RIVERTON, WYOMING, PROCESSING SITE

AN ENVIRONMENTAL RISK ASSESSMENT UPDATE

Final

SEPTEMBER 2021

RIVERTON, WYOMING, PROCESSING SITE:
AN ENVIRONMENTAL RISK ASSESSMENT UPDATE

FINAL

September 2021

Prepared by
Environmental Science Division
Argonne National Laboratory
Lemont, Illinois

In collaboration with

U.S. Department of Energy
Office of Legacy Management
Grand Junction, Colorado

and

The Northern Arapaho Natural Resources Office
Riverton, Wyoming

Foreword to:

RIVERTON, WYOMING, PROCESSING SITE:
AN ENVIRONMENTAL RISK ASSESSMENT UPDATE

The Northern Arapaho Natural Resource Office (NANRO) would like to thank the Argonne National Laboratory for leading this project and preparing the Risk Assessment Update for the Riverton Processing Site. We would also like to thank the US Department of Energy (DOE), Office of Legacy Management (LM), for supporting this effort and providing technical assistance. This report is the result of a collaborative effort, and the findings are of great benefit to the Tribe and community members.

Although surface cleanup of uranium mill tailings and other contaminated materials were completed by 1990, many questions remained regarding the risk of exposure to residual subsurface source material and contaminated groundwater for area residents and the local ecosystem. The original Baseline Risk Assessment, completed by DOE in 1995, was based on outdated assumptions regarding site conditions and exposure scenarios. It focused on the risk to human health from drinking contaminated groundwater, it did not consider cultural and traditional uses of plants or other materials collected from the site, and it did not consider ecological impacts based on actual site data. The Risk Assessment Update fills these data gaps and many others.

The plan for a Risk Assessment Update grew from many years of discussion between NANRO, DOE LM and its partners, our Tribal leadership and elders, and local community members. NANRO has worked closely with DOE and Argonne National Laboratory as this project progressed and is satisfied with the quality and completeness of the result. We have gained a much clearer picture of current site conditions and increased confidence that the Site does not present an undue risk to human health and the environment, provided that the existing monitoring programs and institutional controls continue. This would include the continued operation and maintenance of the Alternate Water Supply System (AWSS) to provide a safe and reliable source of drinking water to the area during the remediation period. The report also demonstrates the importance of continued collaboration and oversight by the Northern Arapaho Tribe and local community.

Finally, we would also like to thank the Northern Arapaho Tribal Historic Preservation Office (THPO), for assisting with the plant identification survey, the vegetation sampling, exposure scenario development by providing information on the cultural and traditional uses of plant material, and document review. THPO's contributions allowed us to conclude that cultural and traditional use of plants, as determined with the knowledge of our Northern Arapaho Tribal Elders, does not need to be restricted in the site vicinity or reference areas that were also tested. A Statement prepared by the THPO Office follows.

By: Northern Arapaho Natural Resource Office

A Statement from the Northern Arapaho Tribal Historic Preservation Office:

The Northern Arapaho Tribal Historic Preservation Office participated in the plant survey and sampling portion of the Argonne National Laboratory Risk Assessment. The various Cultural and Traditional resource uses that could be affected by site contaminants in the project area were considered and evaluated. Plants that the Tribe collects for cultural, medicinal, and traditional uses were sampled and tested. The samples that were taken from the area of concern contained similar levels of site contaminants, including manganese, sulfate, and uranium, as plants that were from a non-impacted control area. Two samples of all plants were taken; one from a "control area" and one from the "project area" and analyzed separately. Both contained similar levels and these levels are considered safe for human consumption, absorption, and inhalation within these areas. Two potential areas of concern for exposure to toxins were identified, however, those areas of concern would have to be utilized regularly by a single human on an almost daily basis over a long period of time to be exposed to a toxic level of contaminants. The THPO office agrees with the results and conclusions of Argonne National Laboratory that the areas sampled are safe for humans to collect and use all plants, medicines, and animals as needed without potential for adverse exposure to site contaminants.

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NOTATION

ACRONYMS

ABS	dermal absorption
AWSS	alternate water supply system
CCME	Canadian Council of Ministries of the Environment
CFR	Code of Federal Regulations
COC	contaminant of concern
CSM	conceptual site exposure model
DCF	dose conversion factor
DOE	U.S. Department of Energy
DQO	data quality objective
ERA	ecological risk assessment
GIABS	gastro intestinal absorption
GPS	global positioning system
HI	hazard index
HQ	hazard quotient
IC	institutional control
ICRP	International Commission on Radiation Protection
IRIS	Integrated Risk Information System
LM	Office of Legacy Management
LOAEL	lowest observed-adverse-effect level
MCL	maximum concentration limit
MSA	method of standard addition
NANRO	Northern Arapaho Natural Resources Office
NATHPO	Northern Arapaho Tribal Preservation and Historic Office
NAW&SD	Northern Arapaho Water & Sewer Department
NOAEL	no observed-adverse-effect level
NRC	Nuclear Regulatory Commission
RfC	reference concentration
RfD	reference dose soil
SSL	soil screening level

TIC	tentatively identified compound
UCL95	95th percentile upper-bound concentration limit
USFWS	U.S. Fish and Wildlife Service
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
USGS	U.S. Geological Survey

UNITS OF MEASURE

cfs	cubic foot (feet) per minute
cm	centimeter(s)
cm^2	square centimeter(s)
d	day(s)
ft	foot (feet)
g	gram(s)
hr	hour(s)
kg	kilogram(s)
L	liter(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
mrem	millirem(s)
pCi	pico-Curie(s)
ppm	parts per million
µg	microgram(s)
yd^3	cubic yard(s)
yr	year(s)

EXECUTIVE SUMMARY

This environmental risk assessment report provides an updated assessment regarding current site conditions for the Riverton, Wyoming, Processing site (referred to as the Riverton site from hereon). Argonne National Laboratory (Argonne) has prepared this update in collaboration with the U.S Department of Energy (DOE) Office of Legacy Management (LM) and the Northern Arapaho Natural Resources Office (NANRO). Argonne was selected to perform this risk assessment to provide an independent assessment.

The Riverton site is in Fremont County, 2 miles southwest of the city of Riverton, Wyoming, and within the boundaries of the Wind River Indian Reservation (Northern Arapaho and the Eastern Shoshone tribes). A privately owned sulfuric acid plant currently operates in the northwest corner of the former processing site. The Riverton site is one of 24 designated uranium mill tailings sites to be remediated in accordance with the requirements of the Uranium Mill Tailings Radiation Control Act (UMTRCA) (42 USC 47901 et seq.) under the oversight of DOE's Uranium Mill Tailings Remedial Action (UMTRA) Project. DOE completed surface remediation in 1990, and the U.S. Nuclear Regulatory Commission (NRC) certified the completion of surface remediation of the site on January 10, 1995.

DOE has implemented "natural flushing" as the remedy for site groundwater (DOE 1998a). As part of the groundwater remedy, DOE has provided an alternate water supply to residents near the site area since 1998. Institutional controls for a designated area on the site or within the institutional control boundary have been implemented to ensure site surface conditions remain protective of human health and the environment while groundwater contaminant concentrations attenuate to the regulatory standards.

The primary objective of this risk assessment update is to determine whether current site conditions are protective of human health from traditional Native American cultural uses of plants, consumption of livestock, or wildlife, and from contact with surface water either through consumption of catch or direct contact. These aspects have not been quantitatively evaluated in past assessments for the Riverton site. The group also concluded that an ecological risk assessment would be useful in determining ecological conditions of plants and other ecological species found at the Riverton site. Accomplishing this objective would provide an update regarding current site conditions that would be comprehensive in documenting current site protectiveness of human health and the environment.

Argonne, DOE, and NANRO, reviewed all site information to date to determine data needs for this update. The data quality objective (DQO) process conducted confirmed that data for plants that are of cultural importance to the Northern Arapaho community, and that are present on the Riverton site area above the plume where groundwater contamination remains, would be useful and would address an outstanding concern.

To provide information for designing the sampling plan, a plant survey was conducted at the Riverton site on the uranium plume area and eight other areas outside the plume area but still within the site institutional control (IC) area. These eight other areas comprise reference area A

for this update. A similar survey was conducted in identifying a second reference location for this update, reference area B, which is located outside of the IC area in the nearby town of Ethete. In selecting the sampling areas, it was assumed that if plants are affected by the remaining contaminants in site groundwater, then plants collected from the plume area would exhibit higher concentrations of the four contaminants of concern (COCs) than plants growing in the two reference areas (i.e., reference areas A and B). The four COCs are manganese, molybdenum, sulfate, and uranium. These COCs are known to be occurring naturally in the environment including plants. As such, data from the reference areas would provide information on the same plants growing in locations other than on the site plume area.

The concentrations in plants collected from the plume area and reference area A are closer in range than those from reference area B. For some of the plants, data from the plume area are slightly higher than samples from reference area A (e.g., uranium average concentrations for gumweed, milkweed, and snakeberry bush). While results from reference area A for other plants appear to be higher than samples from the plume area (e.g., uranium average concentrations for sagebrush, whitetop sulfur, and snowberry). This could be attributable to the proximity of the plume area to reference area A with both located in an industrial area (e.g., there is a sulfuric acid plant nearby). The concentration in plants collected from reference area B appear to be generally lower than those collected from the plume area and reference area A. Reference area B is located a few miles away from the Riverton site in the nearby town of Ethete, and is in a semi-rural non-industrial area.

Discussions were held with NANRO representatives, Northern Arapaho elders, and other members of the Northern Arapaho community to develop reasonably conservative exposure scenario input information representative of the Northern Arapaho cultural uses to enable risk calculations for this report. Argonne was selected to conduct this assessment for its expertise in conducting risk assessments and its ability to provide an independent assessment.

The human health and ecological risk assessment conducted for this update follows U.S. Environmental Protection Agency (EPA) recommended methodology for conducting environmental risk assessments. The 95th percentile upper-bound value of the average was calculated from the plant data obtained and used as the exposure point concentrations. Other site data available for surface water were also used to estimate hazard quotients (HQs) and/or dose for the pathways evaluated. Toxicity values (reference doses [RfDs] or reference concentrations [RfCs]) were obtained from EPA and other health agency databases and publications.

For the human health assessment, plant concentrations from the three areas are protective of the uses identified for the 12 plants evaluated. Cultural uses involving inhalation, ingestion and dermal contact are all found to be less than an HQ of 1 and are thereby protective. The estimates for the consumption of meat from livestock (cows) that are assumed to graze on the plants sampled at the plume area and reference area A (within the IC boundary at the Riverton site) and at reference area B in Ethete are also safe as HQ estimates are less than 1. As to potential exposures to site surface water bodies, estimates for the ingestion of catch (fish) and the incidental ingestion of surface water from Oxbow Lake (location 0747) indicate HQs greater than 1 from the most recent (2018) uranium and manganese concentrations reported for this location. Currently, a warning sign is in place at Oxbow Lake that states that drinking, fishing, or

swimming is not safe. Uranium and manganese concentrations reported for location 0879 could result in HQs greater than 1 depending on availability of fish or catch; this location is a small area that has been found to be dry most years and is not large enough to sustain fish nor swimming. The high COC concentrations were reported in 2016 after flooding of the area. It should be noted that when HQs are estimated to be greater than 1, it is not an indication of the probability of harm occurring; instead, it provides an indication of how much the exposure concentration exceeds the RfDs or RfCs. It should also be noted that although calculations were done for the surface water locations sampled routinely as part of the Riverton site monitoring, for the most part, these surface water locations may not sustain the fishing and swimming scenarios assumed for this update.

For the ecological risk assessment, plant concentrations exceeded the plant screening levels in most cases for both the plume area and reference area A. The receptor-specific screenings for avian and mammalian species were less than an HQ of 1 for all species. The comparison of site surface water data collected in 2018 indicated that some site concentrations of the COCs exceeded screening benchmarks from various agencies for aquatic species suggesting further evaluation may be warranted. However, there is no evidence that aquatic biota is being affected, only that screening values were exceeded.

The human health and ecological assessment presented in this report provides the quantitative risk information that was qualitatively addressed in the 1995 Risk Assessment Report associated with plants, livestock, and surface water exposures at the Riverton site. Based on the results of this update in combination with past completed remedial action and ongoing monitoring activities and IC implementation, it is concluded that the current conditions at the Riverton site are protective of human health and the environment given the continuous monitoring and oversight provided by DOE and the collaboration with NANRO and the Northern Arapaho community for the implementation of the ICs that are in place at the site.

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1 INTRODUCTION

This environmental risk assessment report is an update of previous assessments conducted for the Riverton, Wyoming, Processing site the risk assessment conducted by the U.S. Department of Energy (DOE) in 1995 as documented in the report titled, "Baseline Risk Assessment of the Ground Water Contamination at the Uranium Mill Tailings Site Near Riverton, Wyoming" (DOE 1995). A summary of the 1995 risk assessment is given in Section 5 of this report. Argonne National Laboratory (Argonne) has prepared this update in collaboration with the DOE Office of Legacy Management (LM) and the Northern Arapaho Natural Resources Office (NANRO). Argonne was selected to perform this risk assessment to provide an independent assessment.

An environmental risk assessment is conducted for a site to characterize or assess the nature and magnitude of health risks to humans (e.g., residents, workers, recreational visitors) and ecological receptors (e.g., birds, fish, wildlife) from chemical and radiological contaminants that may be present in the site environment.

2 OBJECTIVE AND SCOPE OF THIS REPORT

The primary objective of this risk assessment update is to determine whether current site conditions are protective of human health from traditional Native American cultural uses of plants, consumption of livestock, or wildlife, and from contact with surface water either through consumption of catch or direct contact. These aspects have not been quantitatively evaluated in past assessments. The group also concluded that an ecological risk assessment would be useful in determining ecological conditions of plants and other ecological species found at the Riverton site. Accomplishing this objective would provide an update regarding current site conditions that would be comprehensive in documenting site protectiveness of human health and the environment.

Argonne, DOE, and NANRO, reviewed all site information to date to determine data needs for this update. The group conducted the data quality objective (DQO) process (as further discussed in Section 5) to ensure that the type and quantity of data collected were adequate to support this update. The DQO process confirmed that data for plants that are of cultural importance to the Northern Arapaho community, and that are present on the Riverton site area above the plume where groundwater contamination remains, would be useful and would address an outstanding concern. Site data on soil, groundwater, and surface water already exist and would be used in this assessment as needed. To provide additional perspective on plant concentrations, samples of the same plants to be collected at the plume area of the site would also be collected at two reference areas.

3 RIVERTON SITE LOCATION, DESCRIPTION, AND HISTORY

The Riverton site is in Fremont County, 2 miles southwest of the city of Riverton, Wyoming (Figure 3.1), and within the boundaries of the Wind River Indian Reservation (Northern Arapaho and the Eastern Shoshone tribes). A privately owned sulfuric acid plant currently operates in the northwest corner of the former processing site. The plant discharges its effluent through an unlined ditch that eventually flows into the Little Wind River.

The Riverton site is one of 24 designated uranium mill tailings sites to be remediated in accordance with the requirements of the Uranium Mill Tailings Radiation Control Act (UMTRCA) (42 USC 47901 et seq.) under the oversight of DOE's Uranium Mill Tailings Remedial Action (UMTRA) Project.

The Riverton site was operated as a uranium and vanadium ore-processing mill from 1958 to 1963. A tailings pile covered about 72 acres of the 140-acre site. DOE conducted remediation of the site surface from 1988 to 1990. DOE completed surface remediation in 1990, and the U.S. Nuclear Regulatory Commission (NRC) certified the completion of surface remediation of the site on January 10, 1995.

The tailings pile was excavated down to an average depth of 4 ft below ground surface based on a radium (Ra-226) soil standard in Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192) (EPA 2008). The remediation resulted in the removal of about 1.8 million cubic yards of tailings and associated materials (including soil) from the site. These materials were transported to the Gas Hills East Disposal Site about 60 miles east of Riverton for stabilization and disposal (DOE 1998a). Soils at and below the water table with elevated thorium (Th-230) concentrations were left in place (DOE 1991) on portions of the former mill site as permitted by the supplemental standards provision of 40 CFR 192.

Groundwater contamination remains at the site. The tailings and associated slurry water were the primary, original source of groundwater contamination of the surficial aquifer. The site is on alluvial deposits between the Wind River, 1 mile north, and the Little Wind River, about 4,000 ft southeast (see Figure 3.1 for locations of the Wind River and the Little Wind River). Three aquifers, which include (in descending stratigraphic order) an unconfined surficial alluvial aquifer (surficial aquifer), a semiconfined sandstone aquifer (semiconfined aquifer), and a confined sandstone aquifer (confined aquifer), underlie the site. Only the uppermost aquifer is within the purview of 40 CFR 192. The NRC enforces the groundwater standards as applied to the uppermost aquifer at the Riverton site. This aquifer comprises the surficial aquifer and semiconfined aquifer.

Because the Riverton site is located on an alluvial terrace between the Wind River and the Little Wind River, site conditions have been influenced by periodic flooding of these rivers. Significant floods of the Little Wind River that likely affected the site occurred in 1963, 1965, 1967, 1983, 1991, 1995, 2010, 2016, and 2017, when peak river discharge was greater than 8000 cubic feet per second (cfs) (DOE 2018). Significant floods of the Wind River that likely

affected the site occurred in 1963, 1967, 1971, 1991, 1997, 1999, 2011, and 2017, when peak stream discharge was greater than 8000 cfs (DOE 2018).

Contaminants of concern (COCs) in the groundwater beneath the Riverton site are manganese, molybdenum, sulfate, and uranium. COCs were selected using a screening process that compared contaminant concentrations with the maximum concentration limits (MCLs) in 40 CFR 192, as appropriate, and evaluated potential human health risks and ecological risks. The MCLs for groundwater implemented for the Riverton site are the MCLs defined for UMTRA sites and are not the same as the EPA's drinking water standards, which are also referred to as MCLs that are applied to community domestic wells. The COC selection process is detailed in the final report, "Environmental Assessment of Ground Water Compliance at the Riverton, Wyoming, Uranium Mill Tailings Site" (DOE 1998b). Molybdenum and uranium were selected as indicator contaminants for compliance monitoring in the" Final Ground Water Compliance Action Plan for the Riverton, Wyoming, Title I UMTRA Project Site" (DOE 1998a). These contaminants were selected as indicator contaminants because they are the most widely distributed and because they form significant aqueous plumes in the uppermost aquifer in the vicinity of the site. The MCL for molybdenum is 0.10 milligram per liter (mg/L) and for uranium, 30 pico-Curies per liter (pCi/L), or 0.044 mg/L (which assumes secular equilibrium of uranium isotopes). EPA's MCL for uranium is 30 ug/L, or 20 pCi/L.

DOE has implemented "natural flushing" as the remedy for site groundwater (DOE 1998a). As part of the groundwater remedy, DOE has provided an alternate water supply to residents near the site area since 1998. In addition, institutional controls (ICs) for a designated area on the site or within the IC boundary have been implemented to ensure site surface conditions remain protective of human health and the environment while groundwater contaminant concentrations attenuate to the regulatory standards. DOE also remediated 42 vicinity properties according to the cleanup standards established for the Riverton site. This remediation resulted in the transport and disposal of about 180,000 yd^3 of material. These properties were in the vicinity of the former mill site.

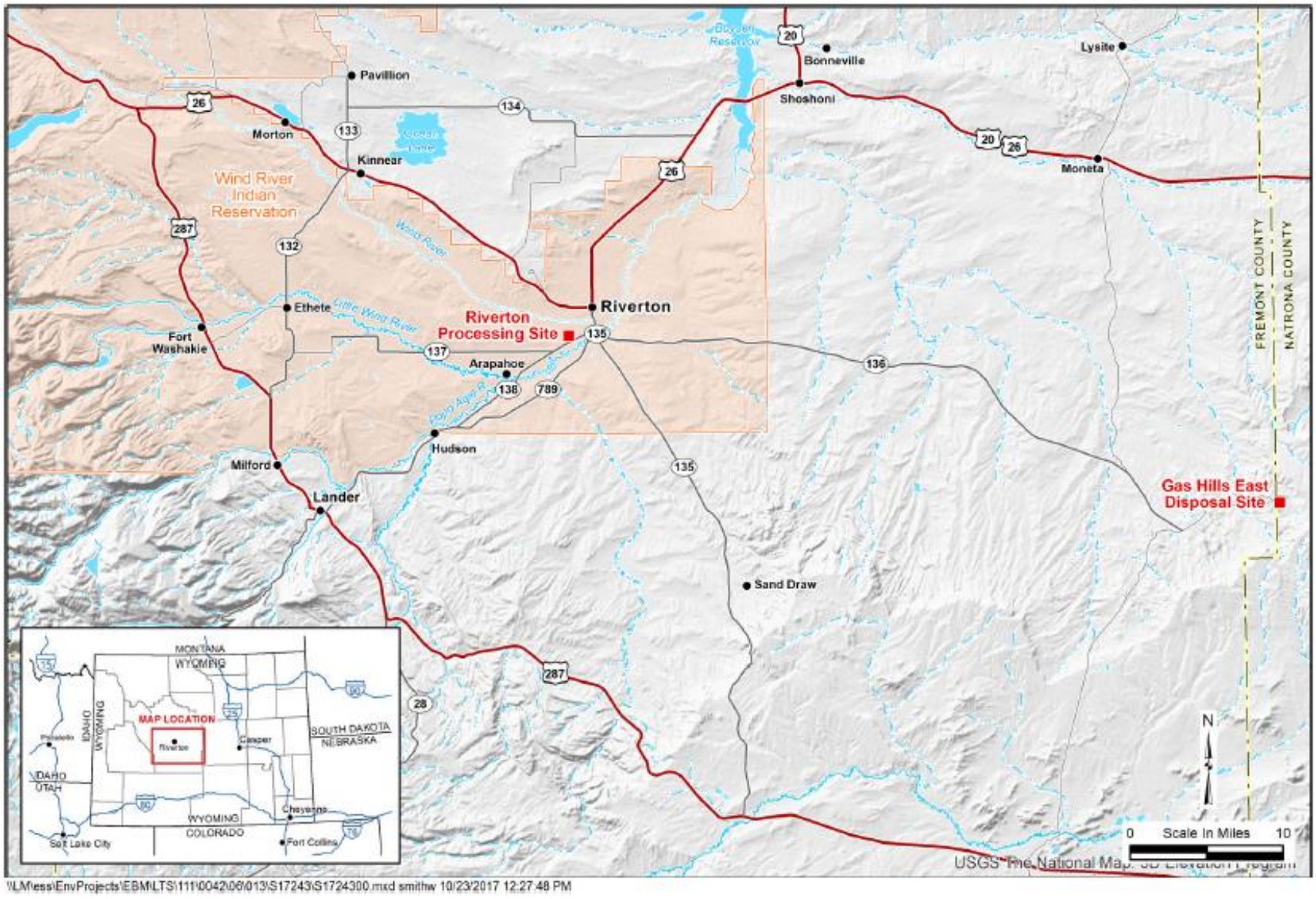

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FIGURE 3.1 Location of the Riverton, Wyoming, Processing Site

4 CURRENT SITE CONDITIONS

As mentioned in Section 3, the tailings pile and associated material including contaminated surface and subsurface soil have been removed from the Riverton site and transported for disposal at the Gas Hills Disposal cell.

To protect human health and the environment during the natural flushing period while groundwater contamination attenuates to protective concentrations (i.e., maximum contaminant concentrations [MCL] for uranium), ICs to prevent exposure to the contaminated groundwater have been implemented. An IC boundary has been established at the Riverton site delineating the area that requires oversight, as shown in Figure 4.1. The IC boundary was delineated to encompass the area of current groundwater contamination (as identified by the plume) and a surrounding buffer zone to allow for potential future plume migration (DOE 2018). A few areas at the site were remediated to supplemental limits for thorium (see Figure 4.2 for the areas where supplemental limits have been applied).

Currently, DOE-LM is responsible for long-term oversight and monitoring of the site and, as such, conducts various activities annually to ensure the site continues to be protective of human health and the environment. NANRO provides technical support for successful implementation of the oversight and maintenance tasks for the site.

Cooperative efforts are ongoing among DOE, the Northern Arapaho Tribe, and the State of Wyoming to implement viable and enforceable ICs at the Riverton site. ICs currently in place include the following:

- An alternate water supply system (AWSS), which is funded by DOE, is currently operated by the Northern Arapaho Water & Sewer Department (NAW&SD) and supplies potable water to residents within the IC boundary to minimize use of groundwater;

- Warning signs installed around Oxbow Lake, which explain that the contaminated water is not safe for human consumption, with instructions not to drink from, fish in, or swim in the lake;

- A tribal ordinance, which restricts well installation, prohibits surface-water impoundments, authorizes access to inspect and sample new wells, and provides notification to drilling contractors of the groundwater contamination within the IC boundary;

- Restrictions on well installation, which include a minimum depth of 150 ft below ground surface (approximately 50 ft below the top of the confined aquifer) and a requirement that surface casing be installed through the contaminated upper aquifer;

- DOE notification to area drilling contractors of the existing groundwater contamination;

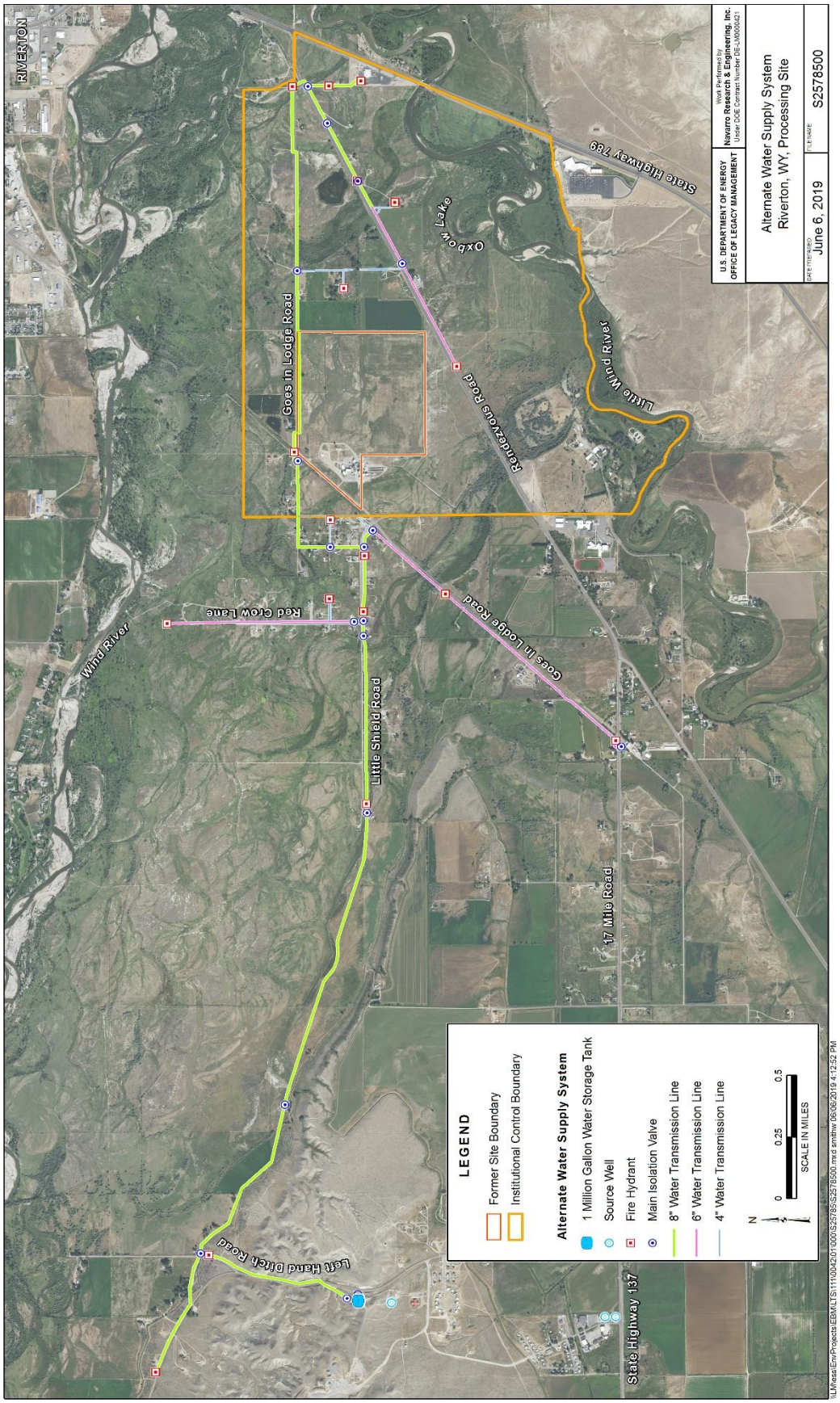

FIGURE 4.1 Aerial Photo Showing Location of the Riverton Site, Institutional Control Boundary, and Alternate Water Supply System

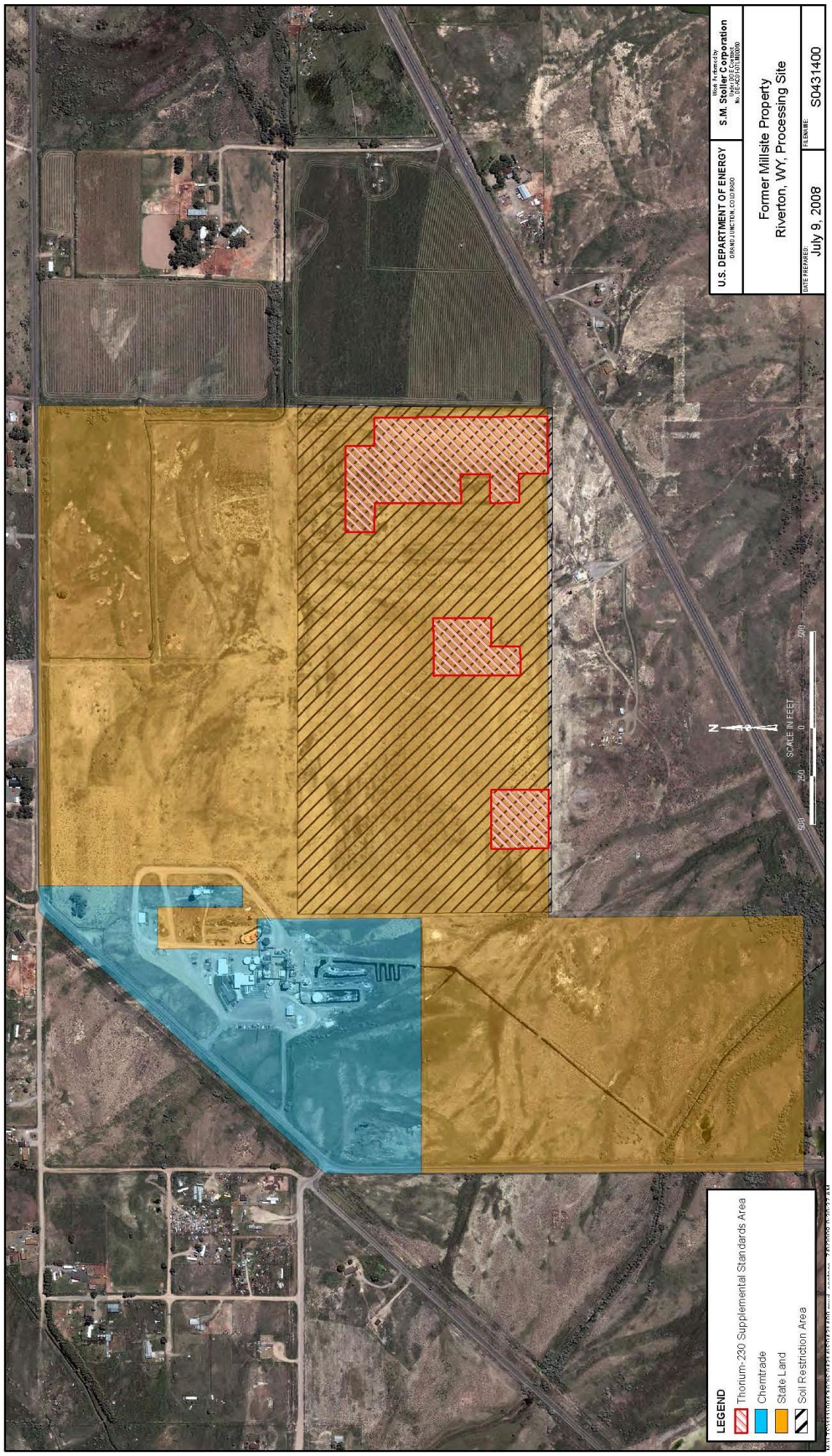

FIGURE 4.2 Thorium Supplemental Standards Areas at the Riverton Site

- A State of Wyoming Department of Environmental Quality notification of existing groundwater contamination to be provided to persons on privately owned land who apply for a gravel pit permit within the IC boundary;

- A U.S. Bureau of Indian Affairs notification of existing groundwater contamination to be provided to persons on tribal land who apply for an impoundment within or adjacent to the IC boundary;

- Notification to DOE by the Wyoming State Engineer's Office when permit applications are received for wells or surface impoundments within or adjacent to the IC boundary, providing DOE with a copy of the application (so that DOE may comment on it), and incorporating DOE's comments on the permit, if approved; and

- An easement and covenant to restrict land use and well drilling on the former mill site property, which was finalized on June 29, 2009.

DOE prepares an annual inspection report detailing the findings of the annual inspection and monitoring efforts conducted for the site.

5 PLANNING THE RISK ASSESSMENT UPDATE

To specify the appropriate scope for this risk assessment update, the risk assessment prepared by DOE in 1995 was reviewed (see Section 5.1 for a summary). As mentioned, Argonne, DOE, and NANRO, also underwent the DQO process to identify the data needed for this update. Table 5.1 presents a summary of the DQO process undertaken. It was concluded that plant data for the four COCs identified for the Riverton site would be needed because no such data have yet been collected. The four COCs are manganese, molybdenum, sulfate, and uranium. Subsequently, a plant survey was conducted to identify the plants present at the Riverton site (see Section 5.2). A certain number of plants with cultural uses were then selected for sampling and analysis (see Section 5.3).

In addition to plant data, uptake modeling or estimations would use available COC data for soil and surface water for the Riverton site. Figures 5.1 and 5.2 illustrate the analyses to be conducted.

