6.99\ E^{-16}$	$2.00\ E^{-15}$
Second Quarter 2007					
AM-6 (Background)	Uranium	04/02/07 – 07/02/07	$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$8.29\ E^{-15}$	$1.19\ E^{-15}$	$2.00\ E^{-15}$
AM-15	Uranium	04/10/07 – 07/12/07	$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$2.47\ E^{-14}$	$2.56\ E^{-15}$	$2.00\ E^{-15}$
Third Quarter 2007					
AM-6 (Background)	Uranium	07/02/07 – 10/01/07	$<1.54\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$1.70\ E^{-14}$	$1.18\ E^{-15}$	$2.00\ E^{-15}$
AM-15	Uranium	07/12/07 – 10/01/07	$1.08\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$1.71\ E^{-14}$	$1.15\ E^{-15}$	$2.00\ E^{-15}$
Fourth Quarter 2007					
AM-6 (Background)	Uranium	10/01/07 – 01/02/07	$8.01\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$3.02\ E^{-16}$	$2.31\ E^{-16}$	$1.00\ E^{-16}$
	Lead 210		$7.60\ E^{-15}$	$9.61\ E^{-16}$	$2.00\ E^{-15}$
AM-15	Uranium	10/01/07 – 01/11/08	$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Radium 226		$<1.00\ E^{-16}$	N/A	$1.00\ E^{-16}$
	Lead 210		$3.71\ E^{-14}$	$2.49\ E^{-15}$	$2.00\ E^{-15}$

Table 2.9-2 Ambient Atmospheric Radon-222 Concentration for Three Crow Expansion Area

Location	Date	Gross Count	Average Radon Concentration (uCi/ml x 10^{-9})	Accuracy (x 10^{-9} uCi/ml)	Percent Effluent Concentration
AM-6 (Control)	1/10/2007 – 7/12/2007	71.3	0.4	0.05	4.0%
AM-15	1/10/2007 – 7/12/2007	82.4	0.5	0.06	5.0%
AM-16	1/10/2007 – 7/12/2007	66.6	0.4	0.05	4.0%
AM-17	1/10/2007 – 7/12/2007	77.5	0.4	0.05	4.0%
AM-18	1/10/2007 – 7/12/2007	152.0	0.8	0.06	8.0%
AM-19	1/10/2007 – 7/12/2007	Bad Detector			
AM-20	1/10/2007 – 7/12/2007	Bad Detector			
AM-21	1/10/2007 – 7/12/2007	59.7	0.3	0.04	3.0%
AM-6 (Control)	7/12/2007 – 1/11/2008	72.4	0.4	0.05	4.0%
AM-15	7/12/2007 – 1/11/2008	Detector fell out of cup – frozen in snow bank			
AM-16	7/12/2007 – 1/11/2008	83.5	0.5	0.05	5.0%
AM-17	7/12/2007 – 1/11/2008	127.2	0.7	0.06	7.0%
AM-18	7/12/2007 – 1/11/2008	134.1	0.7	0.06	7.0%
AM-19	7/12/2007 – 1/11/2008	126.4	0.7	0.06	7.0%
AM-20	7/12/2007 – 1/11/2008	165.0	0.9	0.07	9.0%
AM-21	7/12/2007 – 1/11/2008	91.4	0.5	0.05	5.0%

LLD (x 10^{-9} uCi/ml)

Effluent Concentration Limit, 10 CFR 20 Appendix B, Table 2, Column 1

Table 2.9-3 Summary of Three Crow Expansion Area Dissolved Radiological Analyses for Private Water Supply Wells in TCEA and AOR 2007 - 2009

Radiological Parameter	At or Less than Reporting Limit (RL) (<)				Greater than Reporting Limit (RL) (>)			
	Number [a]	Average	Minimum	Maximum	Number [a]	Average	Minimum	Maximum
		pCi/l Unless Noted Otherwise				pCi/l Unless Noted Otherwise		
DISSOLVED								
Lead – 210	50	6.11	1.0	29.3	1	1.1	1.1	1.1
Polonium - 210	53	0.61	0.1	1.0	11	2.35	0.4	3.6
Thorium – 230	46	0.154	0.06	0.21	5	0.2	0.1	0.3
Radium – 226	53	0.198	0.08	0.3	7	0.21	0.006	0.5
Uranium (mg/l)	--	--	--	--	58	0.0162	0.0078	0.0339

Note:
See **Table 2.9-5** for individual well analytical results.
Private Water Supply Wells Sampled: W-269, W-270. W-272, W-273, W-274, W-275, W-277, W-312, and W-314.
a Number of individual samples collected at each well from 2007 to 2009.

Table 2.9-4 Summary of Groundwater Quality for Three Crow Vicinity

Constituent	Private Wells in AOR[a]		Three Crow Expansion Area Wells[b]		Three Crow Expansion Area Wells[c]	
	Brule Formation		Brule Formation		Basal Chadron Formation	
	Range	Mean	Range	Mean	Range	Mean
	mg/l (unless stated otherwise)					
Calcium	7 – 99	54	14 -101	50.25	8 - 24	13.0
Magnesium	1 – 9	4.2	1 - 14	4.96	2 - 7	3.7
Sodium	16 - 75	28.6	14 - 83	35	333 - 474	399
Potassium	6 - 20	11.7	6 - 12	9.1	6 - 9	9.6
Bicarbonate	170 - 313	227	194 - 478	246	353 - 418	396
Sulfate	4 - 75	19	9 -25	16.4	225 - 361	271.4
Chloride	1 - 42	10	4 - 23	8.54	166 - 274	186
Specific Conductance (µmhos/cm)	246 - 633	436	239 – 735	410	1690 - 2190	1867
Total Dissolved Solids (TDS)	215 - 448	313	221 - 499	302	980 - 1300	1098
pH (Std. units)	7.38 – 8.4	7.82	7.49 – 8.74	7.98	7.82 – 8.75	8.23
Anions (meq/l)	3.0 – 6.24	4.75	3.67 – 8.78	4.78	16.3 – 20.6	17.7
Cations (meq/l)	3.37 – 6.46	5.07	3.43 – 8.06	4.68	16 – 21.8	18.6
Uranium (mg/l)	0.008 – 0.0272	0.0161	0.0032– 0.0264	0.0134	0.0004 – 0.0385	0.0087
Dissolved Ra-226[d] (pCi/l)	0.006 – 0.5	0.28	0.065 – 0.41	0.126	0.23 - 181	18.1
Suspended Ra-226[d] (pCi/l)	--	--	0.04 – 0.20	0.087	--	--

[a] private water supply wells (2007 – 2009)
[b] CBR TCEA Brule monitor wells (includes Well 274 [Miller Well]) (2008 – 2009) [Note Suspended Ra-226 analyses were for 3 sampling events in 2009 for wells BOW 2006-5, BOW 2006-6 and BOW 2006-7]
[c] 10 CBR TCEA Basal Chadron monitor wells (2008 – 2009)
[d] Values less than detection limits reduced by one-half to provide a conservative estimate.
mg/l = milligrams/liter
meq/l = milliequivalents per liter
pCi/l = picocuries per liter
µmhos/cm = micromhos per centimeter

Table 2.9-5 Three Crow Expansion Area and Area of Review Private Well Dissolved Radiological Analytical Results 2007 - 2009

MAJOR IONS	UNITS	W-269		W-269		W-269		W-270		W-270		W-270		W-272		W-272		W-272	
		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<1.0	1.0	--	--	<1.0	1.0	<1.0	1.0	--	--	<1.0	1.0	<1.0	1.0	--	--	<1.0	1.0
Lead 210 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead 210 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polonium 210	pCi/L	<1.0	1.0	--	--	<1.0	1.0	<1.0	1.0	--	--	3.4	1.0	<1.0	1.0	--	--	2.7	1.0
Polonium 210 Precision (+)	pCi/L	--	--	--	--	0.5	--	--	--	--	--	2.8	--	--	--	--	--	2.5	--
Polonium 210 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226	pCi/L	<0.2	0.2	<0.2	0.2	0.5	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2
Radium 226 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorium 230	pCi/L	<0.2	0.2	--	--	<0.2	0.2	<0.2	0.2	--	--	<0.2	0.2	<0.2	0.2	--	--	<0.2	0.2
Thorium 230 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorium MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.0 13	0.0003	0.0184	0.0003	0.0185	0.0003	0.027	0.0003	0.0272	0.0003	0.0236	0.0003	0.014	0.0003	0.0145	0.0003	0.0127	0.0003

MAJOR IONS	UNITS	W-273		W-273		W-273		W-274		W-274		W-274		W-275		W-275		W-275	
		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007		Second Quarter 2007		Third Quarter 2007		Fourth Quarter 2007	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<1.0	1.0	--	--	Well Off		<1.0	1.0	--	--	<1.0	1.0	<1.0	1.0	--	--	<1.0	1.0
Lead 210 Precision (+)	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Lead 210 MDC	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Polonium 210	pCi/L	<1.0	1.0	--	--			<1.0	1.0	--	--	3.6	1.0	2.4	1.0	--	--	3.0	1.0
Polonium 210 Precision (+)	pCi/L	--	--	--	--			2.4	--	--	--	2.8	--	2.4	--	--	--	2.6	--
Polonium 210 MDC	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Radium 226	pCi/L	<0.2	0.2	<0.2	0.2			<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2
Radium 226 Precision (+)	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Radium 226 MDC	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Thorium 230	pCi/L	<0.2	0.2	--	--			<0.2	0.2	--	--	<0.2	0.2	<0.2	0.2	--	--	<0.2	0.2
Thorium 230 Precision (+)	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Thorium MDC	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	pCi/L	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.016	0.0003	0.0159	0.003			0.013	0.0003	0.0126	0.0003	0.0134	0.0003	0.0084	0.0003	0.0085	0.0003	0.0078	0.0003

Not detected at Reporting Limit.

Table 2.9-5 Three Crow Expansion Area and Area of Review Private Well Dissolved Radiological Analytical Results 2007 - 2009

MAJOR IONS	UNITS	W-277 Second Quarter 2007		W-277 Third Quarter 2007		W-277 Fourth Quarter 2007		W-313 Second Quarter 2007		W-313 Third Quarter 2007		W-313 Fourth Quarter 2007		W-313 Second Quarter 2007		W-314 Third Quarter 2007		W-314 Fourth Quarter 2007	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<1.0	1.0	--	--	<1/0	1.0	<1.0	1.0	--	--	<1.0	1.0	<1.0	1.0	--	--	<1.0	1.0
Lead 210 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead 210 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polonium 210	pCi/L	<1.0	1.0	--	--	3.4	1.0	<1.0	1.0	--	--	3.0	1.0	<1.0	1.0	--	--	2.3	1.0
Polonium 210 Precision (+)	pCi/L	--	--	--	--	2.6	--	--	--	--	--	2.3	--	--	--	--	--	2.1	--
Polonium 210 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226	pCi/L	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2
Radium 226 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226 MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorium 230	pCi/L	<0.2	0.2	--	--	<0.2	0.2	<0.2	0.2	--	--	<0.2	0.2	<0.2	0.2	--	--	<0.2	0.2
Thorium 230 Precision (+)	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorium MDC	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.017	0.0003	0.0191	0.0003	0.018	0.0003	0.012	0.0003	0.0118	0.0003	0.0107	0.0003	0.023	0.0003	0.023	0.0003	0.0339	0.0003

MAJOR IONS	UNITS	W-269 Second Quarter 2008		W-269 Third Quarter 2008		W-269 Fourth Quarter 2008		W-269 First Quarter 2009		W-270 Second Quarter 2008		W-270 Third Quarter 2008		W-270 Fourth Quarter 2008		W-270 First Quarter 2009		W-272 Second Quarter 2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<9.4	9.4	<7.4	7.4	<10.8	10.8	<3.2	3.2	<9.4	9.4	<12.5	12.5	<5.4	5.4	<3.8	3.8	<9.4	9.4
Lead 210 Precision (+)	pCi/L	5.6	--	4.5	--	6.6	--	1.9	--	5.6	--	7.4	--	3.3	--	2.3	--	5.6	--
Lead 210 MDC	pCi/L	9.4	--	7.4	--	10.8	--	3.2	--	9.4	--	12.5	--	5.4	--	3.8	--	9.4	--
Polonium 210	pCi/L	<0.1	0.1	<0.6	0.6	<0.3	0.3	<0.5	0.5	<0.4	0.4	<0.9	0.09	<0.2	0.2	<0.5	0.5	<0.4	0.4
Polonium 210 Precision (+)	pCi/L	0.1	--	0.6	--	0.3	--	0.3	--	0.4	--	0.9	--	0.2	--	0.3	--	0.4	--
Polonium 210 MDC	pCi/L	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--	0.5	--	--	--
Radium 226	pCi/L	<0.2	0.2	<0.3	0.3	<0.18	0.18	<0.08	0.08	<0.2	0.2	<0.26	0.26	<0.18	0.18	0.14	0.08	<0.2	0.2
Radium 226 Precision (+)	pCi/L	0.09	--	0.1	--	0.09	--	0.05	--	0.08	--	0.15	--	0.09	--	0.07	--	0.1	--
Radium 226 MDC	pCi/L	0.2	--	0.3	--	0.18	--	0.08	--	0.2	--	0.26	--	0.18	--	0.08	--	0.2	--
Thorium 230	pCi/L	<0.1	0.1	<0.1	0.1	<0.13	0.13	<0.2	0.2	<0.1	0.1	<0.1	0.1	<0.2	0.2	<0.1	0.1	<0.1	0.1
Thorium 230 Precision (+)	pCi/L	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.2	--	0.04	--	0.1	--
Thorium MDC	pCi/L	--	--	--	--	--	--	0.2	--	--	--	--	--	--	--	0.1	--	--	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.0185	0.0003	0.0136	0.0003	0.0185	0.0003	0.0107	0.0003	0.0242	0.0003	0.0258	0.0003	0.0252	0.0003	0.0232	0.0003	0.0145	0.0003

Not detected at Reporting Limit.

Table 2.9-5 Three Crow Expansion Area and Area of Review Private Well Radiological Analytical Results 2007 – 2009

MAJOR IONS	UNITS	W-272 Third Quarter 2008		W-272 Fourth Quarter 2008		W-272 First Quarter 2009		W-273 Second Quarter 2008		W-273 Third Quarter 2008		W-273 Fourth Quarter 2008		W-273 First Quarter 2009		W-274 Second Quarter 2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<12.5	12.5	<5.4	5.4	<5.5	5.5	<9.4	9.4	<7.4	7.4	Well Off		Well Off		1.1	NA
Lead 210 Precision (+)	pCi/L	7.4	--	3.3	--	3.3	--	ND*	--	4.5	--	No Data	No Data	No Data	No Data	3.5	--
Lead 210 MDC	pCi/L	12.5	--	5.4	--	5.5	--	5.9	--	7.4	--	No Data	No Data	No Data	No Data	5.9	--
Polonium 210	pCi/L	<0.4	0.4	<0.2	0.2	0.8	0.8	<1.0	1.0	<0.5	0.5	No Data	No Data	No Data	No Data	0.4	1.0
Polonium 210 Precision (+)	pCi/L	0.5	--	0.2	--	0.8	--	ND*	--	0.5	--	No Data	No Data	No Data	No Data	0.8	--
Polonium 210 MDC	pCi/L	--	--	--	--	0.8	--	--	--	--	--	No Data	No Data	No Data	No Data	--	--
Radium 226	pCi/L	<0.20	0.2	<0.18	0.18	0.36	0.08	0.006	NA	<0.30	0.30	No Data	No Data	No Data	No Data	0.1	NA
Radium 226 Precision (+)	pCi/L	0.15	--	0.13	--	0.15	--	0.1	--	0.1	--	No Data	No Data	No Data	No Data	0.1	--
Radium 226 MDC	pCi/L	0.23	--	0.18	--	0.18	--	0.2	--	0.3	--	No Data	No Data	No Data	No Data	0.2	--
Thorium 230	pCi/L	<0.1	0.1	0.3	0.2	<0.2	0.2	0.1*	0.2	<0.1	0.1	No Data	No Data	No Data	No Data	0.1	0.2
Thorium 230 Precision (+)	pCi/L	0.1	--	0.2	--	0.2	--	0.08	--	0.1	--	No Data	No Data	No Data	No Data	0.1	--
Thorium MDC	pCi/L	--	--	--	--	0.2	--	--	--	--	--	No Data	No Data	No Data	No Data	--	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--		--	--	No Data	No Data	No Data	No Data		
Uranium Activity	mg/l	0.0138	0.0003	0.014	0.0003	0.0139	0.0003	0.0152	0.0003	0.0164	0.0003	No Data	No Data	No Data	No Data	0.0125	0.0003

MAJOR IONS	UNITS	W-274 Third Quarter 2008		W-274 Fourth Quarter 2008		W-274 First Quarter 2009		W-275 Second Quarter 2008		W-275 Third Quarter 2008		W-275 Fourth Quarter 2008		W-275 First Quarter 2009		W-277 Second Quarter 2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<12.5	12,.5	<5.4	5.4	<2.8	2.8	<9.4	9.4	<7.4	7.4	<5.4	5.4	<5.5	5.5	<9.4	9.4
Lead 210 Precision (+)	pCi/L	7.4	--	3.2	--	1.7	--	5.5	--	4.5	--	3.2	--	3.3	--	5.5	--
Lead 210 MDC	pCi/L		12.5	5.4	--	2.8	--	9.4	--	7.4	--	5.4	--	5.5	--	9.4	--
Polonium 210	pCi/L	<0,5	0.5	<0.24	0.2	<0.5	0.5	0.9	0.9	<0.7	0.7	<0.17	0.17	<0.4	0.04	<0.2	0.2
Polonium 210 Precision (+)	pCi/L	1.0	--	0.2	--	0.4	--	0.9	--	0.7	--	0.2	--	0.3	--	0.2	--
Polonium 210 MDC	pCi/L	--	--	--	--	0.5	--	--	--	--	--	--	--	0.4	--	--	--
Radium 226	pCi/L	<0.25	0.25	<0.20	0.20	<0.19	0.19	<0.2	--	<0.3	0.3	<0.18	0.18	<0.19	0.19	<0.2	--
Radium 226 Precision (+)	pCi/L	0.14	--	0.13	--	0.1	--	0.08	--	0.2	--	0.12	--	0.1	--	0.1	--
Radium 226 MDC	pCi/L	0.25	--	0.2	--	0.19	--	0.2	--	0.3	--	0.18	--	0.19	--	0.2	--
Thorium 230	pCi/L	<0.2	0.2	0.3	0.2	<0.2	0.2	<0.1	0.1	<0.1	0.1	0.2	0.2	<0.1	0.1	<0.1	0.1
Thorium 230 Precision (+)	pCi/L	0.2	--	0.2	--	0.1	--	0.1	--	0.1	--	0.2	--	0.05	--	0.1	--
Thorium MDC	pCi/L	--	--	--	--	0.2	--	--	--	--	--	--	--	0.1	--	--	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.0122	0.0003	0.0123	0.0003	0.0118	0.0003	0.008	0.0003	0.0083	0.0003	0.0087	0.0003	0.008	0.0003	0.0181	0.0003

Not detected at Reporting Limit.

Table 2.9-5 Three Crow Expansion Area and Area of Review Private Well Radiological Analytical Results 2007 - 2009

MAJOR IONS	UNITS	W-277 Third Quarter 2008		W-277 Fourth Quarter 2008		W-277 First Quarter 2009		W-313 Second Quarter 2008		W-313 Third Quarter 2008		W-313 Fourth Quarter 2008		W-313 First Quarter 2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<12.5	12.5	<5.4	5.4	<3.8	3.8	<28.8	28.8	<12.5	12.5	<4.1	4.1	<3.2	3.2
Lead 210 Precision (+)	pCi/L	7.3	--	3.2	--	2.3	--	16.9	--	7.3	--	2.5	--	1.9	--
Lead 210 MDC	pCi/L	12.5	--	5.4	--	3.8	--	28.8	--	12.5	--	4.1	--	3.2	--
Polonium 210	pCi/L	<0.6	0.6	<0.2	0.2	<0.5	0.5	<1.0	1.0	<0.7	0.7	<0.3	0.3	<0.5	0.5
Polonium 210 Precision (+)	pCi/L	0.6	--	0.2	--	0.2	--	0.4	--	0.7	--	0.3	--	0.3	--
Polonium 210 MDC	pCi/L	--	--	--	--	0.5	--	--	--	--	--	--	--	0.5	--
Radium 226	pCi/L	<0.21	0.21	<0.19	0.19	<0.08	0.08	<0.1	0.1	<0.3	0.3	<0.17	0.17	0.17	0.11
Radium 226 Precision (+)	pCi/L	0.13	--	0.11	--	0.06	--	0.08	--	0.1	--	0.07	--	0.1	--
Radium 226 MDC	pCi/L	0.21	--	0.19	--	0.08	--	0.1	--	0.3	--	0.17	--	0.11	--
Thorium 230	pCi/L	<0.1	0.1	<0.21	0.21	<0.1	0.1	<0.1	0.1	<0.06	0.06	<0.1	0.1	<0.2	0.2
Thorium 230 Precision (+)	pCi/L	0.1	--	0.2	--	0.06	--	0.1	--	0.06	--	0.1	--	0.1	--
Thorium MDC	pCi/L	--	--	--	--	0.1	--	--	--	--	--	--	--	0.2	0.2
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.0181	0.0003	0.0161	0.0003	0.0156	0.0003	0.0116	0.0003	0.0114	0.0003	0.0103	0.0003	0.0114	0.0003

MAJOR IONS	UNITS	W-314 Second Quarter 2008		W-314 Third Quarter 2008		W-314 Fourth Quarter 2008		W-314 First Quarter 2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
Lead 210	pCi/L	<29.3	29.3	<12.5	12.5	<4.1	4.1	<2.8	2.8
Lead 210 Precision (+)	pCi/L	17.5	--	7.3	--	2.4	--	1.6	--
Lead 210 MDC	pCi/L	29.3	--	12.5	--	4.1	--	2.8	--
Polonium 210	pCi/L	<1.0	1.0	<1.0	1.0	<0.2	0.2	<0.7	0.7
Polonium 210 Precision (+)	pCi/L	0.1	--	1.0	--	0.2	--	0.5	--
Polonium 210 MDC	pCi/L	--	--	--	--	--	--	0.7	--
Radium 226	pCi/L	0.2	0.1	<0.23	0.23	<0.17	0.17	<0.18	0.18
Radium 226 Precision (+)	pCi/L	0.1	--	0.14	--	0.07	--	0.1	--
Radium 226 MDC	pCi/L	0.1	--	0.23		0.17	--	0.18	--
Thorium 230	pCi/L	<0.1	0.1	<0.08	0.08	<0.1	0.1	<0.2	0.2
Thorium 230 Precision (+)	pCi/L	0.1	--	0.08	--	0.1	--	0.08	--
Thorium MDC	pCi/L	--	--	--	--	--	--	0.2	--
Uranium Activity	pCi/L	--	--	--	--	--	--	--	--
Uranium Activity	mg/l	0.0237	0.0003	0.0221	0./0003	0.0205	0.0003	0.0233	0.0003

Not detected at Reporting Limit.