TABLE 5.1 Summary of the DQO Process Conducted to Support this Risk Assessment Update

Problem Statement	Identify the Goal of the Study	Input to the Decision	Study Area Boundaries	Analytic Approach	Performance Criteria	Optimized Sampling Design
There is concern that Riverton site COCs (uranium, molybdenum, manganese, and sulfate) in plants, livestock, wildlife, and surface water may still be posing risks to human health and ecological resources.	Quantitative risk information relative to traditional Native American cultural uses of plants, use of livestock, or wildlife and surface water is needed. As groundwater contamination remains, information is needed with regard plant uptake from groundwater; and groundwater discharges to surface water. A comprehensive narrative describing current site conditions that includes quantitative risk estimates or information on plants and surface water is needed.	Plant data from the site would be useful to support the assessment update. In addition, site data for surface water would be needed for the assessment.	If site COCs were to be present in plants from groundwater to soil uptake, then plants growing on the area or footprint covering the contaminated groundwater plume would exhibit the highest concentrations. Plants growing on areas outside of the plume footprint should then exhibit lower COC concentrations. Therefore, plant sampling locations were identified to include the plume area and eight areas outside of the plume area but within the institutional controls' boundary.	Identify laboratory analytical procedures with adequate sensitivity to detect plant concentrations of manganese, molybdenum, sulfate, and uranium so that screening assessments can be conducted.	Collect adequate data relative to number of plant samples to develop statistically defensible exposure point concentrations; and identify validated data on surface water from current site database for use in this assessment.	Plant sampling design considered the types of plants sampled, the sample size in terms of sample weight for each sample, and number of samples. Sampling areas include both the area above the plume and areas outside the plume for comparison.

In addressing the traditional Native American cultural uses of plants, the study would

- Identify plants at the Riverton site for sampling and analyses of the four COC's.
- Use the new plant data (collected in 2018 and 2020) to estimate human health exposure to the plants from cultural uses and to characterize potential for ecological effects on plants/plant population.

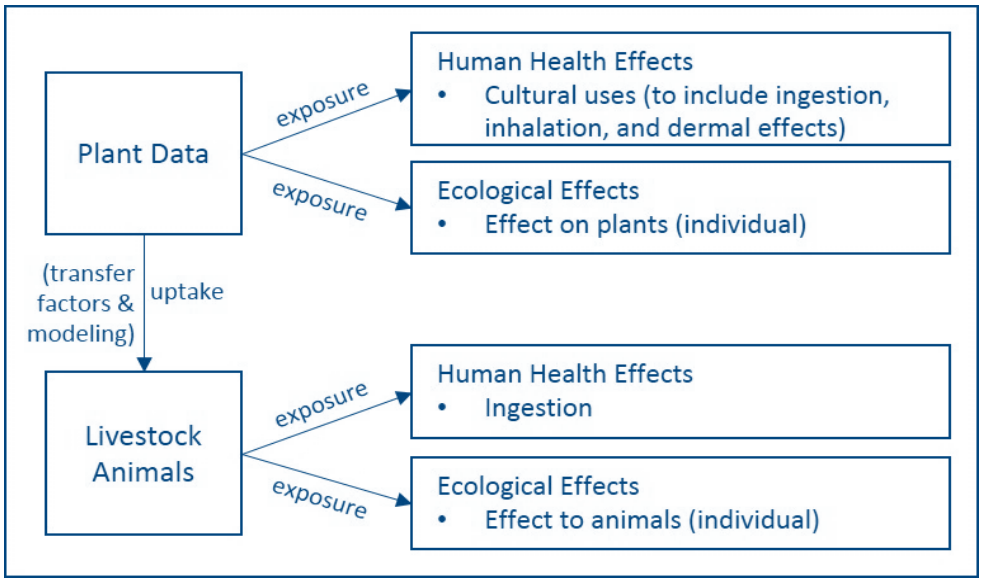

FIGURE 5.1 Use of Plant Data for Risk Assessment Update

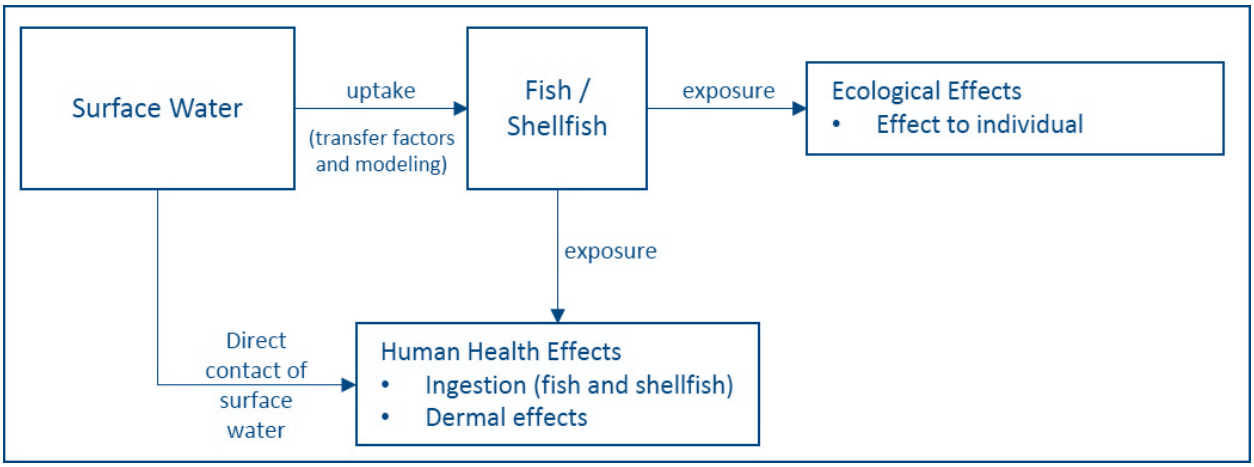

FIGURE 5.2 Use of Surface Water Data for Risk Assessment Update

For livestock and wildlife grazing concerns, the potential effect on livestock and wildlife would be determined through uptake modeling. The study would

- Use the COC data from plants to estimate uptake by livestock or wildlife or conduct modeling of uptake from plants by livestock or wildlife of interest.

- Determine potential human health exposure to livestock by evaluating ingestion of meat from such livestock.

- Determine ecological effects on animals/animal populations.

For fishery or aquatic species impacts, the potential effects on fish (as representative of shellfish and other aquatic species) would be determined through uptake modeling of COCs in surface water by fish (Figure 5.2). The study would use available surface water to develop fish tissue COC concentrations for human health risk estimates for the ingestion of fish. Surface water data would also be used for calculations of potential human health effects from direct contact (such as from wading or swimming and incidental ingestion). Finally, surface water data would be used to compare against available guidelines to determine ecological effects to aquatic species such as fish from site COCs.

5.1 Summary of the 1995 Risk Assessment Report

The Riverton UMTRA project consisted of two phases: the Surface Project and the Groundwater Project. The first addressed the surface contamination including the tailing piles and soil contamination. The second addressed the groundwater contamination. The 1995 risk assessment report was the first site-specific report prepared for the Riverton site under the Groundwater Project.

At the time of the assessment, no one was drinking the site-contaminated groundwater, and therefore no human health risks were associated with the affected groundwater. The 1995 assessment concluded that drinking the groundwater in the contaminated portion of the unconfined surficial aquifer could result in adverse human health effects because of manganese, molybdenum, sulfate, and uranium in the groundwater. The assessment further stated that although site-affected groundwater discharges to the surface, the site impact has not yet been determined at that time and that vegetation growing over the contaminated shallow groundwater may or may not be taking up contaminants through roots extending into the aquifer.

The assessment concluded that human health would not be affected by eating meat or drinking milk from cattle watered with the contaminated groundwater or from eating produce irrigated with the groundwater. No human health effects would be expected from swimming in the Little Wind River or eating fish caught from the river.

The ecological risk assessment presented in the 1995 Risk Assessment was a screening assessment based on limited sampling data and literature information. There was no site-specific data on plant or livestock animals evaluated in the assessment.

5.2 Plant Survey

To provide information for designing the sampling plan, a plant survey was conducted at the Riverton site on the uranium plume area and eight other areas outside the plume area but still within the IC area (see Figure 5.2-1). These eight other areas comprise reference area A for this update. A similar survey was conducted in identifying a second reference location, reference area B, which is in the nearby town of Ethete. In selecting the sampling areas, it was assumed that if plants are affected by the remaining contaminants in site groundwater, then plants collected from the plume area would exhibit higher concentrations of the COCs than plants growing in the two reference areas (i.e., reference areas A and B).

The Northern Arapaho Tribal Preservation and Historic Office (NATHPO) performed the survey and reported that 27 plants were found in the IC area (see Appendix A for the report). The plant survey on the Wind River Reservation by the Riverton Site on the uranium plume area and reference area A was completed on June 22, 2018. Photos of the plants found in 2018 were taken, and global positioning system (GPS) locations were recorded as part of the documentation. The nine areas were surveyed at 10 m between employees, and GPS locations were recorded in concentrated areas of similar plants and new plants along each transecting line. The native plants or plants that have been used traditionally and ceremonially were observed and their purposes documented; there is some variation in use for each plant and in names because of family histories and oral histories. Some plants recorded are not native but are still used by families and peoples in the area for cultural reasons. A walk through of reference area B was conducted in 2020 to ensure similar plants were present or growing at the location.

The plants that were found and documented include but are not limited to the following:

- Bushes: golden currant, greasewood, licorice root, rabbitbrush, red willow bush, sagebrush, saltbrush, and willow;
- Flowers: gumweed, Indian paintbrush, sneezeweed, sunflowers, and whitetop sulfur;
- Fruit: bearberry, prickly currant, snakeberry bush, wax currant;
- Grasses: sweetgrass;
- Herb: mint;
- Plants: peachleaf willow;
- Stalk: cattails and foxtails; and
- Trees: aspen, birch, narrowleaf cottonwood, plains cottonwood, elm.

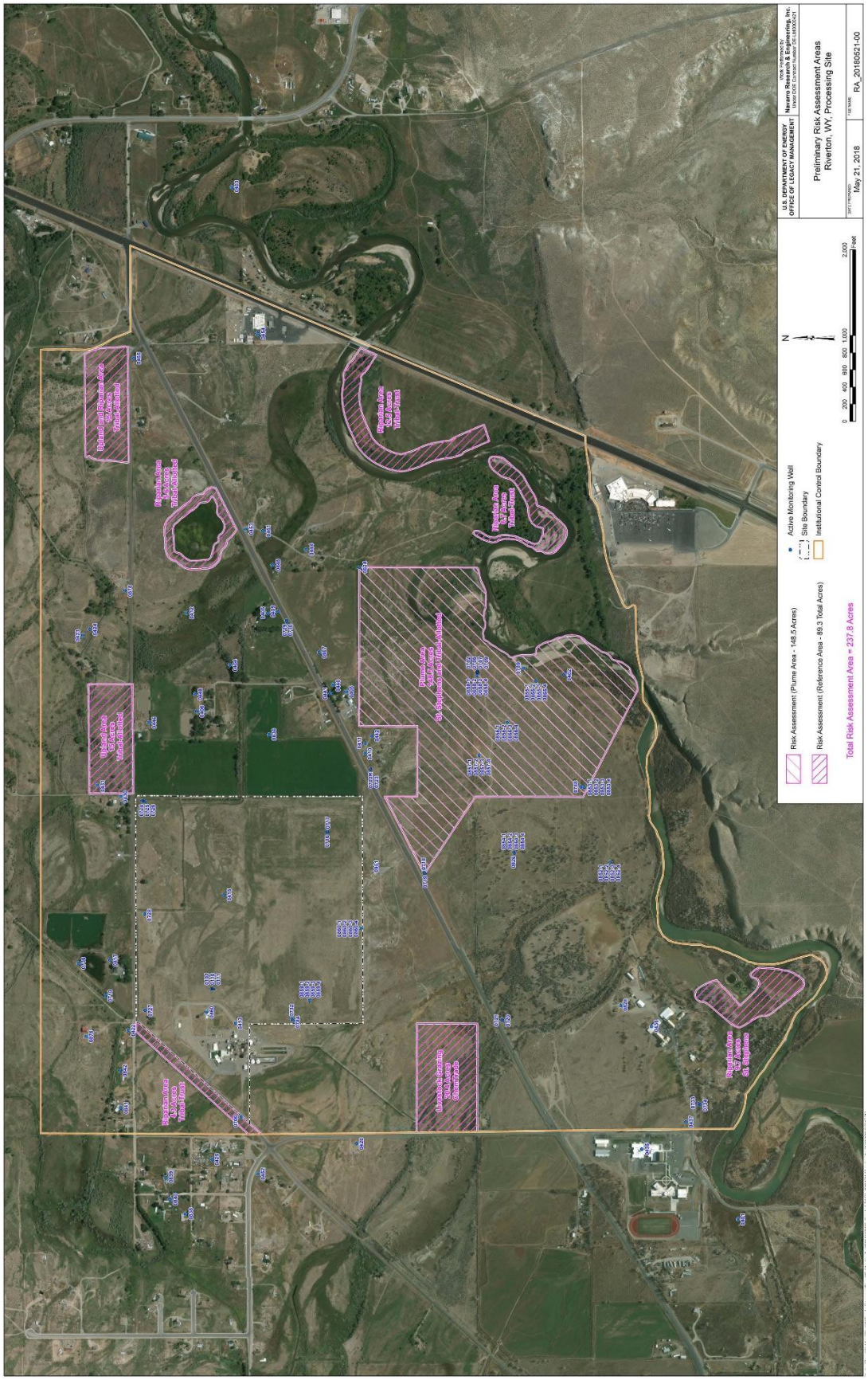

FIGURE 5.2-1 Map of Area with ICs

5.3 Plant Sampling and Analysis

Based on the survey, 12 plant species were selected for sampling and analysis (Table 5.3-1). Figures 5.3-1 to 5.3-12 show images of these plants. Figures 5.3-13 and 5.3-14 show the locations for the asparagus plant and for the other 11 plants at the plume and eight reference areas (at reference area A) sampled in 2018. The asparagus growing season is somewhat ahead of that of the rest of the plants selected for sampling, and was sampled earlier. Figure 5.3-15 shows the location of reference area B in Ethete and the sampling locations at reference area B for the 10 plants collected. The asparagus plant was past its growing season and whitetop sulfur was not present when sampling was conducted in August of 2020. Sampling could not be conducted earlier in 2020 due to the pandemic restrictions in place at the time.

As a conservative approach, it was decided that sampling the roots as much as possible for each plant would be conducted as plant uptake from the soil would typically start at the roots and therefore most likely be most concentrated. Hence, samples of the roots were collected except for the bearberry, golden currant, snakeberry bush, and red willow bush plants. For these four plants, branches were collected and analyzed for the four COCs. Further, for plains cottonwood, because of the large size and longevity of these trees, core samples from the tree trunk were taken as a conservative approach.

The plant samples were processed according to sampling protocols (cleaned or rinsed to remove soil adhering to the samples, weighed, documented, and place in labeled containers) in the field and then transported to the laboratory for analysis. Table 5.3-2 identifies the analytical procedures and detection limits for the laboratory analysis. The analytical procedures are adequately sensitive to detect naturally occurring (low levels) concentrations of the four COCs.

TABLE 5.3-1 Plants Selected for Sampling and Analysis

Common Name	Scientific Name
1. Wild asparagus	*Asparagus prostrates*
2. Bearberry	*Ericaceae* [Heath Family] *Arctostaphylos uva-ursi*
3. Plains cottonwood	*Populus deltoids*
4. Golden currant	*Grossulariaceae* [Gooseberry/Currant Family] *Ribes aureum; probably other Ribes spp.*
5. Gumweed	*Grindelia squarrosa*; possibly other *Grindelia spp.*
6. Licorice root	Glycyrrhiza lepidota; possibly other burr-bearing species by extension, such as *Cenchrus spp. or Xanthium spp.*
7. Milkweed	*Asclepias speciose*
8. Sagebrush	*Artemisia spp.*
9. Snakeberry bush	
10. Snowberry	*Symphoricarpos spp.*
11. Whitetop sulfur	*Eriogonum umbellatum* and related
12. Red willow bush	*Cornaceae* [Dogwood Family]; *Swida sericea*

TABLE 5.3-2 Laboratory Analytical Procedures and Detection Limits for Plant Analysis

Analyte	Preparation Method	Analytical Method	Method Detection Limit
Manganese	SW-846 3050B	SW-846 6020A	0.02 mg/kg
Molybdenum	SW-846 3050B	SW-846 6020A	0.08 mg.kg
Sulfate	SW846 9056A	SW846 9056A	1 mg/kg
Total uranium	SW-846 3050B	SW-846 6020A	0.01 mg.kg

FIGURE 5.3-1 Wild Asparagus

FIGURE 5.3-2 Bearberry

FIGURE 5.3-3 Plains Cottonwood

FIGURE 5.3-4 Golden Currant

FIGURE 5.3-5 Gumweed

FIGURE 5.3-6 Licorice Root

FIGURE 5.3-7 Milkweed

FIGURE 5.3-8 Sagebrush

FIGURE 5.3-9 Snakeberry Bush

FIGURE 5.3-10 Snowberry

FIGURE 5.3-11 Whitetop Sulfur

FIGURE 5.3-12 Red Willow Bush

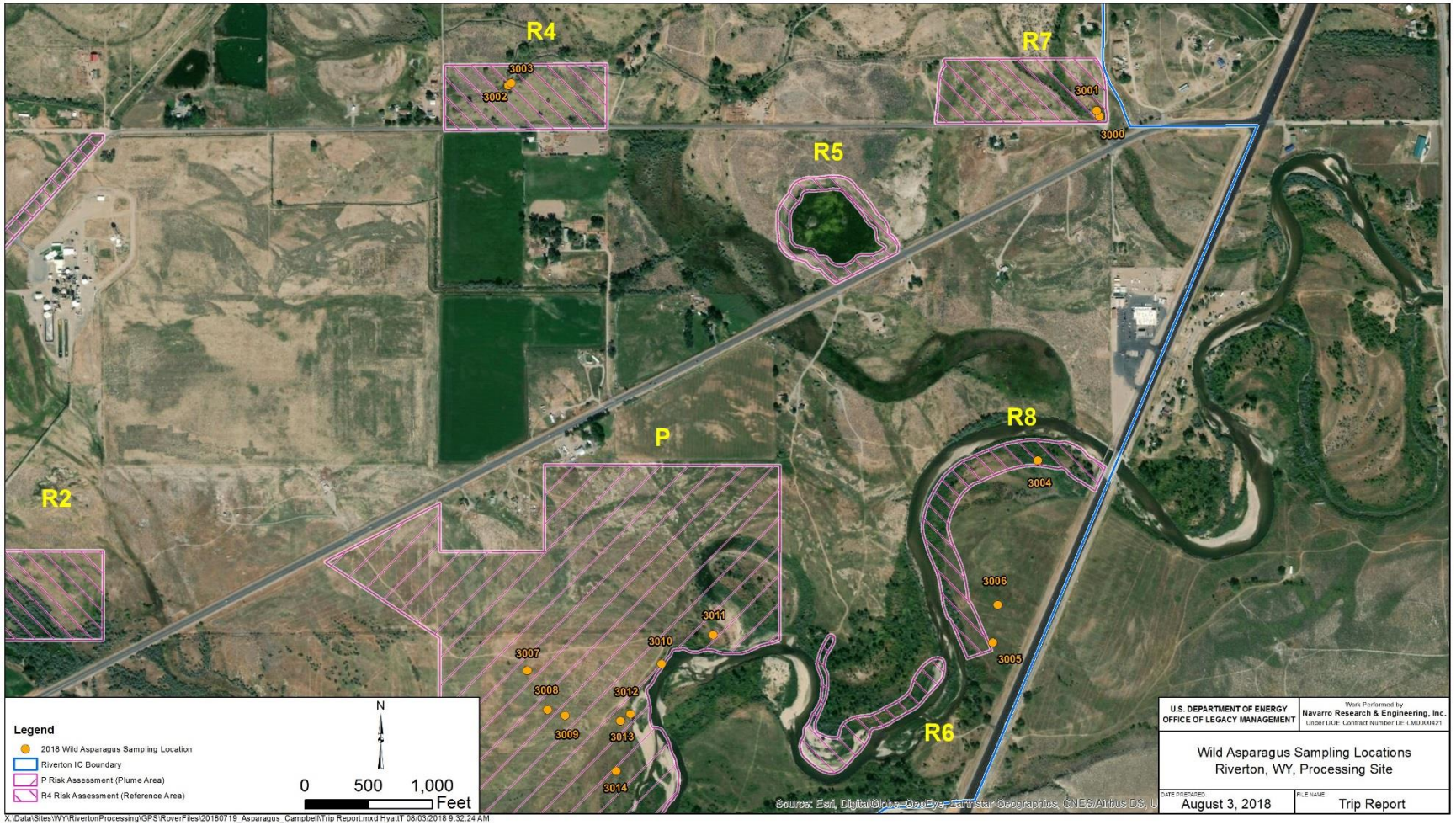

FIGURE 5.3-13 Map of Wild Asparagus Sampling Locations

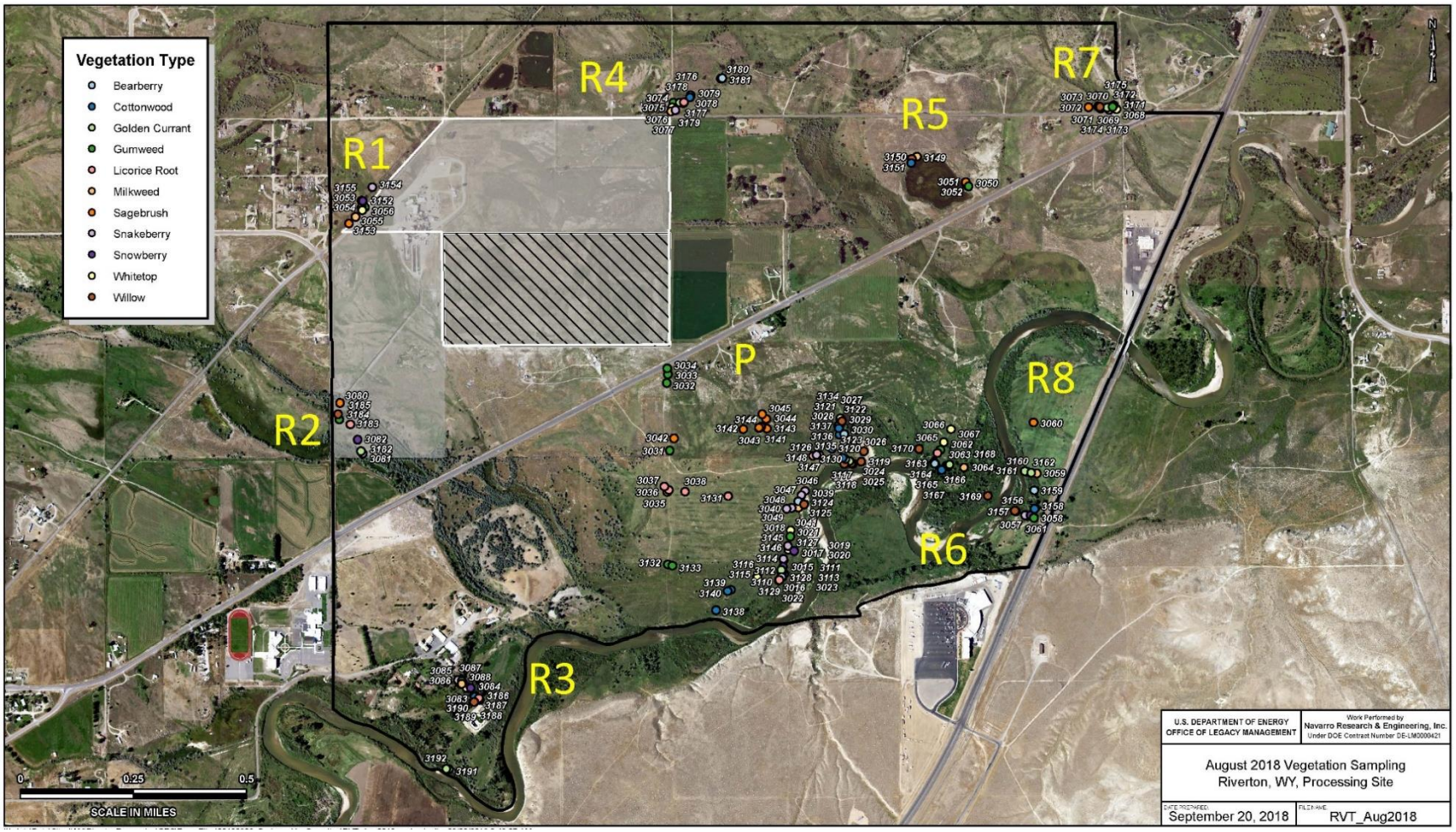

FIGURE 5.3-14 Map of Plant, Other Than Asparagus, Sampling Locations

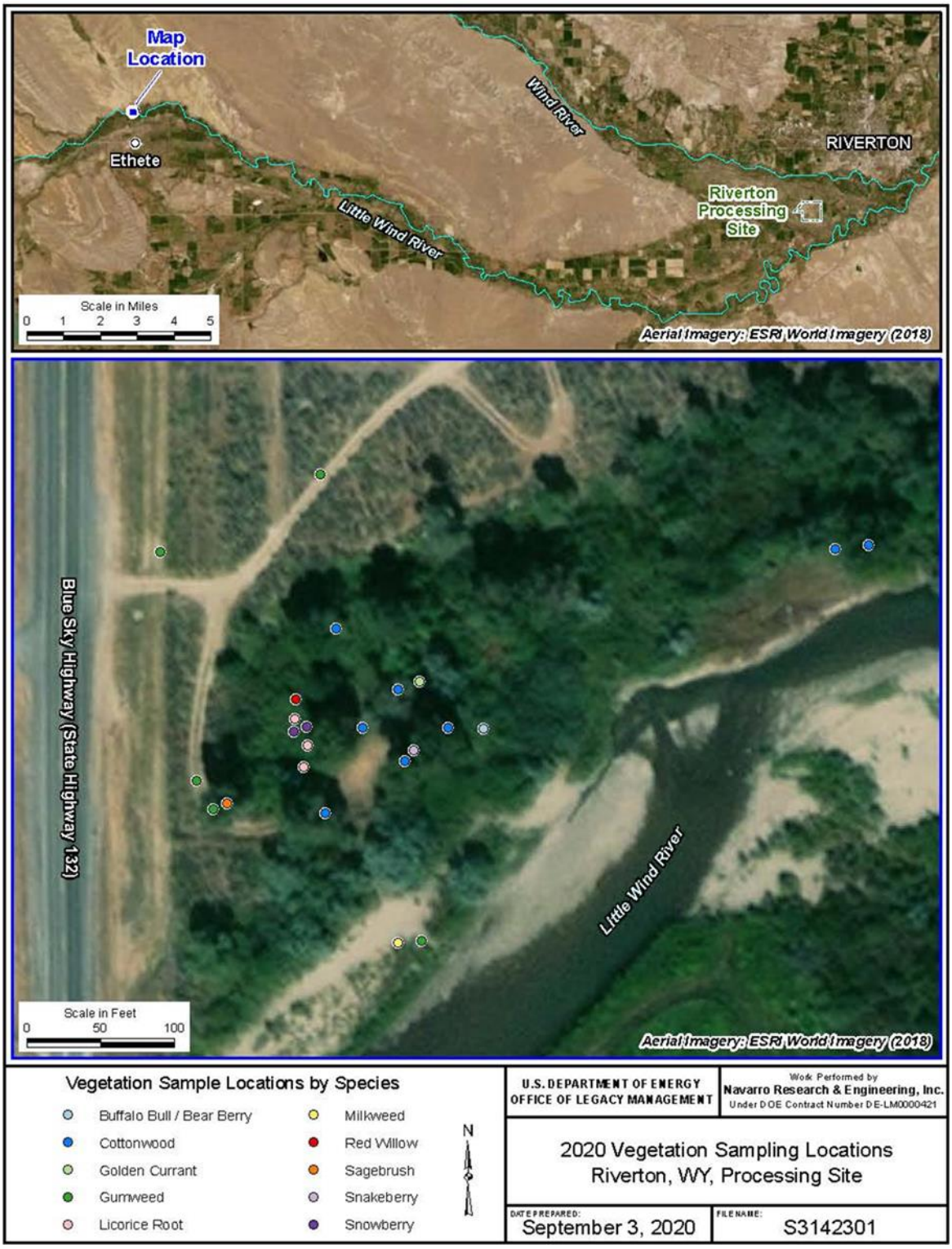

FIGURE 5.3-15 Sampling Locations in Reference Area B in Ethete

5.4 Summary of Plant Data

Plant data from the three areas (i.e., the plume area, reference area A, and reference area B) indicate that the four COCs are present above the detection limits of the analytical methods employed for the analyses of the plant samples collected albeit at varying detection frequencies. The analytical methods and associated detection limits are tabulated in Table 5.3-2. The analytical methods were selected to ensure adequate sensitivity to detect naturally occurring levels of the COCs in the environment. Molybdenum has the lowest detection frequency of the four COCs with manganese detected at the highest frequency; manganese was detected above the detection limit for all the samples collected.

The concentrations in plants collected from the plume area and reference area A are closer in range than those from reference area B. For some of the plants, data from the plume area are slightly higher than those from reference area A (e.g., uranium average concentrations for gumweed, milkweed, and snakeberry bush). While results from reference area A for other plants appear to be higher than those for samples collected from the plume area (e.g., uranium average concentrations for sagebrush, whitetop sulfur, and snowberry). The concentration in plants collected from reference area B appear to be generally lower than those collected from the plume area and reference area A.

The similarity in concentrations from the plume area and reference area A could be attributable to the proximity of the plume area to reference area A with both located within the site IC boundary. The concentrations from these two areas may not necessarily be correlated to the contamination remaining in groundwater beneath the plume area as the four COCs occur naturally in plants at some level. Reference area B is a few miles away from the Riverton site in the nearby town of Ethete (see Figure 5.3.14) and is in a semi-rural non-industrial area. Environmental data throughout the US for soil, plants, groundwater, or surface water tend to be lower in non-industrial than in industrial areas. Despite the differences, the concentrations found in plants from all three areas are generally low and do not result in any adverse impacts to traditional cultural uses as supported by the estimates and discussion presented in the remainder of this report (see Chapters 6 to 8). Appendix B presents a tabulation of all the plant data collected (including sample numbers, sampling locations, and data validation qualifiers).

To provide another perspective to the plant concentrations, maximum soil concentrations of the four COCs reported in 2015 and 2016 for the Riverton site are presented in Table 5.4-1. This table also indicates the approximate nearest plant sampling areas to a given soil sampling location. Figures 5.4-1 and 5.4-2 are provided to show the soil and plant sampling locations and the maximum concentrations reported at those locations for the COCs. As shown in these figures, a definitive correlation between soil and plant concentrations of the COCs could not be determined from the data.

Tables 5.4-2 to 5.4-5 present summary data statistics for the four COCs—manganese, molybdenum, sulfate, and uranium, respectively—from the plants collected from the three areas. In the tables, the 95th percentile upper-bound concentration limits (UCL95) of the average for each plant for both the plume area, reference area A, and reference area B are also presented. The UCL95 was calculated based on equation 11.6 from Gilbert (1987, 139):

$$UL_{1-\alpha} = \bar{x} + t_{1-\alpha,n-1}\frac{s}{\sqrt{n}}$$

The *t* value was obtained from both Table A2 of Gilbert (1987, 255) and the following Excel formula:

$$\text{T.INV.2T}((1 - 0.95) \times 2, \text{n} - 1)$$

TABLE 5.4-1 Soil Maximum Data Collected in 2015 and 2016 and Nearest Plant Sampling Locations in the Plume Area and Reference Area A

Sampling Location		Soil Concentration (mg/kg)			
Soil	Plant Sampling Area Nearby	Manganese	Molybdenum	Sulfate	Uranium
0852	R3	500	0.22	4,100	0.9
0853	P	480	3.0	1,300	1.3
0854	R2 and R3	440	2.2	10,000B	3.1B[a]
0855	P	1,800	1.6	410	3.9
0856	P	3,400	0.91	8,300	1.5
0857	P	260	1.1	4,300	1.2
0858	P	88	6.1	9,700	9.4
0859	R1	400	4.6	11,000B	5.5
0860	R2	190	3.3	4,800B	3.0
0877	P	630	0.52	8500B	20
0880	R8	358	0.28	23	3.1
0881	R5 and R7	328	0.19	2010	1.7
0882	R1	249	0.71	10,400	3.1
0883	R1and R2	363	0.57	7,000	1.8
0884	R1and R4	9160	0.22	3090	1.4
0885	R2	300	0.26	6.4	1.6

[a] Values with “B” indicate the contaminant was also detected in the blank sample; all samples for the COC at the given locations were reported with a “B.”

TABLE 5.4-2 Plant Data Statistics for Manganese[a]

Plant	Plume Area						Reference Area A						Reference Area B					
	Average (mg/kg)	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections
Wild asparagus	1.6	0.68	2.1	0.092	2.4	7/8	1.1	0.63	1.5	0.091	1.9	6/8	-	-	-	-	-	-
Bearberry	3.6	0.62	4.1	2.7	4.7	6/6	4.7	2.4	6.2	2.2	9.9	9/9	3.3	0.88	3.8	2.4	5.5	9/9
Plains cottonwood	200	160	300	2.8	540	9/9	110	130	200	2.2	300	8/8	3.2	1.4	4.0	1.5	6.0	9/9
Golden currant	4.2	0.86	4.7	2.8	5.5	8/8	3.6	1.8	4.8	1.2	6.5	8/8	3.0	0.48	3.3	2.6	4.3	9/9
Gumweed	12	3.9	14	5.0	19	9/9	14	7.4	18	7.7	35	10/10	9.0	5.6	12	4.3	23	9/9
Licorice root	11	9.4	18	5.5	36	8/8	12	7.0	17	4.6	27	8/8	5.2	1.2	5.9	3.7	7.6	9/9
Milkweed	12	7.9	21	4.9	25	4/4	11	4.3	14	4.9	19	9/9	6.8	4.2	9.5	3.8	18	9/9
Sagebrush	38	13	47	16	58	9/9	29	22	44	8.0	81	8/8	19	9.5	25	11	42	9/9
Snakeberry bush	7.6	2.2	9.0	4.8	12	9/9	7.1	3.1	9.2	3.0	12	8/8	14	9.6	20	3.2	32	9/9
Snowberry	38.	18	50	12	78	8/8	48	17	59	26	68	8/8	25	10	32	9.8	37	9/9
Whitetop sulfur	5.5	3.3	7.7	2.2	13	8/8	31	47	60	2.6	160	9/9	-	-	-	-	-	-
Red willow bush	22	13	30	2.2	45	8/8	22	44	50	1.2	150	9/9	3.3	2.4	4.8	1.1	9.1	9/9

[a] Data with laboratory qualifiers of ”U” and ”B” were included as half of the detection limit. Values have been rounded to two significant figures.

TABLE 5.4-3 Plant Data Statistics for Molybdenum[a]

Plant	Plume Area						Reference Area A						Reference Area B					
	Average (mg/kg)	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections
Wild asparagus	0.060	0.056	0.097	0.037	0.21	1/8	0.039	0.0010	0.039	0.036	0.040	0/8	-	-	-	-	-	-
Bearberry	0.046	0.018	0.061	0.037	0.086	1/6	0.073	0.049	0.10	0.038	0.17	3/9	0.14	0.11	0.27	0.035	0.32	4/9
Plains cottonwood	0.039	0.0011	0.039	0.037	0.040	0/9	0.038	0.00093	0.038	0.037	0.039	0/8	0.037	0.0016	-	0.035	0.040	0/9
Golden currant	0.043	0.015	0.053	0.036	0.082	1/8	0.038	0.00063	0.039	0.037	0.039	0/8	0.038	0.0010	-	0.037	0.039	0/9
Gumweed	1.9	2.5	3.4	0.039	7.3	7/9	0.20	0.14	0.28	0.038	0.50	9/10	0.16	0.28	-	0.037	0.95	2/9
Licorice root	2.0	1.5	3.02	0.26	4.6	8/8	0.72	0.98	1.4	0.039	3.1	7/8	0.038	0.0015	-	0.035	0.040	0/9
Milkweed	0.080	0.043	0.13	0.038	0.14	2/4	0.052	0.027	0.068	0.036	0.12	2/9	0.038	0.0012	-	0.036	0.040	0/9
Sagebrush	0.53	0.26	0.69	0.28	1.0	9/9	0.26	0.17	0.38	0.038	0.57	6/8	0.13	0.13	0.35	0.037	0.34	3/9
Snakeberry bush	0.039	0.0011	0.039	0.037	0.040	0/9	0.039	0.0011	0.039	0.036	0.040	0/8	0.039	0.0010	-	0.036	0.040	0/9
Snowberry	0.33	0.19	0.45	0.14	0.67	8/8	0.64	0.62	1.1	0.037	1.6	6/8	0.31	0.29	0.59	0.037	0.87	5/9
Whitetop sulfur	0.47	0.52	0.82	0.036	1.3	6/8	0.18	0.12	0.26	0.040	0.49	8/9	-	-	-	-	-	-
Red willow bush	0.039	0.0012	0.040	0.037	0.040	0/8	0.039	0.00085	0.039	0.037	0.040	0/9	0.039	0.00080	-	0.037	0.040	0/9

[a] Data with laboratory qualifiers of ”U” and ”B” were included as half of the detection limit. Values have been rounded to two significant figures.

TABLE 5.4-4 Plant Data Statistics for Sulfate[a]

	Plume Area						Reference Area A						Reference Area B					
Plant	Average (mg/kg)	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections
Wild asparagus	130	60	180	35	200	8/8	150	130	240	40	460	8/8	-	-	-	-	-	-
Bearberry	110	200	270	4.1	560	6/6	28	30	46	1.8	94	9/9	7.1	16	20	0.37	53	6/9
Plains cottonwood	18	14	27	2.5	55	9/9	72	85	130	13	270	8/8	17	11	24	6.9	40	9/9
Golden currant	6.3	5.4	9.9	2.1	18	8/8	2.6	3.5	9.4	0.43	12	4/8	1.8	0.99	2.5	0.46	3.3	7/9
Gumweed	190	200	310	15	610	9/9	240	350	450	20	1200	10/10	23	18	35	0.72	49	8/9
Licorice root	120	74	170	4.3	230	8/8	400	550	770	13	1700	8/8	5.6	2.5	7.2	2.7	11	9/9
Milkweed	98	42	150	54	160	4/4	250	270	420	8.9	840	9/9	4.8	7.0	10	0.56	24	7/9
Sagebrush	61	42	87	1.3	140	8/9	470	740	970	11	2400	8/8	13	14	23	0.68	42	8/9
Snakeberry bush	5.6	4.6	8.4	0.58	15	7/9	10	7.8	15	1.2	27	8/8	5.9	3.4	8.1	0.39	13	8/9
Snowberry	150	310	360	5.2	960	8/8	330	530	680	7.7	1400	8/8	6.0	3.9	8.4	1.9	14	9/9
Whitetop sulfur	820	640	1300	250	2200	8/8	760	880	1300	46	3000	9/9	-	-	-	-	-	-
Red willow bush	17	16	28	3.6	53	8/8	8.4	18	46	0.48	59	4/9	1.3	0.85	2.0	0.34	3.0	6/9

[a] Data with laboratory qualifiers of ”U” and ”B” were included as half of the detection limit. Values have been rounded to two significant figures.

TABLE 5.4-5 Plant Data Statistics for Uranium[a]

Plant	Plume Area						Reference Area A						Reference Area B					
	Average (mg/kg)	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections	Average	Standard Deviation	UCL95	Minimum	Maximum	Number of Detections
Wild asparagus	0.022	0.040	0.049	0.0060	0.13	1/8	0.0063	0.00017	0.0065	0.0060	0.0066	0/8	-	-	-	-	-	-
Bearberry	0.0063	.00021	0.0065	0.0060	0.0066	0/6	0.010	0.0081	0.015	0.0062	0.031	2/9	0.0062	0.00030	-	0.0058	0.0066	0/9
Plains cottonwood	0.024	0.026	0.040	0.0060	0.082	4/9	0.0062	0.00016	0.0063	0.0060	0.0065	0/8	0.011	0.0024	0.013	0.0064	0.013	7/9
Golden currant	0.0063	0.00029	0.0065	0.0059	0.0067	0/8	0.0063	0.00011	0.0064	0.0062	0.0065	0/8	0.0063	0.00017	-	0.0061	0.0065	0/9
Gumweed	1.2	2.9	2.9	0.0064	9.3	8/9	0.32	0.20	0.43	0.076	0.70	10/10	0.045	0.043	0.086	0.0061	0.14	5/9
Licorice root	0.21	0.29	0.41	0.0061	0.95	7/8	0.25	0.19	0.37	0.033	0.53	8/8	0.12	0.062	0.16	0.042	0.24	9/9
Milkweed	0.35	0.21	0.60	0.085	0.63	4/4	0.11	0.13	0.19	0.0061	0.44	8/9	0.0063	0.00021	-	0.0060	0.0067	0/9
Sagebrush	0.30	0.32	0.50	0.082	1.2	9/9	0.82	0.83	1.4	0.022	2.4	8/8	0.13	0.19	0.26	0.0066	0.61	8/9
Snakeberry bush	0.021	0.013	0.028	0.0065	0.040	6/9	0.0093	0.0054	0.013	0.0060	0.022	2/8	0.16	0.14	0.25	0.0063	0.47	8/9
Snowberry	0.58	0.40	0.85	0.14	1.3	8/8	1.6	2.4	3.2	0.0061	7.7	6/8	0.93	0.82	1.5	0.0065	2.1	8/9
Whitetop sulfur	0.039	0.024	0.055	0.019	0.096	8/8	0.13	0.17	0.23	0.0065	0.54	7/9	-	-	-	-	-	-
Red willow bush	0.059	0.058	0.098	0.0061	0.19	5/8	0.0076	0.0034	0.0097	0.0062	0.017	1/9	0.0064	0.00014	-	0.0061	0.0066	0/9

[a] Data with laboratory qualifiers of ”U” and ”B” were included as half of the detection limit. Values have been rounded to two significant figures.

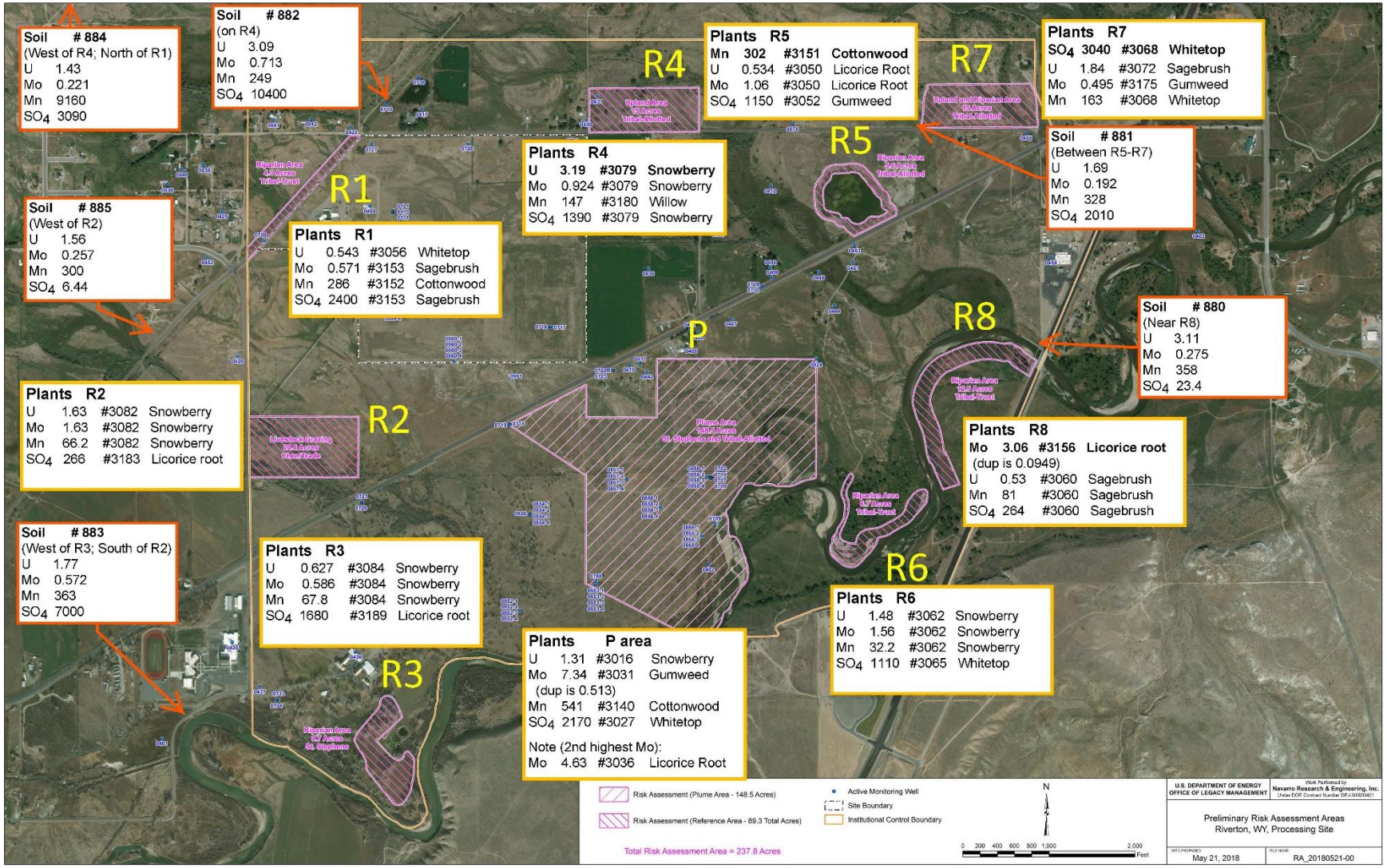

FIGURE 5.4-1 Map Showing 2018 Plant Maximum Concentrations of the COCs in the Plume and Reference Area A Compared to 2016 Riverton Site Soil Maximum Concentrations Near the Plant Locations

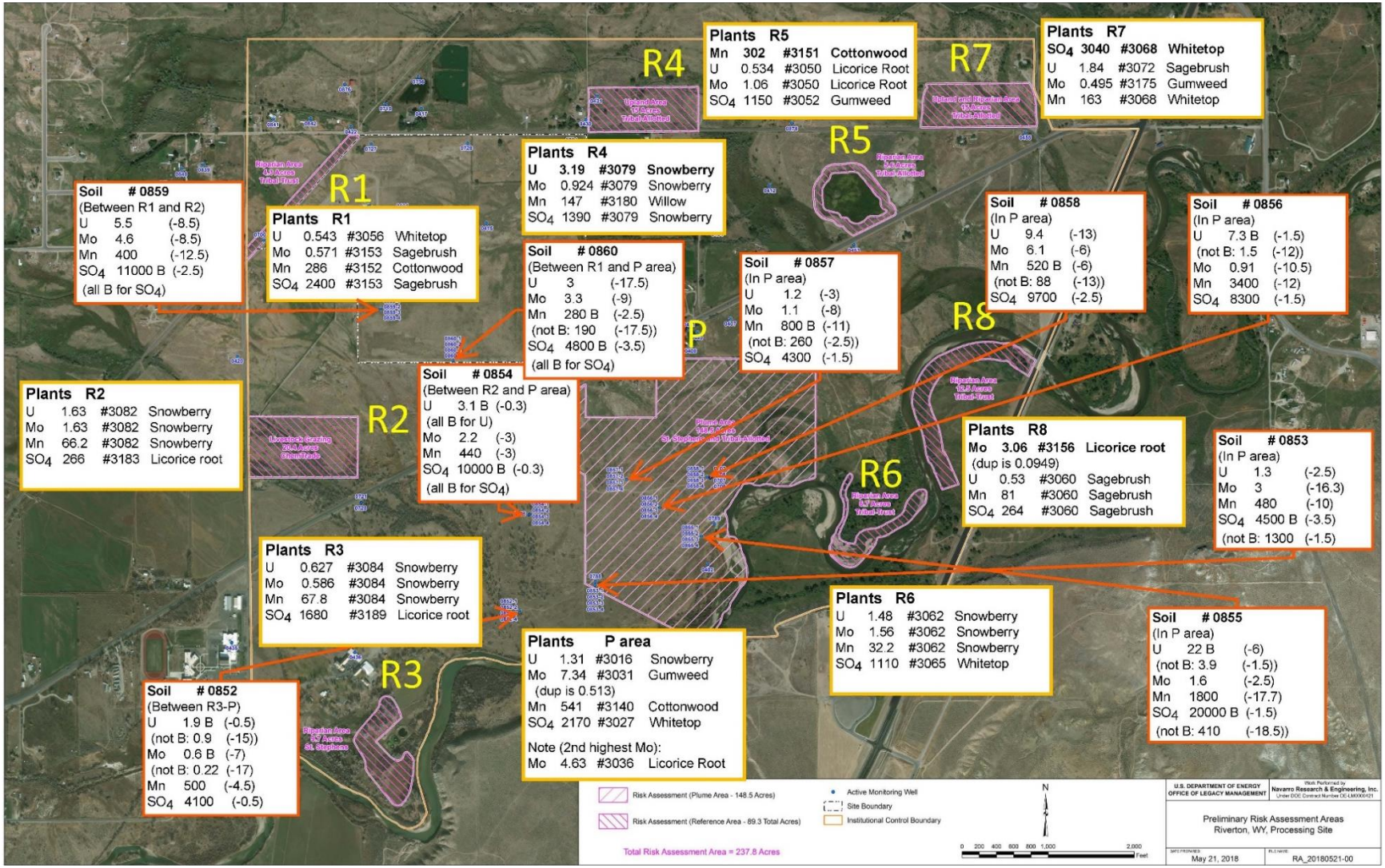

FIGURE 5.4-2 Map Showing Plant Sampling Results (Maximum Concentrations of the COCs) Compared to 2015 Soil Sampling Results Near the Plant Locations Shown

6 HUMAN HEALTH RISK ASSESSMENT

The human health assessment was conducted following the four steps for risk assessments (see Figure 6.1) recommended by the U.S. Environmental Protection Agency (EPA) as follows:

(1) *Hazard Identification* is the process of determining whether exposure to a chemical or contaminant can result in an increase in the incidence of specific adverse health effects (e.g., cancer, reproductive effects). This step also determines whether the adverse health effect is likely to occur in humans. Scientific data or information is used to determine whether there is a link between the negative effects and the contaminants. Section 6.1 provides a more detailed discussion of this step relative to the Riverton site.

(2) *Dose or Exposure Response Assessment* is the process of determining how the likelihood and severity of adverse health effects (the responses) are related to the amount and condition of exposure to a contaminant or chemical (the dose provided). Typically, as the dose increases, the measured response also increases. When all available studies are taken into consideration, the adverse effect that occurs at the lowest dose is selected as the critical effect for risk assessment. The underlying assumption is that if the critical effect is prevented from occurring, then no other effects of concern will occur.

There is frequently a lack of dose-response data available for human subjects. Data often cover only a portion of the possible range of the dose-response relationship. Subsequently, some extrapolation must be done to extrapolate to dose levels lower than the range of data obtained from scientific studies.

Animal studies are frequently conducted to augment the available data. However, dose-response relationships observed from animal studies are often at much higher doses than would be anticipated for humans, so they must be extrapolated to lower doses, and animal studies must also be extrapolated from that animal species to humans to predict the relationship for humans. These extrapolations introduce uncertainty into the dose-response analysis and, subsequently, into the entire risk assessment process.

Section 6.2 presents toxicity information for the COCs identified for the Riverton site.

(3) *Exposure Assessment* is the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent or chemical in the environment. Exposure is commonly estimated indirectly through consideration of measured chemical concentrations in the environment, consideration of models of chemical transport and fate in the environment and estimates of human intake over time.

Exposure assessment considers both the exposure pathway (the course a contaminant or chemical takes from its source to the receptors or person(s) being contacted) as well as the exposure route (means of entry of the chemical into the body). The exposure route is the intake (taken in through a body opening, e.g., as eating, drinking, or inhaling) or uptake (absorption through tissues, e.g., through the skin or eye).

Section 6.3 describes the exposure assessment associated with plants and surface water sampled within the IC boundary of the Riverton site.

(4) *Risk Characterization* conveys the risk assessor's judgment as to the nature and presence or absence of risks, based on the exposure assessment, along with information about how the risk was assessed. The risk characterization step communicates where assumptions and uncertainties still exist.

Section 6.4 provides the estimated hazard quotients and doses from the COCs identified for the Riverton site.

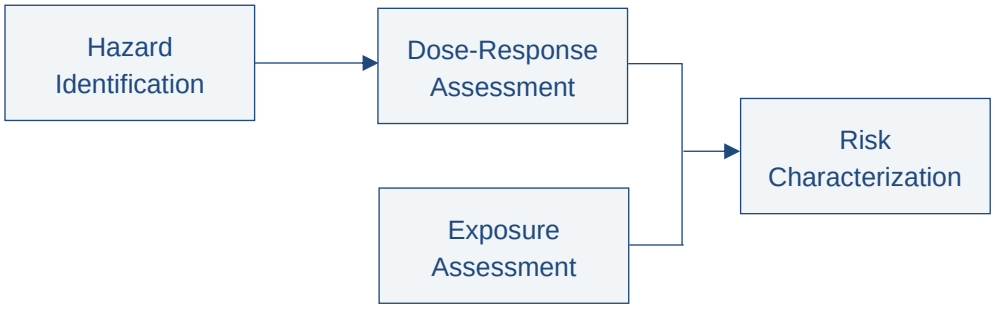

FIGURE 6.1 Four Steps of Human Health Risk Assessment Process

A conceptual site exposure model (CSM) was developed to guide the risk assessment update of potential exposure for human receptors; see Figure 6.2. This CSM shows the historical sources of contamination as the tailing piles, surface soil, and subsurface soils. Since remediation of these sources has been completed with groundwater contamination remaining, the CSM depicts potential completed pathways from plants and surface water as media of potential exposure to allow for the possibility of the contaminated groundwater contributing to surface water and plant COC concentrations. It is assumed that exposure to groundwater is not a complete pathway if an alternate water supply is available and site groundwater is not used. Potential pathways evaluated for this update included cultural uses of plants that involve ingestion, inhalation, and dermal exposure from plants; ingestion of meat from livestock (cattle) that graze on the plants; ingestion of catch (fish) from site surface water; and direct contact with the site surface water. It is assumed that site surface water becomes contaminated due to discharges from site groundwater.

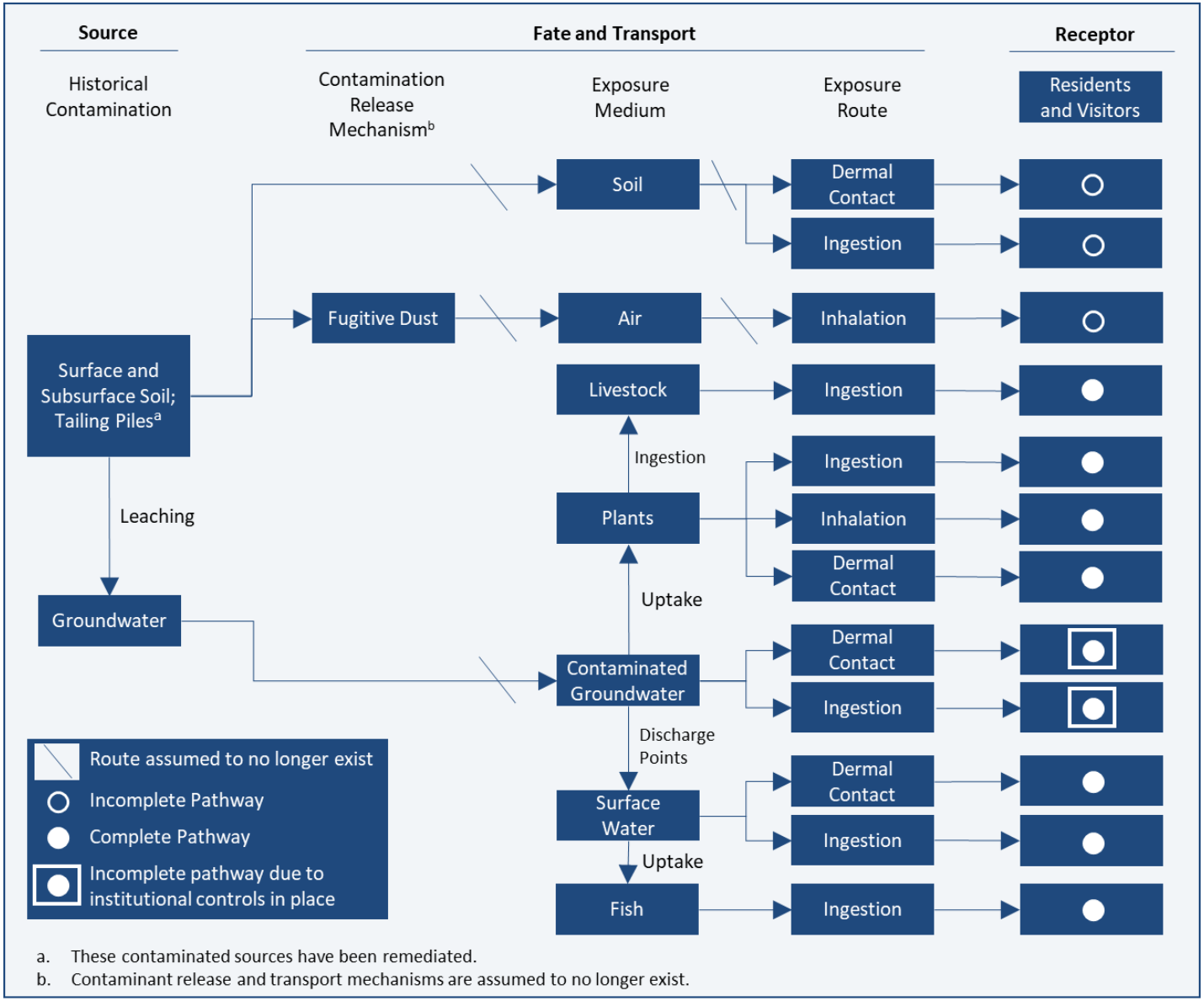

FIGURE 6.2 Conceptual Site Human Health Exposure Model Incorporating Current Conditions

6.1 Hazard Identification

For the human health assessment, the COCs assessed were manganese, molybdenum, sulfate, and uranium. These four chemicals have been identified as the COCs for Riverton site soil, groundwater, surface water, and plants.

Uranium is assessed for both its chemical and radiological effects on human health. Manganese, molybdenum, and sulfate are assessed for their chemical effects. All four COCs are considered noncarcinogenic based on their chemical effects; uranium is considered for its carcinogenic effects as a radioactive agent. Section 6.2 provides a more detailed discussion of the toxicity of each COC.

The Contaminants of Concern (COCs) evaluated are manganese, molybdenum, sulfate, and uranium.

6.2 Toxicity Assessment

The EPA has developed toxicity information for various environmental contaminants. For the four COCs evaluated for the Riverton site, chronic oral reference doses (RfDs, expressed in mg/kg-day) were assessed for uranium, molybdenum, and manganese. An oral RfD for sulfate was not assessed. Chronic inhalation reference concentrations (RfCs, expressed in mg/m^3) were assessed for uranium and manganese but not for molybdenum and sulfate. For the dermal pathway, dermal effects on human health from the four COCs are not considered significant. However, for this update, the oral or ingestion RfD for manganese, molybdenum, and uranium was adjusted to obtain a dermal toxicity value. This is a conservative approach with the intent of being able to provide some reasonable estimates for perspective only. This approach has been applied by EPA only for arsenic thus far, as exposure to arsenic is believed to result in dermal effects that should be evaluated.

- A chronic reference dose (RfD) or reference concentration (RfC) is an estimate of a daily exposure to humans that is likely to be without appreciable risk of deleterious effects during a lifetime.
- The RfD or RfC assumes that thresholds exist for certain toxic effects.

The chronic RfDs or RfCs assume that thresholds exist for certain toxic effects. In general, the RfD or RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

For uranium, the oral RfD is 0.0002 mg/kg-day (ATSDR 2013). The critical effect is initial body weight loss and moderate nephrotoxicity. A no observed-adverse-effect level (NOAEL) value is not given, but the lowest observed-adverse-effect-level (LOAEL) value is 0.02 ppm uranyl nitrate hexahydrate in food (converted to 2.8 mg uranium/kg/day) (ATSDR 2013). The 30 µg/L maximum contaminant level or MCL established by the EPA is based on increased risk of kidney toxicity which also presents an increased risk of cancer from uranium. The EPA states that assuming a conversion factor of 0.9 pCi/µg, an MCL of 30 µg/L will typically correspond to 27 pCi/L which has a lifetime radiogenic cancer risk of slightly less than one in ten thousand

within the EPA's target risk ceiling of 1 x 10^{-4}. The EPA believes the 30 µg/L MCL protects against both cancer risk and risk of kidney damage (EPA 2000).

For molybdenum, the oral RfD is 0.005 mg/kg-day (EPA 2019a). The critical effect is increased uric acid levels. A NOAEL value is not given, but the LOAEL value is 0.14 mg/kg-day. The EPA Integrated Risk Information System (IRIS) database reports that molybdenum has not been evaluated for an inhalation reference dose or for its carcinogenicity.

For manganese, the oral RfD is 0.024 mg/kg-day (EPA 2019b), and the critical effect is on the central nervous system. The oral NOAEL (food) is 0.14 mg/kg-day. The RfC is 0.00005 mg/m^3 for manganese (EPA 2019a). The critical effect is impairment of neurobehavioral function. No NOAEL value is identified, but the LOAEL is 0.15 mg/m^3.

Toxicological profiles are presented in Sections 6.2.1 to 6.2.4 for manganese, molybdenum, sulfate, and uranium, respectively. The toxicity values used for estimating the potential adverse effects of these four COCs are summarized in Table 6.2-1.

Noncarcinogenic endpoints for the COCs

- Manganese – impairment of neurobehavioral function
- Molybdenum – increased uric acid levels
- Sulfate – laxative effects
- Uranium – moderate nephrotoxicity or kidney toxicity

TABLE 6.2-1 Toxicity Values (RfDs or RfCs) Used in Estimating Hazard Quotients[a]

Pathway	Uranium	Molybdenum	Manganese
Ingestion (mg/kg-day)	0.0002	0.005	0.024
Inhalation (mg/m^3)	0.00004	NA[b]	0.00005
Dermal[c]			
Gastrointestinal absorption (GIABS)	1	1	0.04
Dermal absorption (ABS)	0.03	0.03	0.03
Dermal permeability constant (K_p)	0.001	0.001	0.001

[a] The toxicity values were obtained from the EPA IRIS database whenever available; when not available, values from other sources such as ATSDR were used.

[b] The EPA has not evaluated molybdenum for inhalation effects and has not included a toxicity value in its IRIS database.

[c] The toxicity value for the dermal pathway is obtained by multiplying the oral RfD by GIABS. In addition to the RfD, the risk from the dermal absorption pathway is calculated by taking into account the ABS and K_p

6.2.1 Toxicological Profile for Manganese

Manganese is a naturally occurring element and an essential nutrient. Several enzyme systems have been reported to interact with or depend on manganese for their catalytic or regulatory function. As such, manganese is required for the formation of healthy cartilage and bone and the urea cycle; it aids in the maintenance of mitochondria and the production of glucose. It also plays a key role in wound-healing (ATSDR 2012).

Manganese exists in both inorganic and organic forms. An essential ingredient in steel, inorganic manganese is also used in the production of dry-cell batteries, glass, and fireworks; in chemical manufacturing; in the leather and textile industries; and as a fertilizer. The inorganic pigment known as manganese violet (manganese ammonium pyrophosphate complex) has nearly ubiquitous use in cosmetics and is also found in certain paints. Organic forms of manganese are used as fungicides, fuel-oil additives, smoke inhibitors, an antiknock additive in gasoline, and a medical imaging agent (ATSDR 2012).

The average manganese soil concentration in the United States is 40–900 mg/kg; the primary natural source of manganese is the erosion of crustal rock. Its presence in soil results in vegetable and animal foods reliably containing varying amounts of the mineral. Soil concentrations at the Riverton site ranged from 34 mg/kg to 9,160 mg/kg.

The most important source of manganese in the atmosphere is the air erosion of dusts or soils. The mean concentration of manganese in ambient air in the United States is 0.02 μg/m^3; however, ambient levels near industrial sources can range from 0.22 to 0.3 μg/m^3. Manganese is released into waterways mainly through the erosion of rocks and soils, mining activities, and industrial waste, or by the leaching of manganese from anthropogenic materials discarded in landfills or soil, such as dry-cell batteries. Surface waters in the United States contain a median manganese level of 16 μg/L, with 99th percentile concentrations of 400–800 μg/L. Manganese concentrations reported for several surface water locations in 2018 at the Riverton site ranged from 7.0 to 1,700 ug/L. Groundwater in the United States contains median manganese levels of 5 to 150 μg/L, with the 99th percentile at 2,900 or 5,600 μg/L in rural or urban areas, respectively. Manganese concentrations reported for Riverton site groundwater in 2018 ranged from 1.5 to 5,300 ug/L.

The general population is exposed to manganese through consumption of food and water, inhalation of air, and dermal contact with air, water, soil, and consumer products that contain manganese. The primary source of manganese intake is diet. However, the inhalation of air contaminated with particulate matter containing manganese is the primary source of excess manganese exposure for the general population in the United States. Populations living close to mining activities and industries using manganese may be exposed by inhalation to high levels of manganese in dust. Manganese concentrations in soil may be elevated when the soil is close to a mining source or industry using manganese and may therefore pose a risk of excess exposure to children who ingest contaminated soil.

Manganese is ubiquitous in drinking water in the United States. Although certain water sources in the United States are contaminated with excess manganese, there is little risk of excessive exposure to manganese through ingestion of fish or shellfish from contaminated waters, unless the manganese levels in the fish are extremely high and/or the fish are eaten as subsistence. Although many forms of manganese are water-soluble, there is little evidence that dermal contact with manganese results in significant absorption through the skin. Thus, dermal contact with manganese is not generally viewed as an important source of exposure to the population at large.

Although low levels of manganese intake are necessary for human health, exposures to high manganese levels are toxic. Reports of adverse effects resulting from manganese exposure in humans are associated primarily with inhalation in occupational settings. Inhaled manganese is often transported directly to the brain before it is metabolized by the liver. The symptoms of manganese toxicity may appear slowly over months and years. Manganese toxicity can result in a permanent neurological disorder known as manganism with symptoms that include tremors, difficulty walking, and facial muscle spasms.

There is no evidence that manganese causes cancer in humans. Although no firm conclusions can be drawn from the mixed results in animal studies, there are little data to suggest that inorganic manganese is carcinogenic. The IRIS has provided manganese with a weight-of-evidence classification D—not classifiable as to human carcinogenicity.

6.2.2 Toxicological Profile for Molybdenum

Molybdenum is a naturally occurring trace element found extensively in nature. Biologically, molybdenum plays an important role as a micronutrient in plants and animals, including humans. It is widely used in industry for metallurgical applications; some of these applications include high-temperature furnaces, support wire for tungsten filaments in incandescent light bulbs, and a component of steel in solar panels and wind turbines (ATSDR 2017).

Molybdenum is more abundant in areas of natural mineral deposits and can be found in all environmental media. Higher concentrations in air, water, and soil can be found near industrial operations because of contamination. Molybdenum concentrations in ambient air have been reported to range from below detection limits to 0.03 mg/m^3. Concentrations of molybdenum in ambient air of urban areas, 0.01–0.03 µg/m^3, are higher than those found in rural areas, 0.001–0.0032 µg/m^3. It has been reported that concentrations of molybdenum in surface waters are generally <1.0 µg/L, and drinking water and groundwaters contain about 1.0 µg/L. Near industrial sources, surface water molybdenum concentrations can reach 200–400 µg/L, and groundwater concentrations can reach 25,000 µg/L. Concentrations as high as 1,400 µg/L have been detected in drinking waters in areas affected by mining and milling operations, far exceeding the U.S. Geological Survey (USGS) health-based screening level of 40 µg/L (ATSDR 2017). The EPA has identified 0.04 mg/L or 40 µg/L as the drinking water standard for Molybdenum (EPA 2018a). The surface water locations sampled in 2016 and 2018 at the Riverton site indicated molybdenum concentrations ranging from 1.1 to 230 µg/L, and groundwater samples collected in 2018 indicated molybdenum concentrations ranging from 0.19 to 1,300 µg/L.

Globally, most soils contain molybdenum at concentrations between 0.6 and 3.5 ppm, although total concentrations in soils can vary widely depending on geological composition or industrial contamination. The average concentration of soils is generally 1–2 ppm (i.e., 1–2 mg/kg). In the United States, it has been reported that the median concentration of molybdenum in soils is 1.2–1.3 ppm, with a range of 0.1–40 ppm. At the Riverton site, molybdenum concentrations in soil samples collected in 2015 and 2016 ranged from 0.19 to 6.1 mg/kg or ppm.

The exposure of the general population to molybdenum is almost entirely through food. Foods derived from above-ground plants, such as legumes, leafy vegetables, and cauliflower, generally have a relatively higher concentration of molybdenum in comparison to food from tubers or animals. Beans, cereal grains, leafy vegetables, legumes, liver, and milk are reported as the richest sources of molybdenum in the average diet. Drinking water coming from sources close to areas with high molybdenum contamination from industrial effluents may contain a higher concentration of molybdenum. The primary source of dietary molybdenum intake among children in the United States is milk. Exposure to molybdenum in an industrial setting such as mining can be significant.

6.2.3 Toxicological Profile for Sulfate

Sulfates are used for a variety of commercial purposes, including as sulfuric acid for the steel and metal industries, as a reagent in manufacturing processes, and as products such as copper sulfate, which is used as a fungicide and algicide (EPA 1990).