Table 2.9-6 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results - Third Quarter 2007

MAJOR IONS	UNITS	WELL-269		WELL-270		WELL-272		WELL-273		WELL-274		WELL-275		WELL-277		WELL-282	
		9/17/2007		9/14/2007		9/14/2007		9/14/2007		9/14/2007		9/14/2007		9/14/2007		9/14/2007	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	206	1.0	162	1.0	238	1.0	239	1.0	247	1.0	145	1.0	168	1.0	169	1
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1
BICARBONATE AS HCO3	mg/L	251	1.0	198	1.0	290	1.0	292	1.0	301	1.0	177	1.0	205	1.0	206	1
CALCIUM	mg/L	58	1.0	89	1.0	83	1.0	83	1.0	83	1.0	43	1.0	67	1.0	49	1
CHLORIDE	mg/L	5	1.0	40	1.0	7	1.0	6	1.0	4	1.0	1	1.0	8	1.0	2	1
FLUORIDE	mg/L	0.7	0.1	0.4	0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.5	0.1	0.4	0.1	0.5	0.1
MAGNESIUM	mg/L	3	1.0	3	1.0	7	1.0	7	1.0	9	1.0	3	1.0	4	1.0	6	1
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.1	0.1	14.3	0.1	3.3	0.1	2.3	0.1	2.6	0.1	0.6	0.1	3.9	0.1	1	0.1
NITROGEN, NITRITE AS N	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
POTASSIUM	mg/L	18	1.0	19	1.0	9	1.0	9	1.0	6	1.0	6	1.0	11	1.0	6	1
SILICA	mg/L	45.7	0.1	46.1	0.1	60.3	0.1	60.3	0.1	60.1	0.1	66.8	0.1	54.8	0.1	66.5	0.1
SODIUM	mg/L	33	1.0	25	1.0	19	1.0	22	1.0	23	1.0	18	1.0	18	1.0	19	1
SULFATE	mg/L	11	1.0	36	1.0	15	1.0	13	1.0	12	1.0	5	1.0	20	1.0	5	1
PHYSICAL PROPERTIES																	
CONDUCTIVITY	umhos/cm	405	1.0	633	1.0	501	1.0	474	1.0	482	1.0	249	1.0	383	1.0	294	1
pH	s.u.	7.78	0.01	7.78	0.01	7.72	0.01	7.7	0.01	7.83	0.01	7.99	0.01	7.83	0.01	7.93	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	276	10	448	10	354	10	334	10	336	10	234	10	290	10	256	10
METALS, DISSOLVED																	
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.003	0.001	0.002	0.001	0.004	0.001	0.004	0.001	0.004	0.001	0.004	0.001	0.003	0.001	0.003	0.001
BARIUM	mg/L	<0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	<0.1	0.1	0.2	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0,005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0,01	0.01	<0.01	0.01	0.06	0.01	<0.-01	0.01	<0.01	0.01
IRON	mg/L	0.1	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.01	0.1	<01	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.002	0.001	0.012	0.001	0.003	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.005	0.001	<0.005	0.001
URANIUM	mg/L	0.0184	0.0003	0.0272	0.0003	0.0145	0.0003	0.0159	0.0003	0.0126	0.0003	0.0085	0.0003	0.0191	0.0003	0.012	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.01	0.017	0.01	0.06	0.01	0.08	0.01	0.04	0.01
DATA QUALITY																	
A/C BALANCE (± 5)	%	4.43		1.06		2		4.02		4.72		4.3		4.56			
ANIONS	meq/L	4.59		6.15		5.54		5.43		5.53		3.11		4.31			
CATIONS	meq/L	5.02		6.28		5.77		5.88		6.07		3.39		4.72			
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	302		419		359		355		359		234		302			
TDS BALANCE (0.80-1.20)	dec. %	0.91		1.07		0.99		0.94		0.94		1		0.96			

Table 2.9-6 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results - Third Quarter 2007

MAJOR IONS	UNITS	WELL-313		WELL-314	
		9/19/2007		9/17/2007	
		RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	168	1.0	168	1.0
CARBONATE AS CO3	mg/L	3	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	199	1.0	205	1.0
CALCIUM	mg/L	7	1.0	54	1.0
CHLORIDE	mg/L	4	1.0	17	1.0
FLUORIDE	mg/L	0.4	0.1	0.4	0.1
MAGNESIUM	mg/L	<1.0	1.0	2.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1	0.1	1.0	0.1
NITROGEN, NITRITE AS N	mg/L	<0.1	0.1	<0.1	0.1
POTASSIUM	mg/L	12	1.0	20	1.0
SILICA	mg/L	61.9	0.1	54.1	0.1
SODIUM	mg/L	75	1.0	40	1.0
SULFATE	mg/L	10	1.0	40	1.0
PHYSICAL PROPERTIES					
CONDUCTIVITY	umhos/cm	331	1.0	437	1.0
pH	s.u.	8.32	0.01	7.95	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	270	10	306	10
METALS, DISSOLVED					
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.01	0.001	0.003	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01
IRON	mg/L	0.04	0.03	0.1	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.003	0.001	0.009	0.001
URANIUM	mg/L	0.0118	0.0003	0.023	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.01	0.01	0.03	0.01
DATA QUALITY					
A/C BALANCE (± 5)	%	2.45		3.59	
ANIONS	meq/L	3.77		4.77	
CATIONS	meq/L	3.96		5.13	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	276		333	
TDS BALANCE (0.80-1.20)	dec. %	0.98		0.92	

Table 2.9-7 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Second Quarter 2008

MAJOR IONS	UNITS	WELL-269(SULZBACH) 5/23/2008		WELL-270 5/23/2008		WELL-272 5/23/2008		WELL-273 5/30/2008		WELL-274 5/30/2008		WELL-275 5/23/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	195	1.0	158	1.0	225	1.0	221	1.0	231	1.0	140	1.0
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	238	1.0	192	1.0	275	1.0	270	1.0	282	1.0	170	1.0
CALCIUM	mg/L	58	1.0	96	1.0	99	1.0	82	1.0	85	1.0	44	1.0
CHLORIDE	mg/L	2.0	1.0	34	1.0	7.0	1.0	6.0	1.0	3.0	1.0	<1.0	1.0
FLUORIDE	mg/L	0.7	0.1	0.4	0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.4	0.1
MAGNESIUM	mg/L	3.0	1.0	3.0	1.0	7.0	1.0	6.0	1.0	9.0	1.0	4.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.09	0.05	16.8	0.05	9.17	0.05	2.45	0.05	2.83	0.05	0.65	0.05
NITROGEN, NITRITE AS N	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
POTASSIUM	mg/L	18	1.0	18	1.0	10	1.0	9.0	1.0	6.0	1.0	6.0	1.0
SILICA	mg/L	25.5	0.1	25.7	0.1	32.7	0.1	35	0.1	34.8	0.1	35.9	0.1
SODIUM	mg/L	32	1.0	22	1.0	16	1.0	20	1.0	21	1.0	18	1.0
SULFATE	mg/L	11	1.0	32	1.0	18	1.0	14	1.0	13	1.0	5.0	1.0
PHYSICAL PROPERTIES													
CONDUCTIVITY	umhos/cm	416	1.p	584	1.0	545	1.0	486	1.0	498	1.0	286	1.0
pH	s.u.	7.61	0.01	7.74	0.01	7.72	0.01	7.72	0.01	7.61	0.01	8.03	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	266	10	414	10	365	10	336	10	336	10	215	10
METALS, DISSOLVED													
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.003	0.001	0.002	0.001	0.004	0.001	0.003	0.001	0.003	0.001	0.003	0.001
BARIUM	mg/L	<0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.1
BORON	mg/L	<0.1	0.1	<0.,1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0,005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0,05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0,01	0.01	0.01	0.01	<0.01	0.01	<0..01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	0.12	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.002	0.001	0.01	0.001	0.002	0.001	0.002	0.001	0.002	0.001	<0.001	0.001
URANIUM	mg/L	0.0185	0.0003	0.0242	0.0003	0.0145	0.0003	0.0152	0.0003	0.0125	0.0003	0.008	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.03	0.01	0.02	0.01	0.1	0.01	0.03	0.01	0.19	0.01	0.04	0.01
THORIUM 230 precision(±)	pCi/L	0.1		0.1		0.1		0.08		0.1		0.1	
DATA QUALITY													
A/C BALANCE (± 5)	%	7.7		3.78		5.71		6.01		7.64		6.87	
ANIONS	meq/L	4.29		5.99		5.74		5.09		5.2		3	
CATIONS	meq/L	5		6.46		6.44		5.74		6.06		3.44	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	279		407		373		326		333		211	
TDS BALANCE (0.80-1.20)	dec. %	0.95		1.02		0.98		1.03		1.01		1.02	

Table 2.9-7 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Second Quarter 2008

MAJOR IONS	UNITS	WELL-277		WELL-313		WELL-314	
		5/23/2008		5/16/2008		5/16/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	156	1,0	159	1.0	156	1.0
CARBONATE AS CO3	mg/L	<1.0	1,0	<1.0	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	190	1,0	194	1.0	190	1.0
CALCIUM	mg/L	62	1.0	7.0	1.0	54	1.0
CHLORIDE	mg/L	6	1.0	3.0	1.0	18	1.0
FLUORIDE	mg/L	0.4	0.1	0.4	0.1	0.4	0.1
MAGNESIUM	mg/L	4	1.0	<1.0	1.0	2.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	3.8	0.05	0.9	0.05	1.0	0.05
NITROGEN, NITRITE AS N	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1
POTASSIUM	mg/L	10	1.0	11	1.0	19	1.0
SILICA	mg/L	28.8	0.1	36.2	0.1	30.5	0.1
SODIUM	mg/L	19	1.0	74	1.0	38	1.0
SULFATE	mg/L	20	1.0	11	1.0	38	1.0
PHYSICAL PROPERTIES							
CONDUCTIVITY	umhos/cm	391	1.0	349	1.0	454	1.0
pH	s.u.	7.72	0.01	8.11	0.01	7.94	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	276	10	268	10	315	10
METALS, DISSOLVED							
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.003	0.001	0.009	0.001	0.003	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1
BORON	mg/L	0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	0.01	0.01	<0,01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	0.06	0.03	0.06	0.03
LEAD	mg/L	<0.001	0.001	0.002	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.004	0.001	0.003	0.001	0.009	0.001
URANIUM	mg/L	0.0181	0.0003	0.0116	0.0003	0.0237	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.21	0.01	0.03	0.01	0.03	0.01
DATA QUALITY							
A/C BALANCE (± 5)	%	5.66		3.93		5.21	
ANIONS	meq/L	3.99		3.58		4.49	
CATIONS	meq/L	4.47		3.87		4.98	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	268		252		306	
TDS BALANCE (0.80-1.20)	dec. %	1.03		1.06		1.03	

Table 2.9-8 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Third Quarter 2008

MAJOR IONS	UNITS	WELL-269		WELL-270		WELL-272		WELL-273		WELL-274		WELL-275		WELL-277	
		7/21/2008		7/29/2008		7/29/2008		7/21/2008		7/25/2008		7/21/2008		7/29/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	203	1.0	161	1.0	257	1.0	230	1.0	237	1.0	144	1.0	162	1.0
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	248	1.0	196	1.0	313	1.0	281	1.0	289	1.0	175	1.0	197	1.0
CALCIUM	mg/L	66	1.0	84	1.0	83	1.0	85	1.0	67	1.0	44	1.0	55	1.0
CHLORIDE	mg/L	5.0	1.0	42	1.0	9.0	1.0	7.0	1.0	4.0	1.0	1.0	1.0	8.0	1.0
FLUORIDE	mg/L	0.8	0.1	0.4	0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.5	0.1	0.4	0.1
MAGNESIUM	mg/L	5.0	1.0	3.0	1.0	6.0	1.0	7.0	1.0	8	1.0	4.0	1.0	3.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.5	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.3	0.1	16	0.05	5.45	0.05	2.4	0.1	2.43	0.05	0.6	0.1	4.61	0.05
NITROGEN, NITRITE AS N	mg/L														
POTASSIUM	mg/L	12	1.0	19	1.0	9.0	1.0	8.0	1.0	7.0	1.0	6.0	1.0	11	1.0
SILICA	mg/L	68.4	0.2	11.1	0.1	14.9	0.1	77.5	0.2	15.2	0.1	83.6	0.2	13.3	0.1
SODIUM	mg/L	24	1.0	24	1.0	18	1.0	20	1.0	25	1.0	17	1.0	19	1.0
SULFATE	mg/L	12	1.0	33	1.0	15	1.0	12	1.0	9.0	1.0	4.0	1.0	18	1.0
PHYSICAL PROPERTIES															
CONDUCTIVITY	umhos/cm	442	1.0	632	1.0	539	1.0	499	1.0	488	1.0	296	1.0	404	1.0
pH	s.u.	7.38	0.01	7.63	0.01	7.49	0.01	7.4	0.01	7.67	0.01	7.73	0.01	7.67	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	300	10	425	10	362	10	336	10	325	10	216	10	271	10
METALS, DISSOLVED															
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.004	0.001	0.002	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.003	0.001
BARIUM	mg/L	<0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	<0.1	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1	<.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0,05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	0.11	0.03	<0.03	0.03
LEAD	mg/L	<0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0,01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.003	0.001	0.011	0.001	0.003	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.005	0.001
URANIUM	mg/L	0.0136	0.0003	0.0258	0.0003	0.0138	0.0003	0.0164	0.0003	0.0122	0.0003	0.0083	0.0003	0.0181	0.0003
VANADIUM	mg/L	<01	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.03	0.01	0.02	0.01	0.07	0.01	0.03	0.01	0.1	0.01	0.04	0.01	0.09	0.01
DATA QUALITY															
A/C BALANCE (± 5)	%	4.94		-2.36		-4.06		5.72		-0.363		4.73		-0.906	
ANIONS	meq/L	4.58		6.24		6.12		5.23		5.26		3.07		4.2	
CATIONS	meq/L	5.06		5.95		5.64		5.87		5.22		3.37		4.12	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	339		386		337		386		293		271		250	
TDS BALANCE (0.80-1.20)	dec. %	0.88		1.1		1.07		0.87		1.11		0.8		1.08	

Table 2.9-8 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Third Quarter 2008

MAJOR IONS	UNITS	WELL-313 7/29/2008		WELL-314 7/25/2008	
		RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	166	1.0	173	1.0
CARBONATE AS CO3	mg/L	5.0	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	194	1.0	211	1.0
CALCIUM	mg/L	7.0	1.0	60	1.0
CHLORIDE	mg/L	5.0	1.0	21	1.0
FLUORIDE	mg/L	0.4	0.1	0.4	0.1
MAGNESIUM	mg/L	<1.0	1.0	2.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	0.92	0.05	1.19	0.05
NITROGEN, NITRITE AS N	mg/L				
POTASSIUM	mg/L	12	1.0	20	1.0
SILICA	mg/L	14.6	0.1	13.1	0.1
SODIUM	mg/L	72	1.0	33	1.0
SULFATE	mg/L	9.0	1.0	49	1.0
PHYSICAL PROPERTIES					
CONDUCTIVITY	umhos/cm	351	1.0	503	1.0
pH	s.u.	8.31	0.01	7.81	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	259	10	337	10
METALS, DISSOLVED					
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.007	0.001	0.002	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	0.04	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	>0.05	0.05
SELENIUM	mg/L	0.002	0.001	0.009	0.001
URANIUM	mg/L	0.0114	0.0003	0.0221	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.02	0.01	0.08	0.01
DATA QUALITY					
A/C BALANCE (± 5)	%	0.909		-0.529	
ANIONS	meq/L	3.72		5.17	
CATIONS	meq/L	3.79		5.11	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	227		311	
TDS BALANCE (0.80-1.20)	dec. %	1.14		1.08	

Table 2.9-9 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Fourth Quarter 2008

MAJOR IONS	UNITS	WELL-269		WELL-270		WELL-272		WELL-273		WELL-274		WELL-275		WELL-277	
		11/14/2008		11/14/2008		11/14/2008				11/14/2008		11/14/2008		11/14/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	199	1	156	1	232	1	WELL OFF UNTIL SPRING		243	1	145	1	142	1
CARBONATE AS CO3	mg/L	ND	1	ND	1	ND	1			ND	1	ND	1	ND	1
BICARBONATE AS HCO3	mg/L	243	1	190	1	283	1			296	1	177	1	174	1
CALCIUM	mg/L	49	1	92	1	88	1			80	1	41	1	56	1
CHLORIDE	mg/L	4	1	38	1	8	1			4	1	1	1	7	1
FLUORIDE	mg/L	0.7	0.1	0.4	0.1	0.5	0.1			0.6	0.1	0.5	0.1	0.5	0.1
MAGNESIUM	mg/L	2	1	3	1	6	1			9	1	3	1	3	1
NITROGEN, AMMONIA AS N	mg/L	ND	0.05	ND	0.05	ND	0.05			ND	0.05	ND	0.05	ND	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.17	0.05	16.1	0.05	5.29	0.05			2.82	0.05	0.67	0.05	2.84	0.05
POTASSIUM	mg/L	16	1	17	1	9	1			6	1	6	1	9	1
SILICA	mg/L	50.2	0.2	52.3	0.2	67	0.2			64.2	0.2	73.9	0.2	53.8	0.2
SODIUM	mg/L	29	2	22	2	16	2			20	2	17	2	16	2
SULFATE	mg/L	9	1	30	1	13	1			10	1	4	1	13	1
PHYSICAL PROPERTIES															
CONDUCTIVITY	umhos/cm	381	1	592	1	493	1			468	1	246	1	345	1
pH	s.u.	7.74	0.01	7.82	0.01	7.69	0.01			7.88	0.01	8.15	0.01	7.94	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	284	10	440	10	374	10			337	10	227	10	285	10
METALS, DISSOLVED															
ALUMINUM	mg/L	ND	0.1	ND	0.1	ND	0.1			ND	0.1	ND	0.1	ND	0.1
ARSENIC	mg/L	0.003	0.001	ND	0.001	0.003	0.001			0.003	0.001	0.003	0.001	0.002	0.001
BARIUM	mg/L	ND	0.1	0.1	0.1	0.2	0.1			0.1	0.1	0.2	0.1	ND	0.1
BORON	mg/L	ND	0.1	ND	0.1	ND	0.1			ND	0.1	ND	0.1	ND	0.1
CADMIUM	mg/L	ND	0.005	ND	0.005	ND	0.005			ND	0.005	ND	0.005	ND	0.005
CHROMIUM	mg/L	ND	0.05	ND	0.05	ND	0.05			ND	0.05	ND	0.05	ND	0.05
COPPER	mg/L	ND	0.01	ND	0.01	ND	0.01			ND	0.01	ND	0.01	ND	0.01
IRON	mg/L	ND	0.03	ND	0.03	ND	0.03			ND	0.03	0.08	0.03	ND	0.03
LEAD	mg/L	ND	0.001	ND	0.001	ND	0.001			0.003	0.001	ND	0.001	ND	0.001
MANGANESE	mg/L	ND	0.01	ND	0.01	ND	0.01			ND	0.01	ND	0.01	ND	0.01
MERCURY	mg/L	ND	0.001	ND	0.001	ND	0.001			ND	0.001	ND	0.001	ND	0.001
MOLYBDENUM	mg/L	ND	0.1	ND	0.1	ND	0.1			ND	0.1	ND	0.1	ND	0.1
NICKEL	mg/L	ND	0.05	ND	0.05	ND	0.05			ND	0.05	ND	0.05	ND	0.05
SELENIUM	mg/L	0.002	0.001	0.012	0.001	0.002	0.001			ND	0.001	ND	0.001	0.004	0.001
URANIUM	mg/L	0.0185	0.0003	0.0252	0.0003	0.014	0.0003			0.0123	0.0003	0.0087	0.0003	0.0161	0.0003
VANADIUM	mg/L	ND	0.1	ND	0.1	ND	0.1			ND	0.1	ND	0.1	ND	0.1
ZINC	mg/L	0.02	0.01	0.03	0.01	0.12	0.01			1.24	0.01	0.03	0.01	0.16	0.01
DATA QUALITY															
A/C BALANCE (± 5)	%	-0.938		2.05		2.59				3.28		1.95		5.94	
ANIONS	meq/L	4.38		5.99		5.54				5.39		3.09		3.56	
CATIONS	meq/L	4.3		6.24		5.84				5.75		3.21		4.01	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	297		434		388				368		256		272	
TDS BALANCE (0.80-1.20)	dec. %	0.96		1.01		0.96				0.92		0.89		1.05	

Table 2.9-9 Three Crow Expansion Area and Area of Review Private Water Well Non-Radiological Analytical Results – Fourth Quarter 2008

MAJOR IONS	UNITS	WELL-313		WELL-314	
		11/12/2008		11/12/2008	
		RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	165	1	165	1
CARBONATE AS CO3	mg/L	5	1	ND	1
BICARBONATE AS HCO3	mg/L	191	1	201	1
CALCIUM	mg/L	7	1	58	1
CHLORIDE	mg/L	4	1	18	1
FLUORIDE	mg/L	0.4	0.1	0.4	0.1
MAGNESIUM	mg/L	ND	1	2	1
NITROGEN, AMMONIA AS N	mg/L	ND	0.05	ND	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	0.95	0.05	1.05	0.05
POTASSIUM	mg/L	12	1	20	1
SILICA	mg/L	81.2	0.2	67.8	0.2
SODIUM	mg/L	74	2	32	2
SULFATE	mg/L	9	1	42	1
PHYSICAL PROPERTIES					
CONDUCTIVITY	umhos/cm	341	1	470	1
pH	s.u.	8.4	0.01	7.95	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	264	10	327	10
METALS, DISSOLVED					
ALUMINUM	mg/L	ND	0.1	NED	0.1
ARSENIC	mg/L	0.01	0.001	0.003	0.001
BARIUM	mg/L	ND	0.1	ND	0.1
BORON	mg/L	ND	0.1	ND	0.1
CADMIUM	mg/L	ND	0.005	ND	0.005
CHROMIUM	mg/L	ND	0.05	ND	0.05
COPPER	mg/L	ND	0.01	ND	0.01
IRON	mg/L	0.07	0.03	ND	0.03
LEAD	mg/L	ND	0.001	ND	0.001
MANGANESE	mg/L	ND	0.01	ND	0.01
MERCURY	mg/L	ND	0.001	ND	0.001
MOLYBDENUM	mg/L	ND	0.1	ND	0.1
NICKEL	mg/L	ND	0.05	ND	0.05
SELENIUM	mg/L	0.003	0.001	0.01	0.001
URANIUM	mg/L	0.0103	0.0003	0.0205	0.0003
VANADIUM	mg/L	ND	0.1	ND	0.1
ZINC	mg/L	0.02	0.01	0.15	0.01
DATA QUALITY					
A/C BALANCE (± 5)	%	2.25		1.84	
ANIONS	meq/L	3.68		4.76	
CATIONS	meq/L	3.85		4.94	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	311		361	
TDS BALANCE (0.80-1.20)	dec. %	0.85		0.91	

Table 2.9-10 Water Levels – Brule Formation and Basal Chadron Sandstone (January 2009 and 2010)

Well	1/9/2009	1/30/2009	1/22/2010 & 2/8/2010
BRULE FORMATION			
BOW 2006-1	3862.90	3863.34	3863.83
BOW 2006-2	3879.01	3879.07	3878.50
BOW 2006-3	3878.25	3878.05	3877.20
BOW 2006-4	3857.78	3857.50	3861.58
BOW 2006-5	NM	NM	3842.83
BOW 2006-6	NM	NM	3904.43
BOW 2006-7	NM	NM	3913.02
Well 273 (Miller Well)	NM	NM	3819.13
BASAL CHADRON SANDSTONE			
CPW2006-2	3,721.22	3,721.01	3,717.26
COW2006-1	3,723.94	3,723.64	3,720.36
COW2006-2	3,721.11	3,720.85	3,717.13
COW2006-3	3,720.43	3,720.22	3,716.73
COW2006-4	3,720.81	3,720.46	3,717.02
COW2006-5	3,720.26	3,720.03	3,716.46
COW2006-6	3,713.43	3,712.89	3,708.23
COW2006-7	3,711.76	3,712.20	3,707.55
UBCOW2006-1	3,720.51	3,720.36	3,716.73
UBCOW2006-2	3,720.84	3,720.61	3,716.96

Table 2.9-11 Three Crow Expansion Area Monitor Well Radiological (Dissolved) Results 2008-2009

MAJOR IONS	UNITS	COW 2006-1 12/2/2008		COW 2006-1 12/16/2008		COW 2006-1 1/5/2009		COW 2006-2 12/2/2008		COW 2006-2 12/16/2008		COW 2006-2 1/5/2009		COW 2006-3 12/3/2008		COW 2006-3 1/5/2009		COW 2006-3 12/17/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	0.0014	0.0003	0.0016	0.0003	0.0014	0.0003	0.0294	0.0003	0.0339	0.0003	0.0294	0.0003	0.0042	0.0003	0.004	0.0003	0.0046	0.0003
RADIONUCLIDES-DISSOLVED																			
LEAD 210	pCi/L	<4.1	4.1	<4.4	4.4	<4.9	4.9	583	8.3	295	4.4	140	4.9	<4.1	4.1	<4.9	4.9	<8.8	8.8
LEAD 210 precision(±)	pCi/L	2.5		2.6		2.9		11		5.6		4.6		2.5		2.9		5.3	
LEAD 210 MDC	pCi/L	4.1		4.4		4.9		8.3		4.4		4.9		4.1		4.9		8.8	
POLONIUM 210	pCi/L	<0.20	0.2	<0.5	0.5	<0.3	0.3	8.8	2.1	24	5.3	12	2.8	<.48	0.48	<0.3	0.3	<0.2	0.2
POLONIUM 210 precision(±)	pCi/L	0.2		0.5		0.3		2.1		5.3		2.8		0.48		0.3		0.2	
POLONIUM MDC	pCi/L																		
RADIUM 226	pCi/L	1.6	0.16	2.1	0.19	2.6	0.23	181	0.16	157	0.17	150	0.21	5.4	0.17	5.2	0.22	4.8	0.17
RADIUM 226 precision(±)	pCi/L	0.24		0.29		0.36		2.4		2.2		2.4		0.43		0.48		0.4	
RADIUM 226 MDC	pCi/L	0.16		0.19		0.23		0.16		0.17		0.21		0.17		0.22		0.17	
THORIUM 230	pCi/L	<.17	0.17	<0.2	0.2	<0.09	0.09	1.6	0.52	0.8	0.4	0.9	0.3	<.15	0.15	<0.07	0.07	<0.1	0.1
THORIUM 230 precision(±)	pCi/L	0.2		0.2		0.09		0.5		0.4		0.3		0.1		0.07		0.1	
THORIUM 230 MDC	pCi/L																		

MAJOR IONS	UNITS	COW 2006-4 12/1/2008		COW 2006-4 12/15/2008		COW 2006-4 1/6/2009		COW 2006-5 1/16/2009		COW 2006-5 1/30/2009		COW 2006-5 2/13/2009		COW 2006-6 1/16/2009		COW 2006-6 1/30/2009		COW 2006-6 2/13/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	0.0013	0.0003	0.0012	0.0003	0.0012	0.0003	0.0013	0.0003	0.0012	0.0003	0.0011	0.0003	0.001	0.0003	0.0006	0.0003	0.0004	0.0003
RADIONUCLIDES-DISSOLVED																			
LEAD 210	pCi/L	<4.1	4.1	<4.4	4.4	<3.2	3.2	<4.00	4	<3.2	3.2	<2.80	2.8	<4.00	4	<4.4	4.4	<2.80	2.8
LEAD 210 precision(±)	pCi/L	2.4		2.6		1.9		2.3		1.9		1.7		2.4		2.7		1.7	
LEAD 210 MDC	pCi/L	4.1		4.4		3.2		4		3.2		2.8		4		4.4		2.8	
POLONIUM 210	pCi/L	<.26	0.26	<0.4	0.4	<0.5	0.5	<.29	0.3	<0.7	0.7	<0.69	0.7	<.23	0.2	<0.5	0.5	15.2	1.8
POLONIUM 210 precision(±)	pCi/L	0.26		0.4		0.5		0.3		0.3		0.3		0.2		0.2		7.6	
POLONIUM MDC	pCi/L									0.7		0.7				0.5		1.8	
RADIUM 226	pCi/L	0.78	0.18	1.4	0.17	0.85	0.22	0.86	0.19	0.94	0.2	0.33	0.2	2.5	0.2	2.2	0.2	0.85	0.2
RADIUM 226 precision(±)	pCi/L	0.18		0.23		0.23		0.2		0.23		0.16		0.32		0.33		0.21	
RADIUM 226 MDC	pCi/L	0.18		0.17		0.22		0.19		0.2		0.2		0.2		0.2		0.2	
THORIUM 230	pCi/L	<0.31	0.31	<0.09	0.09	<0.09	0.09	<0.08	0.08	<0.1	0.1	<0.20	0.2	<0.11	0.1	<0.1	0.1	<0.20	0.2
THORIUM 230 precision(±)	pCi/L	0.31		0.1		0.09		0.1		0.1		0.1		0.1		0.1		0.09	
THORIUM 230 MDC	pCi/L											0.2						0.2	

Table 2.9-11 Three Crow Expansion Area Monitor Well Radiological (Dissolved) Results 2008-2009

MAJOR IONS	UNITS	COW 2006-7 1/16/2009		COW 2006-7 1/30/2009		COW 2006-7 2/13/2009		CPW 2006-2 11/24/2008		CPW 2006-2 12/8/2008		CPW 2006-2 12/22/2008		UBCOW 2006-1 11/24/2008		UBCOW 2006-1 12/8/2008		UBCOW 2006-1 12/22/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	0.0053	0.0003	0.0056	0.0003	0.0052	0.0003	0.0385	0.0003	0.038	0.0003	0.0335	0.0003	0.0026	0.0003	0.0025	0.0003	0.0021	0.0003
RADIONUCLIDES-DISSOLVED																			
LEAD 210	pCi/L	<4.00	8.8	<3.2	3.2	<2.80	2.8	<4.4	4.4	<4.6	4.6	<4.0	4	<4.4	4.4	<9.2	9.2	<4.0	4
LEAD 210 precision(±)	pCi/L	2.4		1.9		1.7		2.6		2.8		2.4		2.6		5.4		2.4	
LEAD 210 MDC	pCi/L	4		3.2		2.8		4.4		4.6		4		4.4		9.2		4	
POLONIUM 210	pCi/L	<0.24	0.2	<0.4	0.4	<0.41	0.4	<1.2	0.2	<.31	0.31	<0.21	0.21	<0.3	0.3	<.21	0.21	<0.28	0.28
POLONIUM 210 precision(±)	pCi/L	0.2		0.2		0.2		0.2		0.31		0.21		0.3		0.21		0.28	
POLONIUM MDC	pCi/L			0.4		0.4													
RADIUM 226	pCi/L	2.7	0.17	0.26	0.25	1.7	0.21	5.3	0.23	5.5	0.22	4.5	0.11	0.71	0.18	0.32	0.19	0.57	0.17
RADIUM 226 precision(±)	pCi/L	0.32		0.18		0.28		0.49		0.48		0.41		0.19		0.15		0.16	
RADIUM 226 MDC	pCi/L	0.19		0.25		0.21		0.23		0.22		0.11		0.18		0.19		0.17	
THORIUM 230	pCi/L	<0.08	0.1	<0.2	0.2	<0.22	0.2	0.6	0.4	<0.09	0.09	<0.36	0.36	0.5	0.3	<0.12	0.12	<0.22	0.22
THORIUM 230 precision(±)	pCi/L	0.08		0.2		0.1		0.4				0.36		0.3		0.12		0.22	
THORIUM 230 MDC	pCi/L					0.2													

MAJOR IONS	UNITS	UBCOW 2006-2 12/1/2008		UBCOW 2006-2 12/15/2008		UBCOW 2006-2 1/6/2009		BOW 2006-1 11/24/2008		BOW 2006-1 12/8/2008		BOW 2006-1 12/22/2008		BOW 2006-2 12/1/2008		BOW 2006-2 12/15/2008		BOW 2006-2 1/13/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	0.0034	0.0003	0.0032	0.0003	0.0033	0.0003	0.0176	0.0003	0.0172	0.0003	0.0146	0.0003	0.0136	0.0003	0.0128	0.0003	0.014	0.0003
RADIONUCLIDES-DISSOLVED																			
LEAD 210	pCi/L	<8.3	8.3	<4.4	4.4	<4.7	4.7	<4.4	4.4	<4.6	4.6	<4.0	4	<4.1	4.1	<4.4	4.4	<4.00	4
LEAD 210 precision(±)	pCi/L	4.9		2.7		2.8		2.6		2.7		2.4		2.4		2.7		2.4	
LEAD 210 MDC	pCi/L	8.3		4.4		4.7		4.4		4.6		4		4.1		4.4		4	
POLONIUM 210	pCi/L	<0.15	0.15	<0.3	0.3	<0.3	0.3	<.3	0.3	<0.26	0.26	<0.37	0.37	<0.17	0.17	<.4	0.4	<0.60	0.6
POLONIUM 210 precision(±)	pCi/L	0.15		0.3		0.3		0.3		0.26		0.37		0.17		0.4		0.6	
POLONIUM MDC	pCi/L																		
RADIUM 226	pCi/L	0.23	0.18	0.45	0.17	0.6	0.23	0.41	0.18	<0.20	0.2	0.41	0.1	<0.21	0.21	0.19	0.18	<0.19	0.19
RADIUM 226 precision(±)	pCi/L	0.13		0.15		0.21		0.15		0.13		0.13		0.11		0.13		0.14	
RADIUM 226 MDC	pCi/L	0.17		0.17		0.23		0.18		0.2		0.1		0.21		0.18		0.19	
THORIUM 230	pCi/L	<0.31	0.31	<0.2	0.2	<0.09	0.09	<0.1	0.1	<0.07	0.07	<0.09	0.09	<0.12	0.12	<0.1	0.1	<0.10	0.1
THORIUM 230 precision(±)	pCi/L	0.31		0.2		0.09		0.1		0.07		0.09		0.12		0.1		0.1	
THORIUM 230 MDC	pCi/L																		

Table 2.9-11 Three Crow Expansion Area Monitor Well Radiological (Dissolved) Results 2008-2009

MAJOR IONS	UNITS	BOW 2006-3 12/1/2008		BOW 2006-3 12/17/2008		BOW 2006-3 1/13/2009		BOW 2006-4 1/16/2009		BOW 2006-4 1/30/2009		BOW 2006-4 2/13/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	0.0111	0.0003	0.0103	0.0003	0.0032	0.0003	0.0098	0.0003	0.0102	0.0003	0.0099	0.0003
RADIONUCLIDES-DISSOLVED													
LEAD 210	pCi/L	<4.1	4.1	<8.8	8.8	<4.00	4	<4.00	4	<4.4	4.4	<2.80	2.8
LEAD 210 precision(±)	pCi/L	2.4		5.2		2.4		2.4		2.7		1.7	
LEAD 210 MDC	pCi/L	4.1		8.8		4		4		4.4		2.8	
POLONIUM 210	pCi/L	<0.31	0.31	<0.3	0.3	<.43	0.4	<.25	0.3	<0.5	0.5	0.8	0.6
POLONIUM 210 precision(±)	pCi/L	0.31		0.3		0.4		0.3		0.3		0.6	
POLONIUM MDC	pCi/L									0.5		0.6	
RADIUM 226	pCi/L	<0.16	0.16	<.17	0.17	<0.19	0.19	<.19	0.19	<0.19	0.19	<0.21	0.21
RADIUM 226 precision(±)	pCi/L	0.07	0.15	0.11		0.12		0.13		0.12		0.13	
RADIUM 226 MDC	pCi/L	0.16		0.17		0.19		0.19		0.19		0.21	
THORIUM 230	pCi/L	<0.15	0.15	0.4	0.2	<0.12	0.1	<0.11	0.1	<0.09	0.09	<0.16	0.2
THORIUM 230 precision(±)	pCi/L	0.15		0.2		0.1		0.1		0.09		0.07	
THORIUM 230 MDC	pCi/L											0.2	

Table 2.9-12 Three Crow Expansion Area Monitor Well Radiological (Dissolved and Suspended) Results 2008-2009

MAJOR IONS	UNITS	BOW 2006-5 11/24/2009		BOW 2006-5 12/04/2009		BOW 2006-5 12/18/2009		BOW 2006-6 11/20/2009		BOW 2006-6 12/04/2009		BOW 2006-6 12/18/2009		BOW 2006-7 11/20/2009		BOW 2006-7 12/04/2009		BOW 2006-7 121/18/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
RADIONUCLIDES-DISSOLVED																			
LEAD 210	pCi/L	<0.7	0.7	<0.7	0.7	<1.2	1.2	<0.7	0.7	<0.7	0.7	1.3	1.2	<0.7	0.07	<0.7	0.7	<1.2	1.2
LEAD 210 precision(±)	pCi/L	0.4		0.4		0.7		0.4		0.4		0.8		0.4		0.4		0.7	
LEAD 210 MDC	pCi/L	0.7		0.7		1.2		0.7		0.7		1.2		0.7		0.7		1.2	
POLONIUM 210	pCi/L	<1.0	1.0	<0.7	0.07	<0.5	0.5	<0.6	0.6	<0.6	0.6	<0.4	0.4	<0.4	0.4	<0.6	0.6	<0.6	0.6
POLONIUM 210 precision(±)	pCi/L	0.4		0.4		0.3		0.3		0.2		0.2		0.2		0.4		0.2	
POLONIUM MDC	pCi/L	1.0		0.7		0.5		0.6		0.6		0.4		0.4		0.6		0.6	
RADIUM 226	pCi/L	<0.17	0.17	<0.13	0.13	<0.18	0.18	<0.17	0.17	<0.14	0.14	<0.20	0.20	<0.16	0.16	<0.13	0.13	<0.18	0.18
RADIUM 226 precision(±)	pCi/L	0.1		0.08		0.12		0.11		0.07		0.12		0.11		0.08		0.11	
RADIUM 226 MDC	pCi/L	0.17		0.13		0.18		0.17		0.14		0.20		0.16		0.13		0.18	
THORIUM 230	pCi/L	<0.2	0.2	<0.1	0.1	<0.2	0.2	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.2	0.2
THORIUM 230 precision(±)	pCi/L	0.09		0.1		0.09		0.08		0.07		0.06		0.05		0.06		0.09	
THORIUM 230 MDC	pCi/L	0.2		0.1		0.2		0.1		0.1		0.1		0.1		0.1		0.2	

MAJOR IONS	UNITS	BOW 2006-5 11/20/2009		BOW 2006-5 12/04/2009		BOW 2006-5 12/18/2009		BOW 2006-6 11/20/2009		BOW 2006-6 12/04/2009		BOW 2006-6 12/18/2009		BOW 2006-7 11/20/2009		BOW 2006-7 12/04/2009		BOW 2006-7 121/18/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
URANIUM	mg/L	<0.0003	0.0003	0.0005	0.0003	0.0005	0.0003	<0.0003	0.0003	<0.0003	0.0003	0.0011	0.0003	<0.0003	0.0003	0.0004	0.0003	0.0009	0.0003
RADIONUCLIDES-SUSPENDED																			
LEAD 210	pCi/L	<2.7	2.7	<1.6	1.6	<0.5	0.5	<2.7	2.7	<1.6	1.6	<0/5	0.5	<2.7	2.7	<1.6	1.6	<0.5	0.5
LEAD 210 precision(±)	pCi/L	1.6		0.9		0.3		1.6		0.9		0.3		1.6		0.9		0.3	
LEAD 210 MDC	pCi/L	2.7		1.6		0.5		2.7		1.6		0.5		2.8		1.6		0.5	
POLONIUM 210	pCi/L	<0.5	0.05	<0.3	0.3	<0.3	0.3	<0.4	0.4	<0.4	0.4	<0.3	0.3	<0.4	0.4	<0.4	0.4	<0.3	0.3
POLONIUM 210 precision(±)	pCi/L	0.2		0.2		0.2		0.3		0.2		0.1		0.2		0.2		0.2	
POLONIUM MDC	pCi/L	0.5		0.3		0.3		0.4		0.4		0.3		0.4		0.4		0.3	
RADIUM 226	pCi/L	<0.2	0.2	<0.08	0.08	<0.1	0.1	<0.2	0.2	0.1	0.08	0.2	0.1	<0.2	0.2	<0.1	0.1	<0.1	0.1
RADIUM 226 precision(±)	pCi/L	0.08		0.04		0.08		0.07		0.07		0.1		0.09		0.09		0.08	
RADIUM 226 MDC	pCi/L	0.2		0.08		0.1		0.2		0.08		0.1		0.2		0.1		0.1	
THORIUM 230	pCi/L	<0.03	0.03	0.1	0.03	<0.06	0.06	0.04	0.03	0.06	0.03	0.2	0.05	<0.06	0.06	0.06	0.05	<0.08	0.08
THORIUM 230 precision(±)	pCi/L	0.02		0.04		0.04		0.03		0.03		0.06		0.03		0.04		0.04	
THORIUM 230 MDC	pCi/L	0.03		0.03		0.06		0.03		0.03		0.05		0.06		0.05		0.08	

Table 2.9-12 Three Crow Expansion Area Monitor Well Radiological (Dissolved and Suspended) Results 2008-2009

MAJOR IONS	UNITS	MILLER (273) 11/20/2009		MILLER (273) 12/04/2009		MILLER (27S 12/18/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL
RADIONUCLIDES-DISSOLVED							
LEAD 210	pCi/L	<0.7	0.7	<0.7	0.7	<1.2	1.2
LEAD 210 precision(±)	pCi/L	0.4		0.4		0.7	
LEAD 210 MDC	pCi/L	0.7		0.7		1.2	
POLONIUM 210	pCi/L	<0.6	0.6	<0.5	0.5	<0.7	0.7
POLONIUM 210 precision(±)	pCi/L	0.4		0.5		0.5	
POLONIUM MDC	pCi/L	0.6		0.5		0,7	
RADIUM 226	pCi/L	<0.19	0.19	<0.14	0.14	<0.19	0.19
RADIUM 226 precision(±)	pCi/L	0.13		0.08		0.08	
RADIUM 226 MDC	pCi/L	0.19		0.14		0.19	
THORIUM 230	pCi/L	<0.2	0.2	<0.1	0.1	<0.2	0.2
THORIUM 230 precision(±)	pCi/L	0.08		0.07		0.07	
THORIUM 230 MDC	pCi/L	0.2		0.1		0.2	
URANIUM	mg/L	<0.0003	0.0003	0.0142	0.0003	0.0009	0.0003
RADIONUCLIDES-SUSPENDED							
LEAD 210	pCi/L	<2.8	2.8	<1.6	1.6	<0.5	0.5
LEAD 210 precision(±)	pCi/L	1.6		0.9		0.3	
LEAD 210 MDC	pCi/L	2.8		1.6		0.5	
POLONIUM 210	pCi/L	<0.4	0.4	<0.3	0.3	<0.2	0.2
POLONIUM 210 precision(±)	pCi/L	0.2		0.2		0.09	
POLONIUM MDC	pCi/L	0.4		0.3		0.2	
RADIUM 226	pCi/L	<0.2	0.2	0.1	0.09	<0.1	0.1
RADIUM 226 precision(±)	pCi/L	0.07		0.07		0.09	
RADIUM 226 MDC	pCi/L	0.2		0.09		0.1	
THORIUM 230	pCi/L	<0.04	0.04	8.1	0.05	<0.07	0.07
THORIUM 230 precision(±)	pCi/L	0.03		0.9		0.05	
THORIUM 230 MDC	pCi/L	0.04		0.05		0.07	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	COW 2006-1 12/2/2008		COW 2006-1 12/16/2008		COW 2006-1 1/5/2009		COW 2006-2 12/2/2008		COW 2006-2 12/16/2008		COW 2006-2 1/5/2009		COW 2006-3 12/3/2008		COW 2006-3 12/17/2008		COW 2006-3 1/5/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	343	1.0	346	1.0	349	1.0	310	1.0	311	1.0	317	1.0	328	1.0	333	1.0	334	1.0
CARBONATE AS CO3	mg/L	13	1.0	10	1.0	12	1.0	12	1.0	10	1.0	11	1.0	<1.0	1.0	9	1.0	11	1.0
BICARBONATE AS HCO3	mg/L	392	1.0	403	1.0	402	1.0	353	1.0	358	1.0	363	1.0	401	1.0	389	1.0	386	1.0
CALCIUM	mg/L	9	1.0	10	1.0	9	1.0	12	1.0	11	1.0	10	1.0	12	1.0	12	1.0	12	1.
CHLORIDE	mg/L	182	1.0	176	1.0	169	1.0	274	1.0	264	1.0	237	1.0	172	1.0	168	1.0	166	1.0
FLUORIDE	mg/L	1.2	0.1	1.1	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.3	0.1	1.3	0.1
MAGNESIUM	mg/L	3	1.0	3	1.0	3	1.0	3	1.0	3	1.0	3	1.0	3	1.0	3	1.0	3	1.0
NITROGEN, AMMONIA AS N	mg/L	0.44	0.05	0.45	0.05	0.46	0.05	0.49	0.05	0.52	0.05	0.52	0.05	0.46	0.05	0.48	0.05	0.48	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
POTASSIUM	mg/L	8	1.0	7	1.0	7	1.0	11	1.0	12	1.0	10	1.0	8	1.0	8	1.0	8	1.0
SILICA	mg/L	16.2	0.2	15.4	0.2	14.5	0.2	16.5	0.2	14.7	0.2	14.3	0.2	14.7	0.2	14	0.2	14.2	0.2
SODIUM	mg/L	414	2.0	423	2.0	403	2.0	474	2.0	474	2.0	448	2.0	413	2.0	423	2.0	405	2.0
SULFATE	mg/L	242	1.0	244	1.0	242	1.0	289	1.0	289	1.0	291	1.0	286	1.0	285	1.0	283	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	1800	1.0	1810	1.0	1800	1.0	2130	1.0	2140	1.0	2000	1.0	1840	1.0	1870	1.0	1800	1.0
pH	s.u.	8.38	0.01	8.24	0.01	8.3	0.01	8.52	0.01	8.35	0.01	8.4	0.01	8.26	0.01	8.16	0.01	8.2	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1040	10	1040	10	1060	10	1220	10	1230	10	1200	10	1080	10	1110	10	1100	10
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
BORON	mg/L	1.0	0.1	1.1	0.1	1.1	0.1	1.0	0.1	1.1	0.1	1.1	0.1	1.0	0.1	1.2	0.1	1.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	0.04	0.03	0.04	0.03	0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.003	0.001	0.002	0.001	<0.001	0.001	0.002	0.001	0.002	0.001	<0.001	0.001	0.003	0.001	0.002	0.001	<0.001	0.001
URANIUM	mg/L	0.0014	0.0003	0.0016	0.0003	0.0014	0.0003	0.0294	0.0003	0.0339	0.0003	0.0294	0.0003	0.0042	0.0003	0.0046	0.0003	0.004	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.01	0.1	<0.01	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	4.94		6.38		4.38		4.13		4.76		3.44		4.49		5.69		3.85	
ANIONS	meq/L	17.1		17		16.9		20		19.7		19.2		17.5		17.4		17.3	
CATIONS	meq/L	18.9		19.3		18.4		21.8		21.7		20.5		19.1		19.5		18.7	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1090		1090		1040		1270		1260		1210		1110		1120		1100	
TDS BALANCE (0.80-1.20)	dec. %	0.95		0.95		1.02		0.96		0.98		0.99		0.97		0.99		1	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	COW 2006-4		COW 2006-4		COW 2006-4		COW 2006-5		COW 2006-5		COW 2006-5		COW 2006-6		COW 2006-6		COW 2006-6	
		12/1/2008		12/15/2008		1/6/2009		1/16/2009		1/30/2009		2/13/2009		1/16/2009		1/30/2009		2/13/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	348	1.0	350	1.0	350	1.0	337	1.0	339	1.0	339	1.0	348	1.0	350	1.0	354	1.0
CARBONATE AS CO3	mg/L	10	1.0	9	1.0	10	1.0	<1.0	1.0	3	1.0	<1.0	1.0	13	1.0	12	1.0	9	1.0
BICARBONATE AS HCO3	mg/L	405	1.0	409	1.0	406	1.0	411	1.0	408	1.0	414	1.0	398	1.0	402	1.0	413	1.0
CALCIUM	mg/L	10	1.0	10	1.0	9	1.0	8	1.0	8	1.0	9	1.0	11	1.0	11	1.0	12	1.0
CHLORIDE	mg/L	172	1.0	173	1.0	174	1.0	181	1.0	179	1.0	181	1.0	215	1.0	213	1.0	202	1.0
FLUORIDE	mg/L	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.3	0.1	1.2	0.1
MAGNESIUM	mg/L	3.0	1.0	3.0	1.0	3.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0	3.0	1.0	3.0	1.0	4.0	1.0
NITROGEN, AMMONIA AS N	mg/L	0.45	0.05	0.5	0.05	0.48	0.05	0.52	0.05	0.52	0.05	0.48	0.05	0.57	0.05	0.57	0.05	0.51	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
POTASSIUM	mg/L	7	1.0	6	1.0	7.0	1.0	7.0	1.0	7.0	1.0	6. 0	1.0	13	1.0	10	1.0	9.0	1.0
SILICA	mg/L	14.5	0.2	14.3	0.2	14.2		12	0.2	11.5	0.2	12	0.2	11.4	0.2	11	0.2	11.8	0.2
SODIUM	mg/L	394	2.0	398	2.0	390	2.0	372	2	383	2.0	373	1.0	428	2.0	417	2.0	432	1.0
SULFATE	mg/L	227	1.0	225	1.0	228	1.0	276	1.0	274	1.0	274	1.0	354	1.0	361	1.0	348	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	1750	1.0	1780	1.0	1700	1.0	1830	1.0	1890	1.0	1900	1.0	2130	1.0	2180	1.0	2190	1.0
pH	s.u.	8.29	0.01	8.13	0.01	8.2	0.01	8.25	0.01	8.42	0.01	8.22	0.01	8.75	0.01	8.73	0.01	8.5	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1040	10	1050	10	1040	10	1080	10	1100	10	1100	10	1280	10	1300	10	1240	10
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.1
ARSENIC	mg/L	<0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
BORON	mg/L	1.1	0.1	1.1	0.1	1.0	0.1	1.0	0.1	0.9	0.1	1.0	0.1	1.1	0.1	1.0	0.1	1.2	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	0.08	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	0.11	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.002	0.001	<0.001	0.001	<0.001	0.001	0.003	0.001	0.002	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.003	0.001
URANIUM	mg/L	0.0013	0.0003	0.0012	0.0003	0.0012	0.0003	0.0013	0.0003	0.0012	0.0003	0.0011	0.0003	0.001	0.0003	0.0006	0.0003	0.0004	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.01	0.1
ZINC	mg/L	0.07	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.13	0.01	0.04	0.01	0.01	0.01	0.01	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	4.15		4.65		3.26		-1.76		-0.33		-1.74		-1.62		-3.51		-0.35	
ANIONS	meq/L	16.6		16.6		16.7		17.6		17.6		17.7		20.4		20.6		20.1	
CATIONS	meq/L	18.1		18.3		17.9		17		17.5		17.1		19.8		19.2		20	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1040		1040		1040		1070		1070		1070		1250		1240		1240	
TDS BALANCE (0.80-1.20)	dec. %	1		1.01		1		1.01		1.03		1.03		1.02		1.05		1	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	COW 2006-7 1/16/2009		COW 2006-7 1/30/2009		COW 2006-7 2/13/2009		CPW 2006-2 11/24/2008		CPW 2006-2 12/8/2008		CPW 2006-2 12/22/2008		UBCOW 2006-1 11/24/2008		UBCOW 2006-1 12/8/2008		UBCOW 2006-1 12/22/2008	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	329	1.0	334	1.0	330	1.0	343	1.0	350	1.0	348	1.0	332	1.0	340	1.0	339	1.0
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	19	1.0	7	1.0	<1.0	1.0	13	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	401	1.0	408	1.0	403	1.0	418	1.0	389	1.0	410	1.0	405	1.0	387	1.0	413	1.0
CALCIUM	mg/L	18	1.0	16	1.0	17	1.0	9.0	1.0	9.0	1.0	10	1.0	19	1.0	19	1.0	19	1.0
CHLORIDE	mg/L	179	1.0	183	1.0	176	1.0	170	1.0	169	1.0	166	1.0	174	1.0	169	1.0	168	1.0
FLUORIDE	mg/L	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1	1.2	0.1.0	1.1	0.1	1.2	0.1
MAGNESIUM	mg/L	5.0	1.0	4.0	1.0	5.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	5.0	1.0	6	1.0	5	1.0
NITROGEN, AMMONIA AS N	mg/L	0.36	0.05	0.36	0.05	0.32	0.05	0.5	0.05	0.5	0.05	0.48	0.05	0.3	0.05	0.31	0.05	0.29	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	ND	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
POTASSIUM	mg/L	15	1.0	11	1.0	11	1.0	7.0	1.0	7.0	1.0	7.0	1.0	14	1.0	13	1.0	13	1.0
SILICA	mg/L	12.4	0.2	11.2	0.2	12.5	0.2	13.7	0.2	14.7	0.2	13.9	0.2	14.8	0.2	15.5	0.2	14.9	0.2
SODIUM	mg/L	357	2.0	335	2.0	333	1.0	415	2.0	408	2.0	410	2.0	379	2.0	367	2.0	372	2.0
SULFATE	mg/L	263	1.0	262	1.0	258	1.0	263	1.0	259	1.0	256	1.0	236	1.0	227	1.0	227	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	1780	1.0	1840	1.0	1840	1.0	1780	1.0	1820	1.0	1770	1.0	1690	1.0	1720	1.0	1740	1.0
pH	s.u.	8	0.01	8.17	0.01	8.01	0.01	8.17	0.01	8.3	0.01	8.25	0.01	7.82	0.01	8.02	0.01	8.02	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1050	10	1090	10	1070	10	1040	10	1040	10	1070	10	988	10	980	10	1010	10
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	ND	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.002	0.001	0.002	0.001	0.003	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.007	0.001	0.007	0.001	0.007	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
BORON	mg/L	0.9	0.1	0.9	0.1	0.9	0.1	1.1	0.1	1.2	0.1	1.1	0.1	1.0	0.1	1.1	0.1	1.0	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	0.06	0.03	0.12	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	ND	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.002	0.001	0.002	0.001	0.002	0.001	0.003	0.001	0.002	0.001	<0.001	0.001	0.003	0.001	0.002	0.001	<0.001	0.001
URANIUM	mg/L	0.0053	0.0003	0.0056	0.0003	0.0052	0.0003	0.0385	0.0003	0.038	0.0003	0.0335	0.0003	0.0026	0.0003	0.0025	0.0003	0.0021	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.02	0.01	0.03	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	0.153		-4		-3.05		4.71		3.86		4.67		5.0		3.94		4.66	
ANIONS	meq/L	17.2		17.4		17		17.2		17.2		17		16.5		16.4		16.3	
CATIONS	meq/L	17.2		16		16		18.9		18.6		18.7		18.3		17.7		17.9	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1050		1030		1020		1090		1080		1080		1050		1020		1030	
TDS BALANCE (0.80-1.20)	dec. %	1		1.06		1.05		0.95		0.96		0.99		0.94		0.96		0.98	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	UBCOW 2006-2		UBCOW 2006-2		UBCOW 2006-2		BOW 2006-1		BOW 2006-1		BOW 2006-1		BOW 2006-2		BOW 2006-2		BOW 2006-2	
		12/1/2008		12/15/2008		1/6/2009		11/24/2008		12/8/2008		12/22/2008		12/1/2008		12/15/2008		1/13/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	314	1.0	315	1.0	314	1.0	159	1.0	162	1.0	160	1.0	162	1.0	162	1.0	159	1.0
CARBONATE AS CO3	mg/L	8	1.0	<1.0	1.0	5	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0
BICARBONATE AS HCO3	mg/L	367	1.0	383	1.0	374	1.0	194	1.0	197	1.0	196	1.0	197	1.0	197	1.0	194	1.0
CALCIUM	mg/L	23	1.0	24	1.0	23	1.0	62	1.0	65	1.0	63	1.0	48	1.0	53	1.0	51	1.0
CHLORIDE	mg/L	175	1.0	175	1.0	174	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0
FLUORIDE	mg/L	1.1	0.1	1.1	0.1	1.1	0.1	0.4	0.1	0.4	0.1	0.4	0.1	0.4	0.1	0.4	0.1	0.4	0.1
MAGNESIUM	mg/L	7.0	1.0	7.0	1.0	7.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0
NITROGEN, AMMONIA AS N	mg/L	0.28	0.05	0.3	0.05	0.3	0.05	<0.05	0.05	<0.05	0.05	ND	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	3.84	0.05	4.14	0.05	3.9	0.05	2.43	0.05	2.4	0.05	2.33	0.05
POTASSIUM	mg/L	13	1.0	13	1.0	13	1.0	10	1.0	10	1.0	10	1.0	8.0	1.0	9.0	1.0	8.0	1.0
SILICA	mg/L	15.9	0.2	15.3	0.2	15.4		73.2	0.2	69	0.2	65.4	0.2	78.1	0.2	69.4	0.2	56.3	0.2
SODIUM	mg/L	382	2.0	384	2.0	380	2.0	17	2.0	17	2.0	16	2.0	23	2.0	27	2.0	26	2
SULFATE	mg/L	292	1.0	291	1.0	290	1.0	19	1.0	18	1.0	18	1.0	17	1.0	17	1.0	18	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	1820	1.0	1870	1.0	1800	1.0	348	1.0	294	1.0	400	1.0	308	1.0	258	1.0	391	1.0
pH	s.u.	8.09	0.01	7.89	0.01	8,0	0.01	7.49	0.01	7.82	0.01	7.71	0.01	7.81	0.01	7.66	0.01	7.81	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1110	10	1110	10	1100	10	279	10	237	10	284	10	286	10	288	10	264	10
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.007	0.001	0.008	0.001	0.007	0.001	0.002	0.001	0.003	0.001	0.003	0.001	0.006	0.001	0.007	0.001	0.007	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
BORON	mg/L	1.0	0.1	1.0	0.1	0.9	0.1	<0.1	0.1	0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	>0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.04	0.01	0.05	0.01	0.03	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.01	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.005	0.05	<0.5	0.05	<0.05	0.05
SELENIUM	mg/L	0.001	0.001	<0.001	0.001	<0.001	0.001	0.005	0.001	0.004	0.001	0.005	0.001	0.005	0.001	0.006	0.001	0.007	0.001
URANIUM	mg/L	0.0034	0.0003	0.0032	0.0003	0.0033	0.0003	0.0176	0.0003	0.0172	0.0003	0.0146	0.0003	0.0136	0.0003	0.0128	0.0003	0.014	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.10	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.01	0.01	0.01	0.01	<0.01	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	3.75		3.84		3.4		3.93		4.96		4.47		-0.702		4.8		3.6	
ANIONS	meq/L	17.4		17.4		17.3		4.09		4.14		4.1		3.98		4.01		3.95	
CATIONS	meq/L	18.7		18.8		18.5		4.42		4.57		4.49		3.93		4.41		4.25	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1100		1100		1100		325		325		317		314		314		292	
TDS BALANCE (0.80-1.20)	dec. %	1.01		1.01		1		0.86		0.73		0.9		0.91		0.92		0.9	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	BOW 2006-3		BOW 2006-3		BOW 2006-3		BOW 2006-4		BOW 2006-4		BOW 2006-4		BOW 2006-5		BOW 2006-5		BOW 2006-5	
		12/1/2008		12/17/2008		1/13/2009		1/16/2009		1/30/2009		2/13/2009		11/20/2009		12/04/2009		12/18/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	159	1.0	159	1.0	160	1.0	162	1.0	170	1.0	172	1.0	392	5.0	381	5.0	383	5.0
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<5.0	5.0	<5.0	5.0	<5.0	5.0
BICARBONATE AS HCO3	mg/L	194	1.0	194	1.0	195	1.0	198	1.0	207	1.0	210	1.0	478	5.0	464	5.0	467	5.0
CALCIUM	mg/L	26	1.0	27	1.0	25	1.0	14	1.0	14	1.0	17	1.0	100	1.0	101	1.0	97	1.0
CHLORIDE	mg/L	4	1.0	5	1.0	4	1.0	23	1.0	11	1.0	11	1.0	14	1.0	13	1.0	13	1.0
FLUORIDE	mg/L	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.1	0.1	1.2	0.1	1.3	0.1
MAGNESIUM	mg/L	2.0	1.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	14.0	1.0	14	1.0	14	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	2.57	0.05	2.59	0.05	2.49	0.05	2.16	0.05	2.18	0.05	2.23	0.05	<0.1	0.1	2.1	0.1	0.1	0.1
POTASSIUM	mg/L	10	1.0	11	1.0	10	1.0	10	1.0	8.0	1.0	9.0	1.0	12.0	1.0	12	1.0	12	1.0
SILICA	mg/L	81	0.2	73.2	0.2	59.9	0.2	69.9	0.2	62.7	0.2	64.5	0.2	53.1	0.2	52.5	0.2	55.6	0.2
SODIUM	mg/L	56	2.0	56	2.0	59	2.0	83	2.0	68	2.0	67	1.0	34	1.0	35	1.0	31	1.0
SULFATE	mg/L	16	1.0	16	1.0	17	1.0	25	1.0	20	1.0	23	1.0	24	1.0	25	1.0	23	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	286	1.0	239	1.0	375	1.0	466	1.0	445	1.0	311	1.0	730	1.0	735	1.0	728	1.0
pH	s.u.	8.18	0.01	7.95	0.01	8.04	0.01	8.7	0.01	8.74	0.01	8.35	0.01	8.14	0.01	7.78	0.01	7.86	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	280	10	282	10	254	10	312	10	327	10	304	10	499	10.0	470	10.0	442	10.0
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.014	0.001	0.013	0.001	0.015	0.001	0.009	0.001	0.009	0.001	0.01	0.001	0.006	0.001	0.005	0.001	0.006	0.001
BARIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.1	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	N<0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001	<0.001	0.001	0.003	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.07	0.01	0.06	0.01	0.08	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.003	0.001	0.003	0.001	<0.001	0.001	0.005	0.001	0.003	0.001	0.003	0.001	<0.001	0.001	<0.001	0.001	0.001	0.001
URANIUM	mg/L	0.0111	0.0003	0.0103	0.0003	0.0032	0.0003	0.0098	0.0003	0.0102	0.0003	0.0099	0.0003	0.0227	0.0003	0.0242	0.0003	0.0264	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	0.004	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	<0.01	0.01	0.01	0.01	<0.01	0.01	0.23	0.01	0.28	0.01	0.44	0.01	1.14	0.01	1.07	0.01	1.22	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	3.75		4.27		3.71		0.918		-3.71		-3.34		-4.89		-3.86		-5.62	
ANIONS	meq/L	3.83		3.86		3.88		4.59		4.32		4.4		8.78		8.71		8.58	
CATIONS	meq/L	4.13		4.21		4.18		4.68		4.01		4.12		7.96		8.06		7.67	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	323		316		300		352		236		323		5.02		506		493	
TDS BALANCE (0.80-1.20)	dec. %	0.87		0.89		0.85		0.89		1.39		0.94		0.990		0.930		0.900	