Sulfate occurs naturally in soils, sediments, and rocks (EPA 1990). Sulfate can be formed from the oxidation of elemental sulfur. The average sulfur (total) concentration in soils in the US is 1,600 mg/kg and can range up to 48,000 mg/kg (EPA 2003a). Sulfate concentrations in soil at the Riverton site for 2015 and 2016 ranged from 6.4 mg/kg to 10,400 mg/kg. Sulfates are discharged into surface waters in the atmospheric fallout from coal-fired power plants and from the metallurgical roasting process. Sulfate concentrations in surface water reported in 2018 for the Riverton site ranged from 270 mg/L to 2,600 mg/L.

A study of community water conducted in 1969 reported sulfate to be present in 645 of 658 groundwater supplies with concentrations ranging from 1 to 480 mg/L (mean, 43 mg/L). Sulfate was present in all 106 sampled surface water supplies at concentrations ranging from 2 to 358 mg/L (mean, 49 mg/L) (EPA 1990). A rural water survey, conducted in the late 1970s, reported that sulfate was present in 271 of 494 groundwater supplies with a range of 10 to 1000 mg/L (mean, 98 mg/L). In surface water, sulfate was detected in 101 of 154 samples and ranged from 15 to 321 mg/L (mean, 53 mg/L) (EPA 1990). Sulfate concentrations in groundwater reported in 2018 for the Riverton site ranged from 81 mg/L to 8,700 mg/L.

The available toxicological data indicate that sulfate may cause adverse health effects in humans and animals. Sulfate has a laxative effect in high doses, but adverse health effects are temporary, and recovery is rapid (EPA 2003a and 2003b). The major health effect observed with sulfate ingestion is laxative action (Daniels 1988; National Research Council 1977). Sulfate is rapidly eliminated through the kidneys (WHO 1984a). The EPA has identified a drinking water advisory of 500 mg/L, and a secondary drinking water regulation of 250 mg/L based on taste thresholds (EPA 2018a). The EPA has also identified a LOAEL value of 630 mg/L based on diarrhea in infants receiving formula made with high-sulfate water (EPA 1990).

Sulfate can contribute to an undesirable taste in water. The taste threshold for the sulfate ion in water is 300–400 mg/L (National Research Council 1977), and a guidance value of 400 mg/L based on aesthetic quality has been suggested (WHO 1984b). The current EPA national secondary maximum contaminant level for sulfate, based on organoleptic effects, is

250 mg/L (EPA 1990). Neither inhalation or developmental toxicity data nor carcinogenicity data are available.

6.2.4 Toxicological Profile for Uranium

Uranium is a radioactive heavy metal that occurs naturally in nearly all rocks and soils. There are primarily three isotopes of uranium found in the environment: U-234, U-235, and U-238. These three isotopes are found to be at 99.3% U-238, 0.71% U-235, and 0.005% U-234 by mass, and 49% U-238, 2% U-235, and 49% U-234 by radioactivity.

The average concentration of uranium in soils is about 2 pCi/g (or about 3 mg/kg); the concentration levels in soil in the western United States could be higher than the average because of natural geological formations. Man-made or anthropogenic sources of uranium include uranium mining and milling, uranium fuel fabrication, nuclear weapons production, production of phosphate fertilizers from phosphate rock that could also contain uranium, and improper disposal of uranium mine tailings. No uranium is released from nuclear power plants because of the design of the fuel assembly and the physical nature of the uranium oxide fuel. The concentration of uranium in soil collected at the Riverton site in 2015 and 2016 ranged from 0.9 to 9.4 mg/kg.

Uranium levels in drinking water vary widely, with a mean population-weighted average of 0.8 pCi/L. The uranium levels in groundwater at the Riverton site in 2018 ranged from 0.00005 mg/L to 2.2 mg/L. In surface waters in the US, the range of uranium concentrations is 0.01 pCi/L to 582 pCi/L with an average of 1.1 pCi/L. At the Riverton site, surface water concentrations in 2018 ranged from 3.4 pCi/l to 1500 pCi/L.

Uranium is not taken up by plants but instead is adsorbed into the roots. The highest levels of uranium are found in root vegetables, primarily unwashed potatoes. As a result, locally grown vegetables, particularly root crops, at uranium mills or mine sites could have higher concentrations of uranium in the roots. Washing of vegetables before consumption would reduce the amount of uranium adsorbed to the vegetables (ATSDR 2013).

The general population is exposed to uranium primarily via ingestion of food and drinking water; inhalation of air contributes less to potential exposure to uranium. Current evidence from animal studies suggests that the toxicity of uranium is mainly due to its chemical damage to kidney tubular cells following exposure to soluble uranium compounds and the respiratory tract following chronic inhalation exposure to insoluble uranium compounds. Other potential targets of toxicity include the reproductive system and the developing organism. There are limited data on the renal toxicity of uranium following inhalation exposure in humans (ATSDR 2013).

The daily intake of uranium from food sources ranges from 0.6 to 1.0 pCi/day (0.9 to 1.5 μg/day). Compared to the ingestion route, the intake of uranium via inhalation is small; intakes range from 0.0007 to 0.007 pCi/day (0.001 to 0.01 μg/L/day). Uranium is poorly absorbed following inhalation, oral, or dermal exposure, and the amount absorbed is heavily

dependent on the solubility of the compound. The site of deposition of inhaled particles in the respiratory tract also influences absorption (ATSDR 2013).

Uranium may cause lung cancer and tumors of the lymphatic and hematopoietic tissues. However, EPA has not classified uranium for carcinogenicity.

6.3 Exposure Assessment

Based on the CSM shown in Figure 6.2, exposure assumptions for plants from a cultural use perspective needed to be developed. In addition to plants, exposure assumptions for the consumption of cattle that could graze on plants at the Riverton site were developed. Because surface water bodies exist near the site area, exposure assumptions for recreational fishing and subsequent consumption of the catch were also developed for input into risk estimates for the ingestion pathway. Sections 6.3.1 to 6.3.3 describe the exposure assumptions developed for use in the calculations for this report.

6.3.1 Exposure to Plants

The exposure concentrations used for analysis are the UCL95 values shown in Table 6.3.1-1. For samples that were reported as not detected (NDs), half the reported detection limit was used for that given sample for calculating the UCL95 for each plant and contaminant. Maximum values are also shown on Table 6.3.1 for perspective. EPA recommends use of the maximum concentration when the calculated UCL95 is greater than the maximum concentration. This was not the case for any of the plants or contaminants. This is also an indication that an adequate number of samples was collected for each plant.

Root samples were collected from the plants except for plains cottonwood for which coring of the tree trunks was performed to obtain the samples. This approach was taken because of the relatively large size of the trees; the collection of tree trunk core samples is appropriate in this instance based on cultural use of this plant. Samples of the plant roots whenever possible for the remaining 11 plants are considered conservative in that any uptake from the soil would be concentrated on the roots.

Discussions with the NANRO representatives, Northern Arapaho elders, and other members of the Northern Arapaho community were held to develop reasonably conservative and realistic input parameters to estimate potential exposures from traditional Native American cultural uses of plants. These discussions indicated that cultural uses of various plants harvested from the Riverton site IC boundary area could include the ingestion, inhalation, and dermal pathways. Contaminant concentrations in air for plants when inhalation is a pathway of exposure were estimated as presented in Table 6.3.1-2 for input into the inhalation calculations. Table 5.4-1 presents soil data collected in 2015 and 2016 to provide perspective on the plant concentrations reported in Table 6.3.1-1. Realistic upper-bound exposure assumptions as summarized for each plant in Tables 6.3.1-3 to 6.3.1-11 were developed for input into the risk estimates presented in this update.

TABLE 6.3.1-1 UCL95 and Maximum Values for COCs from Plant Samples[a]

Plant	Manganese (mg/kg)						Molybdenum (mg/kg)						Sulfate (mg/kg)						Uranium (mg/kg)					
	Plume Area		Reference Area A		Reference Area B		Plume Area		Reference Area A		Reference Area B		Plume Area		Reference Area A		Reference Area B		Plume Area		Reference Areas A		Reference Area B	
	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max	UCL95	Max
1. Wild asparagus	2.1	2.4	1.5	1.9	-	-	0.097	0.21	0.039	0.040	-	-	180	200	240	460	-	-	0.049	0.13	0.0065	0.0066	-	-
2. Bearberry	4.1	4.7	6.2	9.9	3.8	5.5	0.061	0.086	0.10	0.17	0.27	0.32	270	560	46	94	20	53	0.0065	0.0066	0.015	0.031	-	0.0066
3. Plains cottonwood	300	540	200	300	4.0	6.0	0.039	0.040	0.038	0.039	-	0.040	27	55	130	270	24	40	0.040	0.082	0.0063	0.0065	0.013	0.013
4. Golden currant	4.7	5.5	4.8	6.5	3.3	4.3	0.053	0.082	0.039	0.039	-	0.039	9.9	18	9.4	12	2.5	3.3	0.0065	0.0067	0.0064	0.0065	-	0.0065
5. Gumweed	14	19	18	35	12	23	3.4	7.3	0.28	0.50	-	0.95	310	610	450	1200	35	49	2.9	9.3	0.43	0.70	0.086	0.14
6. Licorice root	18	36	17	27	5.9	7.6	3.0	4.6	1.4	3.1	-	0.040	170	230	770	1700	7.2	11	0.41	0.95	0.37	0.53	0.16	0.24
7. Milkweed	21	25	14	19	9.5	18	0.13	0.14	0.068	0.12	-	0.040	150	160	420	840	10	24	0.60	0.63	0.19	0.44	-	0.0067
8. Sagebrush	47	58	44	81	25	42	0.69	1.0	0.38	0.57	0.35	0.34	87	140	970	2400	23	42	0.50	1.2	1.4	2.4	0.26	0.61
9. Snakeberry bush	9.0	12	9.2	12	20	32	0.039	0.040	0.039	0.040	-	0.040	8.4	15	15	27	8.1	13	0.028	0.040	0.013	0.022	0.25	0.47
10. Snowberry	50	78	59	68	32	37	0.45	0.67	1.1	1.6	0.59	0.87	360	960	680	1400	8.4	14	0.85	1.3	3.2	7.7	1.5	2.1
11. Whitetop sulfur	7.7	13	60	160	-	-	0.82	1.3	0.26	0.49	-	-	1300	2200	1300	3000	-	-	0.055	0.096	0.23	0.54	-	-
12. Red willow bush	30	45	50	150	4.8	9.1	0.040	0.040	0.039	0.040	-	0.040	28	53	46	59	2.0	3.0	0.098	0.19	0.0097	0.017	-	0.0066

[a] Data with laboratory qualifiers of ”U” and ”B” were included as half of the detection limit. Values have been rounded to two significant figures. Samples were collected at the plume area and at reference area A in 2018; and in 2020 for samples from reference area B.

TABLE 6.3.1-2 Air Concentrations (mg/m^3) from Burning or Boiling of Plants

	Manganese			Molybdenum			Uranium		
Plant[a]	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Plains cottonwood	1.3E-03	8.7E-04	1.7E-05	1.7E-07	1.7E-07	1.7E-07	1.8E-07	2.8E-08	6.0E-08
2. Gumweed	1.1E-05	1.3E-05	8.7E-06	2.5E-06	2.1E-07	7.1E-07	2.2E-06	3.2E-07	6.0E-08
3. Licorice root	2.6E-05	2.5E-05	8.7E-06	4.5E-06	2.0E-06	6.0E-08	6.1E-07	5.5E-07	2.4E-07
4. Sagebrush	6.9E-05	6.5E-05	3.7E-05	1.0E-06	5.6E-07	5.0E-07	7.4E-07	2.1E-06	3.9E-07
5. Red willow bush	4.5E-05	7.4E-05	7.1E-06	5.9E-08	5.8E-08	5.9E-08	1.5E-07	1.4E-08	6.8E-09

[a] Only plants with uses that include burning or boiling and subsequent exposure by means of the inhalation route are included in this table. Amounts used each exposure varies by plant as shown in Tables 6.3.1-4, 6.3.1-5, 6.3.1-6, 6.3.1-8, and 6.3.1-11.

TABLE 6.3.1-3 Exposure Assumptions for the Evaluation of Cultural Uses of Wild Asparagus, Bearberry, and Golden Currant

Parameter	Assumption
Use or route(s) of exposure	Ingestion
Estimated amount consumed each time	50 g (assumed weight in grams representing a cupful)
Estimated number of times of exposure per year	10
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-4 Exposure Assumptions for the Evaluation of Cultural Uses of Plains Cottonwood[a]

Parameter	Assumption
Use or route(s) of exposure	Inhalation
Estimated plant amount used each time (12 hours of exposure)	50 kg (about one-twentieth of a cord of wood)
Estimated number of times of exposure per year	Once a week; 16 weeks per year
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

[a] Potential exposure to plains cottonwood is via inhalation when the cottonwood is burned for heat. To enable calculations, it was assumed that the cottonwood is used in an enclosed but vented space. However, use in an outdoor fully vented space could result in lower estimates depending on weather conditions and location of the receptor.

TABLE 6.3.1-5 Exposure Assumptions for the Evaluation of Cultural Uses of Gumweed

Parameter	Assumption
Use or route(s) of exposure	Inhalation
Estimated plant amount used each time	25 g (assumed weight in grams representing one-half of a cup)
Estimated number of times of exposure per year	5
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-6 Exposure Assumptions for the Evaluation of Cultural Uses of Licorice Root

Parameter	Assumption
Use or route(s) of exposure	Inhalation
Estimated plant amount used each time (1 hr of exposure)	50 g (assumed weight in grams representing one cup)
Estimated number of times of exposure per year	10
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-7 Exposure Assumptions for the Evaluation of Cultural Uses of Milkweed

Parameter	Assumption
Use or route(s) of exposure	Dermal
Estimated amount used each time	50 g (assumed weight in grams representing one cup)
Estimated number of times of exposure per year	350 (daily)
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-8 Exposure Assumptions for the Evaluation of Cultural Uses of Sagebrush

Parameter	Assumption
Use or route(s) of exposure	Ingestion, inhalation, and dermal
Estimated amount used each time (for all routes) – 1 hr of exposure for the inhalation pathway	50 g (assumed weight in grams representing one cup)
Estimated number of times of exposure per year	60
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-9 Exposure Assumptions for the Evaluation of Cultural Uses of Snakeberry Bush and Snowberry

Parameter	Assumption
Use or route(s) of exposure	Dermal
Estimated amount used each time	50 g (assumed weight in grams representing one cup)
Estimated number of times of exposure per year	60
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

TABLE 6.3.1-10 Exposure Assumptions for the Evaluation of Cultural Uses of Whitetop Sulfur

Parameter	Assumption
Use or route(s) of exposure	Ingestion
Estimated amount consumed each time	50 g (assumed weight in grams representing one cup)
Estimated number of times of exposure per year	70
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kilograms

TABLE 6.3.1-11 Exposure Assumptions for the Evaluation of Cultural Uses of Red Willow Bush

Parameter	Assumption
Use or route(s) of exposure	Ingestion and inhalation
Estimated amount used each time (1 hr of exposure for inhalation)	5 g (assumed weight in 2 tablespoons) for the ingestion route; 50 g (assumed weight in one cup) for the inhalation route.
Estimated number of times of exposure per year	70 for the ingestion route; 150 for the inhalation route
Number of years of exposure	30
Body weight (standard EPA assumption for average adult)	80 kg

6.3.2 Exposure to Livestock and Wildlife

An analysis to determine potential exposure from consumption of meat from livestock was also performed. The estimates presented in this report for the ingestion-of-meat pathway assume cows graze on the plants sampled in 2018 and 2020. Meat concentrations are then estimated based on the plant concentrations and an uptake factor, as summarized in Table 6.3.2-1. The consumption of other livestock (chickens) and wildlife (buffalo, deer, rabbits) would be represented by the ingestion-of-meat calculations shown in this report as the potential hazard or risk is proportional to the amount ingested and exposure frequency assumed for the estimates. In addition, livestock, or wildlife other than cattle or cows are less likely to graze on plants (e.g., chickens feed on corn). Table 6.3.2-2 summarizes the exposure assumptions for meat ingestion analyzed in this report.

TABLE 6.3.2-1 Meat Concentration Based on Plant Concentrations (UCL95 Values in Table 6.3.1-1)

	Meat Concentration (mg/kg)								
	Manganese			Molybdenum			Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.07	0.05	-	0.007	0.003	-	0.001	0.0002	-
2. Bearberry	0.14	0.21	0.13	0.004	0.007	0.19	0.0002	0.0004	0.0002
3. Plains cottonwood	10	6.7	0.13	0.003	0.003	0.003	0.0009	0.0001	0.0002
4. Golden currant	0.16	0.16	0.11	0.004	0.003	0.003	0.0002	0.0001	0.0001
5. Gumweed	0.49	0.62	0.41	0.23	0.02	0.07	0.07	0.01	0.002
6. Licorice root	0.60	0.57	0.20	0.21	0.09	0.003	0.01	0.009	0.004
7. Milkweed	0.71	0.47	0.32	0.009	0.005	0.003	0.01	0.004	0.0001
8. Sagebrush	1.6	1.5	0.85	0.05	0.03	0.03	0.01	0.03	0.006
9. Snakeberry bush	0.31	0.31	0.67	0.003	0.003	0.003	0.0006	0.0003	0.006
10. Snowberry	1.7	2.0	1.1	0.03	0.07	0.04	0.02	0.07	0.03
11. Whitetop sulfur	0.26	2.1	-	0.06	0.02	-	0.001	0.005	-
12. Red willow bush	1.0	1.7	0.16	0.003	0.003	0.003	0.002	0.0002	0.0001

The chemical concentrations in meat shown in Table 6.3.2-1 were estimated as follows:

$$C_{meat,i} = C_{plant,i} \times Ing\_cow_{plant} \times Biv_{meat,i}$$

where

$C_{meat,i}$ = concentration of chemical *i* in meat (mg/kg),

i = index for chemical contaminant,

$C_{plant,i}$ = measured concentration of chemical *i* in plant (mg/kg),

Ing_cow_{plant} = daily plant ingestion rate for cows (68 kg/d), and

$Biv_{meat,i}$ = meat transfer factor, ratio of chemical concentration in meat to daily intake rate of chemical [(mg/kg)/(mg/d)].

TABLE 6.3.2-2 Exposure Assumptions for the Consumption of Meat from Cattle Grazing on Plants

Parameter	Assumption
Use or route of exposure	Ingestion
Estimated amount of meat ingested each time	250 g
Estimated number of times consumed per year	100 (about two times a week)
Number of years consumed	30
Body weight (standard EPA assumption for average adult)	80 kg

6.3.3 Exposure to Surface Water

As determined during the DQO process, surface water data collected for the Riverton site would be used to estimate potential human health hazards or risk both from a dermal pathway (e.g., via swimming or wading or during fishing) and from consumption of catch (fish) from these site surface water bodies. In addition, incidental ingestion of surface water during swimming or wading was also estimated. Surface water data reported for 2018 (see Table 6.3.3-1) were used as the basis for the risk estimates discussed in Section 6.4. Fish tissue concentrations were derived from surface water concentrations and are presented in Table 6.3.3-2. The exposure assumptions for exposure to surface water (both ingestion of catch or fish, dermal contact, and incidental ingestion of surface water) are summarized in Table 6.3.3-3. The assumptions are used as the basis for the calculations in this update.

As shown in Table 6.3.3-1, the COC concentrations reported for surface water locations 0747 and 0879 are much higher than those reported for the rest of the surface water locations sampled. Location 0747 (see Figures 6.3.3-4 and 6.3.3-5) is also referred to as Oxbow Lake and is known as a discharge point for site groundwater; this location has consistently high concentrations as indicated by monitoring data collected for the past several years. ICs in the form of signage have been posted alerting visitors that drinking the water, fishing, and swimming is not safe at this location. Location 0879 (see Figures 6.3.3-2 and 6.3.3-3) is also a known discharge point for site groundwater; it is dry most of the time and is too small a surface water body to sustain any aquatic species including fish. The concentrations for these two locations are included in this update for completeness. Figure 6.3.3-1 shows the sampling locations listed in Table 6.3.3-1.

TABLE 6.3.3-1 Surface Water Data Collected in 2018

Sampling[a] Location	Manganese (µg/L)	Molybdenum (µg/L)	Sulfate (µg/L)	Uranium (µg/L)
0747	1,700	34	1,600,000	370
0749	160	68	2,600,000	3.4
0794	31	1.8	270,000	7.0
0796	27	1.8	270,000	6.5
0810	7.0	1.3	660,000	5.0
0811	66	2.1	280,000	7.4
0812	32	1.9	280,000	7.2
0822	12	22	1,100,000	4.5
0823	52	1.1	2,100,000	8.2
0879[a]	970	230	11,000,000	1,500

[a] Data shown for location 0879 were reported for 2016. The other locations were sampled in 2018. Further, sampling locations 0747 (also known as Oxbow Lake) and 0879 are near the surface water discharge points and, as such, are expected to have high concentrations of uranium. Location 0879 could not be sampled in 2018 as it was dry as in most years.

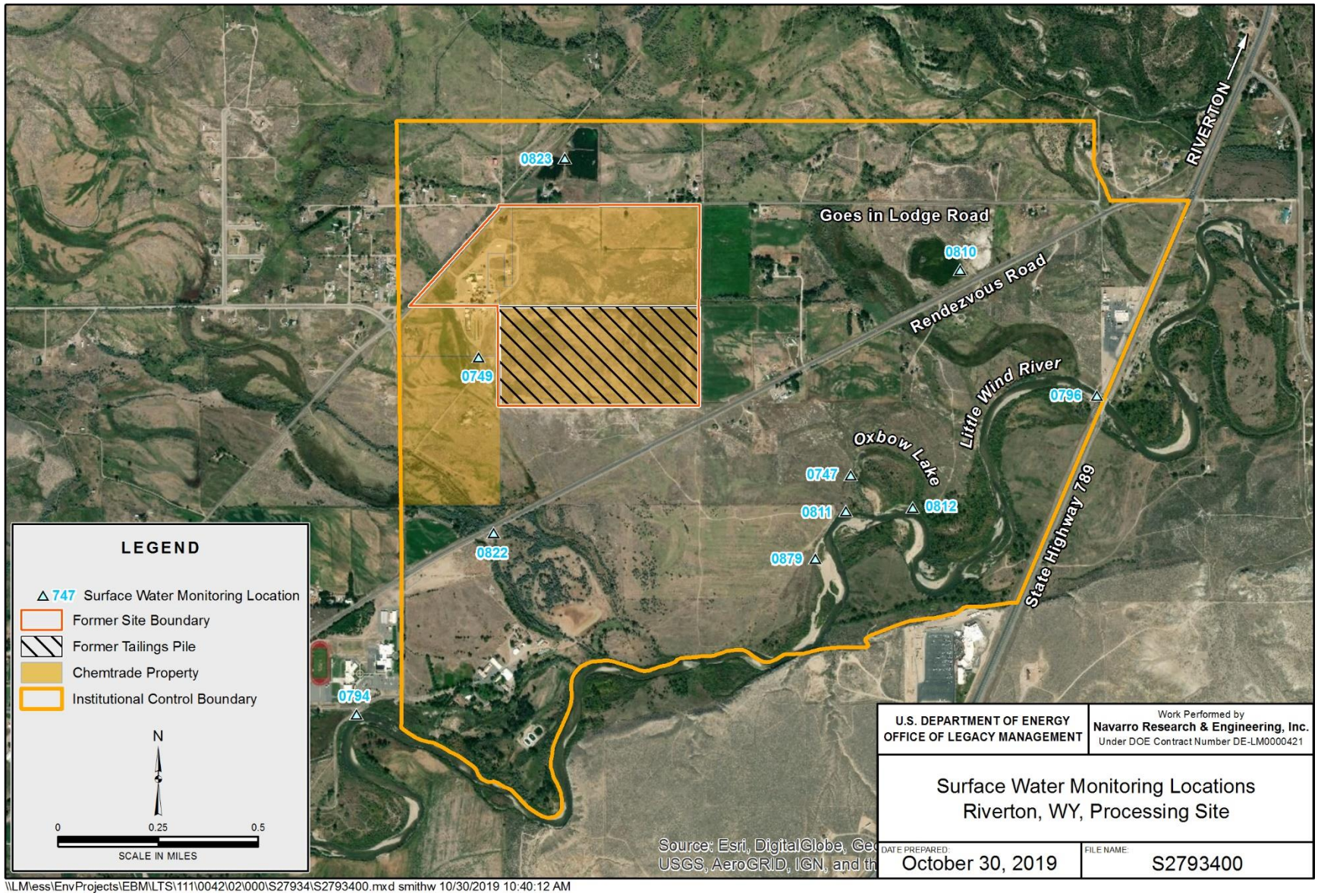

FIGURE 6.3.3-1 Riverton Site Surface Water Locations

Fish tissue concentrations for the COCs presented in Table 6.3.3-2 were derived using surface water concentrations for use as exposure point concentrations for the ingestion-of-fish pathway. The following equation was used to estimate the chemical concentration in fish:

$$C_{fish,i} = C_{w,i} \times 10^{-3} \times \rho_{water} \times Biv_{fish,i}$$

where

$C_{fish,i}$ = concentration of chemical *i* in fish (mg/kg),

$C_{w,i}$ = measured concentration of chemical *i* in water (µg/L),

10^{-3} = unit conversion factor (mg/µg),

ρ_{water} = density of water (1 kg/L), and

$Biv_{fish,i}$ = bioaccumulation factor, i.e., fish to water concentration ratio.

TABLE 6.3.3-2 Estimated Wet Weight Fish Tissue Concentrations Based on Surface Water Data Collected in 2018

Sampling Location	Manganese (mg/kg)	Molybdenum (mg/kg)	Uranium (mg/kg)
0747	680	0.34	3.7
0749	64	0.68	0.034
0794	12	0.018	0.07
0796	11	0.018	0.065
0810	2.8	0.013	0.05
0811	26	0.021	0.074
0812	13	0.019	0.072
0822	4.8	0.22	0.045
0823	21	0.011	0.082
0879[a]	390	2.3	15

[a] Data used for location 0879 were reported for 2016. Location 0879 could not be sampled in 2018 as it was dry as in most years. The other locations were sampled in 2018. Further, sampling locations 0747 (also known as Oxbow Lake) and 0879 are near the surface water discharge points and, as such, are expected to have high concentrations of uranium.

TABLE 6.3.3-3 Exposure Assumptions for Surface Water from Fish Ingestion, Dermal, and Incidental Ingestion Pathways

Parameter	Dermal	Ingestion of Fish	Incidental Ingestion of Surface Water
Estimated amount of fish or surface water ingested each time	NA[a]	110 g	250 ml
Estimated number of times consumed/direct contact per year[a]	75	75	75
Number of years consumed/direct contact	30	30	30
Body weight (standard EPA assumption for average adult)	80 kg	80 kg	80 kg
Time spent in direct contact with surface water (through swimming or wading)	1 hr each time	NA[a]	NA[a]

[a] The estimated frequency or number of times of contact is assumed to be 1 for location 0879 because it is dry most of the time and would not sustain the exposure scenario of fishing or catch and swimming evaluated here. The estimate for a frequency of 1 would provide a risk estimate from which a higher frequency of exposure can be extrapolated linearly. NA means not applicable.

The derived fish tissue concentrations in Table 6.3.3-2 were compared with fish tissue data for uranium collected by the U.S. Fish and Wildlife Service (USFWS) as shown in Table 6.3.3-4. Except for locations 0747 and 0879, the derived wet-weight fish concentrations compare closely to the measured fish data. That is, the derived concentrations range from 0.034 to 0.082 mg/kg, compared to 0.005 to 0.062 mg/kg (measured wet weight). The risk estimates shown in this report are based on the derived concentrations presented in Table 6.3.3-2. The USFWS Wyoming Ecological Services Field Office collected fish samples for uranium analysis in 2012. The fish were adult suckers sampled in the Little Wind River within a half-mile of the Riverton site, all above the bridge by the Big Wind Casino (Mazur 2019).

TABLE 6.3.3-4 Measured Fish Tissue Concentrations of Uranium from USFWS Study[a]

Total Uranium	Percentage Moisture (%)	Dry Weight (mg/kg) Based on Total Uranium	Wet Weight (mg/kg)
	69.2	0.044	0.014
	73.3	0.103	0.028
	69.3	0.038	0.012
	69.6	0.061	0.019
	67.4	0.023	0.007
	67.8	0.192	0.062
	65.3	0.017	0.006
	62.4	0.022	0.008
	72.6	0.047	0.013
	64.5	0.031	0.011
	67.8	0.014	0.005
Mean	–	0.054	0.017
Median	–	0.038	0.012
Maximum	–	0.192	0.062

[a] Source: Mazur 2019.

FIGURE 6.3.3-2 Dry Surface Water Location 0879 (August 2018)

FIGURE 6.3.3-3 Surface Water Location 0879 Looking Downstream

FIGURE 6.3.3-4 Surface Water Location 0747 or Oxbow Lake in August 2018

FIGURE 6.3.3-5 Warning Signs at the Oxbow Lake

6.4 Risk Characterization

Based on the site CSM and the risk assessment steps discussed in Sections 6.1 to 6.3, calculations were completed to estimate chemical hazard quotients (HQs) for the COC concentrations in plants and surface water, and radiation doses for uranium as a radioactive agent. Section 6.4.1 presents the equations and the estimates for determining potential chemical hazards from the COCs for the Riverton site. As no toxicity values have been assessed by the EPA for sulfate, HQs for sulfate were not calculated. Section 6.4.2 presents the results for potential exposure to radioactivity due to uranium.

Hazard Quotient (HQ)

- Less than or equal to 1: adverse effects are not likely
- Greater than 1: exposure concentration exceeds the reference dose (RfD) or reference concentration (RfC); not an indication of harm occurring

For chemical hazards, an HQ less than or equal to 1 indicates that adverse effects are not likely to occur, and the concentration can be considered to have negligible hazard. HQs greater than 1 simply indicate whether an exposure concentration exceeds the RfD or RfC. It is not an indication of the probability of harm occurring; instead, it provides an indication of how much the exposure concentration exceeds the RfD or RfC. Further, if there are multiple COCs that affect the same target organ or organ system, the HQs are summed to obtain a hazard index (HI). As with HQs, aggregate exposures less than an HI of 1.0 derived using target organ specific HQs likely will not result in adverse noncancer health effects over a lifetime of exposure. As the three COCs quantitively estimated in this update do not target the same organs, the estimates for each COC per pathway have not been summed to provide an HI. Rather, the estimated HQs are tabulated and discussed in this risk assessment update.

To determine health effects from radiation, doses from environmental exposures are usually calculated via the use of dose conversion factors (DCFs). For internal radiation, the DCF for a specific radionuclide is the radiation dose from a unit intake of that radionuclide. Using DCFs, total radiation exposures can be easily estimated once concentrations in environmental media are known and the activity and food consumption patterns of an exposed individual are characterized. Table 6.4-1 lists the DCFs used in the dose calculations; they were obtained from International Commission on Radiation Protection (ICRP) Publication 72 (ICRP 1995) for adults.

On average, Americans receive a radiation dose of about 0.62 rem, or 620 mrem, each year. Half of this dose comes from natural background radiation. Most of this background exposure comes from radon in the air, with smaller amounts from cosmic rays and the earth itself. The other half (0.31 rem, or 310 mrem) comes from man-made sources of radiation—medical, commercial, and industrial. In general, a yearly dose of 620 mrem from all radiation sources has not been shown to cause humans any harm (NRC 2019).

TABLE 6.4-1 DCFs for Uranium Isotopes

Uranium Isotope	Ingestion (mrem/pCi)	Inhalation (mrem/pCi)
U-234	1.81E-04	3.48E-02
U-235+D[a]	1.75E-04	3.15E-02
U-238+D[a]	1.79E-04	2.96E-02

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

Radiation emitted by radioactive materials can transfer sufficient localized energy to atoms and remove electrons from the electric field of their nucleus (ionization). In living tissue, this transfer of energy can destroy the cellular constituents and, if the damage is extensive, result in adverse health effects. Radiation exposures are generally expressed in terms of absorbed dose, which is the mean energy imparted by ionizing radiation on unit mass of tissue. Because the damages to biological tissues vary among different types of radiation (e.g., alpha, beta, and gamma), the dose equivalent, which is the multiplication of absorbed dose by a relative biological effectiveness factor, is used to compare potential health effects from different types of radiation.

External radiation exists only when the radiation field is present. Internal radiation, however, may continue long after the intake of radioactive material (through inhalation, ingestion, or dermal absorption) has ceased because of retention of radionuclides within the human body. Therefore, internal radiation is typically reported in terms of committed dose equivalent, which accounts for the total dose equivalent over 50 years after intake of radionuclides.

Since the sensitivity of inducing adverse health effects under radiation exposures is different for different organs, comparing dose equivalents for different organs is not appropriate. To facilitate the comparison, the ICRP recommends that radiation doses be calculated based on whole-body exposure. To do that, the radiation doses to an individual organ are normalized with multiplication by a weighting factor assigned to that organ. The sum of the weighting factors from all organs is 1. In this way, the whole-body exposure, which is called effective dose, can be calculated as the sum of normalized doses from all organs. Radiation exposures reported in this report are committed effective dose equivalent for internal radiation.

The standard or limit for members of the general public is 100 mrem/yr (DOE Order 458.1) from all sources in addition to background radiation (which is 620 mrem/yr as discussed earlier in this section).

6.4.1 Chemical Hazard Quotients

Calculations were performed to determine the potential chemical hazard to human health from uranium, molybdenum, and manganese. The pathways, or exposure routes, considered were (1) ingestion of plants, (2) inhalation resulting from various uses of plants, (3) dermal contact with plants, (4) ingestion of meat from cattle grazing on the plants, (5) ingestion of catch (fish) from surface water bodies at the Riverton site, and (6) dermal contact with surface water through swimming, wading, or other means. Tables 6.4.1-1 to 6.4.1-6 present the results of the calculations.

For the ingestion of plants, the following equation was used to estimate the HQs:

$$HQ_{ing,p,i} = \left(\frac{C_{p,i} \times Ing_p \times EF_{ing,p} \times ED}{365 \times ED \times BW}\right) / RfD_{ing,i}$$

where

$HQ_{ing,p,i}$ = HQ of chemical *i* for the ingestion pathway *p*,

p = index for the ingestion exposure pathway, ingestion of plant food, meat, or fish,

$C_{p,i}$ = concentration of chemical in the ingested food considered for pathway *p* (mg/kg),

Ing_p = food ingestion rate for pathway p (kg/d),

$EF_{ing,p}$ = exposure frequency for the ingestion pathway p (d/yr),

ED = exposure duration (yr),

365 = unit conversion factor (d/yr),

BW = body weight (kg), and

$RfD_{ing,i}$ = ingestion reference dose [mg/(kg × d)].