Table 2.9-13 Three Crow Expansion Area Monitor Well Non-Radiological Analytical Results – 2008 and 2009

MAJOR IONS	UNITS	BOW 2006-6		BOW 2006-6		BOW 2006-6		BOW 2006-7		BOW 2006-7		BOW 2006-7		MILLER WELL (273)		MILLER WELL (273)		MILLER WELL (273)	
		11/20/2009		12/04/2009		12/18/2009		11/20/2009		12/04/2009		12/18/2009		11/20/2009		12/04/2009		12/18/2009	
		RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL	RESULTS	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	172	5.0	171	5.0	173	5.0	162	5.0	163	5.0	168	5.0	246	5.0	241	5.0	243	5.0
CARBONATE AS CO3	mg/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0	<5.0	5.0
BICARBONATE AS HCO3	mg/L	210	5.0	209	5.0	211	5.0	197	5.0	199	5.0	205	5.0	301	5.0	294	5.0	296	5.0
CALCIUM	mg/L	46	1.0	40	1.0	46	1.0	30	1.0	33	1.0	33	1.0	71	1.0	72	1.0	72	1.0
CHLORIDE	mg/L	4.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0	16	1.0	9.0	1.0	6.0	1.0	6.0	1.0	6.0	1.0
FLUORIDE	mg/L	0.4	0.1	0.4	0.1	0.4	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1
MAGNESIUM	mg/L	7.0	1.0	5.0	1.0	6.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	6.0	1.0	5.0	1.0	6.0	1.0
NITROGEN, AMMONIA AS N	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.8	0.1	2.5	0.1	1.8	0.1	1.2	0.1	1.2	0.1	1.2	0.1	2.2	0.1	1.1	0.1	2.5	0.1
POTASSIUM	mg/L	6.0	1.0	7.0	1.0	6.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0	8.0	1.0	9.0	1.0	9.0	1.0
SILICA	mg/L	2.8	0.2	61.6	0.2	64.7	0.2	68.4	0.2	66.5	0.2	72.7	0.2	64.1	0.2	61.7	0.2	65.4	0.2
SODIUM	mg/L	14	1.0	25	1.0	16	1.0	35	1.0	42	1.0	33	1.0	19	1.0	21	1.0	19	1.0
SULFATE	mg/L	10	1.0	11	1.0	9.0	1.0	15	1.0	11	1.0	11	1.0	10	1.0	10	1.0	10	1.0
PHYSICAL PROPERTIES																			
CONDUCTIVITY	umhos/cm	348	1.0	347	1.0	345	1.0	338	1.0	375	1.0	351	1.0	471	1.0	477	1.0	475	1.0
pH	s.u.	8.12	0.01	7.94	0.01	7.96	0.01	8.13	0.01	8.00	0.01	7.96	0.01	8.12	0.01	7.75	0.01	7.68	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	242	10.0	253	10.0	221	10.0	266	10.0	276	10.0	229	10.0	320	10.0	319	10.0	312	10.0
METALS, DISSOLVED																			
ALUMINUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ARSENIC	mg/L	0.004	0.001	0.006	0.001	0.005	0.001	0.007	0.001	0.004	0.001	0.005	0.001	0.003	0.001	0.003	0.001	0.003	0.001
BARIUM	mg/L	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	<0.1	0.1	0.1	0.1
BORON	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
CADMIUM	mg/L	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005	<0.005	0.005
CHROMIUM	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
COPPER	mg/L	<0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
IRON	mg/L	<0.03	0.03	<0.03	0.03	0.04	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
LEAD	mg/L	0.001	0.001	0.002	0.001	0.003	0.001	<0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MANGANESE	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
MERCURY	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
MOLYBDENUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
NICKEL	mg/L	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05
SELENIUM	mg/L	0.003	0.001	0.002	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.003	0.001	0.002	0.001	0.003	0.001
URANIUM	mg/L	0.0083	0.0003	0.0086	0.0003	0.0097	0.0003	0.0100	0.0003	0.0103	0.0003	0.0122	0.0003	0.0137	0.0003	0.0150	0.0003	0.0168	0.0003
VANADIUM	mg/L	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1
ZINC	mg/L	0.62	0.01	0.70	0.01	0.64	0.01	0.29	0.01	0.36	0.01	0.30	0.01	<0.01	0.01	0.01	0.01	<0.01	0.01
DATA QUALITY																			
A/C BALANCE (± 5)	%	-1.91		-2.88		-3.84		-3.34		-1.35		-5.53		-4.48		-1.18		-3.32	
ANIONS	meq/L	3.76		3.95		3.92		3.67		4.05		3.96		5.50		5.30		5.43	
CATIONS	meq/L	3.62		3.73		3.63		3.43		3.94		3.55		5.02		5.17		5.08	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1.90		285		281		192		301		295		359		351		360	
TDS BALANCE (0.80-1.20)	dec. %	1.27		0.890		0.790		1.39		0.920		0.780		0.890		0.910		0.870	

Table 2.9-14 Comparison of Mean Monthly Precipitation With Normal Mean Monthly Discharge of the White River at Crawford, Nebraska

Month	Mean Precipitation [1]		Mean Discharge [2]	
	inches	centimeters	ft^3/sec	$meters^3/sec$
January	0.61	1.55	21	0.59
February	0.76	1.93	23	0.65
March	1.74	4.42	27	0.76
April	2.65	6.73	25	0.71
May	3.11	7.9	27	0.76
June	2.42	6.15	22	0.62
July	2.77	7.04	16	0.45
August	1.21	3.07	13	0.37
September	1.38	3.51	14	0.4
October	1.66	4.22	17	0.48
November	0.82	2.08	19	0.54
December	0.79	2.01	20	0.57

1 – NOAA 1981.

2 – USGS 2004. (Period of Record 1931-2004)

Table 2.9-15 Normal Mean Monthly Discharge of the White River at Crawford, Nebraska 1999 through September 2007

Month	1999 (ft^3/sec)	2000 (ft^3/sec)	2001 (ft^3/sec)	2002 (ft^3/sec)	2003 (ft^3/sec)	2004 (ft^3/sec)	2005 (ft^3/sec)	2006 (ft^3/sec)	2007 (ft^3/sec)
January	22.6	21.7	21.0	22.9	22.6	23.0	23.9	24.1	18.9
February	22.4	24.1	24.3	23.6	24.0	24.8	23.3	24.5	20.2
March	23.1	25.5	27.0	26.8	26.4	25.9	24.5	26.4	22.6
April	26.1	29.1	26.4	25.3	26.5	22.7	25.3	25.9	23.4
May	23.7	10.0	24.7	23.9	25.9	21.1	26.5	23.2	20.3
June	27.1	20.5	18.6	16.6	23.2	17.1	26.5	17.8	15.9
July	21.4	15.4	14.4	10.3	13.2	17.4	17.6	11.0	10.0
August	15.0	11.5	12.5	10.1	11.7	11.3	18.1	10.0	4.1
September	17.0	12.1	12.9	13.7	23.3	17.8	14.8	14.8	8.7
October	19.4	17.4	17.2	18.1	17.5	20.8	18.5	18.6	*
November	20.8	20.1	22.0	22.3	22.6	21.3	21.0	21.1	*
December	21.4	20.7	22.2	22.2	23.1	22.1	23.1	21.3	*
Average	**21.7**	**16.7**	**20.3**	**19.7**	**21.6**	**20.4**	**21.9**	**19.9**	**16.0***

Source: NDNR 2010. Available period of record ended 2007.
*Data not available for fourth quarter of 2007.

Table 2.9-16 Description of NDEQ Sampling Sites on the White River in Dawes and Sioux Counties, Nebraska

Station No.	Segment No.	HUC Code	Latitude & Longitude	Legal Description	Sample Type	Status of Gauge
WHITE RIVER AT FORT ROBINSON						
SWH1WHITE325	WH1-30000	101402010108	42.62777 -103.51752	SE ¼, SW¼ , Sec. 26, T31N, R53W, Sioux County	Monthly water quality and quarterly metals (reduced list)	No existing flow gauge
WHITE RIVER AT CRAWFORD						
SWH1WHITE208	WH1-20000	101402010203	42.68663 -103.41772	SE ¼, SW-¼, Sec. 3, T31N, R52W, Dawes County	Monthly water quality and quarterly metals (reduced list)	Permanent flow Gauge
WHITE RIVER NORTHEAST OF CHADRON, NE						
SW1WHITE105	WH1-10000	101402010806	42.94828 -102.90054	SW ¼, SE ¼, Sec. 6, T34N R47W, Dawes County	Monthly water quality, all quarterly metals	No existing glow gauge

Source: Lund, J. 2010

Table 2.9-17 White River Flow Measurements at Fort Robinson, Crawford and Chadron 2001 – 2009

Location	Year								
	2009	2008	2007	2006	2005	2004	2003		Average
	ft^3/sec (Average flow)								
White River at Ft. Robinson (SWH1WHITE325)	29.68	17.06	10.4	11.0	--	11.2	14.5		15.6
White River at Crawford (SWH1WHITE208)	35.2	15.5	12.6	15.1	--	18.9	26.4		20.6
White River at Chadron (SWH1WHITE105)	25.5	7.41	7.0	12.5	--	13.4	10.0		12.6

Source: Lund J. 2010

Table 2.9-18 NDEQ Field Measurements of White River 2001 - 2009

Sampling Location	Date	Reporting Values	Discharge	Gage Height	Water Temperature	Dissolved Oxygen	pH	Conductivity	Turbidity
			ft^3/sec	Feet	°C	mg/l	Std. Units	umhos/cm	NTU
White River at Ft. Robinson	2009	Average	29.68	NA	10.38	9.16	8.39	314	48.6
		Minimum	11.4	NA	2.02	7.12	7.99	258	3.2
		Maximum	127.2	NA	16.40	12.52	8.82	332	386.0
	2008	Average	17.06	NA	13.90	10.21	8.41	343	8.4
		Minimum	11.2	NA	1.7	7.17	7.92	289	0.0
		Maximum	21.90	NA	21.5	11.94	8.68	444	23.6
	2007	Average	10.4	NA	12.7	9.8	8.06	316	15.1
		Minimum	4.5	NA	0.2	8.0	7.32	298	1.8
		Maximum	18.9	NA	22.9	11.2	8.66	333	84.8
	2006	Average	11.0	NA	12.24	9.12	8.34	322	6.5
		Minimum	4.7	NA	3.82	5.30	7.70	295	1.5
		Maximum	15.2	NA	22.42	11.44	8.85	342	15.9
	2005	Average	No Data	NA	12.53	9.59	8.41	336	5.08
		Minimum	No Data	NA	-0.16	7.21	7.82	282	5.5
		Maximum	No Data	NA	22.06	12.47	9.09	359	17.50
	2004	Average	11.2	NA	12.3	9.6	8.2	327	4.4
		Minimum	2.3	NA	2.4	6.3	7.3	308	0.9
		Maximum	20.0	NA	21.8	11.7	8.9	351	8.4
	2003	Average	14.47	NA	10.80	10.62	8.38	344	5.1
		Minimum	8.85	NA	1.66	8.91	8.05	321	0.0
		Maximum	16.94	NA	21.55	11.75	8.62	356	15.9

Table 2.9-18 NDEQ Field Measurements of White River 2001 - 2009

Sampling Location	Date	Reporting Values	Discharge	Gage Height	Water Temperature	Dissolved Oxygen	pH	Conductivity	Turbidity
			ft^3/sec	Feet	°C	mg/l	Std. Units	umhos/cm	NTU
White River at Ft. Robinson	2002	Average	No Data	NA	15.62	11.33	8.67	344	3.8
		Minimum	No Data	NA	4.39	9.85	8.5	320	0.0[a]
		Maximum	No Data	NA	27.1	12.72	9.16	354	8.2[a]
	2001	Average	No Data	NA	No Data	No Data	No Data	No Data	No Data
		Minimum	No Data	NA	No Data	No Data	No Data	No Data	No Data
		Maximum	No Data	NA	No Data	No Data	No Data	No Data	No Data
White River at Crawford	2009	Average	35.2	2.5	9.28	8.51	8.27	347.2	39.5
		Minimum	10.3	2.00	-0.25	6.45	7.66	317	4.1
		Maximum	121.0	3.86	17.71	11.7	8.71	389	319.0
	2008	Average	15.5	2.10	13.5	8.88	8.22	367.4	34.0
		Minimum	4.0	1.84	0.5	6.45	7.90	313	5.4
		Maximum	28.0	2.38	21.0	12.32	8.77	467	78.1
	2007	Average	12.6	2.03	12.4	8.8	7.82	341.8	43.4
		Minimum	5.0	1.70	0.6	7.1	7.42	325	4.2
		Maximum	20.0	2.30	22.5	10.8	8.21	366	233.0
	2006	Average	15.1	2.20	11.9	8.6	8.04	364.4	18.7
		Minimum	<3.0	1.85	1.10	4.17	7.52	329	4.2
		Maximum	26.0	2.36	21.27	11.87	8.47	607	47.6
	2005	Average	--	--	12.23	8.27	8.01	360	22.6
		Minimum	No Data	No data	0.75	7.47	7.12	294	2.40
		Maximum	No Data	No data	21.90	11.15	8.39	389	113.0
	2004	Average	18.9	2.25	12.0	9.0	8.0	352	12.1
		Minimum	14.7	2.12	1.2	5.9	7.0	335	2.6

Table 2.9-18 NDEQ Field Measurements of White River 2001 - 2009

Sampling Location	Date	Reporting Values	Discharge	Gage Height	Water Temperature	Dissolved Oxygen	pH	Conductivity	Turbidity
			ft^3/sec	Feet	°C	mg/l	Std. Units	umhos/cm	NTU
		Maximum	27.4	2.49	21.7	10.8	8.5	374	21.8
White River at Crawford	2003	Average	26.4	2.38	10.63	10.35	8.20	374	8.9
		Minimum	13.6	2.08	0.81	7.85	7.95	349	0.9
		Maximum	121.2	4.1	21.16	11.51	8.48	386	23.6
	2002	Average	--	2.21	11.38	11.52	8.03	382	6.3
		Minimum	No Data	1.87	0.2	8.43	6.11	355	0
		Maximum	No Data	2.47	25.7	16.75	8.46	403	16.1
	2001	Average	No Data	2.29	10.58	11.36	8.13	368	10.0
		Minimum	No Data	1.85	2.20	7.82	7.00	323	1.0
		Maximum	No Data	2.48	26.10	15.63	9.33	412	38.5
White River at Chadron	2009	Average	25.5	NA	9.46	7.97	8.18	511	760
		Minimum	6.0[a]	NA	-0.22	5.85	7.20	267	5.2
		Maximum	48.3[a]	NA	21.52	11.35	8.72	663	5999
	2008	Average	7.41	NA	10.82	7.60	8.13	576	398
		Minimum	0.7	NA	-0.2	4.21	7.68	514	11.8
		Maximum	14.3	NA	23.1	12.99	8.62	631	2000
	2007	Average	7.0	NA	8.35	8.6	7.76	669	75.3
		Minimum	Dry[a]	NA	-0.2	6.0	7.29	561[a]	22.1
		Maximum	17.3[a]	NA	19.5	12.5	8.18	798[a]	136.0
	2006	Average	12.5	NA	10.80	7.76	7.94	698	110
		Minimum	Dry	NA	-0.26	3.01	7.32	485	7.0

Table 2.9-18 NDEQ Field Measurements of White River 2001 - 2009

Sampling Location	Date	Reporting Values	Discharge	Gage Height	Water Temperature	Dissolved Oxygen	pH	Conductivity	Turbidity
			ft^3/sec	Feet	°C	mg/l	Std. Units	umhos/cm	NTU
		Maximum	34.8	NA	22.0	12.18	8.55	1038	305.0
White River at Chadron	2005	Average	No Data	NA	11.90	7.96	55.26	653	138
		Minimum	No Data	NA	-0.24	4.82	7.44	527	22.9
		Maximum	No Data	NA	24.22	10.94	8.95	1074	520.0
	2004	Average	13.4	NA	12.42	7.6	8.0	590	622
		Minimum	1.4	NA	-0.2	5.2	7.1	257	7.2
		Maximum	37.0	NA	24.2	11.1	8.9	930	5999
	2003	Average	10.01	NA	8.45	9.91	8.05	683	243
		Minimum	0.972[a]	NA	-0.15	5.4	7.7	495	15.0
		Maximum	27.08[a]	NA	22.44	14.95	8.43	972	2000
	2002	Average	No Data	NA	8.76	10.48	8.10	730	61
		Minimum	No Data	NA	-0.18	3.8	7.86	505	19[a]
		Maximum	No Data	NA	24.0	15.9	8.33	898	115[a]
	2001	Average	19.92	NA	9.59	11.08	7.82	624	181
		Minimum	5.9[a]	NA	0.20	7.76	6.00	297	8.47[a]
		Maximum	51.2[a]	NA	26.60	15.30	8.86	826	631[a]

Source: Lund, J. 2010
[a] Missing data: see **Appendix I** for full set of field measurement data.
Sampling locations shown on **Figure 2.9-7**
Complete set of sampling data shown in **Appendix I.**
ft^3/sec = cubic feet per second
NTU = Nephelometric Turbidity Unit
umhos/cm = micromhos/cm

Table 2.9-19 Station Number SWH1WHITE325, White River, Fort Robinson, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
01/07/08	0.07		48.78	2.38	7.422	0.93	20.5		12.32		
02/04/08	0.21			2.62		0.97	22				
03/03/08	0.08			2.13		0.89	36.5				0.04
04/07/08			48.83	2.24	7.011	0.86	39		11.42		0.06
05/05/08				2.18		0.59	37.5				0.05
05/12/08				2.47		0.61	32				
05/19/08	0.06					0.47	46.5			0.55	0.18
05/27/08				2.21		0.61	29.5				
06/02/08				1.96		0.47	44.5				0.05
06/09/08				2.11		0.58	13				0.05
06/16/08				1.65		0.48	9.5				
06/23/08				1.48		0.38	23				
06/30/08				2.29		0.3					
07/07/08				2.41		0.21					
07/14/08						0.21	14				
08/11/08				1.8							
08/18/08				1.48		0.34	26.5				
08/25/08				2.38		0.34	17				
09/01/08				2.68		0.4	22				
09/15/08				2.3		0.58	13				
09/29/08				3.28		0.49					
10/06/08			48.93	2.7	7.252	0.51			11.94		0.1
11/03/08	0.09			2.73		0.63	10.5				0.05
12/01/08				2.55		0.95	22.5				0.04
2008 Average	**0.102**		**48.85**	**2.27**	**7.228**	**0.56**	**25.2**		**11.89**	**0.55**	**0.069**

Table 2.9-19 Station Number SWH1WHITE325, White River, Fort Robinson, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
01/08/07	0.13		54.31	2.42	7.254	1.01	16.5		12.09		0.049869
02/05/07	0.14			2.69		1.09	125			0.553075	0.14495
03/05/07				2.76		1.03	37.5				0.064634
04/02/07			53.54	2.84	7.762	0.72	44		12.91		0.061275
04/16/07	0.06			2.41		0.72	23.5				
05/07/07				2.32		0.70	18.5				0.047956
05/21/07				2.36		0.53	17.5				0.057145
06/04/07	0.06			2.50		0.59	14.5				0.106792
06/11/07				2.07		0.48	7				
07/09/07				2.20		0.18	15				
07/23/07	0.16		46.9	1.93	7.817	0.15			11.89		
08/06/07				2.28		0.12	5				
08/20/07				2.05		0.15	6.5				0.072892
09/10/07				2.15		0.48	5.5				
09/24/07				1.95		0.43	7.5				0.049328
10/01/07			50.53	2.19	7.782	0.45			11.67		
11/05/07	0.41			2.05		0.63	21				0.049024
12/03/07				2.34		0.97	10.5				
2007 Average	**0.16**		**51.32**	**2.31**	**7.654**	**0.58**	**23.44**		**12.14**	**0.553075**	**0.070387**
01/09/06	< 0.05	< 1.0	50.7	2.4	7.12	0.92	9.5	< 5.0	12.4	< 0.5	0.56
02/06/06	0.05			2.1		1.00	10			< 0.5	< 0.04
03/08/06	0.12			2.4		0.86	31.5			< 0.5	0.05
04/03/06	0.07	< 1.0	55.0	2.6	7.26	0.82	28.5	< 5.0	12.68	< 0.5	< 0.04
04/17/06	< 0.05			2.6		0.67	24.5			< 0.5	0.04
05/01/06	0.07			2.1		0.59	15			0.59	< 0.04

Table 2.9-19 Station Number SWH1WHITE325, White River, Fort Robinson, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
05/15/06	0.05			2.3		0.52	19.5			< 0.5	< 0.04
06/05/06	0.06			2.4		0.41	13.5			< 0.5	< 0.04
06/20/06	0.07			2.2		0.31	9.5			< 0.5	< 0.04
07/10/06	< 0.05	< 1.0	48.7	2.3	7.51	0.33	< 5.0	< 5.0	11.05	< 0.5	< 0.04
08/08/06	< 0.05			2.8		0.22	< 5.0			< 0.5	< 0.04
08/21/06	< 0.05			2.5		0.39	7			< 0.5	< 0.04
09/11/06	< 0.05			2.5		0.46	< 5.0			< 0.5	< 0.04
09/25/06	< 0.05			2.3		0.58	< 5.0			< 0.5	< 0.04
2006 Average	**0.07**		**51.5**	**2.4**	**7.30**	**0.58**	**16.85**		**12.04**	**0.59**	**0.22**
01/10/05	< 0.05	< 10.0	49.50	2.70	7.23	0.93	6.50	< 5.0	11.70	< 0.5	< 0.04
02/07/05	0.10			2.51		0.94	14.00			< 0.5	< 0.04
03/07/05	< 0.05			2.69		0.74	10.50			< 0.5	< 0.04
04/04/05	< 0.05	< 10.0	52.00	2.27	7.63	0.59	6.00	< 5.0	12.40	< 0.5	< 0.04
04/18/05	< 0.05			2.23		0.48	< 5.0			< 0.5	0.06
05/01/05	< 0.05			2.49		0.56	< 5.0			< 0.5	< 0.04
05/16/05	< 0.05			2.45		0.34	5.50			< 0.5	< 0.04
06/06/05	< 0.05			2.38		0.34	5.00			< 0.5	< 0.04
06/20/05	< 0.05			2.64		0.18	< 5.0			< 0.5	0.60
07/11/05	0.09	< 10.0	49.20	3.10	7.80	0.23	< 5.0	< 5.0	11.10	< 0.5	< 0.04
07/25/05	< 0.05			3.10		0.38	31.00			0.57	0.05
08/08/05	< 0.05			2.58		0.21	16.00			< 0.5	< 0.04
08/22/05	< 0.05			2.64		0.27	10.00			< 0.5	0.10
09/11/05	< 0.05			2.76		0.44	13.50			< 0.5	< 0.04
09/26/05	< 0.05			2.98		0.67	5.00			< 0.5	< 0.04
10/11/05	0.08	< 10.0	51.40	3.57	7.81	0.71	< 5.0	< 5.0	13.30	< 0.5	< 0.04

Table 2.9-19 Station Number SWH1WHITE325, White River, Fort Robinson, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
11/07/05	< 0.05			2.62		0.72	5.50			< 0.5	0.06
12/05/05	< 0.05			2.88		1.06	17.00			< 0.5	0.10
2005 Average	**0.09**		**50.53**	**2.70**	**7.62**	**0.54**	**11.19**		**12.13**	**0.57**	**0.16**
01/12/04	< 0.05		51.5	3.22	7.47	0.99	8		12.3	< 0.5	0.04
02/02/04	< 0.05			2.46		1.08	6			< 0.5	< 0.04
02/29/04	< 0.05			2.68		0.92	10			< 0.5	0.06
04/05/04	< 0.05		52.4	3.19	7.62	0.70	6.5			< 0.5	0.05
04/19/04	0.06			3.04		0.65	9.5			< 0.5	0.05
05/02/04	0.08			2.92		0.63	11.5			< 0.5	0.07
05/17/04	0.05			4.49		0.54	7.5			< 0.5	< 0.04
06/07/04	0.08			2.65		0.37	7			< 0.5	< 0.04
06/21/04	< 0.05			2.48		0.40	< 5			< 0.5	< 0.04
07/06/04	< 0.05		51.2	2.36	7.73	0.25	< 5		12.1	< 0.5	< 0.04
07/19/04	< 0.05			2.54		0.20	11.5			< 0.5	< 0.04
08/02/04	0.05			3.06		0.24	7.5			< 0.5	< 0.04
08/16/04	< 0.05			2.67		0.28	6			< 0.5	< 0.04
09/06/04	< 0.05			3.50		0.51	7			< 0.5	0.05
09/20/04	< 0.05			2.61		0.40	< 5			< 0.5	< 0.04
10/04/04	< 0.05		54.9	2.57	7.67	0.45	< 5		12.8	< 0.5	0.09
11/02/04	< 0.05			2.74		0.62	< 5			0.74	< 0.04
12/06/04	0.11			2.53		0.84	< 5			< 0.5	< 0.04
2004 Average	**0.07**		**52.5**	**2.87**	**7.62**	**0.56**	**8.17**		**12.40**	**0.74**	**0.059**
01/13/03	< .05	< 10	59.4	2.8	7.6	1.00	13		12.5	< .5	0.04
02/01/03	< .05			2.6		0.85	13.5			< .5	0.05

Table 2.9-19 Station Number SWH1WHITE325, White River, Fort Robinson, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
03/03/03	0.05			2.9		0.87	17			< .5	0.05
04/08/03	< .05	< 10	51.2	3.0	7.54	0.65	12		12.3	< .5	< .04
05/05/03	0.05			2.9		0.49	12.5			< .5	< .04
06/09/03	< .05			2.8		0.35	6			< .5	0.05
07/07/03	< .05	< 10	51.8	2.6	7.71	0.13	< 5		12.8	< .5	0.06
08/05/03	< .05			2.8		0.23	< 5			< .5	0.05
09/08/03	< .05			2.8		0.27	< 5			< .5	< .04
10/06/03	< .05	< 10	54.2	2.7	7.81	0.46	9		12.5	< .5	0.04
2003 Average	**0.05**		**54.2**	**2.8**	**7.67**	**0.53**	**11.9**		**12.5**		**0.05**
06/17/02	< 0.05			2.56		0.23	< 5			< 0.5	0.04
07/08/02	< 0.05	< 10	47.8	2.62	7.44	0.05	9.5	< 5	12.30	< 0.5	< 0.04
08/06/02	< 0.05			3.07		0.14	11			< 0.5	< 0.04
09/03/02	< 0.05			2.69		0.33	8			< 0.5	< 0.04
10/07/02	< 0.05	< 10	54	3.24	7.74	0.44	< 5	< 5	12.10	< 0.5	< 0.04
11/04/02	< 0.05			2.90		0.67	7.0			< 0.5	< 0.04
12/02/02	< 0.05			2.91		0.75	13.0			< 0.5	< 0.04
2002 Average			**50.9**	**2.85**	**7.59**	**0.37**	**9.7**		**12.20**		**0.04**
Total Average	**0.095**		**51.5**	**2.55**	**7.54**	**0.55**	**17.04**		**12.20**	**0.602**	**0.087**

Source: Lund, J. 2010
Blank spaces in column indicate no data presented.

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
01/07/08	0.06		51.18	2.9	7.394	0.7	13.5		13.5		
02/04/08	0.11			2.9		0.76	16.5				
03/03/08	0.12			2.65		0.52	11.5				
04/07/08			52.6	2.66	7.217	0.54	27.5		13.36		0.05
05/05/08				2.81		0.39	40.5				0.06
05/05/08				3.12		0.42	50.5				0.11
05/05/08				2.66		0.27	44			0.56	0.1
05/05/08				3.01		0.44	166			0.8	0.14
06/02/08				2.92		0.36	137			0.69	0.14
06/02/08				2.51		0.41	112				0.12
06/02/08				1.92		0.35	61			0.53	0.1
06/23/08				2.42		0.29	47.5				0.05
06/23/08				2.64		0.25	85				0.07
07/07/08				3.09		0.21	91				0.08
07/07/08						0.22	162				0.1
08/11/08				2.01		0.32	60				0.06
08/11/08				1.98		0.3	39.5				0.05
08/18/08				2.8							
09/01/08	0.07			3		0.34	39.5				0.05
09/01/08				3.37		0.46	101				0.08
09/01/08				2.8		0.48	31				0.05
09/01/08				3.02		0.33	16.5				
10/06/08			51.08	4.99	7.188	0.38	17.5		13.38		0.04
11/03/08				3.23		0.5	18.5				

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
12/01/08	0.1			3.15		0.69	7.5				
2008 Average	**0.092**		**51.62**	**2.86**	**7.266**	**0.41**	**58.19**		**13.41**	**0.65**	**0.081**
01/08/07			58.39	2.74	7.602	0.86	13.5		13.71		0.068365
02/05/07	0.07			3.15		0.98	109				0.100387
03/05/07				3.11		0.78	23				0.075251
04/02/07	0.12		57.92	3.42	7.96	0.46	33		14.43		0.060069
04/16/07	0.18			2.96		0.37	9.5				
05/07/07				2.93		0.43	43				0.09735
05/21/07				2.90		0.39	103			0.519621	0.119432
06/04/07	0.11			2.99		0.39	265				0.166529
06/11/07	0.07			2.46		0.34	28				
07/09/07	0.07			2.70		0.15	167			0.530721	0.119264
07/23/07	0.57		50.47	2.35	7.553	0.15	47.5		14.01		0.04811
08/06/07				2.65		0.19	62.5				
08/20/07				2.49		0.23	53.5				0.133743
09/10/07				2.45		0.38	38.5				0.089017
09/24/07	0.08			2.10		0.30	32.5				0.078473
10/01/07	0.11		53.15	2.72	7.892	0.33	18		12.97		0.084083
11/05/07	0.18			2.94		0.54					
12/03/07	0.06			2.90		0.80	5				
2007 Average	**0.15**		**54.98**	**2.78**	**7.752**	**0.45**	**61.85**		**13.78**	**0.525171**	**0.095390**
01/09/06	< 0.05	< 1.0	56.1	3.0	7.54	0.73	39	< 5.0	14.7	< 0.5	0.05
02/06/06	< 0.05			3.2		0.76	27			< 0.5	0.06
03/08/06	< 0.05			3.2		0.62	67.5			< 0.5	0.08

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
04/03/06	0.17	< 1.0	59.5	3.3	7.50	0.58	50.5	< 5.0	14.6	< 0.5	0.07
04/17/06	0.26			2.9		0.37	50			< 0.5	0.04
05/01/06	0.12			2.8		0.33	40			0.96	< 0.04
05/15/06	0.06			2.4		0.38	93			< 0.5	0.06
06/05/06	< 0.05			2.6		0.33	79.5			0.60	0.14
06/20/06	< 0.05			2.7		0.25	32			< 0.5	< 0.04
07/10/06	< 0.05	< 1.0	49.3	4.2	7.46	0.21	32.5	< 5.0	13.47	< 0.5	0.06
08/08/06	0.06			3.2		0.19	16			< 0.5	0.04
08/21/06	< 0.05			3.1		0.33	34.5			< 0.5	0.05
09/11/06	0.07			3.0		0.40	13.5			< 0.5	0.29
09/25/06	0.06			2.8		0.46	5			< 0.5	0.05
2006 Average	**0.11**		**54.94**	**3.02**	**7.50**	**0.42**	**41.43**		**14.26**	**0.78**	**0.08**
01/10/05	< 0.05	< 10.0	55.10	3.27	7.54	0.80	14.00	< 5.0	13.80	< 0.5	< 0.04
02/07/05	0.09			3.31		0.75	19.00			< 0.5	0.04
03/07/05	0.08			3.40		0.56	7.50			< 0.5	< 0.04
04/04/05	< 0.05	< 10.0	56.80	3.26	7.98	0.39	7.00	< 5.0	14.80	< 0.5	< 0.04
04/18/05	< 0.05			3.01		0.30	< 5.0			< 0.5	0.05
05/01/05	< 0.05			3.09		0.41	27.50			< 0.5	0.05
05/16/05	< 0.05			3.19		0.24	50.00			< 0.5	0.10
06/06/05	< 0.05			3.10		0.32	52.00			< 0.5	0.08
06/20/05	0.06			3.43		0.22	30.50			< 0.5	0.09
07/11/05	< 0.05	< 10.0	52.60	3.86	7.85	0.22	24.00	< 5.0	13.60	< 0.5	0.04
07/25/05	0.20			4.08		0.38	138.00			1.48	0.26
08/08/05	< 0.05			3.03		0.28	32.50			< 0.5	< 0.04

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
08/22/05	< 0.05	–		2.78		0.27	38.50			< 0.5	0.04
09/11/05	< 0.05			3.33		0.46	18.50			< 0.5	0.05
09/26/05	< 0.05			3.27		0.56	26.00			< 0.5	0.05
10/11/05	< 0.05	< 10.0	53.50	4.17	7.82	0.52	37.50	< 5.0	14.70	< 0.5	0.06
11/07/05	< 0.05			3.28		0.56	12.00			< 0.5	0.06
12/05/05	< 0.05			3.35		0.82	10.00			< 0.5	< 0.04
2005 Average	**0.11**		**54.50**	**3.35**	**7.80**	**0.45**	**32.03**		**14.23**	**1.48**	**0.08**
01/12/04	< 0.05		55	3.62	7.62	0.83	8.5		14.3	< 0.5	0.05
02/02/04	< 0.05			3.10		0.89	9			< 0.5	0.05
02/29/04	< 0.05			3.34		0.73	24			< 0.5	0.06
04/05/04	< 0.05		56.3	3.98	7.79	0.49	9			< 0.5	0.06
04/19/04	0.09			3.68		0.35	9			< 0.5	0.05
05/02/04	< 0.05			3.50		0.41	15			< 0.5	0.07
05/17/04	< 0.05			3.44		0.41	32.5			< 0.5	0.06
06/07/04	0.09			3.16		0.24	12			< 0.5	< 0.04
06/21/04	< 0.05			3.04		0.32	14.5			< 0.5	0.05
07/06/04	< 0.05		52.2	3.04	7.81	0.24	15		14.3	< 0.5	0.05
07/19/04	< 0.05			3.20		0.17	9.5			< 0.5	0.05
08/02/04	< 0.05			3.44		0.18	25			< 0.5	0.07
08/16/04	< 0.05			3.34		0.21	11.5			< 0.5	< 0.04
09/06/04	0.10			4.39		0.42	89			0.74	0.14
09/20/04	< 0.05			3.19		0.31	< 5			< 0.5	< 0.04
10/04/04	< 0.05		58.4	3.08	7.73	0.36	7		14.6	< 0.5	0.11
11/02/04	< 0.05			3.33		0.45	< 5			< 0.5	< 0.04

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
12/06/04	0.19			3.12		0.68	9.5			< 0.5	< 0.04
2004 Average	**0.12**		**55.48**	**3.39**	**7.74**	**0.43**	**18.75**		**14.40**	**0.74**	**0.07**
01/13/03	< .05	< 10	7	3.2	7.97	0.82	7		14.2	< .5	< .04
02/01/03	< .05		11	3.4		0.69	11			< .5	0.05
03/03/03	0.06		12.5	3.5		0.69	12.5			< .5	0.05
04/08/03	< .05	< 10	7.5	3.8	7.87	0.48	7.5		14.8	< .5	< .04
05/12/03	< .05		67	4.0		0.36	67			0.61	0.08
06/03/03	< .05		49	3.6		0.28	49			0.58	0.08
07/09/03	< .05	< 10	22	3.0	8.02	0.18	22		15.3	< .5	0.07
08/04/03	< .05		14	3.6		0.20	14			< .5	0.06
09/09/03	0.23		2900	4.7		0.61	2900			8.35	2.44
10/06/03	< .05	< 10	< 5	3.3	7.84	0.26	< 5		14.6	< .5	0.06
2003 Average	**0.14**		**343.28**	**3.61**	**7.93**	**0.46**	**343.28**		**14.73**	**3.18**	**0.36**
01/02/02	0.05	< 10	61.3	3.51	8.33	0.99	7.5	< 5	14.40	< 0.5	< 0.04
02/05/02	< 0.05		56.6	3.45	7.83	0.91	14.5		14.10	< 0.5	0.04
03/05/02	0.07		52.9	3.18	7.4	0.89	21.5		13.50	< 0.5	0.04
04/02/02	< 0.05	< 10	60.2	3.85	7.48	0.57	18.5	< 5	14.00	< 0.5	0.05
05/07/02	< 0.05		61.6	3.67	8.22	0.33	20		15.60	< 0.5	0.04
06/17/02	< 0.05			3.26		0.17	15			< 0.5	0.06
07/08/02	< 0.05	< 10	51.4	3.29	7.77	0.13	37	< 5	15.20	< 0.5	0.08
08/06/02	< 0.05			3.45		0.20	25			< 0.5	0.06
09/03/02	0.08			3.31		0.27	12			< 0.5	0.05
10/07/02	< 0.05	< 10	56.9	3.13	7.8	0.35	< 5	< 5	13.80	< 0.5	< 0.04
11/04/02	< 0.05			3.50		0.53	< 5			< 0.5	< 0.04

Table 2.9-20 Station Number SWH1WHITE208, White River, Crawford, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
12/02/02	< 0.05			3.37		0.59	< 5			< 0.5	< 0.04
2002 Average	**0.07**		**57.27**	**3.41**	**7.83**	**0.49**	**19.00**		**14.37**		**0.05**
01/08/01			62.2	3.9377	8.19	0.7459815	16.5		13.2	0.511973	
02/05/01	0.0884185		46.9	3.353942	7.8	0.704935	11.5		12.5		
03/05/01			63	3.664556	7.61	0.813278	59		14.6		0.0812095
04/02/01	0.113277		51.4	4.1118325	7.48	0.4889085	50		15.4		0.047041
05/07/01	0.064044		56.9	4.7335835	8.01	0.510237	194		17.6	0.658743	0.129153
06/04/01	0.068394		55.3	3.6949865	7.66	0.6602805	110		13.8	0.53056	0.1104615
07/09/01	0.083103		54.6	3.415668	7.57	0.3272945	59		14.9		0.114432
08/05/01	0.064998		46.4	3.745386	7.42	0.1843555			14.9		0.0477565
09/10/01			56.3	3.858378	7.8	0.31297	7		14.7		
10/01/01	0.0723245		50.5	3.2945705	7.74	0.352411	6		13.7		
11/06/01			58.2	3.4458865	7.58	0.560057			15		
12/03/01	0.0639755		58	3.2552535	7.74	0.783853	8		14.6		
2001 Average	**0.077317**		**54.98**	**3.709312**	**7.72**	**0.537047**	**52.10**		**14.58**	**0.56709**	**0.088342**
Total Average	**0.110560**		**111.51**	**3.202731**	**7.72**	**0.449386**	**65.98**		**14.32**	**1.165730**	**0.102817**

Source: Lund, J. 2010
Blank spaces in column indicate no data presented.

Table 2.9-21 Station Number SWH1WHITE105, White River Northeast, Chadron, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
01/07/08	0.07		74.5	7.22	11.97	0.53			41.52		
03/03/08	0.13			8.84		0.31	52			0.99	0.2
04/07/08			65.65	9.39	11.72		41.5		60.41		0.09
05/05/08				9.58			181			0.98	0.23
06/03/08	0.07			5.31		0.07	177			2.65	1.87
09/02/08				9.12			166			1.35	0.3
10/06/08		7.02955	62.15	5.87	10.73		77.3		37.14		0.19
11/03/08				7.85		0.06	47.5				0.14
12/01/08	0.06			8.94		0.06					0.05
2008 Average	**0.08**	**7.0296**	**67.43**	**8.01**	**11.47**	**0.21**	**106.04**		**46.36**	**1.49**	**0.38**
01/08/07			88.55	10.50	16.26	0.49			81.78		
02/05/07	0.05			11.82		0.55					
03/05/07	0.09			8.83		0.12					
04/02/07			71.51	11.10	13.57		16		68.97	0.551777	0.080949
04/16/07	0.06			10.33			79				0.077924
05/07/07	0.08			9.26			211			1.02442	0.277555
05/21/07				10.79			128			0.801414	0.229324
06/04/07	0.09			7.34		0.09	122			0.663214	0.195443
06/11/07	0.08			9.00			155			0.936286	0.219709
10/01/07	0.14		79.94	14.61	17.65		37		107.3	0.803101	0.113263
11/05/07	0.15			9.32			14.5			0.50846	0.081109
12/03/07				8.76		0.10	5.5				
2007 Average	**0.09**		**80.00**	**10.14**	**15.83**	**0.27**	**85.33**		**86.02**	**0.75552**	**0.159410**
01/09/06	0.08	< 1.0	68.3	8.9	12.40	0.37	16.5	< 5.0	60.6	< 0.5	< 0.04

Table 2.9-21 Station Number SWH1WHITE105, White River Northeast, Chadron, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
02/06/06	< 0.05			9.5		0.34	10.5			< 0.5	< 0.04
03/08/06	< 0.05			9.8		0.18	17.5			< 0.5	0.04
04/03/06	0.32	< 1.0	62.2	13.6	9.06	0.29	452	< 5.0	50.99	1.29	0.53
04/17/06	0.09			8.9		0.18	324			1.15	0.33
05/01/06	0.19			11.8		0.22	1060			2.54	1.02
05/15/06	0.16			8.9		< 0.05	111			0.77	0.14
06/05/06	0.11			8.9		< 0.05	105			0.86	0.17
06/20/06	0.08			11.7		< 0.05	119			1.31	0.19
07/10/06	< 0.05	< 1.0	61.3	11.3	11.98	< 0.05	138	< 5.0	81.17	1.59	0.29
08/08/06	0.08			11.5		< 0.05	139			1.45	0.27
08/21/06	0.12			9.6		< 0.05	129			1.44	0.27
09/25/06	0.13			9.9		< 0.05	79			1.52	0.26
2006 Average	**0.14**		**63.9**	**10.33**	**11.15**	**0.26**	**207.73**		**64.25**	**1.39**	**0.32**
01/10/05	< 0.05	< 10.0	86.40	13.51	17.50	0.53	7.50	< 5.0	89.90	< 0.5	< 0.04
02/07/05	0.05			10.43		0.32	14.00			< 0.5	0.04
03/07/05	< 0.05			10.46		0.08	31.00			< 0.5	0.05
04/04/05	< 0.05	< 10.0	72.40	12.08	14.10	0.20	184.00	< 5.0	110.00	0.63	0.18
04/18/05	< 0.05			21.96		< 0.05	158.00			1.04	0.23
05/01/05	0.15			12.11		0.31	110.00			0.68	0.20
05/16/05	0.21			11.01		0.41	2210.00			2.61	2.21
06/06/05	0.09			9.03		0.32	1090.00			2.01	1.04
06/20/05	0.16			14.36		0.28	488.00			1.77	0.69
07/11/05	< 0.05	< 10.0	65.70	9.75	10.50	0.29	204.00	< 5.0	41.10	1.00	0.25
07/25/05	0.07			11.16		0.16	330.00			1.30	0.40

Table 2.9-21 Station Number SWH1WHITE105, White River Northeast, Chadron, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
08/08/05	0.21			8.56		< 0.05	110.00			0.74	0.17
08/22/05	< 0.05			7.28		0.22	406.00			1.17	0.43
09/11/05	< 0.05			9.57		< 0.05	93.00			0.64	0.14
09/26/05	0.07			12.25		< 0.05	43.00			< 0.5	0.09
10/11/05	0.15	< 10.0	65.60	10.16	12.80	< 0.05	38.00	< 5.0	59.00	0.51	0.15
11/07/05	0.21			10.33		< 0.05	15.00			< 0.5	0.09
12/05/05	< 0.05			16.42		0.28	< 5.0			< 0.5	< 0.04
2005 Average	**0.14**		**72.53**	**11.69**	**13.73**	**0.28**	**325.38**		**75.00**	**1.18**	**0.40**
01/12/04	< 0.05		87.7	15.26	17.8	0.56	< 5		105	< 0.5	< 0.04
02/02/04	< 0.05			12.71		0.43	< 5			0.67	0.08
02/29/04	< 0.05			9.37		0.20	11			0.53	0.08
04/05/04	< 0.05		62.9	9.24	11	< 0.05	89			0.57	0.12
04/19/04	0.05			10.06		< 0.05	94			0.55	0.14
05/02/04	0.05			8.64		< 0.05	57.5			< 0.5	0.11
05/17/04	< 0.05			9.77		< 0.05	55.5			0.55	0.10
06/07/04	0.10			13.86		< 0.05	70			0.55	0.12
06/21/04	< 0.05			10.82		< 0.05	79			0.77	0.13
07/06/04	0.11		43.2	12.73	7.51	0.29	370		48.7	1.62	0.45
07/19/04	0.08			11.18		0.17	241			1.22	0.34
08/02/04	0.11			15.01		< 0.05	196			1.29	0.28
08/16/04	0.08			10.25		< 0.05	183			1.07	0.26
09/06/04	0.23			1.97		0.38	2910			6.53	3.21
09/20/04	0.05			9.82		0.06	448			1.52	0.50
10/04/04	0.09		26.4	4.20	3.86	0.39	2040		31.2	2.81	1.25