For the inhalation pathway, concentrations in the air from burning or boiling (as the case may be) of the particular plant(s) were estimated first as follows:

$$C_{air,i} = \frac{M_{plant} \times C_{plant,i} \times (1 - f_{release}) \times E_{PM2.5}}{V_{room} \times E_{air}} \times \left(1 - \frac{1 - e^{-E_{air} \times \Delta t}}{E_{air} \times \Delta t}\right)$$

where

$C_{air,i}$ = average concentration of chemical *i* in the air during burning (mg/m^3),

M_{plant} = mass of wood burned per hour (kg/hr),

$E_{PM2.5}$ = emission fraction of $PM_{2.5}$ particles (0.005, i.e., 5 g of PM2.5 particles generated per kilogram of wood burned),

$f_{release}$ = fraction of $PM_{2.5}$ particles released immediately after emission through the opening (0.9 for use of Plains cottonwood, 0 for use of other plants),

V_{room} = volume of the room where burning takes place (47 m^3 for use of plains cottonwood and 27 m^3 for use of other plants),

E_{air} = air exchange rate (10 hr^{-1} for use of plains cottonwood and 5 hr^{-1} for use of other plants), and

Δt = duration of burning each time (12 hr for use of *p*lains cottonwood and 1 hr for use of other plants).

Then the following equation was used to estimate the HQs:

$$HQ_{inh,i} = \left(\frac{C_{air,i} \times ET_{inh} \times EF_{inh} \times ED}{24 \times 365 \times ED}\right) / RfC_{inh,i}$$

where

$HQ_{inh,i} = HQ$ for the inhalation pathway,

$C_{air,i}$ = average air concentration of chemical *i* (mg/m^3),

ET_{inh} = exposure time for inhalation (i. e. , exposure time for each plant burning or boiling, 12 hr for use of Plains cottonwood and 1 hr for use of other plants),

EF_{inh} = exposure frequency for inhalation (i. e. , number of times of plant burning, yr^{-1}),

ED = exposure duration (yr),

24 = unit conversion factor (hr/d),

365 = unit conversion factor (d/yr), and

$RfC_{inh,i}$ = inhalation reference concentration (mg/m^3).

For dermal contact with plants, calculations were based on the following equation:

$$HQ_{dermal_p,i} = \left(\frac{C_{plant,i} \times AD_{dermal_p} \times A_{dermal_p} \times ABS_{dermal,i} \times EF_{dermal_p} \times ED}{365 \times ED \times BW}\right) / (RfD_{ing,i} \times GIABS_i)$$

where

$HQ_{dermal\_p,i}$ = HQ for the dermal absorption pathway, through rubbing plants on skin,

AD_{dermal} = adherence factor (i.e., mass of plant tissue adhering to unit area of skin, 6 mg/m^2),

A_{dermal_p} = rubbed skin area (0.827m^2),

$ABS_{dermal,i}$ = fraction of chemical absorbed through skin,

EF_{dermal_p} = exposure frequency for dermal absorption (number of times of occurrence) (yr^{-1}), and

$GIABS_i$ = GIABS fraction of chemical *i* (for adjusting $RfD_{ing,i}$ for dermal absorption).

For the ingestion of meat from cattle grazing on plants, the HQs from the ingestion of meat were estimated using the same equation as in the ingestion of plants shown above.

For the ingestion of fish, the HQs from the ingestion of fish were estimated using the same equation as in the ingestion of plants shown above.

Finally, for the dermal contact pathway through swimming or wading, the following equation was used for the estimates:

$$HQ_{dermal\_s,i} = \left(\frac{C_{w,i} \times 10^{-6} \times A_{dermal_s} \times 10^4 \times Kp_i \times ET_s \times EF_s \times ED}{365 \times ED \times BW}\right) / (RfD_{ing,i} \times GIABS_i)$$

where

$HQ_{dermal\_s,i}$ = HQ for the dermal absorption pathway, through swimming,

10^{-6} = unit conversion factor [(mg/cm^3)/(µg/L)],

A_{dermal_s} = skin contact area with water (1.965m^2),

10^4 = unit conversion factor (cm^2/m^2),

Kp_i = dermal permeability constant for chemical *i* (cm/hr),

ET_s = exposure time for swimming (hr), and

EF_s = exposure frequency for swimming (i.e., number of times of swimming, yr^{-1}).

TABLE 6.4.1-1 HQ Estimates for Uranium, Molybdenum, and Manganese for Cultural Uses Involving Ingestion of Plants[a]

	Manganese			Molybdenum			Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.001	0.001	-[b]	0.0003	0.0001	-	0.004	0.0006	-
2. Bearberry	0.003	0.004	0.002	0.0002	0.0003	0.0008	0.0006	0.001	0.0004
3. Golden currant	0.003	0.003	0.002	0.0002	0.0001	0.0001	0.0006	0.0005	0.0005
4. Sagebrush	0.2	0.2	0.1	0.01	0.008	0.007	0.3	0.7	0.1
5. Whitetop sulfur	0.04	0.3	-	0.02	0.006	-	0.03	0.1	-
6. Red willow bush	0.02	0.02	0.002	0.0001	0.00009	0.00009	0.006	0.0006	0.0004

[a] The UCL values shown in Table 6.3.1-1 were used as the exposure point concentrations for the estimates. The exposure assumptions for the various plants are shown in Tables 6.3.1-3 to 6.3.1-11. HQs have been rounded to one significant figure.

[b] "-" entries indicate no samples were taken for the given plant and location.

TABLE 6.4.1-2 HQ Estimates for Uranium, Molybdenum, and Manganese for Cultural Uses Involving Inhalation of Plants[a,b]

	Manganese			Molybdenum			Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Plains cottonwood	0.6	0.4	0.008	NA[c]	NA	NA	0.0001	0.00002	0.00004
2. Gumweed	0.0001	0.0002	0.0001	NA	NA	NA	0.00003	0.000005	0.000001
3. Licorice root	0.0006	0.0006	0.0002	NA	NA	NA	0.00002	0.00002	0.000009
4. Sagebrush	0.01	0.009	0.005	NA	NA	NA	0.0001	0.0004	0.00007
5. Red willow bush	0.008	0.01	0.001	NA	NA	NA	0.00003	0.000003	.000002

[a] The UCL values shown in Table 6.3.1-1 were used as the exposure point concentrations for the estimates. The exposure assumptions for the various plants are shown in Tables 6.3.1-3 to 6.3.1-11.

[b] HQs have been rounded to one significant figure.

[c] NA means not applicable; estimates of inhalation of molybdenum are not calculated as no inhalation reference concentration has been developed by the EPA.

TABLE 6.4.1-3 HQ Estimates for Uranium, Molybdenum, and Manganese for Cultural Uses Involving Dermal Exposure to Plants[a,b]

	Manganese			Molybdenum			Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Milkweed	0.4	0.3	0.2	0.0005	0.0002	0.0001	0.05	0.02	0.0007
2. Sagebrush	0.1	0.1	0.06	0.0004	0.0002	0.0002	0.008	0.02	0.004
3. Snakeberry bush	0.03	0.03	0.07	0.00002	0.00002	0.00002	0.0004	0.0002	0.004
4. Snowberry	0.2	0.2	0.1	0.0003	0.0007	0.0004	0.01	0.05	0.02

[a] The UCL values shown in Table 6.3.1-1 were used as the exposure point concentrations for the estimates. The exposure assumptions for the various plants are shown in Tables 6.3.1-3 to 6.3.1-11.

[b] HQs have been rounded to one significant figure.

TABLE 6.4.1-4 HQ Estimates for Uranium, Molybdenum, and Manganese Involving Ingestion of Meat from Grazing Cows[a]

	Manganese			Molybdenum			Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.003	0.002	-[b]	0.001	0.0005	-	0.005	0.0006	-
2. Bearberry	0.005	0.008	0.005	0.0007	0.001	0.003	0.0006	0.001	0.0006
3. Plains cottonwood	0.4	0.2	0.004	0.0005	0.0004	0.0004	0.004	0.0006	0.001
4. Golden currant	0.006	0.006	0.004	0.0006	0.0005	0.0005	0.0006	0.0006	0.0006
5. Gumweed	0.02	0.02	0.01	0.04	0.003	0.01	0.3	0.04	0.008
6. Licorice root	0.02	0.02	0.007	0.03	0.02	0.0006	0.04	0.04	0.02
7. Milkweed	0.03	0.02	0.01	0.002	0.0008	0.0005	0.06	0.02	0.0007
8. Sagebrush	0.06	0.05	0.03	0.008	0.004	0.004	0.05	0.1	0.02
9. Snakeberry bush	0.01	0.01	0.02	0.0005	0.0005	0.0005	0.003	0.001	0.02
10. Snowberry	0.06	0.07	0.04	0.005	0.01	0.005	0.08	0.3	0.1
11. Whitetop sulfur	0.009	0.07	-	0.01	0.003	-	0.005	0.02	-
12. Red willow bush	0.04	0.06	0.006	0.0005	0.0005	0.0005	0.01	0.001	0.0007

[a] The values shown in Table 6.3.2-1 were used as the exposure point concentrations for the estimates. The exposure assumption for meat ingestion from grazing livestock is shown in Table 6.3.2-2. HQs have been rounded to one significant figure.

[b] "-" entries indicate no samples were taken for the given plant and location.

TABLE 6.4.1-5 HQ Estimates for Uranium, Molybdenum, and Manganese Involving Ingestion of Fish Calculated from Surface Water Concentrations[a,b]

Sampling Location	Manganese	Molybdenum	Uranium
0747	8	0.02	5
0749	0.8	0.04	0.05
0794	0.1	0.001	0.1
0796	0.1	0.001	0.1
0810	0.03	0.0007	0.07
0811	0.3	0.001	0.1
0812	0.2	0.001	0.1
0822	0.06	0.01	0.06
0823	0.2	0.0006	0.1
0879[a]	0.06	0.002	0.3

[a] The surface water concentrations are shown in Table 6.3.3-1 and the derived fish tissue concentrations are presented in Table 6.3.3-2. For location 0879, the estimated HQ reflects a one-time exposure frequency to account for dry conditions at this location most of the time.

[b] HQs have been rounded to one significant figure.

TABLE 6.4.1-6 HQ Estimates for Uranium, Molybdenum, and Manganese Involving Dermal Contact of Surface Water[a,b]

Sampling Location	Manganese	Molybdenum	Uranium
0747	0.09	0.0003	0.09
0749	0.008	0.0007	0.0009
0794	0.002	0.00002	0.002
0796	0.001	0.00002	0.002
0810	0.0004	0.00001	0.001
0811	0.003	0.00002	0.002
0812	0.002	0.00002	0.002
0822	0.0006	0.0002	0.001
0823	0.003	0.00001	0.002
0879[a]	0.0007	0.00003	0.005

[a] The surface water concentrations are shown in Table 6.3.3-1. For location 0879, the estimated HQ reflects a one-time exposure frequency to account for dry conditions at this location most of the time.

[b] HQs have been rounded to one significant figure.

TABLE 6.4.1-7 HQ Estimates for Uranium, Molybdenum, and Manganese Involving Incidental Ingestion of Surface Water[a,b]

Sampling Location	Manganese	Molybdenum	Uranium
0747	0.05	0.004	1
0749	0.004	0.009	0.01
0794	0.0008	0.0002	0.02
0796	0.0007	0.0002	0.02
0810	0.0002	0.0002	0.02
0811	0.002	0.0003	0.02
0812	0.0009	0.0002	0.02
0822	0.0003	0.003	0.01
0823	0.001	0.0001	0.03
0879[a]	0.0003	0.0004	0.06

[a] The surface water concentrations are shown in Table 6.3.3-1. For location 0879, HQ reflects a one-time exposure frequency to account for dry conditions at this location most of the time.

[b] HQs have been rounded to one significant figure.

6.4.2 Radiation Risk

Since uranium is also radioactive, calculations were performed to determine the radiation dose that could result from (1) ingestion of plants, fish, meat, and surface water and (2) inhalation from plant use. Tables 6.4.2-1 to 6.4.2-10 present the results of the calculations.

For the calculation of radiation dose for the ingestion pathway, the following equation was used:

$$Dose_{ing,p,i} = R_{p,i} \times Ing_p \times EF_{ing,p} \times DCF_{ing,i}$$

where

$Dose_{ing,p,i}$ = annual radiation dose of radionuclide i for the ingestion pathway p (mrem/yr),

$R_{p,i}$ = concentration of radionuclide i in the ingested food considered for pathway p (pCi/kg), and

$DCF_{ing,i}$ = ingestion dose conversion factor of radionuclide i (mrem/pCi).

For the inhalation-of-plants pathway, the following equation was used:

$$Dose_{inh,i} = R_{air,i} \times Inh \times ET_{inh} \times EF_{inh} \times DCF_{inh,i}$$

where

$Dose_{inh,i}$ = annual radiation dose of radionuclide *i* for the inhalation pathway (mrem/yr),

$R_{air,i}$ = concentration of radionuclide *i* in the air (pCi/m^3),

Inh = inhalation rate (20 m^3/hr), and

$DCF_{inh,i}$ = inhalation dose conversion factor of radionuclide i (mrem/pCi).

In addition, because the uranium data are reported as mass concentration of total uranium, the following equation was used to convert the data to activity concentration of uranium isotopes:

$$R_i = C_{total\ U} \times 10^{-3} \times f_i \times SA_i$$

where

R_i = activity concentration of uranium isotope in plant, meat, fish, or air (pCi/kg for plant, meat, or fish and pCi/m^3 for air),

i = index for uranium isotope, U-234, U-235, or U-238,

$C_{total\ U}$ = mass concentration of total uranium in plant, meat, fish, or air (mg/kg for plant, meat, or fish and mg/m^3 for air),

10^{-3} = unit conversion factor (g/mg)

f_i = mass fraction of the uranium isotope I in total uranium (5.34×10^{-5} for U-234, 7.10×10^{-3} for U-235, and 9.93×10^{-1} for U-238, assuming natural uranium), and

SA_i = specific activity of the uranium isotope i (6.25×10^9 pCi/g for U-234, 2.16×10^6 pCi/g for U-235 and 3.36×10^5 pCi/g for U-238).

TABLE 6.4.2-1 Calculated Activity Concentrations of Uranium and Uranium Isotopes in Plants

	Total Uranium (mg/kg)			Concentration (pCi/kg)								
				U-234			U-235			U-238		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.05	0.007	-	16	2.2	-	0.75	0.10	-	16	2.2	-
2. Bearberry	0.007	0.02	0.007	2.2	5.0	2.2	0.10	0.23	0.10	2.2	5.0	2.2
3. Plains cottonwood	0.04	0.006	0.013	13	2.1	4.3	0.61	0.097	0.20	13	2.1	4.3
4. Golden currant	0.007	0.006	0.007	2.2	2.1	2.1	0.10	0.098	0.098	2.2	2.1	2.1
5. Gumweed	2.9	0.43	0.086	980	140	28	45	6.6	1.3	980	140	28
6. Licorice root	0.41	0.37	0.16	140	120	52	6.3	5.7	2.5	140	120	52
7. Milkweed	0.60	0.19	0.007	200	63	2.3	9.2	2.9	0.11	200	63	2.3
8. Sagebrush	0.50	1.4	0.26	170	460	85	7.7	21	3.9	170	460	85
9. Snakeberry bush	0.028	0.013	0.25	9.3	4.3	83	0.43	0.20	3.8	9.4	4.3	83
10. Snowberry	0.85	3.2	1.5	280	110	52	13	49	22	280	110	52
11. Whitetop sulfur	0.06	0.23	-	18	77	-	0.84	3.5	-	18	77	-
12. Red willow bush	0.1	0.01	0.007	33	3.2	2.2	1.5	0.15	0.11	33	3.2	2.2

TABLE 6.4.2-2 Radiation Dose Estimates for Uranium and Uranium Isotopes from Ingestion of Plants

	Radiation Dose (mrem/yr)											
	U-234			U-235+D[a]			U-238+D[a]			Total Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.001	0.0002	-	0.00007	0.000009	-	0.001	0.0002	-	0.003	0.0004	-
2. Bearberry	0.0002	0.0005	0.0002	0.000009	0.00002	0.000009	0.0002	0.0004	0.0002	0.0004	0.001	0.0004
3. Golden currant	0.0002	0.0002	0.0002	0.000009	0.000009	0.000009	0.0002	0.0002	0.0002	0.0004	0.0004	0.0004
4. Sagebrush	0.09	0.3	0.055	0.004	0.01	0.002	0.09	0.2	0.037	0.2	0.5	0.09
5. Whitetop sulfur	0.01	0.05	-	0.0005	0.002	-	0.01	0.05	-	0.02	0.1	-
6. Red willow bush	0.002	0.0002	0.0001	0.00009	0.000009	0.0000007	0.002	0.0002	0.0001	0.004	0.0004	0.0003

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

TABLE 6.4.2-3 Calculated Air Concentrations of Uranium and Uranium Isotopes from the Inhalation of Plants (Burning or Boiling Uses)

	Total Uranium (mg/m^3)			Concentration (pCi/m^3)								
				U-234			U-235+D[a]			U-238+D[a]		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Plains cottonwood	1.8E-07	2.8E-08	5.8E-08	5.9E-05	9.2E-06	1.9E-05	2.7E-06	4.2E-07	8.7E-07	5.9E-05	9.2E-06	1.9E-05
2. Gumweed	2.2E-06	3.2E-07	6.4E-08	7.3E-04	1.1E-04	2.2E-05	3.3E-04	4.9E-05	9.7E-06	7.3E-04	1.1E-04	2.2E-05
3. Licorice root	6.1E-07	5.5E-07	2.4E-07	2.0E-04	1.8E-04	7.8E-05	9.3E-06	8.4E-06	3.7E-06	2.0E-04	1.8E-04	7.8E-05
4. Sagebrush	7.4E-07	2.1E-06	3.9E-08	2.5E-04	6.8E-04	1.3E-04	1.1E-05	3.1E-05	5.6E-06	2.5E-04	6.8E-04	1.3E-04
5. Red willow bush	1.5E-07	1.4E-08	9.5E-09	4.9E-05	4.8E-06	3.3E-06	2.2E-06	2.2E-07	1.6E-07	4.9E-05	4.8E-06	3.3E-06

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

TABLE 6.4.2-4 Radiation Dose Estimates for Uranium and Uranium Isotopes from the Inhalation of Plants (Burning or Boiling Uses)

	Radiation Dose (mrem/yr)											
	U-234			U-235+D[a]			U-238+D[a]			Total Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Plains cottonwood	0.0078	0.0012	0.0024	0.00033	0.000051	0.00011	0.0067	0.0011	0.0023	0.015	0.0023	0.0047
2. Gumweed	0.0025	0.00037	0.000074	0.00011	0.000015	0.000003	0.0022	0.00032	0.000064	0.0048	0.00070	0.00014
3. Licorice root	0.0014	0.0013	0.00056	0.000058	0.000053	0.000023	0.0012	0.0011	0.00048	0.0027	0.0024	0.0010
4. Sagebrush	0.010	0.029	0.0054	0.00043	0.0012	0.00022	0.0088	0.024	0.0044	0.020	0.054	0.010
5. Red willow bush	0.0024	0.00023	0.00018	0.000098	0.0000097	0.0000066	0.0020	0.00020	0.00014	0.0045	0.00044	0.00030

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

TABLE 6.4.2-5 Calculated Activity Concentrations of Uranium and Uranium Isotopes in Meat from Cows Grazing on Plants

	Concentration (pCi/kg)											
	Total Uranium (mg/kg)			U-234			U-235+D[a]			U-238+D[a]		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.001	0.0002	-	0.4	0.05	-	0.02	0.002	-	0.4	0.05	-
2. Bearberry	0.0002	0.0005	0.0002	0.05	0.1	0.044	0.002	0.005	0.002	0.05	0.1	0.044
3. Plains cottonwood	0.0009	0.0002	0.0004	0.3	0.05	0.1	0.01	0.002	0.004	0.3	0.05	0.1
4. Golden currant	0.0002	0.0002	0.0002	0.05	0.05	0.05	0.002	0.002	0.002	0.05	0.05	0.05
5. Gumweed	0.068	0.01	0.002	20	3	0.6	1	0.2	0.04	20	3	0.6
6. Licorice root	0.009	0.009	0.004	3	3	1	0.1	0.1	0.4	3	3	1
7. Milkweed	0.01	0.004	0.0001	5	2	0.07	0.2	0.07	0.002	5	1	0.07
8. Sagebrush	0.01	0.03	0.006	4	10	2	0.2	0.5	0.09	4	10	2
9. Snakeberry bush	0.0007	0.0003	0.0006	0.2	0.1	2	0.01	0.005	0.1	0.2	0.1	2
10. Snowberry	0.02	0.07	0.03	7	20	9	0.3	1	0.5	7	20	9
11. Whitetop sulfur	0.001	0.005	-	0.4	2	-	0.02	0.08	-	0.4	2	-
12. Red willow bush	0.002	0.0002	0.0001	0.8	0.08	0.05	0.03	0.003	0.002	0.8	0.08	0.05

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

TABLE 6.4.2-6 Radiation Dose Estimates for Uranium and Uranium Isotopes from Ingestion of Meat from Cows Grazing on Plants

	Radiation Dose (mrem/yr)											
	U-234			U-235+D[a]			U-238+D[a]			Total Uranium		
Plant	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B	Plume Area	Reference Area A	Reference Area B
1. Wild asparagus	0.002	0.0002	-	0.00008	0.00001	-	0.002	0.0002	-	0.004	0.0005	-
2. Bearberry	0.0002	0.0005	0.0002	0.00001	0.00002	0.00001	0.0002	0.0005	0.0002	0.0005	0.001	0.0004
3. Plains cottonwood	0.001	0.0002	0.0004	0.00006	0.00001	0.00002	0.0014	0.00022	0.0004	0.0028	0.0004	0.0008
4. Golden currant	0.0002	0.0002	0.0002	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0005	0.0005	0.0005
5. Gumweed	0.1	0.02	0.004	0.005	0.0007	0.0001	0.1	0.01	0.004	0.2	0.03	0.006
6. Licorice root	0.01	0.01	0.004	0.0006	0.0006	0.0003	0.01	0.01	0.004	0.03	0.03	0.1
7. Milkweed	0.02	0.007	0.0002	0.0009	0.0003	0.00001	0.02	0.007	0.0002	0.04	0.01	0.0004
8. Sagebrush	0.02	0.05	0.009	0.0008	0.002	0.0004	0.02	0.05	0.009	0.04	0.1	0.02
9. Snakeberry bush	0.001	0.0005	0.01	0.00004	0.00002	0.0004	0.001	0.0004	0.01	0.002	0.0009	0.02
10. Snowberry	0.03	0.1	0.05	0.001	0.005	0.002	0.03	0.1	0.05	0.06	0.2	0.09
11. Whitetop sulfur	0.002	0.008	-	0.00009	0.0004	-	0.002	0.008	-	0.004	0.02	-
12. Red willow bush	0.003	0.0003	0.0002	0.0002	0.00002	0.00001	0.003	0.0003	0.0002	0.007	0.0007	0.0005

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

TABLE 6.4.2-7 Calculated Activity Concentrations of Uranium and Uranium Isotopes in Fish

Surface Water Location	Total Uranium Concentration in Fish (mg/kg)	Concentration (pCi/g)		
		U-234	U-235	U-238
0747	3.7	1230	56.7	1230
0749	0.034	11.3	0.52	11.3
0794	0.070	23.4	1.07	23.4
0796	0.065	21.7	1.00	21.7
0810	0.050	16.7	0.77	16.7
0811	0.074	24.7	1.13	24.7
0812	0.072	24.0	1.10	24.0
0822	0.045	15.0	0.69	15.0
0823	0.082	27.4	1.26	27.4
0879	15	5000	230	5000

TABLE 6.4.2-8 Radiation Dose Estimates for the Ingestion of Fish Calculated from Surface Water Uranium Concentrations

Surface Water Location	Radiation Dose (mrem/yr)			
	Total Uranium	U-234	U-235+D[a]	U-238+D[a]
0747	3.8	1.9	0.082	1.8
0749	0.035	0.017	0.0007	0.017
0794	0.071	0.035	0.015	0.035
0796	0.066	0.033	0.0014	0.032
0810	0.051	0.025	0.0011	0.025
0811	0.075	0.037	0.0016	0.037
0812	0.073	0.036	0.0016	0.036
0822	0.046	0.023	0.001	0.022
0823	0.083	0.041	0.0018	0.040
0879[b]	0.2	0.1	0.004	0.1

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

[b] For location 0879, the estimated dose reflects a one-time exposure to account for dry conditions at this location most of the time. Increasing the frequency of exposure would result in a proportional increase in the estimated dose.

TABLE 6.4.2-9 Calculated Activity Concentrations of Uranium and Uranium Isotopes in Surface Water

Surface Water Location	Total Uranium Concentration in Fish (mg/kg)	Concentration (pCi/L)		
		U-234	U-235	U-238
0747	0.37	123	5.67	123
0749	0.0034	1.13	0.052	1.13
0794	0.007	2.34	0.11	2.34
0796	0.0065	2.17	0.10	2.17
0810	0.005	1.67	0.077	1.67
0811	0.0074	2.47	0.11	2.47
0812	0.0072	2.40	0.11	2.40
0822	0.0045	1.50	0.069	1.50
0823	0.0082	2.74	0.126	2.74
0879	1.5	500	23	500

TABLE 6.4.2-10 Radiation Dose Estimates for the Incidental Ingestion of Uranium in Surface Water

Surface Water Location	Radiation Dose (mrem/yr)			
	U-234	U-235+D[a]	U-238+D[a]	Total Uranium
0747	0.42	0.019	0.42	0.85
0749	0.0039	0.00017	0.0038	0.0078
0794	0.0079	0.00035	0.0078	0.016
0796	0.0074	0.00033	0.0073	0.015
0810	0.0057	0.00025	0.0056	0.012
0811	0.0084	0.00037	0.0083	0.017
0812	0.0082	0.00036	0.0081	0.017
0822	0.0051	0.00023	0.0050	0.010
0823	0.0093	0.00041	0.0092	0.019
0879[b]	0.023	0.0010	0.022	0.046

[a] "+D" indicates that short-lived progenies were considered to be in secular equilibrium with the parent radionuclides; that is, they had the same activity concentration as the parent radionuclide, and their contributions to radiation dose were included in that reported for the parent radionuclide.

[b] For location 0879, the estimated dose reflects a one-time exposure to account for dry conditions at this location most of the time. Increasing the frequency of exposure would result in a proportional increase in the estimated dose.

6.4.3 Summary of Human Health Chemical Hazard and Radiation Risk Estimates

Sulfate Values

- Drinking Water Advisory (EPA).....500 mg/L
- Secondary Drinking Water Regulations (EPA).....250 mg/L
- 2018 Site Groundwater..... 81 to 8,700 mg/L
- 2018 Site Surface Water ..... 270 to 2,600 mg/L

The chemical hazard and radiation risk estimates for the human health risk assessment at the Riverton site are summarized in the following sections for traditional Native American cultural uses of plants (Section 6.4.3.1); ingestion of meat from grazing livestock (Section 6.4.3.2); ingestion of fish from surface water catch (Section 6.4.3.3); and dermal contact with and incidental ingestion of surface water (Section 6.4.3.4). The quantitative analysis was conducted only for three of four of the COCs (uranium, molybdenum, and manganese) as no toxicity values have been assessed by the EPA for sulfate. A discussion of sulfate toxicity is presented in Section 6.2.3 to provide perspective. As discussed in that section, the primary concern for human health for sulfate ingestion is its laxative effect. Sulfate also contributes to undesirable taste in water. Maximum sulfate concentrations reported for site soil in 2015 and 2016 are 9,700 mg/kg and 10,400 mg/kg for the locations near a plant sampling location at the plume area and reference area. The maximum plant sulfate concentrations near these soil locations are 2,200 mg/kg (plume) and 3,000 mg/kg (reference area A). Maximum site groundwater and surface water sulfate concentrations in 2018 exceeded available sulfate guidelines for drinking water and for odor and taste.

6.4.3.1 Cultural Uses of Plants

In deriving the estimates, the UCL95 values shown in Table 6.3.1-1 were used as the exposure point concentrations. The exposure assumptions for the plants are summarized in Tables 6.3.1-3 to 6.3.1-11. The plants evaluated at the plume area, reference area A, and reference area B contain concentrations of manganese, molybdenum, sulfate, and uranium above the analytical detection limits. The concentrations in plants collected from the plume area and reference area A are closer in range than those from reference area B. For some of the plants, data from the plume area are slightly higher than those from reference area A (e.g., uranium average concentrations for gumweed, milkweed, and snakeberry bush). While results from reference area A for other plants appear to be higher than those for samples collected from the plume area (e.g., uranium average concentrations for sagebrush, whitetop sulfur, and snowberry). The concentration in plants collected from reference area B appear to be generally lower than those collected from the plume area and reference area A. Subsequently, estimated HQs follow this same trend. However, the HQ estimates for all the plants and COCs are less than 1; and dose estimates are also all less than the 100 mrem/yr standard. Hence, no adverse effects are indicated based on cultural use scenarios analyzed for this update. Specifically, the findings for each of the 12 plants are as follows:

Wild asparagus. The pathway of interest is ingestion, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.0001 to 0.004 for the plume area and reference area A; asparagus was not sampled at

reference area B (see Table 6.4.1-1). The radiation dose estimates for uranium in asparagus are 0.003 mrem/yr and 0.0004 mrem/yr at the plume area and reference area A, respectively.

Bearberry. The pathway of interest for the bearberry plant is ingestion. And based on the cultural use of the bearberry plant evaluated, the estimated HQs for uranium, molybdenum, and manganese range from 0.0002 to 0.004 for the plume and reference areas (see Table 6.4.1-1). The radiation dose estimates for uranium in bearberry are 0.0004 mrem/yr, 0.001 mrem/yr, and 0.0004 mrem/yr, at the plume area and reference areas A and B, respectively.

Plains cottonwood. The pathway of interest is inhalation, and based on the cultural use evaluated for this plant, the estimated HQs for uranium and manganese range from 0.00002 to 0.6 (see Table 6.4.1-2). An inhalation HQ is not calculated for molybdenum as EPA has not assessed molybdenum for inhalation effects. The radiation dose estimates for uranium in plains cottonwood are 0.015, 0.0023, and 0.0047 at the plume area, reference area A, and reference area B, respectively.

Golden currant. The pathway of interest is ingestion, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.0001 to 0.003 for the plume and reference areas (see Table 6.4.1-1). The radiation dose estimates for uranium in golden currant for the three areas are the same at 0.0004 mrem/yr.

Gumweed. The pathway of interest is inhalation, and based on the cultural use evaluated for this plant, the estimated HQs for uranium and manganese range from 0.000001 to 0.0002 (see Table 6.4.1-2). An inhalation HQ is not calculated for molybdenum as EPA has not assessed molybdenum for inhalation effects. The radiation dose estimates for uranium in gumweed are 0.0048 mrem/yr, 0.00070 mrem/yr, and 0.00014 mrem/yr at the plume area, reference area A, and reference area B, respectively.

Licorice root. The pathway of interest is inhalation, and based on the cultural use evaluated for this plant, the estimated HQs for uranium and manganese range from 0.000009 to 0.0006 (see Table 6.4.1-2). An inhalation HQ is not calculated for molybdenum as EPA has not assessed molybdenum for inhalation effects. The radiation dose estimates for uranium in licorice root are 0.0027 mrem/yr, 0.0024 mrem/yr, and 0.0010 mrem/yr at the plume area, reference area A, and reference area B, respectively.

Milkweed. The pathway of interest is dermal contact, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.0001 to 0.4 for the plume and reference areas (see Table 6.4.1-3). The dose from the dermal pathway is not typically calculated for uranium as the radiation effects would not be significant or appreciable.

Sagebrush. The pathways of interest are ingestion, inhalation, and dermal contact. Based on the cultural uses evaluated for this plant, the estimated HQs for the plume and reference areas range from 0.007 to 0.7 for the ingestion pathway; from 0.00007 to 0.01 for the inhalation pathway; and from 0.0002 to 0.1 for the dermal pathway. An inhalation HQ is not calculated for molybdenum as EPA has not assessed molybdenum for inhalation effects. See Tables 6.4.1-1 to

6.4.1-3 for the estimates. The radiation dose estimates for uranium in sagebrush are 0.2 mrem/yr, 0.5 mrem/yr, and 0.09 mrem/yr for the ingestion pathway; and 0.020 mrem/yr, 0.054 mrem/yr, and 0.010 mrem/yr for the inhalation pathway, at the plume and reference areas A and B, respectively. The dose from the dermal pathway is not typically calculated for uranium as the radiation effects would not be significant or appreciable.

Snakeberry bush. The pathway of interest is dermal contact, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.0002 to 0.07 for the plume and reference areas (see Table 6.4.1-3). The dose from the dermal pathway is not typically calculated for uranium as the radiation effects would not be significant or appreciable.

Snowberry. The pathway of interest is dermal contact, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.0003 to 0.2 for the plume and reference areas (see Table 6.4.1-3). The dose from the dermal pathway is not typically calculated for uranium as the radiation effects would not be significant or appreciable.

Whitetop sulfur. The pathway of interest is ingestion, and based on the cultural use evaluated for this plant, the estimated HQs for uranium, molybdenum, and manganese range from 0.006 to 0.3 for the plume and reference area A (see Table 6.4.1-1). The radiation dose estimates for uranium in whitetop sulfur are 0.02 mrem/yr and 0.1 mrem/yr at the plume and reference area A, respectively. Whitetop sulfur plants were not present at reference area B during the 2020 sampling effort.

Red willow bush. The pathways of interest are ingestion and inhalation. Based on the cultural uses evaluated for this plant, for the plume and reference areas, the estimated HQs range from 0.00009 to 0.02 for the ingestion pathway; and 0.000002 to 0.01 for the inhalation pathway. An inhalation HQ is not calculated for molybdenum as EPA has not assessed the chemical for inhalation effects. See Tables 6.4.1-1 and 6.4.1-2 for the estimates. The radiation dose estimates for uranium in red willow bush are 0.0040 mrem/yr, 0.00040 mrem/yr, and 0.00030 mrem/yr for the ingestion pathway; and 0.0045 mrem/yr, 0.00044 mrem/yr, and 0.00030 mrem/yr for the inhalation pathway, at the plume and reference areas, respectively).

6.4.3.2 Ingestion of Meat from Grazing Cattle

The HQ estimates for the ingestion of meat from cattle grazing on plants are all less than 1 (see Table 6.4.1-4). The range of HQs for the plants for uranium is 0.0006 to 0.3 at the plume area and reference area A; and from 0.0006 to 0.1 at reference area B. The highest HQ for uranium is reported in samples for gumweed (plume area), snowberry (reference area B), and licorice root, sagebrush, and snakeberry bush (reference area B). The ranges of the HQs for molybdenum in plants are 0.0005 to 0.04, 0.0004 to 0.02, and 0.0004 to 0.01 for the plume area, reference area A, and reference area B, respectively. The maximum molybdenum concentrations at the three areas are due to samples of gumweed and licorice root. For manganese, the range of HQs are 0.003 to 0.4, 0.002 to 0.2, and 0.004 to 0.04, at the plume area,

reference area A, and reference area B, respectively. The maximum manganese concentrations are attributable to samples of plains cottonwood and snowberry.