Table 2.9-21 Station Number SWH1WHITE105, White River Northeast, Chadron, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
11/02/04	< 0.05			7.04		< 0.05	134			0.61	0.19
12/06/04	0.11			11.94		0.51	17.5			< 0.5	< 0.04
2004 Average	**0.10**		**55.05**	**10.22**	**10.04**	**0.33**	**437.22**		**61.63**	**1.39**	**0.46**
01/13/03	0.05	< 10	107	13.8	19.9	0.25	15		106	< .5	< .04
02/01/03	< .05			11.2		0.58	5			< .5	0.05
03/03/03	0.05			12.7		0.45	< 5			< .5	< .04
04/08/03	0.05	< 10	69.9	13.0	12.1	<.05	75		74.5	< .5	0.10
05/05/03	0.13			8.5		0.50	3580			2.49	2.91
06/09/03	< .05			10.4		0.18	209			0.97	0.28
07/07/03	< .05	11.25	64.9	8.8	10.2	<.05	180		45.8	1.00	0.28
08/05/03	< .05			16.5		<.05	81			0.91	0.17
09/08/03	< .05			8.4		<.05	67			0.69	0.13
10/06/03	< .05	< 10	59.8	7.6	10.1	<.05	87		45	0.54	0.12
2003 Average	**0.07**		**75.40**	**11.09**	**13.08**	**0.39**	**477.67**		**67.83**	**1.10**	**0.51**
01/02/02	< 0.05	< 10	96.7	14.83	18.3	0.73	5	< 5	103.00	< 0.5	< 0.04
02/05/02	0.05		81.1	10.83	15.9	0.69	6		69.20	< 0.5	< 0.04
03/05/02	0.06		75.9	10.12	13.9	0.67	8		57.90	< 0.5	< 0.04
04/02/02	0.08	< 10	36.7	6.05	6.16	0.53	1248	< 5	63.20	2.06	1.20
05/07/02	< 0.05		58.7	16.31	10.9	0.11	1520		75.70	2.52	1.36
06/17/02	< 0.05			10.15		< 0.05	83			0.61	0.16
07/08/02	< 0.05	11.55	74.4	10.85	13.5	< 0.05	131	< 5	75.40	1.36	0.30
08/06/02	0.10			11.26		< 0.05	97			1.35	0.27
09/03/02	0.09			9.65		< 0.05	79			0.75	0.19
10/07/02	< 0.05	< 10	63	8.39	10.2	< 0.05	46	< 5	59.20	0.54	0.09

Table 2.9-21 Station Number SWH1WHITE105, White River Northeast, Chadron, NE

Sampling Date	Ammonia, mg/l	Arsenic, Dissolved, ug/l	Calcium, Dissolved, mg/l	Chloride, mg/l	Magnesium, Dissolved, mg/l	Nitrite + Nitrate (as N), mg/l	Residue, Nonfilterable (TSS), mg/l	Selenium, Total, ug/l	Sodium, Dissolved, mg/l	Total Kjeldahl Nitrogen, mg/l	Total Phosphorus, mg/l
11/04/02	0.05			13.36		< 0.05	11.5			0.58	0.06
12/02/02	< 0.05			12.95		0.30	19.0			< 0.5	< 0.04
2002 Average	**0.07**		**69.50**	**11.23**	**12.69**	**0.50**	**271.13**		**71.94**	**1.22**	**0.46**
01/08/01	0.0799215		93.6	13.88383	18.1	0.9216275	28		104	0.8248095	0.081833
02/05/01	0.063545		70.1	12.013683	15.5	0.8222615	18.5		91.7	0.5187015	0.0746595
03/05/01	0.1877735		43.3	6.227005	10.1	0.514814	306		74.7	1.8659715	0.479757
04/02/01	0.063917		61	11.293366	10.9	0.269359	110		56	0.6884615	0.134018
05/07/01	0.089157		62.8	14.9983155	15.7	0.2021355	510		105	1.5102885	0.4679395
06/04/01	0.0551175		65.9	11.4562915	12	0.463248	194		63.8	0.9829295	0.258926
07/09/01	0.1043685		48.5	8.7321115	9.63	0.4237985	878		77.4	1.6997155	0.7003655
08/05/01	0.062077		69.7	11.8997445	14.3		88		79.7	0.799391	0.1692175
09/10/01			59.1	9.6251515	10.7		96		60.4	0.9433605	0.167058
10/01/01	0.087271		60.4	9.828956	13.1		58		64	0.529504	0.104046
11/06/01			77.6	10.7712315	15.1		10.5		77.1		0.0654255
12/03/01	0.050924		78.1	11.910215	15.3	0.5643575			78.6		
2001 Average	**0.08441**		**65.84**	**11.05333**	**13.37**	**0.522700**	**208.82**		**77.70**	**1.036313**	**0.24575**
Total Average	**0.10230**		**68.06**	**10.58347**	**12.80**	**0.348082**	**282.84**		**71.34**	**1.206751**	**0.371745**

Source: Lund, J. 2010
Blank spaces in column indicate no data presented.

Table 2.9-22 Three Crow Surface Water Dissolved Radiological Baseline Data 2007 - 2009

Radionuclide	Sampling Locations							
	Icehouse Pond		Grabel Pond		Cherry Creek Pond		Sulzbach Pond	
	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/l							
First Quarter 2009								
Lead 210	<2.8	2.8	<2.8	2.8	<2.8	2.8	<0.38	3.8
Lead 210 Precision (+)	1.6	--	1.7	--	1.6	--	2.3	--
Lead 210 MDC	2.8	--	2.8	--	2.8	--	3.8	--
Polonium 210	<0.5	0.5	0.4	0.4	<0.4	0.4	<0.6	0.6
Polonium 21o Precision (+)	0.3	--	0.4	--	0.3	--	0.3	--
Polonium 210 MDC	0.5	--	0.4	--	0.4	--	0.6	--
Radium 226	<0.21	0.21	<.20	.20	<0.19	0.19	<0.08	0.08
Radium 226 Precision (+)	0.14	--	0.14	--	0.12	--	0.05	--
Radium 226 MDC	0.21	--	0.2	--	0.19	--	0.08	--
Thorium 230	<0.2	0.2	<0.4	0.4	<0.1	0.1	<0.3	0.3
Thorium 230 Precision (+)	0.2	--	0.2	--	0.05	--	0.1	--
Thorium 230 MDC	0.2	--	0.4	--	0.1	--	0.3	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.0087	0.0003	0.0127	0.003	0.0154	0.0003	0.0077	0.0003
Fourth Quarter 2008								
Lead 210	<4.1	4.1	<5.4	5.4	<10.8	10.8	<5.4	5.4
Lead 210 Precision (+)	2.4	--	3.3	--	6.6	3.2	--	--
Lead 210 MDC	4.1	--	5.4	--	10.8	--	5.4	--
Polonium 210	<0.2	0.2	<0.3	0.3	<0.29	.3	<.31	0.3
Polonium 21o Precision (+)	0.2	--	0.3	--	0.3	--	0.3	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<0.18	0.18	<0.17	0.17	<0.2	0.2	<0.2	0.2
Radium 226 Precision (+)	0.07	--	0.11	--	0.1	--	0.08	--
Radium 226 MDC	0.18	--	0.17	--	0.2	--	0.2	--
Thorium 230	<0.2	0.2	<0.11	0.10	<0.07	0.07	<0.2	0.2
Thorium 230 Precision (+)	0.2	--	0.1	--	0.07	--	0.2	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--

Table 2.9-22 Three Crow Surface Water Dissolved Radiological Baseline Data 2007 - 2009

Radionuclide	Sampling Locations							
	Icehouse Pond		Grabel Pond		Cherry Creek Pond		Sulzbach Pond	
	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/l							
Uranium, mg/l	0.0159	0.0003	0.0134	0.0003	0.0167	0.0003	0.013	0.0003
Third Quarter 2008								
Lead 210	<2.1	2.1	<2.1	2.1	<2.1	2.1	<12.5	12.5
Lead 210 Precision (+)	1.3	--	1.3	--	1.3	--	7.4	--
Lead 210 MDC	2.1	--	2.1	--	2.1	--	12.5	--
Polonium 210	<0.4	0.4	0.8	<0.8	0.6	<0.6	<0.8	0.8
Polonium 21o Precision (+)	0.4	--	0.8	--	0.6	--	0.8	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<0.26	0.26	<0.22	0.22	<0.2	0.2	<0.2	0.2
Radium 226 Precision (+)	0.12	--	0.13	--	<0.1	0.2	<0.09	0.09
Radium 226 MDC	0.26	--	0.22	--	0.2	--	0.2	--
Thorium 230	<0.2	0.2	<0.1	0.1	<0.07	0.07	<0.1	0.1
Thorium 230 Precision (+)	0.2	--	0.1	--	0.07	--	0.1	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.0063	0.0003	0.0125	0.0003	0.0147	0.0003	0.0029	0.0003
Second Quarter 2008								
Lead 210	<30.2	30.2	<29.3	29.3	<29.7	29.7	<9.4	9.4
Lead 210 Precision (+)	18.0	--	17.4	--	17.9	--	5.6	--
Lead 210 MDC	30.2	--	29.3	--	29.7	--	9.4	--
Polonium 210	<1.0	1.0	<0.8	0.8	<1.0	1.0	<0.5	0.5
Polonium 21o Precision (+)	0.9	--	0.8	--	0.1	--	0.5	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	0.2	0.2	0.2	0.1	0.3	0.1	<0.2	0.2
Radium 226 Precision (+)	0.1	--	0.1	--	0.1	--	0.1	--
Radium 226 MDC	0.1	--	0.1	--	0.1	--	0.2	--
Thorium 230	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1

Table 2.9-22 Three Crow Surface Water Dissolved Radiological Baseline Data 2007 - 2009

Radionuclide	Sampling Locations							
	Icehouse Pond		Grabel Pond		Cherry Creek Pond		Sulzbach Pond	
	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/l							
Thorium 230 Precision (+)	0.1	--	0.1	--	0.1	--	0.1	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.013	0.0003	0.0137	0.0003	0.013	0.0003	0.0154	0.0003
First Quarter 2008								
Lead 210	--	--	--	--	--	--	--	--
Lead 210 Precision (+)	--	--	--	--	--	--	--	--
Lead 210 MDC	--	--	--	--	--	--	--	--
Polonium 210	--	--	--	--	--	--	--	--
Polonium 210 Precision (+)	--	--	--	--	--	--	--	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<0.17	0.17	<0.18	0.18	<0.17	0.17	--	--
Radium 226 Precision (+)	0.083	--	0.1	--	0.099	--	--	--
Radium 226 MDC	0.17	--	0.18	--	0.17	--	--	--
Thorium 230								
Thorium 230 Precision (+)								
Thorium 230 MDC								
Uranium Activity	9.0	0.2	9.3	0.2	11.3	0.2	--	--
Uranium, mg/l	0.0133	0.0003	0.0137	0.0003	0.0166	0.0003	--	--
Fourth Quarter 2007								
Lead 210	<1.0	1.0	<1.0	1.0	<1.0	1.0	--	--
Lead 210 Precision (+)	--	--	--	--	--	--	--	--
Lead 210 MDC	--	--	--	--	--	--	--	--
Polonium 210	<1.0	1.0	<1.0	1.0	<1.0	1.0	--	--
Polonium 210 Precision (+)	--	--	--	--	--	--	--	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<1.0	1.0	<0.2	0.2	<0.2	0.2		

Table 2.9-22 Three Crow Surface Water Dissolved Radiological Baseline Data 2007 - 2009

Radionuclide	Sampling Locations							
	Icehouse Pond		Grabel Pond		Cherry Creek Pond		Sulzbach Pond	
	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/l							
Radium 226 Precision (±)	--	--	--	--	--	--	--	--
Radium 226 MDC	--	--	--	--	--	--	--	--
Thorium 230	<0.2	0.2	<0.2	0.2	<0..2	0.2		
Thorium 230 Precision (±)	--	--	--	--	--	--	--	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.0125	0.0003	0.0133	0.0003	0.0165	0.0003	--	--
Third Quarter 2007								
Lead 210	--	--	--	--	--	--	--	--
Lead 210 Precision (±)	--	--	--	--	--	--	--	--
Lead 210 MDC	--	--	--	--	--	--	--	--
Polonium 210	--	--	--	--	--	--	--	--
Polonium 210 Precision (±)	--	--	--	--	--	--	--	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<0.2	0.2	<0.2	0.2	<0.2	0.2	--	--
Radium 226 Precision (±)	--	--	--	--	--	--	--	--
Radium 226 MDC	--	--	--	--	--	--	--	--
Thorium 230	--	--	--	--	--	--	--	--
Thorium 230 Precision (±)	--	--	--	--	--	--	--	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.0185	0.0003	0.0141	0.0003	0.0041	0.0003	--	--
Second Quarter 2007	--	--	--	--	--	--	--	--
Lead 210	<1.0	1.0	<1.0	1.0	<1.0	1.0	--	--
Lead 210 Precision (±)	--	--	--	--	--	--	--	--
Lead 210 MDC	--	--	--	--	--	--	--	--
Polonium 210	<1.0	1.0	<1.0	1.0	7.0	1.0	--	--

Table 2.9-22 Three Crow Surface Water Dissolved Radiological Baseline Data 2007 - 2009

Radionuclide	Sampling Locations							
	Icehouse Pond		Grabel Pond		Cherry Creek Pond		Sulzbach Pond	
	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/l							
Polonium 210 Precision (+)	--	--	--	--	3.9	--	--	--
Polonium 210 MDC	--	--	--	--	--	--	--	--
Radium 226	<0.2	0.2	<0.2	0.2	<0.2	0.2	--	--
Radium 226 Precision (+)	--	--	--	--	--	--	--	--
Radium 226 MDC	--	--	--	--	--	--	--	--
Thorium 230	<0.2	0.2	<0.2	0.2	<0.2	0.2	--	--
Thorium 230 Precision (+)	--	--	--	--	--	--	--	--
Thorium 230 MDC	--	--	--	--	--	--	--	--
Uranium Activity	--	--	--	--	--	--	--	--
Uranium, mg/l	0.0078	0.0003	0.014	0.0003	0.014	0.0003	--	--

Table 2.9-23 Three Crow Surface Water Non-Radiological Sampling Results

Parameter	Units	Ice House Pond (I-10)	Cherry Creek Pond (I-11)	Grabel Ponds	Sulzbach Pond (I-9)	Reporting Limit
Fourth Quarter 2008						
Alkalinity, Total, as $CaCO_3$	mg/l	229	223	214	236	1.0
Carbonate as CO_3	mg/l	<1.0	<1.0	<1.0	<1.0	1.0
Bicarbonate as HCO_3	mg/l	280	273	261	288	1.0
Calcium	mg/l	72	83	66	52	1.0
Chloride	mg/l	14	6	4	20	1.0
Fluoride	mg/l	0.7	0.6	0.6	1.4	0.1
Magnesium	mg/l	6	7	7	15	1.0
Nitrogen, Ammonia as N	mg/l	<0.05	<0.05	<0.0	<0.05	0.05
Nitrogen, Nitrate + Nitrite as N	mg/l	<0.05	1.27	1.63	<0.05	0.05
Nitrogen, Nitrite as N	mg/l	--	--	--	--	--
Potassium	mg/l	24	13	7	18	1.0
Silica	mg/l	41.9	65.1	69.5	21.8	0.1
Sodium	mg/l	38	30	23	45	2.0
Sulfate	mg/l	22	15	11	18	1.0
PHYSICAL PROPERTIES						
Conductivity	umhos/cm	521	444	411	518	1.0
pH	std. units	7.96	7.93	7.81	8.17	0.01
Solids, Total Dissolved @180°C	mg/l	349	332	323	371	10
METALS, DISSOLVED						
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Arsenic	mg/l	0.005	0.003	0.003	0.005	0.001
Barium	mg/l	0.1	0.1	<0.1	<0.1	0.1
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	0.005
Chromium	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Copper	mg/l	<0.01	<0.01	<0.01	<0.01	0.01
Iron	mg/l	0.06	<0.03	<0.03	<0.03	0.03
Lead	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/l	0.1	<0.01	<0.01	<0.01	0.01
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Molybdenum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Selenium	mg/l	<0.001	0.002	0.002	<0.001	0.001
Uranium	Mg/l	0.0159	0.0167	0.0134	0.013	0.0003
Vanadium	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Zinc	mg/l	0.02	<0.01	<0.1	<0.01	0.01
DATA QUALITY						
A/C Balance (± 5)	%	7.87	11.2	2.85	4.99	--
Anions	meq/l	5.47	5.07	4.78	5.72	--
Cations	meg/l	6.41	6.35	5.06	6.32	--
Solids, Total Dissolved Calc.	mg/l	369	377	343	340	--
TDS Balance (0.80-1.20)	dec.%	0.95	0.88	0.94	1.09	--

Table 2.9-23 Three Crow Surface Water Non-Radiological Sampling Results

Parameter	Units	Ice House Pond (I-10)	Cherry Creek Pond (I-11)	Grabel Ponds	Sulzbach Pond (I-9)	Reporting Limit
Third Quarter 2008						
Alkalinity, Total, as $CaCO_3$	mg/l	187	219	215	201	1.0
Carbonate as CO_3	mg/l	<1.0	<1.0	<1.0	14	1.0
Bicarbonate as HCO_3	mg/l	228	267	262	216	1.0
Calcium	mg/l	42	60	59	34	1.0
Chloride	mg/l	10	6	5	13	1.0
Fluoride	mg/l	0.7	0.6	0.7	1.5	0.1
Magnesium	mg/l	4	5	7	14	1.0
Nitrogen, Ammonia as N	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Nitrogen, Nitrate + Nitrite as N	mg/l	<0.05	1.44	1.57	<0.05	0.05
Nitrogen, Nitrite as N	mg/l	--	--	--	--	--
Potassium	mg/l	18	12	8	16	1.0
Silica	mg/l	7.6	14.5	15	5	0.1
Sodium	mg/l	33	25	25	47	2.0
Sulfate	mg/l	17	12	12	19	1.0
PHYSICAL PROPERTIES						
Conductivity	umhos/cm	405	439	427	458	1.0
pH	std. units	7.54	7.56	7.62	8.94	0.01
Solids, Total Dissolved @180°C	mg/l	295	321	313	321	10
METALS, DISSOLVED						
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Arsenic	mg/l	0.004	0.004	0.004	0.007	0.001
Barium	mg/l	<0.1	0.1	<0.1	<0.1	0.1
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	0.005
Chromium	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Copper	mg/l	<0.01	<0.01	<0.01	<0.01	0.01
Iron	mg/l	<0.03	<.03	<0.03	<0.03	0.03
Lead	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/l	0.03	<0.01	<0.01	<0.01	0.01
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Molybdenum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Selenium	mg/l	0.002	0.002	0.002	<0.001	0.001
Uranium	Mg/l	0.0063	0.0147	0.0125	0.0029	0.0003
Vanadium	mg/l	<0.1	0.1	<0.1	<0.1	0.1
Zinc	mg/l	<0.01	<0.01	<0.01	<0.01	0.01
DATA QUALITY						
A/C Balance (± 5)	%	-0.679	-1.49	-0.46	4.08	--
Anions	meq/l	4.42	4.93	4.83	4.87	--
Cations	meg/l	4.37	4.78	4.79	5.28	--
Solids, Total Dissolved Calc.	mg/l	248	276	271	272	--
TDS Balance (0.80-1.20)	dec.%	1.19	1.16	1.15	1.18	--

Table 2.9-23 Three Crow Surface Water Non-Radiological Sampling Results

Parameter	Units	Ice House Pond (I-10)	Cherry Creek Pond (I-11)	Grabel Ponds	Sulzbach Pond (I-9)	Reporting Limit
Second Quarter 2008						
Alkalinity, Total, as $CaCO_3$	mg/l	194	248	203	254	1
Carbonate as CO_3	mg/l	ND	ND	ND	ND	1
Bicarbonate as HCO_3	mg/l	237	303	247	309	1
Calcium	mg/l	58	82	67	90	1
Chloride	mg/l	11	5	5	12	1
Fluoride	mg/l	0.6	0.7	0.6	1.3	0.1
Magnesium	mg/l	5	6	7	15	1
Nitrogen, Ammonia as N	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Nitrogen, Nitrate + Nitrite as N	mg/l	<0.05	0.4	1.4	<0.05	0.05
Nitrogen, Nitrite as N	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Potassium	mg/l	19	10	7	13	1
Silica	mg/l	9.4	29	33.9	11.7	0.1
Sodium	mg/l	30	32	24	40	1
Sulfate	mg/l	16	19	14	41	1
PHYSICAL PROPERTIES						
Conductivity	umhos/cm	447	529	439	603	1
pH	std. units	8.28	7.99	7.98	7.83	0.01
Solids, Total Dissolved @180°C	mg/l	289	365	308	383	10
METALS, DISSOLVED						
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Arsenic	mg/l	0.004	0.003	0.004	0.008	0.001
Barium	mg/l	<0.1	0.2	<0.1	0.2	0.1
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	0.005
Chromium	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Copper	mg/l	<0.01	<0.01	<0.01	0.01	0.01
Iron	mg/l	<0.03	<0.03	<0.03	0.05	0.03
Lead	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/l	0.01	0.03	<0.01	0.04	0.01
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	0.001
Molybdenum	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/l	<0.05	<0.05	<0.05	<0.05	0.05
Selenium	mg/l	0.002	0.002	0.003	<0.001	0.001
Uranium	Mg/l	0.013	0.013	0.0137	0.0154	0.0003
Vanadium	mg/l	<0.1	<0.1	<0.1	<0.1	0.1
Zinc	mg/l	0.01	0.01	0.01	<0.01	0.01
DATA QUALITY						
A/C Balance (± 5)	%	5.39	5.75	5.69	10.2	--
Anions	meq/l	4.58	5.56	4.59	6.33	--
Cations	meg/l	5.1	6.24	5.15	7.76	--
Solids, Total Dissolved Calc.	mg/l	269	341	294	378	--
TDS Balance (0.80-1.20)	dec.%	1.07	1.07	1.05	1.01	--

Table 2.9-23 Three Crow Surface Water Non-Radiological Sampling Results

Parameter	Units	Ice House Pond (I-10)	Cherry Creek Pond (I-11)	Grabel Ponds	Sulzbach Pond (I-9)	Reporting Limit
THIRD QUARTER 2007						
Alkalinity, Total as $CaCO_3$	mg/l	192	563	190	--	1.0
Carbonate as CO_3	mg/l	<1.0	<1.0	<1.0	--	1.0
Bicarbonate, as HCO_3	mg/l	234	686	231	--	1.0
Calcium	mg/l	42	87	53	--	1.0
Chloride	mg/l	14	25	6	--	1.0
Fluoride	mg/l	0.9	1.8	0.6	--	0.1
Magnesium	mg/l	9	22	8	--	1.0
Nitrogen, Ammonia as N	mg/l	0.05	0.15	0.05	--	0.05
Nitrogen, Nitrate + Nitrite as N	mg/l	<0.1	<0.1	0.4	--	0.1
Nitrogen, Nitrite as N	mg/l	<0.1	<0.1	<0.1	--	0.1
Potassium	mg/l	23	36	8	--	1.0
Silica	mg/l	29.3	39.8	45.4	--	0.1
Sodium	mg/l	41	142	26	--	1.0
Sulfate	mg/l	25	18	14	--	1.0
PHYSICAL PROPERTIES						
Conductivity	umho/cm	439	1140	365	--	1.0
pH	std. units	8.08	8.08	7.9	--	0.01
Solids, Total Dissolved @ 180°C	mg/l	294	770	258	--	10
METALS, DISSOLVED						
Aluminum	mg/l	<0.1	<0.1	<0.1	--	0.1
Arsenic	mg/l	0.006	0.005	0.004	--	0.001
Barium	mg/l	<0.1	0.3	<0.1	--	0.1
Boron	mg/l	<0.1	0.2	<0.1	--	0.1
Cadmium	mg/l	<0.005	<0.005	<0.005	--	0.005
Chromium	mg/l	<0.05	<0.05	<0.05	--	0.05
Copper	mg/l	<0.01	<0.01	<0.01	--	0.01
Iron	mg/l	<0.03	0.17	<0.03	--	0.03
Lead	mg/l	<0.001	<0.001	<0.001	--	0.001
Manganese	mg/l	0.02	0.17	<0.01	--	0.01
Mercury	mg/l	<0.001	<0.001	<0.001	--	0.001
Molybdenum	mg/l	<0.1	<0.1	<0.1	--	0.1
Nickel	mg/l	<0.05	<0.05	<0.05	--	0.05
Selenium	mg/l	0.002	ND	0.002	--	0.001
Vanadium	mg/l	<0.1	<0.1	<0.1	--	0.1
Zinc	mg/l	<0.01	<0.01	<0.01	--	0.01
DATA BALANCE						
A/C Balance (± 5)	%	4.06	3.68	3.49	--	--
Anions	meq/l	4.79	12.4	4.31	--	--
Cations	meg/l	5.19	13.3	4.62	--	--
Solids, Total Dissolved Calc.	mg/l	298	710	276	--	--
TDS Balance (0.80-1.20)	dec.%	0.99	1.08	0.93	--	--