The total radiation dose from uranium in meat from cows grazing on the plants sampled range from 0.0005 mrem/yr to 0.2 mrem/yr at the plume area and reference area A; the range at reference area B is 0.0004 to 0.1. The maximum doses for the three areas are attributable to gumweed, snowberry, and licorice root.

6.4.3.3 Ingestion of Fish from Surface Water Catch

The assessment for the ingestion of fish from surface water bodies sampled at the Riverton site resulted in HQs less than 1 except at location 0747. The HQ from the ingestion of fish from surface water location 0747 was estimated to be 5 and 8 for uranium and manganese, respectively. The HQ estimates for location 0879 reflects a one-time exposure and are below 1 for manganese, molybdenum, and uranium. Locations 0747 and 0879 are known to exhibit higher concentrations than the rest of the locations as they are located near or at groundwater discharge points; however, 0879 is dry most of the time and would not sustain fish adequate for consumption as catch. The remaining eight surface water locations have HQ estimates of 0.05 to 0.10 for uranium and 0.03 to 0.8 for manganese. HQ estimates for molybdenum for all locations (including locations 0747 and 0879) are all less than 1, ranging from 0.0006 to 0.04.

Likewise, the radiation dose estimates from the ingestion of fish containing uranium at location 0747 is highest at 3.8 mrem/yr. the estimate for one time exposure at location 0879 is 0.2 mrem/yr. The estimated radiation doses from uranium at the other surface water locations range from 0.035 mrem/yr to 0.083 mrem/yr. The results are based on conservative assumptions and many of the locations might not be able to sustain adequate number of fish at intake amounts assumed in this update.

6.4.3.4 Dermal Contact with and Incidental Ingestion of Surface Water

The estimated HQs from dermal contact with the surface water COC concentrations reported for the various surface water locations sampled at the Riverton site are all less than 1. The HQ estimates range from 0.0009 to 0.09 for uranium, 0.00001 to 0.0007 for molybdenum, and 0.0004 to 0.09 for manganese.

The dermal pathway for radiation effects is not typically calculated as the effects would not be significant or appreciable; hence, estimates (for dermal radiation effects from uranium) have not been included for this assessment.

The estimated HQs from the incidental ingestion of surface water while swimming or wading are all less than 1 for the various surface water locations sampled at the Riverton site, except for location 0747 where the HQ is about 1 for uranium.

7 ECOLOGICAL RISK ASSESSMENT

To support the ecological risk assessment (ERA), a CSM for the Riverton site was developed, as shown in Figure 7.1. The current potential sources of contamination are plants and surface water. Like the human health risk assessment discussed in Section 6, site data available for plants and surface water were reviewed for usability for the ERA.

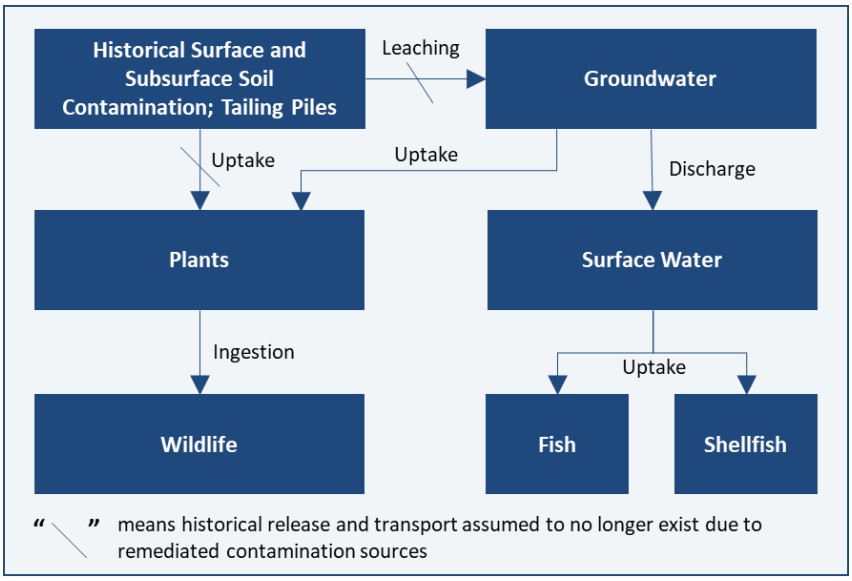

FIGURE 7.1 CSM for Ecological Health Evaluation

For this update, the ERA conducted for the Riverton site follows the EPA framework (EPA 1997) recommended for completing such an assessment. For this update, the following assessments were conducted: a screening-level ERA for plants and aquatic species, a screening-level receptor-specific ERA for avian and mammalian species, and an evaluation for aquatic species based on site surface water.

Screening-level ERAs generally compare maximal concentrations of the COCs in soil-to-soil screening levels (SSLs) considered protective of ecological resources. Since plant data are available for the Riverton site, this screening-level ERA used conservative assumptions and the available data to compare the maximum COC concentrations in plant samples to a calculated plant screening level. The plant screening levels were derived by multiplying SSLs protective of all ecological receptors (EPA 2018b) by fresh-weight transfer factors (Yu et al. 2015). HQ ratios of the maximum contaminant concentrations in plants collected in 2018 within the plume area compared to the derived plant screening level were used to determine whether there is a potential for unacceptable risks (HQ > 1). The SSLs for manganese, molybdenum, and uranium are 220 mg/kg, 2 mg/kg, and 25 mg/kg, respectively. Transfer factors from soil to plant for manganese, molybdenum, and uranium are 0.3, 0.13. and 0.0025, respectively.

For the receptor-specific ERA, a total dose (the dose from ingestion of plants plus the dose from ingestion of water) was calculated for individual mammalian and avian wildlife

species. The receptor-specific total dose was compared to calculated NOAEL toxicological benchmarks to determine the potential for unacceptable ecological risk. HQ values greater than 1 again indicate a potential for unacceptable risk.

The ERA described above was conducted for manganese, molybdenum, and uranium. The fourth COC, sulfate, was not similarly evaluated as no SSL for sulfate is available; guidelines for surface water are likewise not available to support an evaluation for sulfate. Currently, the Canadian Council of Ministers of the Environment (CCME) recommends a water quality guideline of 1,000 mg/L sulfate for livestock (Meays and Nordin 2013); however, Olkowski (2009) stated that for ruminant livestock, this level may cause serious health problems, especially when combined with dietary sources. British Columbia does not have a guideline for the protection of livestock, and therefore it is recommended that the current CCME water quality guideline of 1,000 mg/L be used until the CCME update is complete. Further, a report prepared for the Petroleum Association of Wyoming states that ingestion of surface water with sulfate concentrations up to 3,010 mg/L will not result in injury to the animals and is protective of wildlife and livestock (Geomega Inc. 2007).

7.1 Plant Screening-Level ERA

While many of the plant samples from the plume area exceeded the plant screening levels (HQ > 1), in most cases plant samples from reference areas exceeded the plant screening level as well (see Tables 7.1-1 to 7.1-3). This finding indicates that COC levels may be high throughout the area rather than only within the Riverton site. The manganese toxicity threshold for plants depends highly on the plant species (Millaleo et al. 2010). It is a micronutrient in plants, and 50 mg/kg is an adequate concentration in plants (Lohry 2007). Also, manganese is required for metabolic processes, but an excess of it can be toxic for plants, especially in acidic soils (Millaleo et al. 2010). The level at which toxicity occurs varies greatly among plant species.

Molybdenum in plants exhibits a narrow range between deficiency and toxicity, and toxicity thresholds vary enormously among different soils (McGrath et al. 2010). Uranium toxicity at sublethal levels has an impact on root growth rather on than above-ground vegetation (USGS 2010). HQ values greater than 1 were present for at least one plant for each COC.

TABLE 7.1-1 Manganese Plant Screening Level Compared to Maximum Plant Concentrations

Plant	Maximum Plant Concentration (mg/kg)			Plant Screening Level (mg/kg)[a]	Plume Area HQ	Reference Area A HQ	Reference Area B
	Plume Area	Reference Area A	Reference Area B				
Wild asparagus	2.42	1.9	-	66	0.04	0.03	-
Bearberry	4.7	9.93	5.5	66	0.01	0.15	0.08
Plains cottonwood	541	302	6.0	66	8	5	0.09
Golden currant	5.54	6.45	4.3	66	0.08	0.1	0.07
Gumweed	19.2	34.9	23	66	0.3	0.5	0.3
Licorice root	35.6	26.8	7.6	66	0.5	0.4	0.1
Milkweed	25.1	19.1	18	66	0.4	0.3	0.0.3
Sagebrush	57.6	81	42	66	0.9	1	0.6
Snakeberry bush	12.4	11.5	32	66	0.2	0.2	0.5
Snowberry	77.5	67.8	37	66	1	1	0.6
Whitetop sulfur	12.5	163	-	66	0.2	2	-
Red willow bush	45.1	147	9.1	66	0.7	2	0.1

[a] Plant screening level = SSL × fresh-weight transfer factor = 220 mg/kg × 0.3 = 66 mg/kg. HQ values have been rounded to 1 significant figure.

TABLE 7.1-2 Molybdenum Plant Screening Level Compared to Maximum Plant Concentrations[a]

Plant	Maximum Plant Concentration (mg/kg)			Plant Screening Level (mg/kg)[b]	Plume Area HQ	Reference Area A HQ	Reference Area B
	Plume Area	Reference Area A	Reference Area B				
Wild asparagus	0.21	ND[c]	NA	0.26	0.8	NA[c]	NA
Bearberry	0.090	0.17	0.32	0.26	0.3	0.7	1.2
Golden currant	0.080	ND[c]	ND	0.26	0.3	NA[c]	ND
Gumweed	7.3	0.5	0.95	0.26	30	2	3.7
Licorice root	4.6	3.1	ND	0.26	20	10	ND
Milkweed	0.14	0.12	ND	0.26	0.5	0.5	ND
Sagebrush	1.0	0.57	0.34	0.26	4	2	1.3
Snowberry	0.67	1.6	0.87	0.26	3	6	3.3
Whitetop sulfur	1.3	0.49	NA	0.26	5	2	NA

[a] All values have been rounded to two significant figures except HQ values which are rounded to 1 significant figure.

[b] Plant screening level = SSL × fresh-weight transfer factor = 2 mg/kg × 0.13 = 0.26 mg/kg.

[c] ND means all samples collected were reported as non-detects; NA means not applicable.

TABLE 7.1-3 Uranium Plant Screening Level Compared to Maximum Plant Concentrations[a]

Plant	Maximum Plant Concentration (mg/kg)			Plant Screening Level (mg/kg)[b]	Plume Area HQ	Reference Area A HQ	Reference Area B HQ
	Plume Area	Reference Area A	Reference Area B				
Wild asparagus	0.13	ND[c]	NA	0.063	2	NA[c]	NA
Plains cottonwood	0.080	ND[c]	0.013	0.063	1	NA[c]	0.2
Gumweed	9.3	0.7	0.14	0.063	100	10	2.2
Licorice root	0.95	0.53	0.24	0.063	20	8	3.8
Milkweed	0.63	0.44	ND	0.063	10	7	ND
Sagebrush	1.2	2.4	0.61	0.063	20	40	9.7
Snakeberry bush	0.040	0.02	0.47	0.063	0.6	0.3	7.5
Snowberry	1.3	7.7	2.1	0.063	20	100	33
Whitetop sulfur	0.10	0.54	NA	0.063	2	9	NA
Red willow bush	0.19	0.020	ND	0.063	3	0.3	ND

[a] All values have been rounded to two significant figures except HQ values which are rounded to 1 significant figure.

[b] Plant screening level = SSL × fresh-weight transfer factor = 25 mg/kg × 0.0025 = 0.0625 mg/kg.

[c] ND means all samples collected were reported as non-detects; NA means not applicable.

7.2 Avian and Mammalian Receptor-Specific ERA

For the receptor-specific ERA, a conservative worst-case scenario total daily dose was first determined based on the maximum plant concentration, maximum surface water concentration, and maximum body weight of the wildlife species. The total contaminant-specific dose was estimated using the equation (EPA 1993):

$$D_T = [(C \times FI) \div BW]_{\text{plants}} + [(C \times \text{WI}) \div BW]_{\text{water}}$$

where

D_T = total daily dose (mg/kg/d),

C = contaminant concentration (mg/kg),

FI = food ingestion rate (kg/d),

BW = body weight (kg), and

WI = water ingestion rate (L/d).

The food ingestion rate is an allometric equation based on body weight (EPA 1993):

For herbivorous mammals

$$FI \text{ (g/d)} = 0.577 \times BW^{0.727} .$$

For birds

$$FI \text{ (kg/d)} = 0.0582 \times BW^{0.651} .$$

The water ingestion rate is an allometric equation based on body weight (EPA 1993):

For mammals

$$WI \text{ (L/d)} = 0.099 \times BW^{0.90} .$$

For birds

$$WI \text{ (L/d)} = 0.059 \times BW^{0.67} .$$

The total daily dose was then compared to the wildlife NOAEL (mg/kg/d). The NOAEL for each species was determined by adjusting the NOAEL for a test species for body size using the following equations (ORNL 1996):

For mammals

$$NOAEL_{wildlife} = NOAEL_{test\ species} \times (BW_{test\ species}/BW_{wildlife})^{1/4} .$$

For birds

$$NOAEL_{wildlife} = NOAEL_{test\ species} .$$

The results of this evaluation are presented in Table 7.2-1

TABLE 7.2-1 Summary of Screening-Level Receptor-Specific HQ Estimates[a]

Wildlife Species	Maximum Plant Concentration (mg/kg)	Maximum Surface Water Concentration (µg/L)	Food Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Total Dose	Wildlife NOAEL (mg/kg/d)	HQ
Uranium							
Cow	9.3	1500	14	54	0.19	0.22	0.9
Horse	9.3	1500	7.5	24	0.23	0.27	0.9
Prairie dog	9.3	1500	0.10	0.10	0.87	1.1	0.8
Antelope	9.3	1500	1.7	3.9	0.36	0.45	0.8
Rabbit	9.3	1500	0.10	0.20	0.81	1.1	0.8
Ring-necked pheasant	9.3	1500	0.10	0.10	0.43	16	0.03
Molybdenum							
Cow	7.3	230	14	54	0.11	0.020	6
Horse	7.3	230	7.5	24	0.13	0.020	6
Prairie dog	7.3	230	0.10	0.10	0.60	0.10	6
Antelope	7.3	230	1.7	3.9	0.23	0.040	6
Rabbit	7.3	230	0.10	0.20	0.55	0.090	6
Ring-necked pheasant	7.3	230	0.10	0.10	0.30	3.5	0.08
Manganese							
Cow	540	1700	14	54	7.1	12	0.6
Horse	540	1700	7.5	24	9.0	15	0.6
Prairie Dog	540	1700	0.10	0.10	43	62	0.7
Antelope	540	1700	1.7	3.9	16	25	0.6
Rabbit	540	1700	0.10	0.20	39	58	0.7
Ring-necked pheasant	540	1700	0.10	0.10	22	1000	0.02

[a] All values have been rounded to two significant figures except HQ values, which are rounded to 1 significant figure.

The HQ results for uranium and manganese were all less than 1; however, the HQ values for molybdenum exceeded 1 for all the mammals. Hence, a more realistic total daily dose was determined based on the UCL95 plant and surface water concentrations and the average body weight for each species. All HQs for the more realistic molybdenum scenario are less than 1; therefore, molybdenum does not need further evaluation.

TABLE 7.2-2 Further Determination of Molybdenum Ecological Risk Using UCL95 Values[a]

Wildlife Species	Plant Concentration max UCL95 (mg/kg)	Surface Water Concentration UCL95 (µg/L)	Food Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Total Dose	Wildlife NOAEL (mg/kg/d)	HQ
Molybdenum							
Cow	0.69	81	11	38	0.014	0.021	0.7
Horse	0.69	81	6.1	19	0.016	0.025	0.7
Prairie Dog	0.69	81	0.10	0.10	0.067	0.107	0.6
Antelope	0.69	81	1.5	3.5	0.026	0.041	0.6
Rabbit	0.69	81	0.10	0.10	0.065	0.105	0.6

[a] All values have been rounded to two significant figures except HQ values, which are rounded to 1 significant figure.

7.3 Ecological Risk Evaluation for Aquatic Species Based on Surface Water Data

Surface water samples from 2018 were used to determine potential effects on fish and other aquatic species. Surface water concentrations are compared to various freshwater screening value standards in Table 7.3-1. The surface water site samples exhibit a wide range of COC concentrations. Freshwater screening values also differ quite a bit among various sources. In general, uranium concentrations exceeded the freshwater chronic screening values except for the screening values from the Canadian Water Quality Guidelines for the Protection of Aquatic Life. The toxicity of uranium to aquatic biota varies greatly by species and is heavily dependent on water quality conditions. Toxic effects are greater in soft water than in hard water (Hinck et al. 2010). Molybdenum surface concentrations were below the freshwater screening values except for one sampling location that exceeded the NOAA SQuiRT chronic screening value. Molybdenum has relatively low toxicity, and typically the effects of molybdenum on livestock are a much greater concern than toxic effects on aquatic life (Tetra Tech, Inc. 2008). For manganese, all but two sampling locations had concentrations below the chronic screening values. Manganese toxicity for aquatic biota varies by species and is dependent on water hardness and pH (Peters et al. 2011).

7.4 ERA Conclusion

For plants, the maximum concentrations reported in the plants sampled exceeded the plant screening levels in most cases for both the plume and reference areas. Except for snakeberry for which the HQ for the plume area and reference area A is estimated at 0.6 and 0.3, respectively; for plains cottonwood at reference area B, the estimated HQ is 0.2; and the red willow bush at reference area A has an estimated HQ of 0.3. The range of the HQs for uranium for the rest of the plants is 1 (plains cottonwood) to 100 (gumweed). For molybdenum, four plants have HQ estimates less than 1, while the other plants ranged from 3 (snowberry) to 30 (gumweed). For manganese, HQ estimates were less than 1 except for snowberry and plains cottonwood at both the plume area and reference area A, while sagebrush, whitetop sulfur, and the red willow bush also had estimated HQs greater than 1 (see Tables 7.1.1 to 7.1.3.

For the mammalian and avian species evaluated, the receptor-specific screening conducted indicated no exposures exceeding the screening levels from ingestion of plants and

surface water from the plume and reference areas. The evaluation using maximum concentrations of plants and surface water resulted in HQ estimates for uranium and manganese to be less than 1 for all receptors. For molybdenum, the HQ was less than 1 for avian species but greater than 1 for all the mammalian species. Using UCL95 concentrations in plants and surface water for evaluating more realistic HQs for mammals as the next step, HQs for molybdenum were less than 1 for all species.

For aquatic species, the comparison of site surface water data to available screening values and/or screening benchmarks from various agencies (as shown in Table 7.3-1) indicated that concentrations from locations 0747 (Oxbow Lake) and 0879 generally exceed chronic guidelines for uranium, molybdenum, and manganese. If these two locations were excluded from the comparison, the maximum end of the range for manganese still exceed all chronic guidelines shown. However, there is no evidence that aquatic biota is being affected, only that screening values are exceeded. And if essential to support further project or site management decisions, further evaluation maybe warranted (e.g., a possible next step would be to conduct toxicity testing for specific species at specific surface water locations).

TABLE 7.3-1 Surface Water Screening Value Standards Compared to 2018 Riverton Site Surface Water Data

	Screening Value (µg/L)							
	EPA Region 4 Surface Water Screening Values for Hazardous Waste Sites[a]		NOAA SQuiRTs[b]		Canadian Water Quality Guidelines for the Protection of Aquatic Life[c]		EPA Region III BTAG Freshwater Screening Benchmarks[d]	
COC	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Site Data, Range (µg/L)[e]
Uranium	2.6	46	0.5	46	15	33	2.6	3.4–370
Molybdenum	800	7200	34	16000	73		73	1.1–68
Manganese	93	1680	80	2300			120	7.0–1,700

[a] Source: EPA 2018b.

[b] Source: NOAA 2008.

[c] Source: CCME 2019.

[d] Source: EPA 2006.

[e] See Table 6.3.3-1 for a compilation of the site surface water data collected in 2018. If concentrations for 0747 and 0879 are excluded, the ranges would be 3.4 ug/L to 8.4 ug/L, 1,1 ug/l to 68 ug/L, and 7.0 ug/L to 160 ug/L for uranium, molybdenum, and manganese, respectively.

8 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

To summarize, this risk assessment update provides an evaluation of human health and ecological risk addressing the following aspects:

- Human health
  (1) Traditional Native American cultural uses of plants (including through ingestion, inhalation and dermal contact);
  (2) Exposure to grazing livestock (consumption of meat from cattle);
  (3) Exposure to surface water through consumption of catch (fish); and
  (4) Direct contact with surface water (dermal and incidental ingestion).

- Ecological risk
  (1) Toxicity to plants;
  (2) Toxicity to avian and mammalian species; and
  (3) Toxicity to aquatic species.

8.1 Human Health

Based on the results discussed in Section 6, the human health pathways evaluated do not indicate the potential for adverse effects as the estimated HQs are less than 1 for all pathways. Sulfate concentrations in surface water generally exceed guidelines for drinking water and for aesthetics (odor and taste). Radiation dose estimates for uranium are less than 100 mrem/yr. The following sections discuss the human health evaluation of the four aspects listed above.

8.1.1 Chemical HQs and Radiation Doses from Traditional Native American Cultural Uses of Plants

In deriving the estimates, the UCL95 values shown in Table 6.3.1-1 were used as the exposure point concentrations. The exposure assumptions for the plants are summarized in Tables 6.3.1-3 to 6.3.1-11.

For cultural plant uses involving the ingestion pathway, the HQ estimates for all the COCs are less than 1 (see Table 6.4.1-1). There are six plants for which cultural uses involve the ingestion pathway. For manganese, the HQ ranges are 0.001 to 0.2, 0.001to 0.3, and 0.002 to 0.01, for the plume area, reference area A, and reference area B, respectively. For molybdenum, the HQ ranges are 0.0001to 0.02, 0.00009 to 0.008, and 0.00009 to 0.007, for the plume area, reference area A, and reference area B, respectively. For uranium, the HQs range from 0.0006 to 0.3, 0.0005 to 0.7, and 0.0004 to 0.1, for the plume area, reference area A, and reference area B, respectively. The maximum values discussed in the ranges for each COC are due to ingestion of either whitetop sulfur (i.e., for manganese in reference area A; and for molybdenum in the plume area) or the sagebrush plant (i.e., for uranium in reference area B). HQ estimates through the ingestion pathway for the three areas sampled were reported for the whitetop sulfur (both manganese and molybdenum) and sagebrush (for uranium).

For the radiation dose estimate for ingestion of plants with uranium (see Table 6.4.2-2), the ranges for the plume area, reference area A, and reference area B are 0.0004 to 0.2 mrem/yr, 0.0004 to 0.5 mrem/yr, and 0.0004 to 0.09 mrem/yr, respectively; with all maximum values in the ranges from concentrations of uranium reported for the sagebrush plant.

For cultural plant uses involving the inhalation pathway (5 of the 12 plants have uses that result in the possible inhalation of plant COC concentrations), the HQ estimates are all less than 1 with the highest estimates resulting from cultural use of the plains cottonwood samples (see Table 6.4.1-2) at 0.6, 0.4, and 0.008, for the plume area, reference area A, and reference area B samples, respectively. These HQ estimates are due to the manganese concentrations. The radiation dose estimates from inhalation of plants range from 0.0027 to 0.02 mrem/yr, 0.00044 to 0.054 mrem/yr, and 0.00014 to 0.010 for the plume area, reference area A, and reference area B samples, respectively (see Table 6.4.2-4). These estimates are from the sagebrush plant samples. These dose estimates are much lower than the dose limit of 100 mrem/yr for members of the general public.

For cultural plant uses involving the dermal pathway, all HQ estimates are less than 1. Radiation dose for the dermal pathway was not estimated as radiation effects of uranium are primarily internal.

8.1.2 Chemical HQs and Radiation Doses from the Ingestion of Meat

Based on estimates presented in Table 6.4.1-4, the HQ estimates for the ingestion of meat from cows grazing on plants are all less than 1. The highest HQ estimate for manganese is for cows grazing on the plains cottonwood from both the plume area and reference area A at 0.4, 0.2, respectively. For reference area B samples, the highest HQ estimate for manganese was reported for snowberry at 0.1. For molybdenum, the highest HQ is 0.04 from gumweed at the plume area, 0.02 from licorice root at reference area A, and 0.01 from gumweed at reference area B. The highest HQ for uranium is reported for gumweed (0.3) for the plume area samples, snowberry (0.3) for reference area A samples, and again snowberry (0.1) for reference area B samples.

The total radiation dose from uranium in meat from cows grazing on the plants sampled range from 0.0005 mrem/yr to 0.2 mrem/yr, 0.0004 mrem/yr to 0.2 mrem/yr, and 0.0004 mrem/yr to 0.1 mrem/yr, for the plume area and reference areas A and B, respectively. The upper end values are due to gumweed (plume area), snowberry (reference area A), and licorice root (reference area B).

8.1.3 Chemical HQs and Radiation Doses from the Ingestion of Fish

The ingestion of fish from surface water location 0747 was estimated to result in an HQ greater than 1. The estimates for uranium and manganese for location 0747 are 5 and 8, respectively. The remaining surface water locations have HQ estimates of 0.05 to 0.3 for uranium and 0.03 to 0.8 for manganese. HQ estimates for molybdenum for all locations (including locations 0747 and 0879) are all less than 1, ranging from 0.0006 to 0.04.

Likewise, the radiation dose estimates from the ingestion of fish containing uranium at location 0747 is the highest at 3.8 mrem/yr. The remaining surface water locations have estimates of 0.035 to 0.2 mrem/yr. The chemical HQs and radiation doses summarized here are conservative. That is, many of the surface water locations might not contain fish at intake amounts assumed in the calculations.

8.1.4 Chemical HQs and Radiation Doses from Dermal Contact and Incidental Ingestion of Surface Water

The estimated HQs from dermal contact with the surface water COC concentrations reported for the various surface water locations sampled at the Riverton site are all less than 1.

The dermal pathway is typically not calculated for radiation effects as exposure via this pathway would not be significant or appreciable. Hence, dose estimates for the dermal pathway relative to radiological effects of uranium have not been included in this assessment.

The estimated HQs from the incidental ingestion of surface water while swimming or wading are all less than 1 for the various surface water locations sampled at the Riverton site, except for location 0747 for uranium.

8.2 Ecological Risk

For the ERA, plant concentrations reported exceeded the plant screening levels in most cases for both the plume and reference areas. In contrast, the receptor-specific screening for avian and mammalian species found HQs of less than 1 for all species and COCs. The comparison of site surface water data collected in 2018 indicated that some site concentrations of the COCs exceeded screening benchmarks from various agencies for aquatic species. If essential to support further project or site management decisions, a possible next step would be to conduct toxicity testing for specific species at specific surface water locations, as needed.

8.3 Uncertainties

In interpreting the risk assessment results presented in this update, uncertainties inherent in the risk assessment process need to be considered. For the human health assessment, uncertainties that could be considered include the following:

- For plant data available for the analysis as exposure point concentrations, the number of samples and breadth of coverage of the areas chosen for analysis are adequate to meet the objective of the update.

- The portion of the plant sampled was the root in all cases except for the plains cottonwood. This approach could introduce some conservatism as other parts of the plant are used also and COCs typically concentrate or are adsorbed on the root system.

- For the ingestion of meat of livestock (cows) grazing on plants at the Riverton site, uptake factors were used to derive the meat tissue concentrations. This update utilized transfer factors from commonly cited literature. There is inherent uncertainty (towards conservatism) with the transfer factors. However, estimated HQs from the ingestion of meat pathway are all less than 1, hence, the conservatism applied does not affect the overall outcome of this report.

- For the ingestion of catch (fish) from the site surface water locations sampled, it was assumed that fish is present to allow such catch at the frequency assumed. However, this may be a conservative assumption as many of the locations might not be able to sustain the amount of fish assumed as the intake amounts in this update.

- Toxicity values needed to quantitatively evaluate sulfate and molybdenum (inhalation pathway) are not available from the EPA. Hence, HQ estimates have not been included in this assessment. However, this lack of information is not likely to underestimate the potential hazards presented in this update.

- The exposure scenario input parameters were developed in consultation with NANRO representatives, Northern Arapaho elders, and other members of the Northern Arapaho community. Realistic upper-bound input values were incorporated into the assessment. UCLs for the COCs for each plant from the plume and reference areas samples were used as the exposure point concentrations. If input parameters vary towards higher values (e.g., higher intake), the HQ estimates would likely remain less than 1 as current estimated HQs presented in this update are generally very much less than 1.

Several uncertainties are associated with the ecological screening risk assessment:

- The risk assessment for wildlife is based on estimated food and water ingestion rates. No receptor-specific ingestion rates were available for the species evaluated. To address this data gap, allometric equations based on body weights were used to provide receptor-specific rates. How closely these derived ingestion rates reflect actual rates is uncertain.

- Similarly, no species-specific/COC-specific NOAEL dose values are available. To address this data gap, similar allometric equations were used to derive species-specific/COC-specific NOAEL values. How closely these derived NOAELs reflect actual dose responses of the various receptors to each of the COCs is uncertain.

- The wildlife dose models assume a site use factor of 1. In other words, regardless of the size, mobility, and ecological requirements of each of the receptor species, all were assumed to obtain 100% of their food and water from the site. This is a very conservative assumption that acts to overestimate actual COC uptake by the wildlife receptors.

- The plant screening ERA was based on exposure to maximum COC concentrations in the soil, which will result in maximum estimated exposure levels that are likely not reflective of actual exposures across the site.

- The ecological SSLs used for the plant screening ERA are based on pre-2007 data. In the case of manganese, the value is based on three studies, one using barley, one using cotton, and one using Nile grass. Among these studies, the maximum allowable toxicant concentrations ranged from 71 for barley to 707 for cotton and Nile grass. The screening value was then derived as the geometric mean of these values. How reflective these three test species are of the native vegetation that was sampled at the site is very uncertain.

8.4 Conclusions and Recommendations

The estimates presented in this update provide quantitative risk information for the completed pathways shown in Figure 6.2. As such, this update fulfills the gap on human health risk information relevant to the Riverton site. Pathways stemming from historical sources of contamination including the tailing piles, contaminated surface and subsurface soil, and site groundwater have all either been remediated (tailing piles and contaminated soil removed and transported to the Gas Hills Disposal Cell for disposal) or have a remedy in place (natural flushing for site groundwater along with implementation of ICs including the provision of an alternate water supply).

Based on the estimates discussed in this update, HQ estimates from cultural uses of plants from the plume area and reference areas were less than 1. As a conservative approach, the assessment for the plains cottonwood simulated use of the plant for firewood in a vented enclosed space to enable calculations for this update as numerous uncertainties are associated with simulating its cultural use in an outdoor environment. Such calculations necessitate input parameters such as wind speed, stability, and temperature which can vary significantly throughout the year. However, in general, the dilution would be greater in an outdoor environment than indoor; therefore, the potential hazards associated with outdoor use should be less than those presented in this report. Finally, plant data from a location other than the Riverton site (IC boundary) were collected (samples for reference area B in Ethete) providing the perspective that concentrations of manganese, molybdenum, sulfate, and uranium are also present in plants in areas not associated with the site as these four chemical elements occur naturally in the environment. The data collected also demonstrate that concentrations of the four COCs could be lower in a non-industrial area such as at reference area B (located in Ethete).

The ingestion of fish from surface water location 0747 resulted in an HQ estimate greater than 1 (HQ of 8 for manganese and HQ of 5 for uranium). However, HQ estimates for the remaining surface water sampling locations were below 1 for all COCs. The radiation dose estimate from the ingestion of fish containing uranium at location 0747 is the highest at 3.8 mrem/yr. The remaining surface water locations have much lower estimates. These findings are consistent with previous DOE observations about contaminant concentrations at Oxbow Lake (location 0747). DOE monitors these surface locations closely and has posted a warning sign at Oxbow Lake to alert visitors to the contaminants present at this location.

As far as potential toxicity to plants, COC concentrations in the plant samples exceeded the plant screening levels in most cases for both the plume and reference areas. However, HQs were less than 1 for avian and mammalian species based on the receptor-specific screening conducted. Finally, site surface water COC concentrations exceeded screening benchmarks from various agencies for aquatic species. However, there is no evidence that aquatic species are being affected, only that benchmarks or guidelines are exceeded. If essential to support critical future project or site management decisions, further testing (e.g., toxicity testing for specific species at specific surface water locations) could be conducted.

The human health and ecological assessment presented in this report provides the quantitative risk information that was qualitatively addressed in the 1995 Risk Assessment Report associated with plants, livestock, and surface water exposures at the Riverton site. The update information indicates the following:

- Traditional Native American cultural uses of plants found at the Riverton site are safe (HQs are less than 1);
- Ingestion of meat from livestock grazing on plants at the site are safe (HQs are less than 1);
- Exposure to surface water bodies (via ingestion of fish, dermal contact and incidental ingestion of the surface water) monitored at the Riverton site result in HQs less than 1 except at two locations that are already known to contain potentially unsafe contaminant concentrations;
- Sulfate concentrations in surface water generally exceed guidelines for drinking water and for aesthetics (odor and taste);
- Ecological screening on plants resulted in HQs greater than 1 for most of the plants, although there is no evidence of harm to the plants;
- Ecological receptor-specific screening for avian and mammalian species resulted in HQs less than 1 for all species; and finally,
- Site surface water COC concentrations exceeded screening benchmarks for aquatic species. However, there is no evidence that aquatic species are affected. Further testing could be conducted if the information is needed for future project management decisions.

Based on these results in combination with past completed remedial action and ongoing monitoring activities and IC implementation, the conditions at the Riverton site are protective of human health and the environment given the continuous monitoring and oversight provided by DOE and the collaboration with NANRO and the Northern Arapaho community for the implementation of the ICs that are in place at the site.

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APPENDIX A PLANT SURVEY REPORT

Hinono'einino'
Northern Arapaho Tribe
TRIBAL HISTORIC PRESERVATION OFFICE
P.O. Box 67 - St. Stephens, Wyoming 82524 - PH: 307.856.1628 -
creynolds.thpo@gmail.com

6/22/2018

To Whom it may concern:

The plant survey on the Wind River Reservation near the affected area of the Uranium Plume and the risk assessment areas has been completed. Pictures have been taken of plants we were unable to identify and GPS locations of those plants and pictures were also collected. The risk assessment areas were surveyed at 10m between employees and GPS locations were recorded in concentrated areas of similar plants and new plants along each transecting line. The plume area on the south side of the road was completed first on Monday and Tuesday. The other areas were completed on Wednesday and Thursday. The native plants to the area or the plants that have been used traditionally and ceremonially were observed and documented with their purposes, there is some variation in use for each plant use and names due to family histories and passed down oral histories. Some plants recorded were not native but were still used by the families and peoples in the area for cultural reasons.