Table 2.9-24 Three Crow Vegetation Monitoring 2009

Collection Date	Radionuclide	Three Crow West Side		Three Crow Middle Side		Three Crow East Side	
		Results	RL	Results	RL	Results	RL
		uCi/kg					
7/08/2009	Lead 210	4.80E-04	9.00E-06	3.60E-04	7.40E-06	5.8E-04	7.6E-06
	Lead 210 Precision (±)	9.30E-06		7.30E-06		8.8E-06	
	Lead 210 MDC	9.00E-06		7.40E-06		7.6E-06	
	Polonium 210	5.50E-05	1.40E-06	7.30E-06	7.80E-07	5.6E-06	6.7E-07
	Polonium 210 Precision (±)	1.60E-05		2.60E-06		1.9E-06	
	Polonium 210 MDC	1.40E-06		7.80E-07		6.7E-07	
	Radium 226	1.40E-05	4.80E-08	1.00E-05	4.10E-08	1.00E-05	4.2E-08
	Radium 226 Precision (±)	3.10E-07		2.40E-07		2.5E-07	
	Radium 226 MDC	4.80E-08		4.10E-08		4.2E-08	
	Thorium 230	8.80E-06	2.70E-06	8.60E-06	1.70E-06	<7.1E-06	7.1E-06
	Thorium 230 Precision (±)	2.40E-06		2.10E-06		4.3E-06	
	Thorium 230 MDC	2.70E-06		1.70E-06		7.1E-06	
	Uranium Activity	2.30E-05	2.00E-07	1.70E-05	2.00E-07	1.6E-05	2.0E-07
	Uranium, mg/kg	0.034	0.0003	0.025	0.0003	0.024	0.00030
	Uranium, mg/kg	0.034	0.0003	0.025	0.0003	0.024	0.00030
8/03/2009	Lead 210 Precision (±)	1.50E-05		1.20E-05		1.20E-05	
	Lead 210 MDC	1.50E-05		1.50E-05		1.50E-05	
	Polonium 210	2.10E-05	1.50E-06	6.20E-06	2.60E-06	1.20E-05	1.30E-06
	Polonium 210 Precision (±)	6.00E-06		4.00E-06		4.10E-06	
	Polonium 210 MDC	1.50E-06		2.60E-06		1.30E-06	
	Radium 226	1.10E-05	6.60E-08	1.10E-05	7.20E-08	8.40E-06	1.10E-07
	Radium 226 Precision (±)	4.80E-07		5.10E-07		5.40E-07	
	Radium 226 MDC	6.60E-08		7.20E-08		1.10E-07	
	Thorium 230	5.30E-06	1.00E-06	9.70E-06	1.00E-06	2.90E-06	1.30E-06
	Thorium 230 Precision (±)	1.40E-06		2.20E-06		1.30E-06	
	Uranium Activity	1.10E-05	2.00E-07	1.60E-05	2.00E-07	4.80E-06	2.00E-07
	Uranium, mg/kg	0.016	0.0003	0.023	0.0003	0.0071	0.0003

Table 2.9-24 Three Crow Vegetation Monitoring 2009

Collection Date	Radionuclide	Three Crow West Side		Three Crow Middle Side		Three Crow East Side	
		Results	RL	Results	RL	Results	RL
		uCi/kg					
9/01/2009	Lead 210	5.50E-04	9.40E-06	4.00E-04	8.60E-06	7.00E-04	8.00E-06
	Lead 210 Precision (±)	1.10E-05		9.30E-06		1.10E-05	
	Lead 210 MDC	9.40E-06		8.60E-06		8.00E-06	
	Polonium 210	5.50E-05	9.70E-07	3.80E-05	1.80E-06	7.50E-05	1.40E-06
	Polonium 210 Precision (±)	1.10E-05		1.00E-05		1.70E-05	
	Polonium 210 MDC	9.70E-07		1.80E-06		1.40E-06	
	Radium 226	2.20E-05	1.30E-07	1.50E-05	9.10E-08	1.40E-05	9.00E-08
	Radium 226 Precision (±)	7.60E-07		5.20E-07		5.10E-07	
	Radium 226 MDC	1.30E-07		9.10E-08		9.00E-08	
	Thorium 230	3.60E-05	2.50E-06	<0.00	2.70E-06	2.30E-06	1.40E-06
	Thorium 230 Precision (±)	8.00E-06		1.80E-06		1.40E-06	
	Uranium Activity	1.40E-05	2.00E-07	1.10E-05	2.00E-07	1.10E-05	2.00E-07
	Uranium, mg/kg	0.02	0.0003	0.016	0.0003	0.016	0.0003

MDC – Minimum Detection Concentration
RL - Reporting Limit

Table 2.9-25 Three Crow Soil Baseline Sampling 2008

Radionuclides	Sampling Locations													
	AM-15		AM-16		AM-17		AM-18		AM-19		AM-20		AM-21	
	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL
	pCi/gm - Dry													
July 03 2008														
Lead 210	0.4	0.2	0.3	0.2	0.6	0.2	0.4	0.2	0.6	0.2	0.6	0.2	0.6	0.2
Lead 210 Precision (±)	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--
Lead 210 MDC	0.2	--	0.2	--	0.2	--	0.2	--	0.2	--	0.2	--	0.2	--
Radium 226	0.7	0.06	0.6	0.07	0.5	0.06	0.5	0.07	0.6	0.07	0.5	0.07	0.6	0.06
Radium 226 Precision (±)	0.1	--	0.1	--	0.09	--	0.1	--	0.1	--	0.1	--	0.1	--
Radium 226 MDC	0.06	--	0.07	--	0.06	--	0.07	--	0.07	--	0.07	--	0.06	--
Thorium 230	0.3	0.1	0.2	0.09	0.3	0.1	0.4	0.1	0.4	0.1	0.3	0.1	0.3	0.1
Thorium 230 Precision (±)	0.1	--	0.09	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--
Uranium Activity	0.6	0.3	0.4	0.3	0.4	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6	0.3
Uranium, mg/kg	0.8	0.5	0.6	0.5	0.6	0.5	0.9	0.6	0.8	0.5	0.9	0.5	0.8	0.5

MDC – Minimum Detection Concentration RL – Reporting Limits ND – Non Detection (<RL)

Table 2.9-26 Three Crow Sediment Baseline Sampling 2007 and 2008

Radionuclides	Date	Sampling Locations							
		Cherry Creek Pond		Ice House Pond		Grabel Pond		Sulzbach Pond	
		Results	RL	Results	RL	Results	RL	Results	RL
		pCi/g - Dry							
Lead 210	8/01/2008[1]	1.0	0.4	0.6	0.2	0.6	0.2	<2.3	2.3
Lead 210 Precision (±)		0.3	--	0.1	--	0.1	--	1.4	--
Lead 210 MDC		0.4	--	0.2	--	0.2	--	2.3	--
Radium 226		0.4	0.07	0.2	0.08	1.0	0.07	0.4	0.06
Radium 226 Precision (±)		0.09	--	0.07	--	0.1	--	0.08	--
Radium 226 MDC		0.07	--	0.08	--	0.07	--	0.06	--
Polonium 210		1.3	0.3	0.6	0.2	0.6	0.3	--	--
Polonium 210 Precision (±)		0.3		0.2	--	0.3	--	--	--
Thorium 230		0.08	0.07	<0.09	0.09	0.7	0.2	--	--
Thorium 230 Precision (±)		0.07		0.09	--	0.2	--	--	--
Uranium Activity		22.0	0.3	8.3	0.3	2.4	0.3	1.4	0.3
Uranium, mg/kg		32.5	0.5	12.3	0.5	3.6	0.5	2.1	0.5
Lead 210	12/19/2007[2]	0.8	0.1	4.1	0.01	1.2	0.1	--	--
Lead 210 Precision (±)		0.1	--	0.3	--	0.1	--	--	--
Lead 210 MDC		--	--	--	--	--	--	--	--
Radium 226		0.5	0.1	0.5	0.01	0.8	0.1	--	--
Radium 226 Precision (±)		0.1	--	0.1	--	0.1	--	--	--
Uranium Activity		1.56	0.02	6.29	0.02	2.38	0.02	--	--
Uranium, mg/kg		2.3	0.03	9.29	0.03	3.51	0.03	--	--

[1] Sulzbach Pond sampled 7/29/2008
[2] Ice House Pond sampled 1/21/2008
MDC – Minimum Detection Limit

Table 2.9-27 Three Crow Expansion Area Gamma Exposure Rate Results 2007 - 2008

Environmental Thermoluminescent Detetctor			Environmental Optically Stimulated Luminescence Detector		
Location	Date	Gamma Exposure Rate (mrem/qtr)	Location	Date	Gamma Exposure Rate (mrem/qtr)
AM-15	01/10/07 - 04/10/07	5	AM-15	01/02/08 – 04/02/08	6.6
	04/10/07 - 07/12/07	6		04/02/08 – 07/03/08	9.1
	07/12/07 - 10/01/07	6		--	--
	10/01/07 - 01/11/08	8		--	--
AM-16	01/10/07 – 04/10/07	7	AM-16	01/02/08 – 04/02/08	6.3
	04/10/07 – 07/12/07	4		04/02/08 – 07/03/08	11.8
	07/12/07 – 10/01/07	6		--	--
	10/01/07 – 01/11/08	8		--	--
AM-17	01/10/07 – 04/10/07	3	AM-17	01/02/08 – 04/02/08	2.7
	04/10/07 – 07/12/07	5		04/02/08 – 07/03/08	8.0
	07/12/07 – 10/01/07	6		--	--
	10/01/07 – 01/11/08	7		--	--
AM-18	01/10/07 – 04/10/07	5	AM-18	01/02/08 – 04/02/08	3.3
	04/10/07 – 07/12/07	4		04/02/08 – 07/03/08	12.4
	07/12/07 – 10/01/07	6		--	--
	10/01/07 – 01/11/08	8		--	--
AM-19	01/10/07 – 04/10/07	7	AM-19	01/02/08 – 04/02/08	5.4
	04/10/07 – 07/12/-7	5		04/02/08 – 07/03/08	8.5
	07/12/07 – 10/01/07	5		--	--
	10/01/07 – 01/11/08	10		--	--
AM-20	01/10/07 – 04/10/07	5	AM-20	01/02/08 – 04/02/08	7.9
	04/10/07 – 07/12/-7	5		04/02/08 – 07/03/08	12.2
	07/12/07 – 10/01/07	4		--	--
	10/01/07 – 01/11/08	9		--	--
AM-21	01/10/07 – 04/10/07	6	AM-21	01/02/08 – 04/02/08	7.4
	04/10/07 – 07/12/-7	3		04/02/08 – 07/03/08	13.4
	07/12/07 – 10/01/07	6		--	--
	10/01/07 – 01/11/08	10		--	--
AM-26[1]	01/02/07 – 04/02/07	5	AM-26[1]	01/02/08 – 04/02/08	8.1
	04/02/07 – 07/02/07	6		04/02/08 – 07/07/08	7.4
	07/02/07 – 10/01/07	7		--	--
	10/01/07 – 01/02/08	5		--	--

[1] Background

Table 2.9-28 Three Crow Expansion Area Preoperational Monitoring Program

	Sample Collection				Sample Analysis	
Type of Sample	**Number**	**Location**	**Method**	**Frequency**	**Frequency**	**Type of Analysis**
Air Particulates	3	On TCEA northern boundary	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
	1	Nearest Resident	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
	1	Control background location east of TCEA License Boundary	Continuous	Weekly filter change	Quarterly composites of weekly samples	Natural uranium, Ra-226, Th-230, and Pb-210
Radon Gas	3	On TCEA northern boundary	Continuous using RadTrak Type DRNF	Quarterly	Quarterly	Rn-222
	1	Nearest Resident	Continuous using RadTrak Type DRNF	Quarterly	Quarterly	Rn-222
	1	Control background location east of TCEA License Boundary	Continuous using RadTrak Type DRNF	Quarterly	Quarterly	Rn-222
Groundwater	1	Wells within 0.5 Mile of site boundary (W-269, W-274, W-275, W-312, W-314	Grab	Quarterly	Quarterly	Suspended & Dissolved Natural Uranium, Ra-226, Th-230, Th-230 Pb-210 & Po-210

Table 2.9-28 Three Crow Expansion Area Preoperational Monitoring Program

	Sample Collection				Sample Analysis	
Type of Sample	**Number**	**Location**	**Method**	**Frequency**	**Frequency**	**Type of Analysis**
Surface Water	2 [1]	White River (W-4 and W-5) Cherry Creek, Unnamed Creek, Bozle Creek	Grab	Quarterly	Quarterly	Suspended & Dissolved Natural Uranium, Ra-226, & Th-230
			Grab	--	Semiannually	Suspended & Dissolved Pb-210 & Po-210
	1	Cherry Creek Pond, Ice House Pond, Sulzbach Pond, & Grabel Pond(s)	Grab	Quarterly	Quarterly	Suspended & Dissolved Natural Uranium, Ra-226, & Th-230
			Grab	--	Semiannually	Suspended & Dissolved Pb-210 & Po-210
Vegetation	3	Grazing areas near the site in different sectors that will have the highest predicted air particulate concentrations during milling operations	Grab	3 times during grazing season	3 Times	Natural Uranium, Ra-226, Th-2320, Pb-210, & Pb-210
Food	3	Crops	Grab	Time of Harvest or Slaughter	1	Natural Uranium, Ra-226, Th-230, Pb-210, & Po-210
	3	Livestock			1	
	3	Private Garden Vegetables			1	
Fish	Each Body of Water	Collection of fish from White River (W-4 & W-5); Cherry Creek & Bozle Creek	Grab	Semiannually	2	Natural Uranium, Ra-226, Th-230, Pb-210, & Po-210
Surface Soil [2]	Up to 40	300 meter intervals to a distance	Grab	Once prior to	1	All samples for

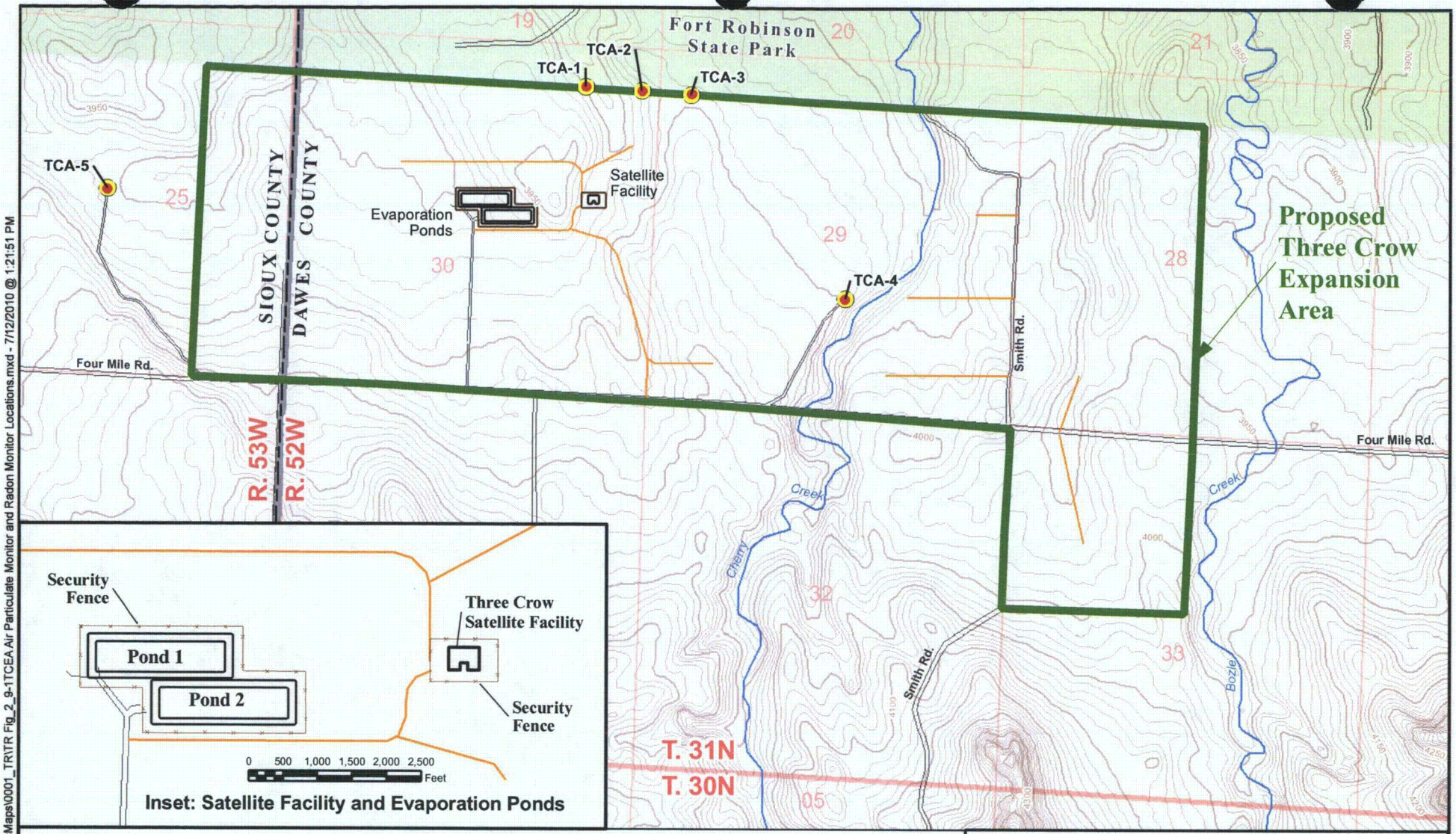
Table 2.9-28 Three Crow Expansion Area Preoperational Monitoring Program

	Sample Collection				Sample Analysis	
Type of Sample	**Number**	**Location**	**Method**	**Frequency**	**Frequency**	**Type of Analysis**
		of 1500 meters in each of 8 directions from centerpoint of satellite facility; additional transects through wellfields		construction. Repeat for location disturbed by excavation, leveling or contouring		Ra-226, 10% of samples natural uranium, Th-230 & Pb-210
	5	Same location used for collection of air particulates	Grab	Once prior to construction	1	Natural Uranium, Ra-226, Th-230 & Pb-210
Subsurface Soil [3]	5	At centerpoint of satellite facility & at distances of 750 meters in each of 4 directions	Grab	Once prior to construction. Repeat for location disturbed by construction	1	Ra-226 (all samples) Natural Uranium, Th-203 & Pb210 (one set of ssamples)
Sediment	2 from each stream	Up and down gradient samples from Cherry Creek, Unnamed Drainage, Bozle Creek & White River (W-4 & W-5)	Grab (Composite samples)	Once following spring runoff & late summer following period of extended low flow	2	Natural Uranium, Ra-226, Th-230 & Pb-210
	1 from each pond	Cherry Creek Pond, Ice House Pond, Sulzbach Pond & Grable Pond(s)	Grab	Once prior to construction	1	Natural Uranium, Ra-226, Th-230 & Pb-210

Table 2.9-28 Three Crow Expansion Area Preoperational Monitoring Program

	Sample Collection				Sample Analysis	
Type of Sample	Number	Location	Method	Frequency	Frequency	Type of Analysis
Direct Radiation (Survey)	Up to 80	150 meter intervals to a distance of 1500 meters in each of 8 directions from centerpoint of satellite facility	Grab	Once prior to construction. Repeat for areas disturbed by site preparation or construction	1	Gamma exposure using sodium iodide scintillometer
Direct Radiation (Continuous)	5	Same location used for collection of air particulates	Grab	Once prior to construction	1	Gamma exposure using a continuous integrating device

[1] Two from surface water that could be impacted by project operations.
[2] Surface soil samples collected to a depth of 5 cm using a consistent technique.
[3] Subsurface soil samples collected to a depth of 1 meter; samples divided into 3 equal sections for analysis.



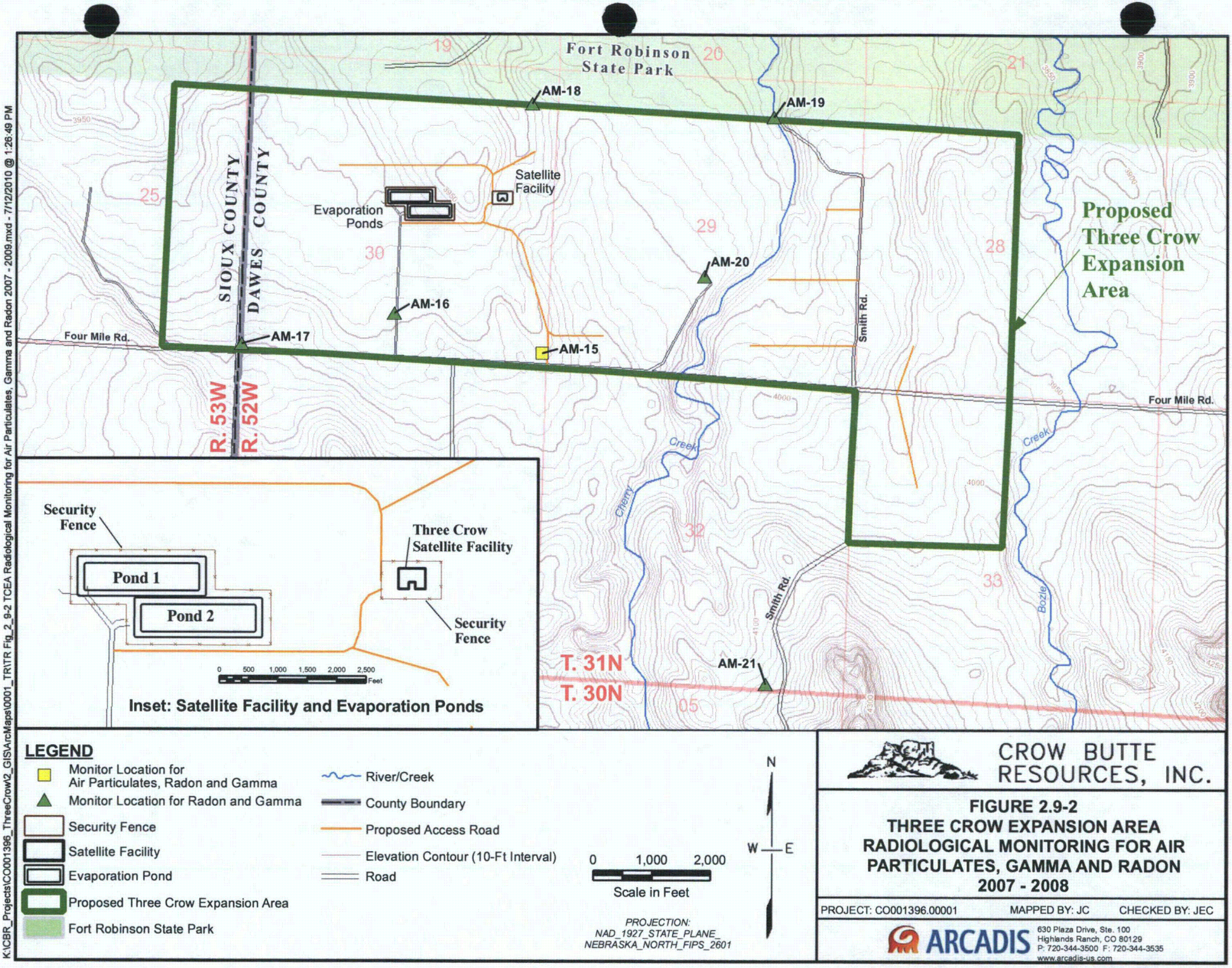
CROW BUTTE RESOURCES, INC.

FIGURE 2.9-1
THREE CROW EXPANSION AREA
AIR PARTICULATE MONITOR
AND RADON MONITOR LOCATIONS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TR\TR Fig_2_9-1TCEA Air Particulate Monitor and Radon Monitor Locations.mxd - 7/12/2010 @ 1:21:51 PM



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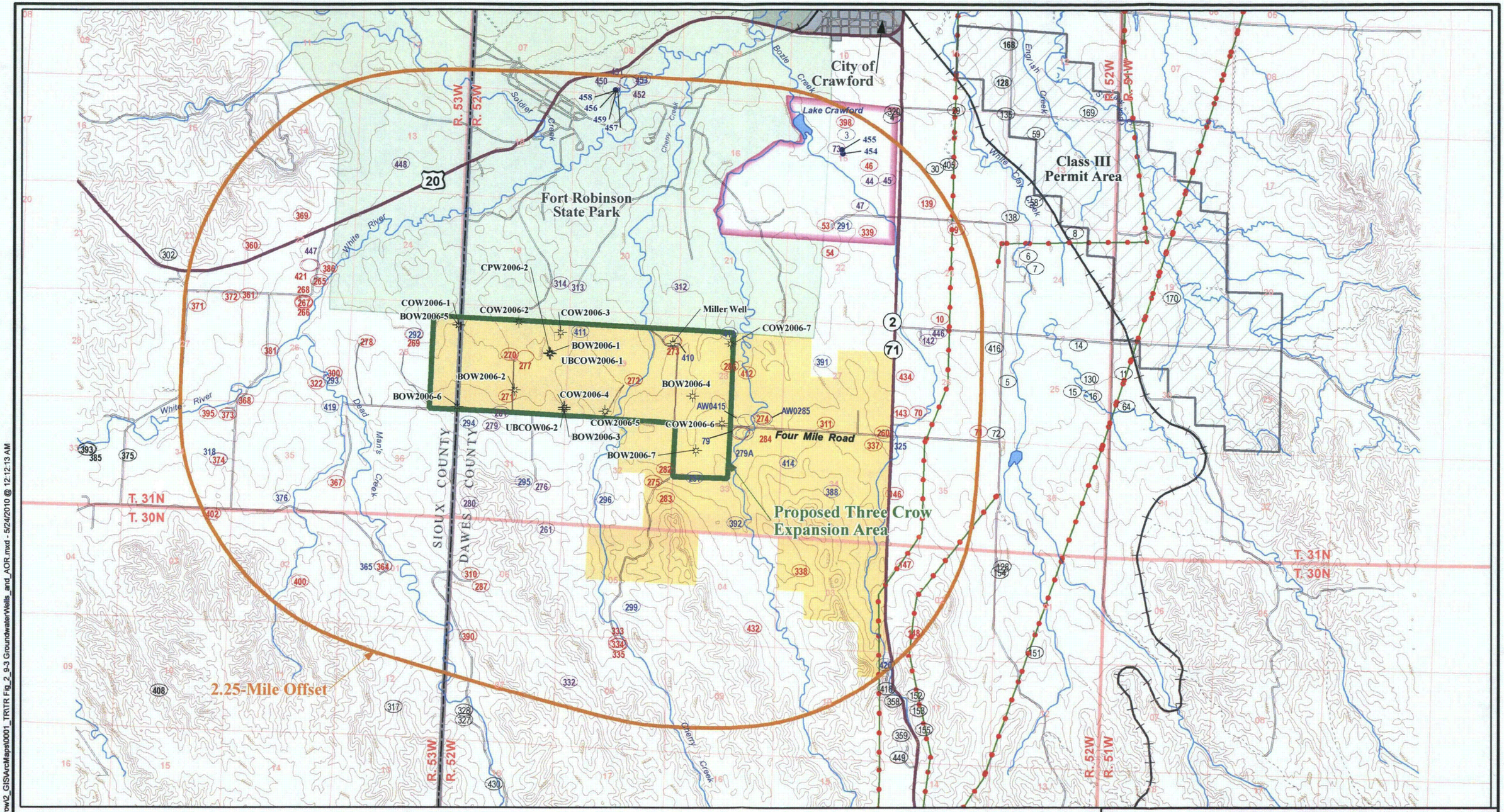
CROW BUTTE RESOURCES, INC.