The list of plants that were found and documented include but are not limited to: Bushes- Golden Currant, Greasewood, Licorice root, rabbitbrush, red willow, Sagebrush, Saltbrush, Willow. Flowers- Gumweed, Indian Paintbrush, Sneezeweed, Sunflowers, Whitetop. Fruit- Bearberry, Prickly Currant, Snakeberry bush, Wax Currant. Grasses- Sweetgrass. Herb- Mint. Plants- Peachleaf willow. Stalk- Cattails, foxtails. Trees- Aspen, Birch, Narrowleaf Cottonwood, Plains cottonwood, Elm.
A file with the pictures of the plants found will be shared with your company. A map will be soon to come as well for spatial details and high concentration areas.

If you have any questions, please contact our office at 307-856-1628 or email at creynolds.thpo@gmail.com.

Sincerely,

Crystal Reynolds

Crystal Reynolds
Tribal Archaeologist
NATHPO

APPENDIX B PLANT DATA COLLECTED IN 2018 AND 2020

TABLE B-1 Plant Data Collected in 2018

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3000	Manganese	7/25/2018	F	0.775	B		0.181	mg/kg	Y	Asparagus	Root		43.00167949	-108.3858202
3001	Manganese	7/25/2018	F	1.2			0.195	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775	43.0017992	-108.3858927
3002	Manganese	7/25/2018	F	1.76			0.2	mg/kg	Y	Asparagus	Root		43.00239349	-108.4031809
3003	Manganese	7/25/2018	F	1.08			0.182	mg/kg	Y	Asparagus	Root		43.00244263	-108.4031012
3004	Manganese	7/25/2018	F	0.846	B		0.193	mg/kg	Y	Asparagus	Root		42.99426968	-108.3876694
3005	Manganese	7/25/2018	F	1.1			0.195	mg/kg	Y	Asparagus	Root		42.99034752	-108.3890153
3006	Manganese	7/25/2018	F	1.9			0.184	mg/kg	Y	Asparagus	Root		42.99116393	-108.3888647
3007	Manganese	7/26/2018	F	2.42			0.201	mg/kg	Y	Asparagus	Root		42.98979225	-108.4026909
3008	Manganese	7/26/2018	F	1.57			0.192	mg/kg	Y	Asparagus	Root		42.98894765	-108.4021004
3009	Manganese	7/26/2018	F	2.35			0.2	mg/kg	Y	Asparagus	Root		42.98881675	-108.4015848
3010	Manganese	7/26/2018	F	1.91			0.181	mg/kg	Y	Asparagus	Root		42.98991767	-108.3987509
3011	Manganese	7/26/2018	F	0.869	B		0.183	mg/kg	Y	Asparagus	Root		42.99054632	-108.3972282
3012	Manganese	7/26/2018	F	1.38			0.196	mg/kg	Y	Asparagus	Root		42.98884902	-108.3996643
3013	Manganese	7/26/2018	F	1.61			0.2	mg/kg	Y	Asparagus	Root		42.98869688	-108.3999628
3014	Manganese	7/26/2018	F	1.5			0.197	mg/kg	Y	Asparagus	Root		42.98761306	-108.400093
3015	Manganese	8/28/2018	F	77.5			0.184	mg/kg	Y	Snowberry	Root		42.98654751	-108.4004598
3016	Manganese	8/28/2018	F	41.5			0.2	mg/kg	Y	Snowberry	Root and stem		42.98665883	-108.4002923
3017	Manganese	8/28/2018	F	32.7		J	0.183	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3018	Manganese	8/28/2018	F	12.3			0.2	mg/kg	Y	Snowberry	Root		42.98751905	-108.4000382
3019	Manganese	8/28/2018	F	2.77		J	0.193	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3020	Manganese	8/28/2018	F	41.1			0.184	mg/kg	Y	Snowberry	Root		42.9874775	-108.3997785
3021	Manganese	8/28/2018	F	2.18			0.191	mg/kg	Y	Whitetop	Root and stem		42.98813442	-108.399931
3022	Manganese	8/28/2018	F	38.3			0.181	mg/kg	Y	Snowberry	Root		42.98697846	-108.4002589
3023	Manganese	8/28/2018	F	17.9			0.185	mg/kg	Y	Snowberry	Root		42.98674311	-108.4002189
3024	Manganese	8/28/2018	F	3.12			0.196	mg/kg	Y	Golden Currant	Branch		42.99025462	-108.397206
3025	Manganese	8/28/2018	F	2.24		J	0.186	mg/kg	Y	Willow	Branch		42.99032311	-108.3968403
3026	Manganese	8/28/2018	F	8.53			0.183	mg/kg	Y	Willow	Branch		42.99065918	-108.3967295
3027	Manganese	8/28/2018	F	4.38			0.179	mg/kg	Y	Whitetop	Root		42.99157458	-108.3977444
3028	Manganese	8/28/2018	F	4.78			0.192	mg/kg	Y	Whitetop	Root		42.99171397	-108.3977358
3029	Manganese	8/28/2018	F	5.72			0.193	mg/kg	Y	Whitetop	Root		42.99154294	-108.3977203
3030	Manganese	8/28/2018	F	2.96			0.188	mg/kg	Y	Whitetop	Root		42.99145863	-108.3978447
3031	Manganese	8/28/2018	F	4.99		J	0.195	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3032	Manganese	8/28/2018	F	8.08			0.187	mg/kg	Y	Gumweed	Root		42.99286844	-108.4053083
3033	Manganese	8/28/2018	F	15			0.186	mg/kg	Y	Gumweed	Root and stem	Whole plant	42.99313776	-108.4052615
3034	Manganese	8/28/2018	F	13.4		J	0.193	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3035	Manganese	8/29/2018	F	6.29			0.185	mg/kg	Y	Licorice Root	Root		42.98937296	-108.4053119
3036	Manganese	8/29/2018	F	7.81			0.193	mg/kg	Y	Licorice Root	Root		42.98943583	-108.4052381
3037	Manganese	8/29/2018	F	7.71			0.196	mg/kg	Y	Licorice Root	Root		42.98955353	-108.4054295
3038	Manganese	8/29/2018	F	8.79			0.201	mg/kg	Y	Licorice Root	Root		42.98938548	-108.404523
3039	Manganese	8/29/2018	F	10			0.195	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98893018	-108.3995946
3040	Manganese	8/29/2018	F	7.02		J	0.191	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3041	Manganese	8/29/2018	F	4.94			0.187	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98886529	-108.3995744
3042	Manganese	8/29/2018	F	16.4		J	0.187	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3043	Manganese	8/29/2018	F	54.4			0.197	mg/kg	Y	Sagebrush	Root		42.99137086	-108.4019706
3044	Manganese	8/29/2018	F	57.6			0.199	mg/kg	Y	Sagebrush	Root		42.99169601	-108.4009754
3045	Manganese	8/29/2018	F	44			0.196	mg/kg	Y	Sagebrush	Root and stem		42.9918555	-108.4011476
3046	Manganese	8/29/2018	F	6.75			0.199	mg/kg	Y	Snakeberry	Branch		42.98939401	-108.3992901
3047	Manganese	8/29/2018	F	5.49			0.191	mg/kg	Y	Snakeberry	Branch		42.98925385	-108.3994524
3048	Manganese	8/29/2018	F	9.16			0.195	mg/kg	Y	Snakeberry	Branch		42.98885761	-108.3998798
3049	Manganese	8/29/2018	F	12.4			0.186	mg/kg	Y	Snakeberry	Branch		42.98882206	-108.4000908
3050	Manganese	8/29/2018	F	4.57			0.187	mg/kg	Y	Licorice Root	Root		42.99918054	-108.3922055
3051	Manganese	8/29/2018	F	8			0.191	mg/kg	Y	Sagebrush	Root and branch		42.99924646	-108.3922265
3052	Manganese	8/29/2018	F	11.4		J	0.197	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3053	Manganese	8/29/2018	F	16.9			0.197	mg/kg	Y	Gumweed	Root		42.9985176	-108.4184486
3054	Manganese	8/29/2018	F	13.7			0.192	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3055	Manganese	8/29/2018	F	13.3			0.19	mg/kg	Y	Milkweed	Root		42.99821794	-108.418861
3056	Manganese	8/29/2018	F	12.5		J	0.188	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3057	Manganese	8/30/2018	F	8.62			0.197	mg/kg	Y	Snakeberry	Branch		42.98859093	-108.3896948
3058	Manganese	8/30/2018	F	34			0.198	mg/kg	Y	Snowberry	Root		42.98858762	-108.3894671
3059	Manganese	8/30/2018	F	7.07			0.185	mg/kg	Y	Milkweed	Root		42.98992737	-108.3891733
3060	Manganese	8/30/2018	F	81			0.187	mg/kg	Y	Sagebrush	Root		42.99154567	-108.3893162
3061	Manganese	8/30/2018	F	34.9			0.189	mg/kg	Y	Gumweed	Root		42.98850302	-108.3893197
3062	Manganese	8/30/2018	F	32.2			0.2	mg/kg	Y	Snowberry	Root		42.99018031	-108.393125
3063	Manganese	8/30/2018	F	5.91			0.192	mg/kg	Y	Snakeberry	Branch		42.99015641	-108.3930567
3064	Manganese	8/30/2018	F	5.94			0.192	mg/kg	Y	Milkweed	Root		42.99012225	-108.3923481
3065	Manganese	8/30/2018	F	24.2			0.195	mg/kg	Y	Whitetop	Root		42.99093689	-108.3932336
3066	Manganese	8/30/2018	F	13.4		J	0.195	mg/kg	Y	Whitetop	Root		42.99134549	-108.3929184
3067	Manganese	8/30/2018	F	13.9			0.189	mg/kg	Y	Gumweed	Root		42.99069078	-108.3933916
3068	Manganese	8/30/2018	F	163			0.193	mg/kg	Y	Whitetop	Root		43.0015561	-108.3856453
3069	Manganese	8/30/2018	F	14.2			0.181	mg/kg	Y	Milkweed	Root		43.00154389	-108.3859518
3070	Manganese	8/30/2018	F	35.1			0.19	mg/kg	Y	Snowberry	Root		43.00158489	-108.3863229
3071	Manganese	8/30/2018	F	11.5			0.192	mg/kg	Y	Snakeberry	Branch		43.00164215	-108.3864355

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3072	Manganese	8/30/2018	F	9.94			0.198	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3073	Manganese	8/30/2018	F	35.3			0.197	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3074	Manganese	8/30/2018	F	8.73			0.2	mg/kg	Y	Gumweed	Root		43.00182771	-108.4049704
3075	Manganese	8/30/2018	F	12.2			0.191	mg/kg	Y	Whitetop	Root		43.00167526	-108.4050328
3076	Manganese	8/30/2018	F	19.1			0.2	mg/kg	Y	Milkweed	Root		43.00155143	-108.4050764
3077	Manganese	8/30/2018	F	8.65			0.197	mg/kg	Y	Snakeberry	Branch		43.00159063	-108.4048772
3078	Manganese	8/30/2018	F	35.7			0.2	mg/kg	Y	Sagebrush	Root		43.00202029	-108.4042081
3079	Manganese	8/30/2018	F	26.1			0.2	mg/kg	Y	Snowberry	Root		43.00205733	-108.4042154
3080	Manganese	8/30/2018	F	28.7			0.193	mg/kg	Y	Sagebrush	Root		42.99226859	-108.4195675
3081	Manganese	8/30/2018	F	11			0.197	mg/kg	Y	Snakeberry	Branch		42.99064427	-108.4185735
3082	Manganese	8/30/2018	F	66.2			0.191	mg/kg	Y	Snowberry	Root		42.9910979	-108.4187918
3083	Manganese	8/30/2018	F	2.59			0.201	mg/kg	Y	Whitetop	Root		42.98313719	-108.4140894
3084	Manganese	8/30/2018	F	67.8			0.195	mg/kg	Y	Snowberry	Root		42.9831361	-108.4139117
3085	Manganese	8/30/2018	F	12.1			0.181	mg/kg	Y	Whitetop	Root		42.98326886	-108.4143452
3086	Manganese	8/30/2018	F	4.25			0.2	mg/kg	Y	Snakeberry	Branch		42.983393	-108.4144593
3087	Manganese	8/30/2018	F	9.12			0.188	mg/kg	Y	Gumweed	Root		42.98336604	-108.4143015
3088	Manganese	8/30/2018	F	4.92			0.192	mg/kg	Y	Milkweed	Root		42.98326743	-108.4142913
3110	Manganese	8/28/2018	F	3.55			0.199	mg/kg	Y	Bearberry	Branch		42.9866419	-108.4003338
3111	Manganese	8/28/2018	F	4.6			0.202	mg/kg	Y	Golden Currant	Branch		42.98665978	-108.4003467
3112	Manganese	8/28/2018	F	4.46			0.199	mg/kg	Y	Golden Currant	Branch		42.98678087	-108.400302
3113	Manganese	8/28/2018	F	4.73			0.182	mg/kg	Y	Golden Currant	Branch		42.9868319	-108.4003566
3114	Manganese	8/28/2018	F	3.6			0.184	mg/kg	Y	Golden Currant	Branch		42.98686755	-108.4003535
3115	Manganese	8/28/2018	F	379			1.98	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98665973	-108.4013982
3116	Manganese	8/28/2018	F	12.5			0.189	mg/kg	Y	Whitetop	Root		42.98664176	-108.4013834
3117	Manganese	8/28/2018	F	15			0.193	mg/kg	Y	Willow	Branch		42.99027066	-108.3972593
3118	Manganese	8/28/2018	F	2.77		J	0.18	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3119	Manganese	8/28/2018	F	28			0.198	mg/kg	Y	Willow	Branch		42.99025251	-108.3975823
3120	Manganese	8/28/2018	F	4.35			0.183	mg/kg	Y	Golden Currant	Branch		42.99040222	-108.3975173
3121	Manganese	8/28/2018	F	18.8			0.2	mg/kg	Y	Willow	Branch		42.99159623	-108.3976718
3122	Manganese	8/28/2018	F	45.1			0.197	mg/kg	Y	Willow	Branch		42.99161732	-108.3976773
3123	Manganese	8/28/2018	F	3.17			0.193	mg/kg	Y	Bearberry	Branch		42.99120462	-108.3975819
3124	Manganese	8/28/2018	F	3.77			0.198	mg/kg	Y	Bearberry	Branch		42.98906181	-108.3995876
3125	Manganese	8/28/2018	F	22.3		J	0.201	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3126	Manganese	8/28/2018	F	7.09			0.186	mg/kg	Y	Licorice Root	Root		42.99050551	-108.3989351
3127	Manganese	8/29/2018	F	13.7		J	0.184	mg/kg	Y	Gumweed	Root		42.98793759	-108.3999523
3128	Manganese	8/28/2018	F	4.7			0.182	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Manganese	8/28/2018	F	5.47		J	0.183	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Manganese	8/29/2018	F	4.18		J	0.196	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3131	Manganese	8/29/2018	F	11			0.183	mg/kg	Y	Licorice Root	Root		42.98923925	-108.4026445

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3132	Manganese	8/29/2018	F	10.5			0.198	mg/kg	Y	Gumweed	Root		42.9870639	-108.4052893
3133	Manganese	8/29/2018	F	9.42			0.192	mg/kg	Y	Gumweed	Root		42.98702149	-108.4051014
3134	Manganese	8/29/2018	F	217			1.95	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99074871	-108.398113
3135	Manganese	8/29/2018	F	155			0.195	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99118736	-108.3977841
3136	Manganese	8/29/2018	F	2.65			0.187	mg/kg	Y	Bearberry	Branch		42.99120208	-108.3975768
3137	Manganese	8/29/2018	F	179			0.189	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99139446	-108.3978089
3138	Manganese	8/29/2018	F	132			0.196	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98559863	-108.4032029
3139	Manganese	8/29/2018	F	224			1.82	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98624442	-108.402547
3140	Manganese	8/29/2018	F	541			1.84	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98620239	-108.4026917
3141	Manganese	8/29/2018	F	31.1			0.196	mg/kg	Y	Sagebrush	Root and branch		42.99139478	-108.4009542
3142	Manganese	8/29/2018	F	38.3			0.199	mg/kg	Y	Sagebrush	Root and branch		42.99145482	-108.4012103
3143	Manganese	8/29/2018	F	22.4			0.184	mg/kg	Y	Sagebrush	Root and branch		42.99140302	-108.4012881
3144	Manganese	8/29/2018	F	48.3			0.197	mg/kg	Y	Sagebrush	Root and branch		42.99142316	-108.4012815
3145	Manganese	8/29/2018	F	4.76			0.2	mg/kg	Y	Snakeberry	Branch		42.98764263	-108.4000412
3146	Manganese	8/29/2018	F	5.63		J	0.196	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3147	Manganese	8/29/2018	F	7.76			0.195	mg/kg	Y	Snakeberry	Branch		42.99054238	-108.3986745
3148	Manganese	8/29/2018	F	7.52			0.198	mg/kg	Y	Snakeberry	Branch		42.99053513	-108.3987845
3149	Manganese	8/29/2018	F	10.7			0.189	mg/kg	Y	Milkweed	Root		43.00006932	-108.3943489
3150	Manganese	8/29/2018	F	10.3			0.198	mg/kg	Y	Willow	Branch		42.99999167	-108.3945748
3151	Manganese	8/29/2018	F	302			9.84	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99986394	-108.3946151
3152	Manganese	8/29/2018	F	286			9.19	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935
3153	Manganese	8/29/2018	F	10.1		J	0.2	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Manganese	8/29/2018	F	3.01			0.181	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Manganese	8/29/2018	F	60			1.95	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Manganese	8/30/2018	F	5.9		J	0.184	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Manganese	8/30/2018	F	8.55		J	0.195	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3158	Manganese	8/30/2018	F	2.23			0.189	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98879277	-108.389296
3159	Manganese	8/30/2018	F	2.37			0.199	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3160	Manganese	8/30/2018	F	4.89			0.188	mg/kg	Y	Bearberry	Branch		42.98997946	-108.3895909
3161	Manganese	8/30/2018	F	1.93			0.192	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3162	Manganese	8/30/2018	F	5.11			0.193	mg/kg	Y	Golden Currant	Branch		42.98994236	-108.3894244
3163	Manganese	8/30/2018	F	17.7			0.195	mg/kg	Y	Licorice Root	Root		42.99058769	-108.3935141
3164	Manganese	8/30/2018	F	6.41			0.192	mg/kg	Y	Bearberry	Branch		42.99028744	-108.3936618
3165	Manganese	8/30/2018	F	6.2			0.199	mg/kg	Y	Bearberry	Branch		42.99024635	-108.3936283
3166	Manganese	8/30/2018	F	5.41			0.182	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99005312	-108.3933383

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3167	Manganese	8/30/2018	F	9.93		J	0.2	mg/kg	Y	Bearberry	Branch		42.99015797	-108.3930447
3168	Manganese	8/30/2018	F	2.41			0.187	mg/kg	Y	Golden Currant	Branch		42.99020918	-108.3929777
3169	Manganese	8/30/2018	F	3.03			0.198	mg/kg	Y	Willow	Branch		42.98921432	-108.3913272
3170	Manganese	8/30/2018	F	4.19			0.199	mg/kg	Y	Willow	Branch		42.99072666	-108.39431
3171	Manganese	8/30/2018	F	6.24			0.195	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00167995	-108.385751
3172	Manganese	8/30/2018	F	8.71			0.193	mg/kg	Y	Licorice Root	Root		43.00167358	-108.3857762
3173	Manganese	8/30/2018	F	5.56			0.195	mg/kg	Y	Golden Currant	Branch		43.0016122	-108.386048
3174	Manganese	8/30/2018	F	3.97			0.189	mg/kg	Y	Willow	Branch		43.00163755	-108.3863497
3175	Manganese	8/30/2018	F	12.5			0.188	mg/kg	Y	Gumweed	Root		43.00162834	-108.3858126
3176	Manganese	8/30/2018	F	2.45			0.186	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00198465	-108.4042455
3177	Manganese	8/30/2018	F	4.23			0.192	mg/kg	Y	Bearberry	Branch		43.0018071	-108.4045377
3178	Manganese	8/30/2018	F	6.45			0.193	mg/kg	Y	Golden Currant	Branch		43.00182264	-108.4046925
3179	Manganese	8/30/2018	F	15.3			0.198	mg/kg	Y	Licorice Root	Root		43.00183012	-108.4045152
3180	Manganese	8/30/2018	F	147			0.199	mg/kg	Y	Willow	Branch		43.00259331	-108.4028916
3181	Manganese	8/30/2018	F	2.74			0.187	mg/kg	Y	Bearberry	Branch		43.00259844	-108.402835
3182	Manganese	8/30/2018	F	3.23			0.186	mg/kg	Y	Golden Currant	Branch		42.99071813	-108.4186572
3183	Manganese	8/30/2018	F	26.8			0.196	mg/kg	Y	Licorice Root	Root		42.99157761	-108.4191177
3184	Manganese	8/30/2018	F	13.6			0.193	mg/kg	Y	Gumweed	Root		42.9917342	-108.419586
3185	Manganese	8/30/2018	F	10.3			0.193	mg/kg	Y	Willow	Branch		42.99190875	-108.4196497
3186	Manganese	8/30/2018	F	5.05			0.187	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98286181	-108.4137372
3187	Manganese	8/30/2018	F	11.5		J	0.192	mg/kg	Y	Gumweed	Root		42.98275064	-108.413531
3188	Manganese	8/30/2018	F	9.51			0.198	mg/kg	Y	Whitetop	Root		42.98275314	-108.4135117
3189	Manganese	8/30/2018	F	7.43			0.187	mg/kg	Y	Licorice Root	Root		42.98280148	-108.4135542
3190	Manganese	8/30/2018	F	1.23			0.192	mg/kg	Y	Willow	Branch		42.98269227	-108.413762
3191	Manganese	8/30/2018	F	3.61			0.194	mg/kg	Y	Bearberry	Branch		42.98054745	-108.4148905
3192	Manganese	8/30/2018	F	2.63			0.188	mg/kg	Y	Golden Currant	Branch		42.98056162	-108.4149797
3000	Molybdenum	7/25/2018	F	0.0792	U		0.0792	mg/kg	Y	Asparagus	Root		43.00167949	-108.3858202
3001	Molybdenum	7/25/2018	F	0.0762	U		0.0762	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775	43.0017992	-108.3858927
3002	Molybdenum	7/25/2018	F	0.0752	U		0.0752	mg/kg	Y	Asparagus	Root		43.00239349	-108.4031809
3003	Molybdenum	7/25/2018	F	0.0783	U		0.0783	mg/kg	Y	Asparagus	Root		43.00244263	-108.4031012
3004	Molybdenum	7/25/2018	F	0.0771	U		0.0771	mg/kg	Y	Asparagus	Root		42.99426968	-108.3876694
3005	Molybdenum	7/25/2018	F	0.0794	U		0.0794	mg/kg	Y	Asparagus	Root		42.99034752	-108.3890153
3006	Molybdenum	7/25/2018	F	0.0727	U		0.0727	mg/kg	Y	Asparagus	Root		42.99116393	-108.3888647
3007	Molybdenum	7/26/2018	F	0.184	B		0.0797	mg/kg	Y	Asparagus	Root		42.98979225	-108.4026909
3008	Molybdenum	7/26/2018	F	0.0784	U		0.0784	mg/kg	Y	Asparagus	Root		42.98894765	-108.4021004
3009	Molybdenum	7/26/2018	F	0.105	B		0.0802	mg/kg	Y	Asparagus	Root		42.98881675	-108.4015848
3010	Molybdenum	7/26/2018	F	0.208			0.0727	mg/kg	Y	Asparagus	Root		42.98991767	-108.3987509
3011	Molybdenum	7/26/2018	F	0.085	B		0.0762	mg/kg	Y	Asparagus	Root		42.99054632	-108.3972282
3012	Molybdenum	7/26/2018	F	0.0743	U		0.0743	mg/kg	Y	Asparagus	Root		42.98884902	-108.3996643
3013	Molybdenum	7/26/2018	F	0.0742	U		0.0742	mg/kg	Y	Asparagus	Root		42.98869688	-108.3999628
3014	Molybdenum	7/26/2018	F	0.0771	U		0.0771	mg/kg	Y	Asparagus	Root		42.98761306	-108.400093
3015	Molybdenum	8/28/2018	F	0.375			0.0737	mg/kg	Y	Snowberry	Root		42.98654751	-108.4004598

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3016	Molybdenum	8/28/2018	F	0.371			0.08	mg/kg	Y	Snowberry	Root and stem		42.98665883	-108.4002923
3017	Molybdenum	8/28/2018	F	0.668		J	0.0731	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3018	Molybdenum	8/28/2018	F	0.153	J		0.0802	mg/kg	Y	Snowberry	Root		42.98751905	-108.4000382
3019	Molybdenum	8/28/2018	F	0.869			0.0771	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3020	Molybdenum	8/28/2018	F	0.178	J		0.0737	mg/kg	Y	Snowberry	Root		42.9874775	-108.3997785
3021	Molybdenum	8/28/2018	F	1.32			0.0763	mg/kg	Y	Whitetop	Root and stem		42.98813442	-108.399931
3022	Molybdenum	8/28/2018	F	0.546			0.0723	mg/kg	Y	Snowberry	Root		42.98697846	-108.4002589
3023	Molybdenum	8/28/2018	F	0.14	J		0.0738	mg/kg	Y	Snowberry	Root		42.98674311	-108.4002189
3024	Molybdenum	8/28/2018	F	0.0786	U		0.0786	mg/kg	Y	Golden Currant	Branch		42.99025462	-108.397206
3025	Molybdenum	8/28/2018	F	0.0742	U		0.0742	mg/kg	Y	Willow	Branch		42.99032311	-108.3968403
3026	Molybdenum	8/28/2018	F	0.0734	U		0.0734	mg/kg	Y	Willow	Branch		42.99065918	-108.3967295
3027	Molybdenum	8/28/2018	F	0.0717	U		0.0717	mg/kg	Y	Whitetop	Root		42.99157458	-108.3977444
3028	Molybdenum	8/28/2018	F	0.099	J		0.0768	mg/kg	Y	Whitetop	Root		42.99171397	-108.3977358
3029	Molybdenum	8/28/2018	F	0.155	J		0.0774	mg/kg	Y	Whitetop	Root		42.99154294	-108.3977203
3030	Molybdenum	8/28/2018	F	0.0753	U		0.0753	mg/kg	Y	Whitetop	Root		42.99145863	-108.3978447
3031	Molybdenum	8/28/2018	F	0.513		J	0.0781	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3032	Molybdenum	8/28/2018	F	5.47			0.0748	mg/kg	Y	Gumweed	Root		42.99286844	-108.4053083
3033	Molybdenum	8/28/2018	F	0.959			0.0742	mg/kg	Y	Gumweed	Root and stem	Whole plant	42.99313776	-108.4052615
3034	Molybdenum	8/28/2018	F	1.1			0.0771	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3035	Molybdenum	8/29/2018	F	1.74			0.0741	mg/kg	Y	Licorice Root	Root		42.98937296	-108.4053119
3036	Molybdenum	8/29/2018	F	4.63			0.0772	mg/kg	Y	Licorice Root	Root		42.98943583	-108.4052381
3037	Molybdenum	8/29/2018	F	1.03			0.0784	mg/kg	Y	Licorice Root	Root		42.98955353	-108.4054295
3038	Molybdenum	8/29/2018	F	2.44			0.0803	mg/kg	Y	Licorice Root	Root		42.98938548	-108.404523
3039	Molybdenum	8/29/2018	F	0.135	J		0.078	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98893018	-108.3995946
3040	Molybdenum	8/29/2018	F	0.0765	U		0.0765	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3041	Molybdenum	8/29/2018	F	0.0749	U		0.0749	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98886529	-108.3995744
3042	Molybdenum	8/29/2018	F	0.275			0.0746	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3043	Molybdenum	8/29/2018	F	0.502			0.0787	mg/kg	Y	Sagebrush	Root		42.99137086	-108.4019706
3044	Molybdenum	8/29/2018	F	0.339			0.0795	mg/kg	Y	Sagebrush	Root		42.99169601	-108.4009754
3045	Molybdenum	8/29/2018	F	0.368			0.0784	mg/kg	Y	Sagebrush	Root and stem		42.9918555	-108.4011476
3046	Molybdenum	8/29/2018	F	0.0795	U		0.0795	mg/kg	Y	Snakeberry	Branch		42.98939401	-108.3992901
3047	Molybdenum	8/29/2018	F	0.0763	U		0.0763	mg/kg	Y	Snakeberry	Branch		42.98925385	-108.3994524
3048	Molybdenum	8/29/2018	F	0.0781	U		0.0781	mg/kg	Y	Snakeberry	Branch		42.98885761	-108.3998798
3049	Molybdenum	8/29/2018	F	0.0743	U		0.0743	mg/kg	Y	Snakeberry	Branch		42.98882206	-108.4000908
3050	Molybdenum	8/29/2018	F	1.06			0.0749	mg/kg	Y	Licorice Root	Root		42.99918054	-108.3922055

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3051	Molybdenum	8/29/2018	F	0.0763	U		0.0763	mg/kg	Y	Sagebrush	Root and branch		42.99924646	-108.3922265
3052	Molybdenum	8/29/2018	F	0.117	J		0.0787	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3053	Molybdenum	8/29/2018	F	0.159	J		0.0787	mg/kg	Y	Gumweed	Root		42.9985176	-108.4184486
3054	Molybdenum	8/29/2018	F	0.0766	U		0.0766	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3055	Molybdenum	8/29/2018	F	0.076	U		0.076	mg/kg	Y	Milkweed	Root		42.99821794	-108.418861
3056	Molybdenum	8/29/2018	F	0.113	J		0.0753	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3057	Molybdenum	8/30/2018	F	0.0787	U		0.0787	mg/kg	Y	Snakeberry	Branch		42.98859093	-108.3896948
3058	Molybdenum	8/30/2018	F	0.104	J		0.0791	mg/kg	Y	Snowberry	Root		42.98858762	-108.3894671
3059	Molybdenum	8/30/2018	F	0.0741	U		0.0741	mg/kg	Y	Milkweed	Root		42.98992737	-108.3891733
3060	Molybdenum	8/30/2018	F	0.298			0.0746	mg/kg	Y	Sagebrush	Root		42.99154567	-108.3893162
3061	Molybdenum	8/30/2018	F	0.0755	U		0.0755	mg/kg	Y	Gumweed	Root		42.98850302	-108.3893197
3062	Molybdenum	8/30/2018	F	1.56			0.0798	mg/kg	Y	Snowberry	Root		42.99018031	-108.393125
3063	Molybdenum	8/30/2018	F	0.0769	U		0.0769	mg/kg	Y	Snakeberry	Branch		42.99015641	-108.3930567
3064	Molybdenum	8/30/2018	F	0.0769	U		0.0769	mg/kg	Y	Milkweed	Root		42.99012225	-108.3923481
3065	Molybdenum	8/30/2018	F	0.488			0.0778	mg/kg	Y	Whitetop	Root		42.99093689	-108.3932336
3066	Molybdenum	8/30/2018	F	0.171	J		0.078	mg/kg	Y	Whitetop	Root		42.99134549	-108.3929184
3067	Molybdenum	8/30/2018	F	0.0854	J		0.0758	mg/kg	Y	Gumweed	Root		42.99069078	-108.3933916
3068	Molybdenum	8/30/2018	F	0.2			0.0774	mg/kg	Y	Whitetop	Root		43.0015561	-108.3856453
3069	Molybdenum	8/30/2018	F	0.0723	U		0.0723	mg/kg	Y	Milkweed	Root		43.00154389	-108.3859518
3070	Molybdenum	8/30/2018	F	0.251			0.0762	mg/kg	Y	Snowberry	Root		43.00158489	-108.3863229
3071	Molybdenum	8/30/2018	F	0.0768	U		0.0768	mg/kg	Y	Snakeberry	Branch		43.00164215	-108.3864355
3072	Molybdenum	8/30/2018	F	0.24			0.0792	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3073	Molybdenum	8/30/2018	F	0.333			0.0787	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3074	Molybdenum	8/30/2018	F	0.156	J		0.08	mg/kg	Y	Gumweed	Root		43.00182771	-108.4049704
3075	Molybdenum	8/30/2018	F	0.168	J		0.0763	mg/kg	Y	Whitetop	Root		43.00167526	-108.4050328
3076	Molybdenum	8/30/2018	F	0.116	J		0.08	mg/kg	Y	Milkweed	Root		43.00155143	-108.4050764
3077	Molybdenum	8/30/2018	F	0.0787	U		0.0787	mg/kg	Y	Snakeberry	Branch		43.00159063	-108.4048772
3078	Molybdenum	8/30/2018	F	0.403			0.08	mg/kg	Y	Sagebrush	Root		43.00202029	-108.4042081
3079	Molybdenum	8/30/2018	F	0.924			0.08	mg/kg	Y	Snowberry	Root		43.00205733	-108.4042154
3080	Molybdenum	8/30/2018	F	0.163	J		0.0772	mg/kg	Y	Sagebrush	Root		42.99226859	-108.4195675
3081	Molybdenum	8/30/2018	F	0.0787	U		0.0787	mg/kg	Y	Snakeberry	Branch		42.99064427	-108.4185735
3082	Molybdenum	8/30/2018	F	1.63			0.0763	mg/kg	Y	Snowberry	Root		42.9910979	-108.4187918
3083	Molybdenum	8/30/2018	F	0.0803	U		0.0803	mg/kg	Y	Whitetop	Root		42.98313719	-108.4140894
3084	Molybdenum	8/30/2018	F	0.586			0.0781	mg/kg	Y	Snowberry	Root		42.9831361	-108.4139117
3085	Molybdenum	8/30/2018	F	0.111	J		0.0725	mg/kg	Y	Whitetop	Root		42.98326886	-108.4143452
3086	Molybdenum	8/30/2018	F	0.0798	U		0.0798	mg/kg	Y	Snakeberry	Branch		42.983393	-108.4144593
3087	Molybdenum	8/30/2018	F	0.153	J		0.0752	mg/kg	Y	Gumweed	Root		42.98336604	-108.4143015
3088	Molybdenum	8/30/2018	F	0.0769	U		0.0769	mg/kg	Y	Milkweed	Root		42.98326743	-108.4142913
3110	Molybdenum	8/28/2018	F	0.0795	U		0.0795	mg/kg	Y	Bearberry	Branch		42.9866419	-108.4003338
3111	Molybdenum	8/28/2018	F	0.0808	U		0.0808	mg/kg	Y	Golden Currant	Branch		42.98665978	-108.4003467