FIGURE 2.9-2
THREE CROW EXPANSION AREA
RADIOLOGICAL MONITORING FOR AIR PARTICULATES, GAMMA AND RADON
2007 - 2008

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com



LEGEND

- Monitoring Well
- Active Public Water Supply Well

Private Wells

- (400) Active Surveyed Well
- (280) Active Unsurveyed Well
- (376) Abandoned Well
- (359) Well Located outside of AOR

- Proposed Three Crow Expansion Area
- 2.25-Mile Area of Review (AOR)
- River/Creek
- Lake
- Class III Permit Area
- Transmission Line
- Highway
- County Boundary
- Elevation Contour (50-Ft Interval)
- Road
- Trail
- Railroad
- Fort Robinson State Park
- Leased Area
- City of Crawford
- City of Crawford's Wellhead Protection Area

0 2,000 4,000
Scale in Feet

N
W — E

PROJECTION: NAD_1927_STATEPLANE_NEBRASKA_NORTH_FIPS_2601

ALL ELEVATIONS ARE IN FT-AMSL.

CROW BUTTE RESOURCES, INC.

FIGURE 2.9-3
LOCATION OF GROUNDWATER WELLS IN THE THREE CROW EXPANSION AREA AND 2.25-MILE AREA OF REVIEW

PROJECT: CO001396.00003 | MAPPED BY: JC | CHECKED BY: MS

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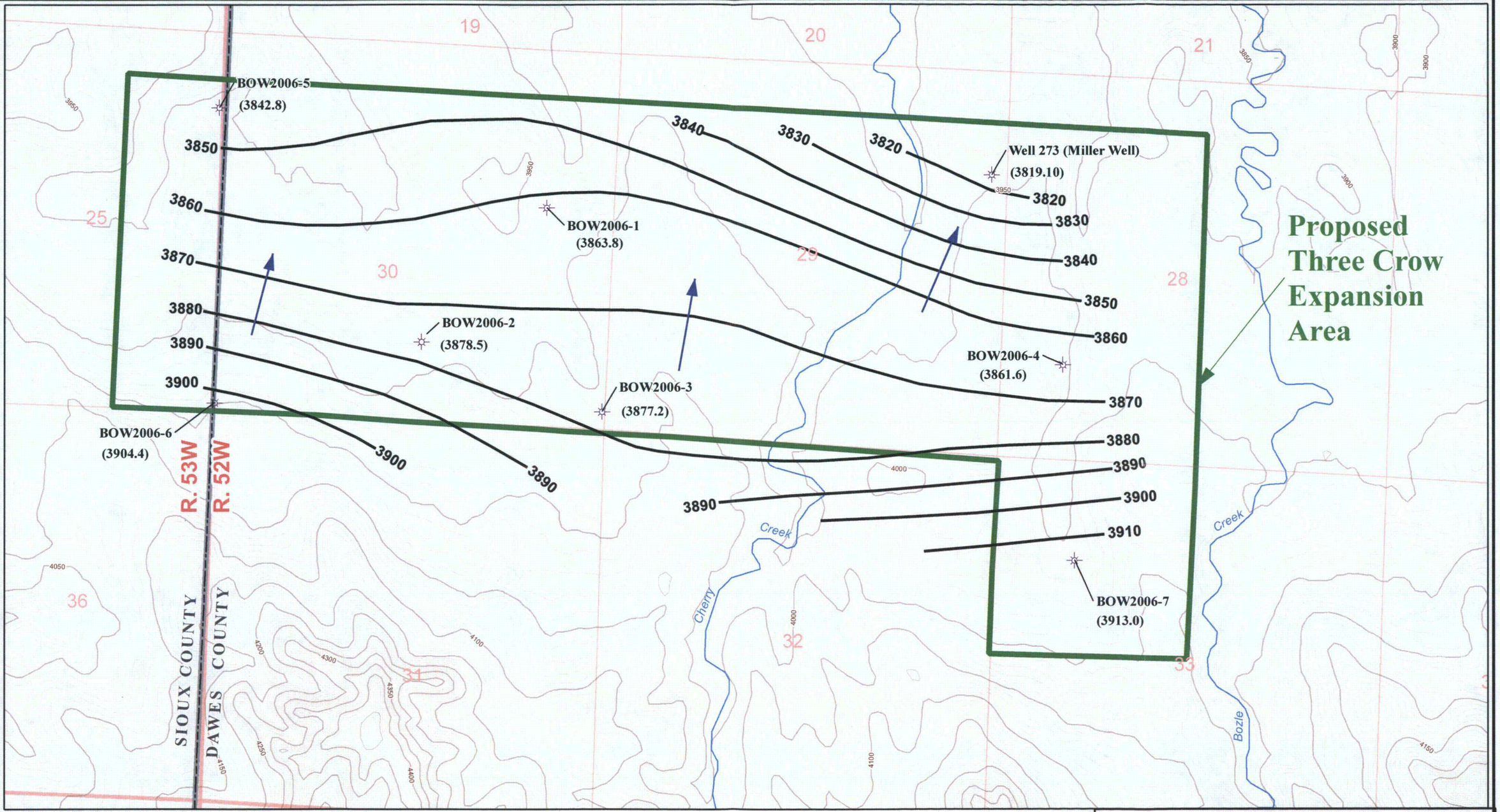

LEGEND

- Brule Formation Monitoring Well
- Groundwater Potentiometric Surface (FT-AMSL)
- (3879) Groundwater Elevation (FT-AMSL)
- Groundwater Flow Direction
- River/Creek
- Elevation Contour (10-Ft Interval)
- County Boundary
- Proposed Three Crow Expansion Area

Notes:
1. Water levels at all well locations were collected on 1/22/2010, with the exception of Well 273 (Miller Well), which was collected on 2/8/10
2. All Elevations are in ft-amsl.

0 750 1,500
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

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FIGURE 2.9-4
THREE CROW EXPANSION AREA WATER LEVEL MAP - BRULE FORMATION (01/22/10 & 02/08/10)

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COW2006-1
(3720.4)

COW2006-2
(3717.1)

COW2006-3
(3716.7)

UBCOW2006-1
(3717.7)

CPW2006-2
(3717.3)

UBCOW06-2
(3717.0)

COW2006-4
(3717.0)

COW2006-5
(3716.5)

COW2006-6
(3708.2)

COW2006-7
(3707.6)

3720
3719
3718
3717
3716
3715
3714
3713
3712
3711
3710
3709
3708

Proposed Three Crow Expansion Area

19 20 21 22
25 30 29 28 27
36 31 32 33 34

SIOUX COUNTY
DAWES COUNTY

Creek
Creek
Cherry
Bozle

R. 53W
R. 52W
T. 31N
T. 30N

LEGEND

- Lower Basal Chadron Sandstone Monitoring Well
- Upper Basal Chadron Sandstone Monitoring Well
- (3720.5) Groundwater Elevation (FT-AMSL)
- River/Creek
- County Boundary
- Groundwater Flow Direction
- Proposed Three Crow Expansion Area

Notes:
1. Groundwater elevations are shown for wells screened in the Upper Basal Chadron Sandstone, but were not included in contouring.
2. All elevations are in ft-amsl.

0 1,000 2,000
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

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FIGURE 2.9-5
THREE CROW EXPANSION AREA
POTENTIOMETRIC SURFACE -
BASAL CHADRON SANDSTONE (01/22/2010)

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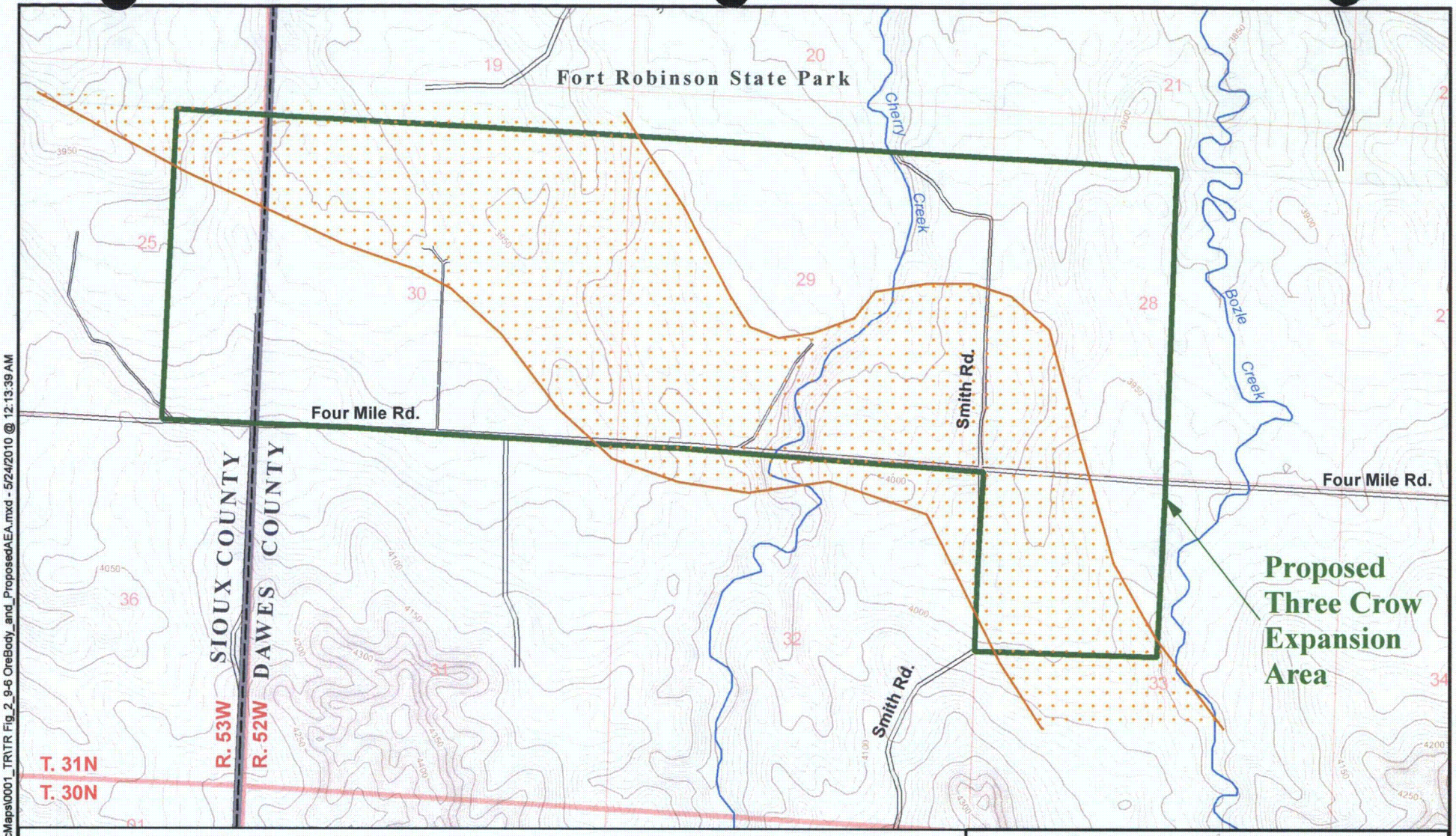

LEGEND

- General Ore Trend
- Proposed Three Crow Expansion Area
- River/Creek
- County Boundary
- Elevation Contour (10-Ft Interval)
- Road

0 1,000 2,000

Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

ALL ELEVATIONS ARE IN FT-AMSL

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W — E

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FIGURE 2.9-6
THREE CROW EXPANSION AREA ORE BODY

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

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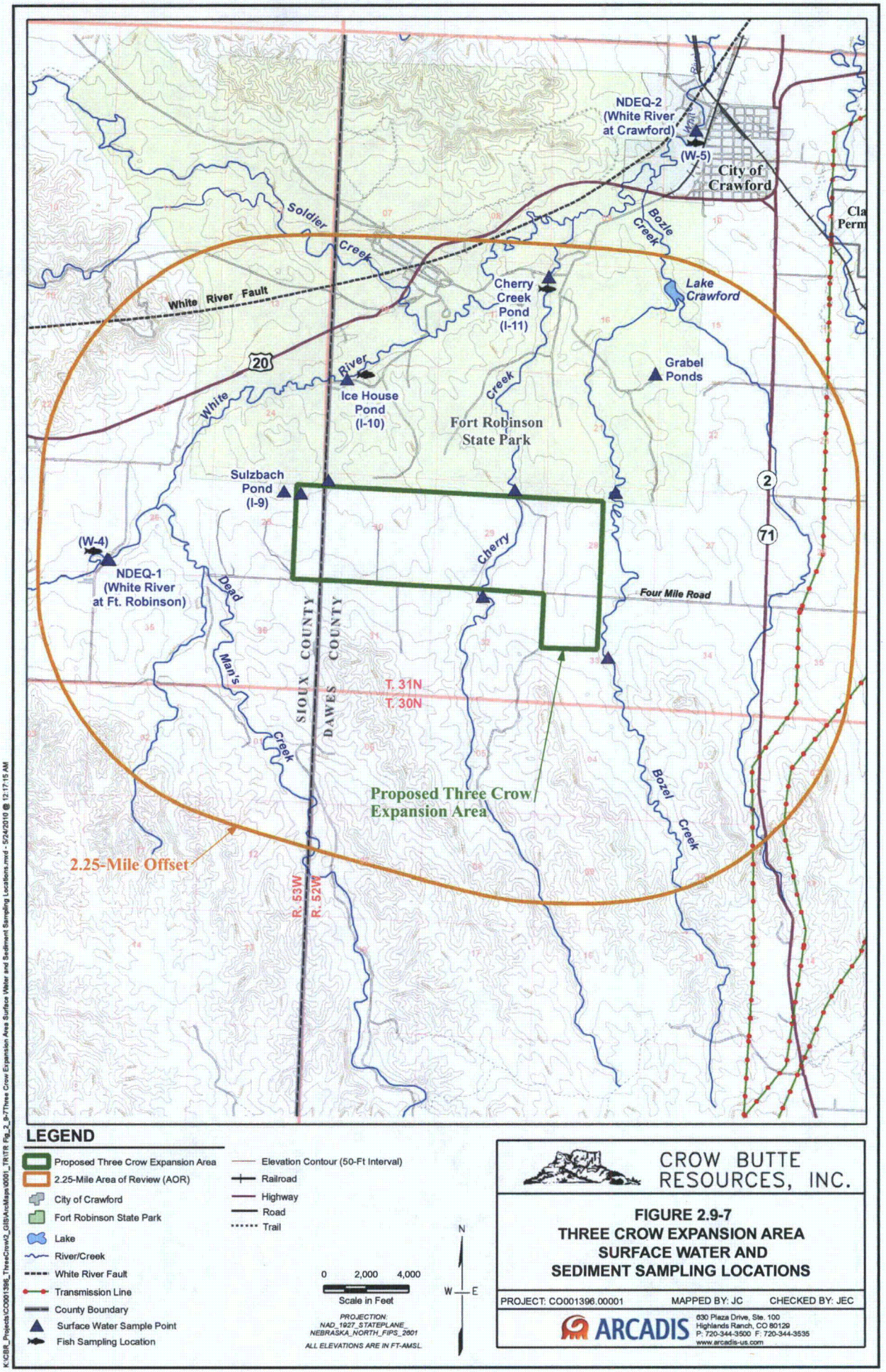

LEGEND

- Proposed Three Crow Expansion Area
- 2.25-Mile Area of Review (AOR)
- City of Crawford
- Fort Robinson State Park
- Lake
- River/Creek
- White River Fault
- Transmission Line
- County Boundary
- Surface Water Sample Point
- Fish Sampling Location
- Elevation Contour (50-Ft Interval)
- Railroad
- Highway
- Road
- Trail

0 2,000 4,000
Scale in Feet

PROJECTION:
NAD_1927_STATEPLANE_
NEBRASKA_NORTH_FIPS_2601

ALL ELEVATIONS ARE IN FT-AMSL

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W E

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FIGURE 2.9-7
THREE CROW EXPANSION AREA
SURFACE WATER AND
SEDIMENT SAMPLING LOCATIONS

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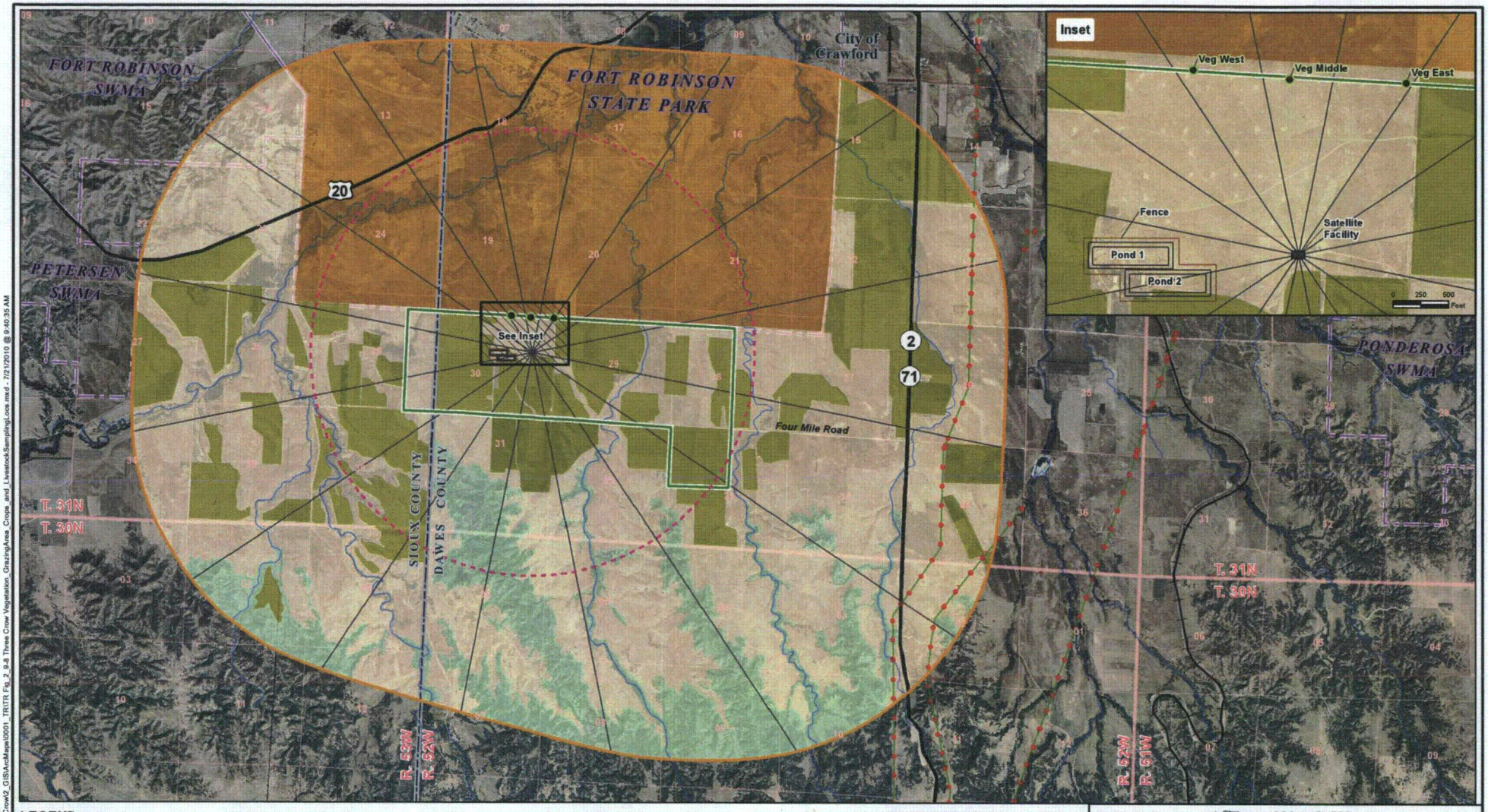
K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TR\TR Fig_2_9-7Three Crow Expansion Area Surface Water and Sediment Sampling Locations.mxd - 5/24/2010 @ 12:17:15 AM



LEGEND

- Vegetation Sampling Location

Land Use

- Cropland
- Forested Land
- Rangeland
- Recreational Land

- Proposed Three Crow Expansion Area (TCEA)
- 2.25-Mile Buffer of Proposed TCEA Boundary
- 3000-Meter Radius from Center of Satellite Facility
- State Park or State Wildlife Management Area (SWMA)

- Fence
- Satellite Facility
- Evaporation Pond
- Grid Sector

- River/Creek
- Transmission Line
- Highway
- County Boundary
- Railroad

0 2,000 4,000

Scale in Feet

PROJECTION: NAD_1927_STATE_PLANE_NEBRASKA_NORTH_FIPS_2601

SOURCE: AERIALS: NAIP 2006, DAWES COUNTY AND SIOUX COUNTY, NE

LAND USE: CROW BUTTE RESOURCES, INC.

STATE PARK & SWMA: USGS 1:100,000 TOPOGRAPHIC MAP - CRAWFORD (1986), NE

N

W — E

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FIGURE 2.9-8
THREE CROW EXPANSION AREA VEGETATION, GRAZING AREA, CROPS AND LIVESTOCK SAMPLING LOCATIONS

PROJECT: CO001396.00002 | MAPPED BY: JC | CHECKED BY: JEC

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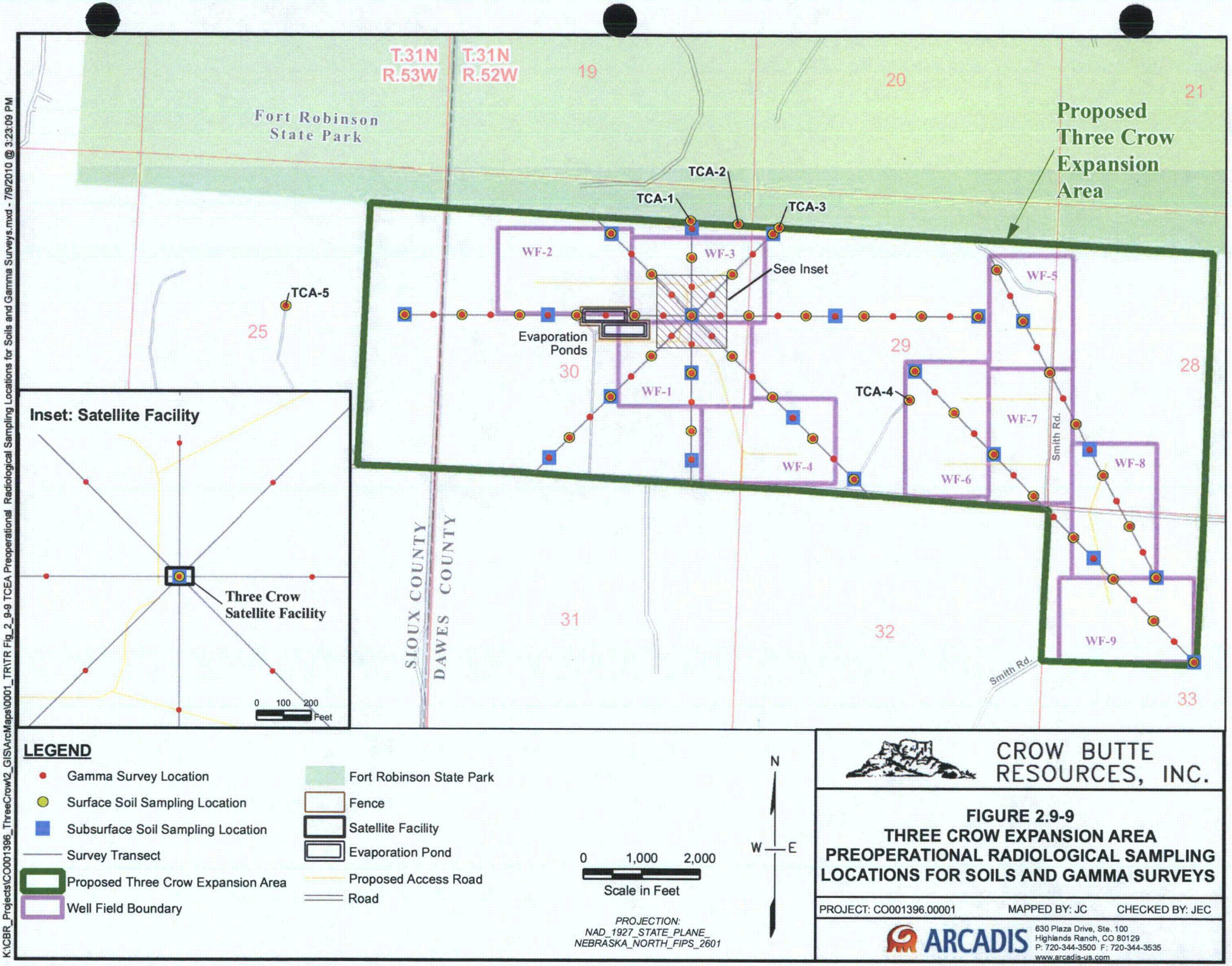
T.31N R.53W
T.31N R.52W
19
20
21
Fort Robinson State Park
Proposed Three Crow Expansion Area
TCA-1
TCA-2
TCA-3
TCA-4
TCA-5
WF-1
WF-2
WF-3
WF-4
WF-5
WF-6
WF-7
WF-8
WF-9
See Inset
Evaporation Ponds
25
29
30
28
31
32
33
SIOUX COUNTY
DAWES COUNTY
Smith Rd.
Smith Rd.
Inset: Satellite Facility
Three Crow Satellite Facility
0 100 200
Feet
LEGEND
Gamma Survey Location
Surface Soil Sampling Location
Subsurface Soil Sampling Location
Survey Transect
Proposed Three Crow Expansion Area
Well Field Boundary
Fort Robinson State Park
Fence
Satellite Facility
Evaporation Pond
Proposed Access Road
Road
0 1,000 2,000
Scale in Feet
N
W E
PROJECTION:
NAD_1927_STATE_PLANE_
NEBRASKA_NORTH_FIPS_2601
CROW BUTTE RESOURCES, INC.
FIGURE 2.9-9
THREE CROW EXPANSION AREA
PREOPERATIONAL RADIOLOGICAL SAMPLING
LOCATIONS FOR SOILS AND GAMMA SURVEYS
PROJECT: CO001396.00001
MAPPED BY: JC
CHECKED BY: JEC
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K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TR\TR Fig_2_9-9 TCEA Preoperational Radiological Sampling Locations for Soils and Gamma Surveys.mxd - 7/9/2010 @ 3:23:09 PM