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3112	Molybdenum	8/28/2018	F	0.0795	U		0.0795	mg/kg	Y	Golden Currant	Branch		42.98678087	-108.400302
3113	Molybdenum	8/28/2018	F	0.0729	U		0.0729	mg/kg	Y	Golden Currant	Branch		42.9868319	-108.4003566
3114	Molybdenum	8/28/2018	F	0.0735	U		0.0735	mg/kg	Y	Golden Currant	Branch		42.98686755	-108.4003535
3115	Molybdenum	8/28/2018	F	0.0794	U		0.0794	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98665973	-108.4013982
3116	Molybdenum	8/28/2018	F	0.0787	J		0.0755	mg/kg	Y	Whitetop	Root		42.98664176	-108.4013834
3117	Molybdenum	8/28/2018	F	0.0772	U		0.0772	mg/kg	Y	Willow	Branch		42.99027066	-108.3972593
3118	Molybdenum	8/28/2018	F	0.0718	U		0.0718	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3119	Molybdenum	8/28/2018	F	0.0791	U		0.0791	mg/kg	Y	Willow	Branch		42.99025251	-108.3975823
3120	Molybdenum	8/28/2018	F	0.0731	U		0.0731	mg/kg	Y	Golden Currant	Branch		42.99040222	-108.3975173
3121	Molybdenum	8/28/2018	F	0.0802	U		0.0802	mg/kg	Y	Willow	Branch		42.99159623	-108.3976718
3122	Molybdenum	8/28/2018	F	0.0789	U		0.0789	mg/kg	Y	Willow	Branch		42.99161732	-108.3976773
3123	Molybdenum	8/28/2018	F	0.0859	J		0.0774	mg/kg	Y	Bearberry	Branch		42.99120462	-108.3975819
3124	Molybdenum	8/28/2018	F	0.0792	U		0.0792	mg/kg	Y	Bearberry	Branch		42.98906181	-108.3995876
3125	Molybdenum	8/28/2018	F	0.0803	U		0.0803	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3126	Molybdenum	8/28/2018	F	4.19			0.0743	mg/kg	Y	Licorice Root	Root		42.99050551	-108.3989351
3127	Molybdenum	8/29/2018	F	0.141	J	U	0.0737	mg/kg	Y	Gumweed	Root		42.98793759	-108.3999523
3128	Molybdenum	8/28/2018	F	0.0729	U		0.0729	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Molybdenum	8/28/2018	F	0.613		U	0.0731	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Molybdenum	8/29/2018	F	0.0784	U		0.0784	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3131	Molybdenum	8/29/2018	F	1.07		U	0.0731	mg/kg	Y	Licorice Root	Root		42.98923925	-108.4026445
3132	Molybdenum	8/29/2018	F	0.0792	U		0.0792	mg/kg	Y	Gumweed	Root		42.9870639	-108.4052893
3133	Molybdenum	8/29/2018	F	0.0769	U		0.0769	mg/kg	Y	Gumweed	Root		42.98702149	-108.4051014
3134	Molybdenum	8/29/2018	F	0.0781	U		0.0781	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99074871	-108.398113
3135	Molybdenum	8/29/2018	F	0.0781	U		0.0781	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99118736	-108.3977841
3136	Molybdenum	8/29/2018	F	0.0748	U		0.0748	mg/kg	Y	Bearberry	Branch		42.99120208	-108.3975768
3137	Molybdenum	8/29/2018	F	0.0758	U		0.0758	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99139446	-108.3978089
3138	Molybdenum	8/29/2018	F	0.0786	U		0.0786	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98559863	-108.4032029
3139	Molybdenum	8/29/2018	F	0.073	U		0.073	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98624442	-108.402547
3140	Molybdenum	8/29/2018	F	0.0737	U		0.0737	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98620239	-108.4026917
3141	Molybdenum	8/29/2018	F	0.506		U	0.0783	mg/kg	Y	Sagebrush	Root and branch		42.99139478	-108.4009542
3142	Molybdenum	8/29/2018	F	0.96		U	0.0795	mg/kg	Y	Sagebrush	Root and branch		42.99145482	-108.4012103
3143	Molybdenum	8/29/2018	F	1.04		U	0.0737	mg/kg	Y	Sagebrush	Root and branch		42.99140302	-108.4012881
3144	Molybdenum	8/29/2018	F	0.456		U	0.0789	mg/kg	Y	Sagebrush	Root and branch		42.99142316	-108.4012815
3145	Molybdenum	8/29/2018	F	0.0802	U		0.0802	mg/kg	Y	Snakeberry	Branch		42.98764263	-108.4000412
3146	Molybdenum	8/29/2018	F	0.0784	U		0.0784	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3147	Molybdenum	8/29/2018	F	0.078	U		0.078	mg/kg	Y	Snakeberry	Branch		42.99054238	-108.3986745
3148	Molybdenum	8/29/2018	F	0.0791	U		0.0791	mg/kg	Y	Snakeberry	Branch		42.99053513	-108.3987845

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3149	Molybdenum	8/29/2018	F	0.0832	J		0.0756	mg/kg	Y	Milkweed	Root		43.00006932	-108.3943489
3150	Molybdenum	8/29/2018	F	0.0792	U		0.0792	mg/kg	Y	Willow	Branch		42.99999167	-108.3945748
3151	Molybdenum	8/29/2018	F	0.0787	U		0.0787	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99986394	-108.3946151
3152	Molybdenum	8/29/2018	F	0.0735	U		0.0735	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935
3153	Molybdenum	8/29/2018	F	0.08	U	J	0.08	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Molybdenum	8/29/2018	F	0.0725	U		0.0725	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Molybdenum	8/29/2018	F	0.078	U		0.078	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Molybdenum	8/30/2018	F	0.0949	J	J	0.0735	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Molybdenum	8/30/2018	F	0.0778	U		0.0778	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3158	Molybdenum	8/30/2018	F	0.0755	U		0.0755	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98879277	-108.389296
3159	Molybdenum	8/30/2018	F	0.0797	U		0.0797	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3160	Molybdenum	8/30/2018	F	0.075	U		0.075	mg/kg	Y	Bearberry	Branch		42.98997946	-108.3895909
3161	Molybdenum	8/30/2018	F	0.0766	U		0.0766	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3162	Molybdenum	8/30/2018	F	0.0774	U		0.0774	mg/kg	Y	Golden Currant	Branch		42.98994236	-108.3894244
3163	Molybdenum	8/30/2018	F	0.187	J		0.0781	mg/kg	Y	Licorice Root	Root		42.99058769	-108.3935141
3164	Molybdenum	8/30/2018	F	0.0768	U		0.0768	mg/kg	Y	Bearberry	Branch		42.99028744	-108.3936618
3165	Molybdenum	8/30/2018	F	0.0797	U		0.0797	mg/kg	Y	Bearberry	Branch		42.99024635	-108.3936283
3166	Molybdenum	8/30/2018	F	0.073	U		0.073	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99005312	-108.3933383
3167	Molybdenum	8/30/2018	F	0.127	J		0.0798	mg/kg	Y	Bearberry	Branch		42.99015797	-108.3930447
3168	Molybdenum	8/30/2018	F	0.0749	U		0.0749	mg/kg	Y	Golden Currant	Branch		42.99020918	-108.3929777
3169	Molybdenum	8/30/2018	F	0.0791	U		0.0791	mg/kg	Y	Willow	Branch		42.98921432	-108.3913272
3170	Molybdenum	8/30/2018	F	0.0795	U		0.0795	mg/kg	Y	Willow	Branch		42.99072666	-108.39431
3171	Molybdenum	8/30/2018	F	0.0778	U		0.0778	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00167995	-108.385751
3172	Molybdenum	8/30/2018	F	0.0772	U		0.0772	mg/kg	Y	Licorice Root	Root		43.00167358	-108.3857762
3173	Molybdenum	8/30/2018	F	0.078	U		0.078	mg/kg	Y	Golden Currant	Branch		43.0016122	-108.386048
3174	Molybdenum	8/30/2018	F	0.0758	U		0.0758	mg/kg	Y	Willow	Branch		43.00163755	-108.3863497
3175	Molybdenum	8/30/2018	F	0.495			0.0753	mg/kg	Y	Gumweed	Root		43.00162834	-108.3858126
3176	Molybdenum	8/30/2018	F	0.0743	U		0.0743	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00198465	-108.4042455
3177	Molybdenum	8/30/2018	F	0.0768	U		0.0768	mg/kg	Y	Bearberry	Branch		43.0018071	-108.4045377
3178	Molybdenum	8/30/2018	F	0.0774	U		0.0774	mg/kg	Y	Golden Currant	Branch		43.00182264	-108.4046925
3179	Molybdenum	8/30/2018	F	0.0945	J		0.0791	mg/kg	Y	Licorice Root	Root		43.00183012	-108.4045152
3180	Molybdenum	8/30/2018	F	0.0795	U		0.0795	mg/kg	Y	Willow	Branch		43.00259331	-108.4028916
3181	Molybdenum	8/30/2018	F	0.127	J		0.0746	mg/kg	Y	Bearberry	Branch		43.00259844	-108.402835
3182	Molybdenum	8/30/2018	F	0.0745	U		0.0745	mg/kg	Y	Golden Currant	Branch		42.99071813	-108.4186572
3183	Molybdenum	8/30/2018	F	1.1			0.0784	mg/kg	Y	Licorice Root	Root		42.99157761	-108.4191177
3184	Molybdenum	8/30/2018	F	0.332			0.0774	mg/kg	Y	Gumweed	Root		42.9917342	-108.419586
3185	Molybdenum	8/30/2018	F	0.0771	U		0.0771	mg/kg	Y	Willow	Branch		42.99190875	-108.4196497
3186	Molybdenum	8/30/2018	F	0.0749	U		0.0749	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98286181	-108.4137372

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3187	Molybdenum	8/30/2018	F	0.273			0.0766	mg/kg	Y	Gumweed	Root		42.98275064	-108.413531
3188	Molybdenum	8/30/2018	F	0.12	J		0.0794	mg/kg	Y	Whitetop	Root		42.98275314	-108.4135117
3189	Molybdenum	8/30/2018	F	0.1	J		0.0749	mg/kg	Y	Licorice Root	Root		42.98280148	-108.4135542
3190	Molybdenum	8/30/2018	F	0.0768	U		0.0768	mg/kg	Y	Willow	Branch		42.98269227	-108.413762
3191	Molybdenum	8/30/2018	F	0.166	J		0.0777	mg/kg	Y	Bearberry	Branch		42.98054745	-108.4148905
3192	Molybdenum	8/30/2018	F	0.0753	U		0.0753	mg/kg	Y	Golden Currant	Branch		42.98056162	-108.4149797
3000	Sulfate	7/25/2018	F	109		J	1.31	mg/kg	Y	Asparagus	Root		43.00167949	-108.3858202
3001	Sulfate	7/25/2018	F	121		J	1.28	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775	43.0017992	-108.3858927
3002	Sulfate	7/25/2018	F	131			1.25	mg/kg	Y	Asparagus	Root		43.00239349	-108.4031809
3003	Sulfate	7/25/2018	F	40.3			1.28	mg/kg	Y	Asparagus	Root		43.00244263	-108.4031012
3004	Sulfate	7/25/2018	F	228			2.48	mg/kg	Y	Asparagus	Root		42.99426968	-108.3876694
3005	Sulfate	7/25/2018	F	43			1.2	mg/kg	Y	Asparagus	Root		42.99034752	-108.3890153
3006	Sulfate	7/25/2018	F	77.7			1.25	mg/kg	Y	Asparagus	Root		42.99116393	-108.3888647
3007	Sulfate	7/26/2018	F	203			2.58	mg/kg	Y	Asparagus	Root		42.98979225	-108.4026909
3008	Sulfate	7/26/2018	F	35.4			1.32	mg/kg	Y	Asparagus	Root		42.98894765	-108.4021004
3009	Sulfate	7/26/2018	F	43.7			1.28	mg/kg	Y	Asparagus	Root		42.98881675	-108.4015848
3010	Sulfate	7/26/2018	F	143		J	1.27	mg/kg	Y	Asparagus	Root		42.98991767	-108.3987509
3011	Sulfate	7/26/2018	F	184			1.24	mg/kg	Y	Asparagus	Root		42.99054632	-108.3972282
3012	Sulfate	7/26/2018	F	114			1.28	mg/kg	Y	Asparagus	Root		42.98884902	-108.3996643
3013	Sulfate	7/26/2018	F	170			1.32	mg/kg	Y	Asparagus	Root		42.98869688	-108.3999628
3014	Sulfate	7/26/2018	F	180			1.31	mg/kg	Y	Asparagus	Root		42.98761306	-108.400093
3015	Sulfate	8/28/2018	F	10.8			1.23	mg/kg	Y	Snowberry	Root		42.98654751	-108.4004598
3016	Sulfate	8/28/2018	F	21.7			1.19	mg/kg	Y	Snowberry	Root and stem		42.98665883	-108.4002923
3017	Sulfate	8/28/2018	F	27.9		J	1.32	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3018	Sulfate	8/28/2018	F	10.8			1.25	mg/kg	Y	Snowberry	Root		42.98751905	-108.4000382
3019	Sulfate	8/28/2018	F	640		J	6.17	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3020	Sulfate	8/28/2018	F	956			13	mg/kg	Y	Snowberry	Root		42.9874775	-108.3997785
3021	Sulfate	8/28/2018	F	1390			12.7	mg/kg	Y	Whitetop	Root and stem		42.98813442	-108.399931
3022	Sulfate	8/28/2018	F	128			1.25	mg/kg	Y	Snowberry	Root		42.98697846	-108.4002589
3023	Sulfate	8/28/2018	F	5.24			1.14	mg/kg	Y	Snowberry	Root		42.98674311	-108.4002189
3024	Sulfate	8/28/2018	F	3.66			1.14	mg/kg	Y	Golden Currant	Branch		42.99025462	-108.397206
3025	Sulfate	8/28/2018	F	10.8			1.32	mg/kg	Y	Willow	Branch		42.99032311	-108.3968403
3026	Sulfate	8/28/2018	F	5.89			1.32	mg/kg	Y	Willow	Branch		42.99065918	-108.3967295
3027	Sulfate	8/28/2018	F	2170			26.4	mg/kg	Y	Whitetop	Root		42.99157458	-108.3977444
3028	Sulfate	8/28/2018	F	377			5.29	mg/kg	Y	Whitetop	Root		42.99171397	-108.3977358
3029	Sulfate	8/28/2018	F	329			5.22	mg/kg	Y	Whitetop	Root		42.99154294	-108.3977203
3030	Sulfate	8/28/2018	F	254			2.65	mg/kg	Y	Whitetop	Root		42.99145863	-108.3978447
3031	Sulfate	8/28/2018	F	406		J	5.32	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3032	Sulfate	8/28/2018	F	325			5.28	mg/kg	Y	Gumweed	Root		42.99286844	-108.4053083

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3033	Sulfate	8/28/2018	F	71.9			6.62	mg/kg	Y	Gumweed	Root and stem	Whole plant	42.99313776	-108.4052615
3034	Sulfate	8/28/2018	F	14.5		J	1.32	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3035	Sulfate	8/29/2018	F	63.2		J	6.65	mg/kg	Y	Licorice Root	Root		42.98937296	-108.4053119
3036	Sulfate	8/29/2018	F	126			2.46	mg/kg	Y	Licorice Root	Root		42.98943583	-108.4052381
3037	Sulfate	8/29/2018	F	170			1.28	mg/kg	Y	Licorice Root	Root		42.98955353	-108.4054295
3038	Sulfate	8/29/2018	F	118			1.31	mg/kg	Y	Licorice Root	Root		42.98938548	-108.404523
3039	Sulfate	8/29/2018	F	64.3			1.27	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98893018	-108.3995946
3040	Sulfate	8/29/2018	F	115		J	1.27	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3041	Sulfate	8/29/2018	F	157			1.25	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98886529	-108.3995744
3042	Sulfate	8/29/2018	F	117			1.28	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3043	Sulfate	8/29/2018	F	27.8			2.63	mg/kg	Y	Sagebrush	Root		42.99137086	-108.4019706
3044	Sulfate	8/29/2018	F	45.2			1.19	mg/kg	Y	Sagebrush	Root		42.99169601	-108.4009754
3045	Sulfate	8/29/2018	F	76.4		J	13	mg/kg	Y	Sagebrush	Root and stem		42.9918555	-108.4011476
3046	Sulfate	8/29/2018	F	2.04	Jh		1.24	mg/kg	Y	Snakeberry	Branch		42.98939401	-108.3992901
3047	Sulfate	8/29/2018	F	6.68			1.23	mg/kg	Y	Snakeberry	Branch		42.98925385	-108.3994524
3048	Sulfate	8/29/2018	F	3.89	J		1.3	mg/kg	Y	Snakeberry	Branch		42.98885761	-108.3998798
3049	Sulfate	8/29/2018	F	15			1.33	mg/kg	Y	Snakeberry	Branch		42.98882206	-108.4000908
3050	Sulfate	8/29/2018	F	864			12.4	mg/kg	Y	Licorice Root	Root		42.99918054	-108.3922055
3051	Sulfate	8/29/2018	F	201			2.45	mg/kg	Y	Sagebrush	Root and branch		42.99924646	-108.3922265
3052	Sulfate	8/29/2018	F	647		J	6.41	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3053	Sulfate	8/29/2018	F	31.8			1.32	mg/kg	Y	Gumweed	Root		42.9985176	-108.4184486
3054	Sulfate	8/29/2018	F	39.3		J	1.25	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3055	Sulfate	8/29/2018	F	51.3			1.14	mg/kg	Y	Milkweed	Root		42.99821794	-108.418861
3056	Sulfate	8/29/2018	F	46.2		J	1.32	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3057	Sulfate	8/30/2018	F	4.56			1.33	mg/kg	Y	Snakeberry	Branch		42.98859093	-108.3896948
3058	Sulfate	8/30/2018	F	26.8			1.33	mg/kg	Y	Snowberry	Root		42.98858762	-108.3894671
3059	Sulfate	8/30/2018	F	8.91			1.32	mg/kg	Y	Milkweed	Root		42.98992737	-108.3891733
3060	Sulfate	8/30/2018	F	264			2.65	mg/kg	Y	Sagebrush	Root		42.99154567	-108.3893162
3061	Sulfate	8/30/2018	F	19.5			1.33	mg/kg	Y	Gumweed	Root		42.98850302	-108.3893197
3062	Sulfate	8/30/2018	F	72.3			1.3	mg/kg	Y	Snowberry	Root		42.99018031	-108.393125
3063	Sulfate	8/30/2018	F	7.02			1.33	mg/kg	Y	Snakeberry	Branch		42.99015641	-108.3930567
3064	Sulfate	8/30/2018	F	568			5.22	mg/kg	Y	Milkweed	Root		42.99012225	-108.3923481
3065	Sulfate	8/30/2018	F	1110			13.1	mg/kg	Y	Whitetop	Root		42.99093689	-108.3932336
3066	Sulfate	8/30/2018	F	863			13.2	mg/kg	Y	Whitetop	Root		42.99134549	-108.3929184
3067	Sulfate	8/30/2018	F	80.1			6.13	mg/kg	Y	Gumweed	Root		42.99069078	-108.3933916
3068	Sulfate	8/30/2018	F	3040			51.4	mg/kg	Y	Whitetop	Root		43.0015561	-108.3856453

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3069	Sulfate	8/30/2018	F	838			6.1	mg/kg	Y	Milkweed	Root		43.00154389	-108.3859518
3070	Sulfate	8/30/2018	F	1070			13.1	mg/kg	Y	Snowberry	Root		43.00158489	-108.3863229
3071	Sulfate	8/30/2018	F	27.2			1.29	mg/kg	Y	Snakeberry	Branch		43.00164215	-108.3864355
3072	Sulfate	8/30/2018	F	240			6.32	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3073	Sulfate	8/30/2018	F	412			5.73	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3074	Sulfate	8/30/2018	F	22.2			1.16	mg/kg	Y	Gumweed	Root		43.00182771	-108.4049704
3075	Sulfate	8/30/2018	F	696			6.62	mg/kg	Y	Whitetop	Root		43.00167526	-108.4050328
3076	Sulfate	8/30/2018	F	367		J	13.2	mg/kg	Y	Milkweed	Root		43.00155143	-108.4050764
3077	Sulfate	8/30/2018	F	6.1			1.33	mg/kg	Y	Snakeberry	Branch		43.00159063	-108.4048772
3078	Sulfate	8/30/2018	F	186			1.33	mg/kg	Y	Sagebrush	Root		43.00202029	-108.4042081
3079	Sulfate	8/30/2018	F	1390			13.3	mg/kg	Y	Snowberry	Root		43.00205733	-108.4042154
3080	Sulfate	8/30/2018	F	73.7			1.3	mg/kg	Y	Sagebrush	Root		42.99226859	-108.4195675
3081	Sulfate	8/30/2018	F	8.42			1.33	mg/kg	Y	Snakeberry	Branch		42.99064427	-108.4185735
3082	Sulfate	8/30/2018	F	7.71			1.3	mg/kg	Y	Snowberry	Root		42.9910979	-108.4187918
3083	Sulfate	8/30/2018	F	630			5.2	mg/kg	Y	Whitetop	Root		42.98313719	-108.4140894
3084	Sulfate	8/30/2018	F	16.1			1.33	mg/kg	Y	Snowberry	Root		42.9831361	-108.4139117
3085	Sulfate	8/30/2018	F	129			1.33	mg/kg	Y	Whitetop	Root		42.98326886	-108.4143452
3086	Sulfate	8/30/2018	F	17.1			1.27	mg/kg	Y	Snakeberry	Branch		42.983393	-108.4144593
3087	Sulfate	8/30/2018	F	95.6			1.3	mg/kg	Y	Gumweed	Root		42.98336604	-108.4143015
3088	Sulfate	8/30/2018	F	151			1.25	mg/kg	Y	Milkweed	Root		42.98326743	-108.4142913
3110	Sulfate	8/28/2018	F	557			11.8	mg/kg	Y	Bearberry	Branch		42.9866419	-108.4003338
3111	Sulfate	8/28/2018	F	2.14	J		1.32	mg/kg	Y	Golden Currant	Branch		42.98665978	-108.4003467
3112	Sulfate	8/28/2018	F	5.64			1.33	mg/kg	Y	Golden Currant	Branch		42.98678087	-108.400302
3113	Sulfate	8/28/2018	F	13.1			1.32	mg/kg	Y	Golden Currant	Branch		42.9868319	-108.4003566
3114	Sulfate	8/28/2018	F	17.5			1.26	mg/kg	Y	Golden Currant	Branch		42.98686755	-108.4003535
3115	Sulfate	8/28/2018	F	2.46	J		1.28	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98665973	-108.4013982
3116	Sulfate	8/28/2018	F	326			11.8	mg/kg	Y	Whitetop	Root		42.98664176	-108.4013834
3117	Sulfate	8/28/2018	F	19.1		J	1.19	mg/kg	Y	Willow	Branch		42.99027066	-108.3972593
3118	Sulfate	8/28/2018	F	2.87	J		1.33	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3119	Sulfate	8/28/2018	F	4.42			1.32	mg/kg	Y	Willow	Branch		42.99025251	-108.3975823
3120	Sulfate	8/28/2018	F	2.29	J		1.17	mg/kg	Y	Golden Currant	Branch		42.99040222	-108.3975173
3121	Sulfate	8/28/2018	F	53.1			1.33	mg/kg	Y	Willow	Branch		42.99159623	-108.3976718
3122	Sulfate	8/28/2018	F	9.12			1.31	mg/kg	Y	Willow	Branch		42.99161732	-108.3976773
3123	Sulfate	8/28/2018	F	14.6			1.18	mg/kg	Y	Bearberry	Branch		42.99120462	-108.3975819
3124	Sulfate	8/28/2018	F	41.1			1.27	mg/kg	Y	Bearberry	Branch		42.98906181	-108.3995876
3125	Sulfate	8/28/2018	F	32.8		J	1.29	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3126	Sulfate	8/28/2018	F	183			1.3	mg/kg	Y	Licorice Root	Root		42.99050551	-108.3989351
3127	Sulfate	8/29/2018	F	119			1.32	mg/kg	Y	Gumweed	Root		42.98793759	-108.3999523
3128	Sulfate	8/28/2018	F	16.6		J	1.33	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Sulfate	8/28/2018	F	4.26		J	1.32	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3130	Sulfate	8/29/2018	F	14.6		J	1.31	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3131	Sulfate	8/29/2018	F	234			2.66	mg/kg	Y	Licorice Root	Root		42.98923925	-108.4026445
3132	Sulfate	8/29/2018	F	28.1			1.33	mg/kg	Y	Gumweed	Root		42.9870639	-108.4052893
3133	Sulfate	8/29/2018	F	94.5			1.33	mg/kg	Y	Gumweed	Root		42.98702149	-108.4051014
3134	Sulfate	8/29/2018	F	11.9			1.31	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99074871	-108.398113
3135	Sulfate	8/29/2018	F	14.1			1.32	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99118736	-108.3977841
3136	Sulfate	8/29/2018	F	7.04			1.32	mg/kg	Y	Bearberry	Branch		42.99120208	-108.3975768
3137	Sulfate	8/29/2018	F	15.1			1.33	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99139446	-108.3978089
3138	Sulfate	8/29/2018	F	25.9			6.57	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98559863	-108.4032029
3139	Sulfate	8/29/2018	F	54.6			6.57	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98624442	-108.402547
3140	Sulfate	8/29/2018	F	14.8			1.32	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98620239	-108.4026917
3141	Sulfate	8/29/2018	F	69.5			1.32	mg/kg	Y	Sagebrush	Root and branch		42.99139478	-108.4009542
3142	Sulfate	8/29/2018	F	26.8			1.32	mg/kg	Y	Sagebrush	Root and branch		42.99145482	-108.4012103
3143	Sulfate	8/29/2018	F	2.65	U		2.65	mg/kg	Y	Sagebrush	Root and branch		42.99140302	-108.4012881
3144	Sulfate	8/29/2018	F	49.7			1.3	mg/kg	Y	Sagebrush	Root and branch		42.99142316	-108.4012815
3145	Sulfate	8/29/2018	F	1.33	U		1.33	mg/kg	Y	Snakeberry	Branch		42.98764263	-108.4000412
3146	Sulfate	8/29/2018	F	1.16	U		1.16	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3147	Sulfate	8/29/2018	F	6.25			1.32	mg/kg	Y	Snakeberry	Branch		42.99054238	-108.3986745
3148	Sulfate	8/29/2018	F	11			1.29	mg/kg	Y	Snakeberry	Branch		42.99053513	-108.3987845
3149	Sulfate	8/29/2018	F	180			1.23	mg/kg	Y	Milkweed	Root		43.00006932	-108.3943489
3150	Sulfate	8/29/2018	F	6.44			1.31	mg/kg	Y	Willow	Branch		42.99999167	-108.3945748
3151	Sulfate	8/29/2018	F	22.8			1.33	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99986394	-108.3946151
3152	Sulfate	8/29/2018	F	13.4			1.27	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935
3153	Sulfate	8/29/2018	F	2400		J	25.2	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Sulfate	8/29/2018	F	8.72		J	1.33	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Sulfate	8/29/2018	F	8.23			1.23	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Sulfate	8/30/2018	F	12.8		J	1.27	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Sulfate	8/30/2018	F	59.3		J	1.33	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3158	Sulfate	8/30/2018	F	133			1.25	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98879277	-108.389296
3159	Sulfate	8/30/2018	F	24		J	1.27	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3160	Sulfate	8/30/2018	F	94.2			1.27	mg/kg	Y	Bearberry	Branch		42.98997946	-108.3895909
3161	Sulfate	8/30/2018	F	11.5		J	1.27	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3162	Sulfate	8/30/2018	F	3.34			1.11	mg/kg	Y	Golden Currant	Branch		42.98994236	-108.3894244

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3163	Sulfate	8/30/2018	F	159			1.23	mg/kg	Y	Licorice Root	Root		42.99058769	-108.3935141
3164	Sulfate	8/30/2018	F	31.6			1.31	mg/kg	Y	Bearberry	Branch		42.99028744	-108.3936618
3165	Sulfate	8/30/2018	F	60.8			1.33	mg/kg	Y	Bearberry	Branch		42.99024635	-108.3936283
3166	Sulfate	8/30/2018	F	14.1			1.3	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99005312	-108.3933383
3167	Sulfate	8/30/2018	F	23.2			1.2	mg/kg	Y	Bearberry	Branch		42.99015797	-108.3930447
3168	Sulfate	8/30/2018	F	0.859	U		0.859	mg/kg	Y	Golden Currant	Branch		42.99020918	-108.3929777
3169	Sulfate	8/30/2018	F	1.03	U		1.03	mg/kg	Y	Willow	Branch		42.98921432	-108.3913272
3170	Sulfate	8/30/2018	F	1.1	U		1.1	mg/kg	Y	Willow	Branch		42.99072666	-108.39431
3171	Sulfate	8/30/2018	F	24.8			1.32	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00167995	-108.385751
3172	Sulfate	8/30/2018	F	88.6			1.32	mg/kg	Y	Licorice Root	Root		43.00167358	-108.3857762
3173	Sulfate	8/30/2018	F	2.04	J		1.09	mg/kg	Y	Golden Currant	Branch		43.0016122	-108.386048
3174	Sulfate	8/30/2018	F	1.14	U		1.14	mg/kg	Y	Willow	Branch		43.00163755	-108.3863497
3175	Sulfate	8/30/2018	F	171			1.3	mg/kg	Y	Gumweed	Root		43.00162834	-108.3858126
3176	Sulfate	8/30/2018	F	82.4			1.32	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00198465	-108.4042455
3177	Sulfate	8/30/2018	F	5.99			0.799	mg/kg	Y	Bearberry	Branch		43.0018071	-108.4045377
3178	Sulfate	8/30/2018	F	1	U		1	mg/kg	Y	Golden Currant	Branch		43.00182264	-108.4046925
3179	Sulfate	8/30/2018	F	105			1.29	mg/kg	Y	Licorice Root	Root		43.00183012	-108.4045152
3180	Sulfate	8/30/2018	F	1.32	U		1.32	mg/kg	Y	Willow	Branch		43.00259331	-108.4028916
3181	Sulfate	8/30/2018	F	2.65	J		1.16	mg/kg	Y	Bearberry	Branch		43.00259844	-108.402835
3182	Sulfate	8/30/2018	F	0.943	U		0.943	mg/kg	Y	Golden Currant	Branch		42.99071813	-108.4186572
3183	Sulfate	8/30/2018	F	266			5.41	mg/kg	Y	Licorice Root	Root		42.99157761	-108.4191177
3184	Sulfate	8/30/2018	F	54.9			1.29	mg/kg	Y	Gumweed	Root		42.9917342	-108.419586
3185	Sulfate	8/30/2018	F	0.96	U		0.96	mg/kg	Y	Willow	Branch		42.99190875	-108.4196497
3186	Sulfate	8/30/2018	F	269			6.62	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98286181	-108.4137372
3187	Sulfate	8/30/2018	F	149			1.19	mg/kg	Y	Gumweed	Root		42.98275064	-108.413531
3188	Sulfate	8/30/2018	F	253			6.05	mg/kg	Y	Whitetop	Root		42.98275314	-108.4135117
3189	Sulfate	8/30/2018	F	1680			31.5	mg/kg	Y	Licorice Root	Root		42.98280148	-108.4135542
3190	Sulfate	8/30/2018	F	4.46			0.851	mg/kg	Y	Willow	Branch		42.98269227	-108.413762
3191	Sulfate	8/30/2018	F	5.08			1.2	mg/kg	Y	Bearberry	Branch		42.98054745	-108.4148905
3192	Sulfate	8/30/2018	F	1.69	J		0.695	mg/kg	Y	Golden Currant	Branch		42.98056162	-108.4149797
3000	Uranium	7/25/2018	F	0.021	B		0.0131	mg/kg	Y	Asparagus	Root		43.00167949	-108.3858202
3001	Uranium	7/25/2018	F	0.0131	B		0.0126	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775	43.0017992	-108.3858927
3002	Uranium	7/25/2018	F	0.0124	U		0.0124	mg/kg	Y	Asparagus	Root		43.00239349	-108.4031809
3003	Uranium	7/25/2018	F	0.0129	U		0.0129	mg/kg	Y	Asparagus	Root		43.00244263	-108.4031012
3004	Uranium	7/25/2018	F	0.0127	U		0.0127	mg/kg	Y	Asparagus	Root		42.99426968	-108.3876694
3005	Uranium	7/25/2018	F	0.0131	U		0.0131	mg/kg	Y	Asparagus	Root		42.99034752	-108.3890153
3006	Uranium	7/25/2018	F	0.012	U		0.012	mg/kg	Y	Asparagus	Root		42.99116393	-108.3888647
3007	Uranium	7/26/2018	F	0.0269	B		0.0131	mg/kg	Y	Asparagus	Root		42.98979225	-108.4026909
3008	Uranium	7/26/2018	F	0.0129	U		0.0129	mg/kg	Y	Asparagus	Root		42.98894765	-108.4021004
3009	Uranium	7/26/2018	F	0.0132	U		0.0132	mg/kg	Y	Asparagus	Root		42.98881675	-108.4015848
3010	Uranium	7/26/2018	F	0.0125	B		0.012	mg/kg	Y	Asparagus	Root		42.98991767	-108.3987509
3011	Uranium	7/26/2018	F	0.128			0.0126	mg/kg	Y	Asparagus	Root		42.99054632	-108.3972282
3012	Uranium	7/26/2018	F	0.0123	U		0.0123	mg/kg	Y	Asparagus	Root		42.98884902	-108.3996643

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3013	Uranium	7/26/2018	F	0.0143	B		0.0122	mg/kg	Y	Asparagus	Root		42.98869688	-108.3999628
3014	Uranium	7/26/2018	F	0.0127	U		0.0127	mg/kg	Y	Asparagus	Root		42.98761306	-108.400093
3015	Uranium	8/28/2018	F	1.01			0.0122	mg/kg	Y	Snowberry	Root		42.98654751	-108.4004598
3016	Uranium	8/28/2018	F	1.31			0.0132	mg/kg	Y	Snowberry	Root and stem		42.98665883	-108.4002923
3017	Uranium	8/28/2018	F	0.359		J	0.0121	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3018	Uranium	8/28/2018	F	0.582			0.0132	mg/kg	Y	Snowberry	Root		42.98751905	-108.4000382
3019	Uranium	8/28/2018	F	0.0956			0.0127	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3020	Uranium	8/28/2018	F	0.794			0.0122	mg/kg	Y	Snowberry	Root		42.9874775	-108.3997785
3021	Uranium	8/28/2018	F	0.0384			0.0126	mg/kg	Y	Whitetop	Root and stem		42.98813442	-108.399931
3022	Uranium	8/28/2018	F	0.243			0.0119	mg/kg	Y	Snowberry	Root		42.98697846	-108.4002589
3023	Uranium	8/28/2018	F	0.182			0.0122	mg/kg	Y	Snowberry	Root		42.98674311	-108.4002189
3024	Uranium	8/28/2018	F	0.013	U		0.013	mg/kg	Y	Golden Currant	Branch		42.99025462	-108.397206
3025	Uranium	8/28/2018	F	0.0475			0.0122	mg/kg	Y	Willow	Branch		42.99032311	-108.3968403
3026	Uranium	8/28/2018	F	0.0121	U		0.0121	mg/kg	Y	Willow	Branch		42.99065918	-108.3967295
3027	Uranium	8/28/2018	F	0.0317	J		0.0118	mg/kg	Y	Whitetop	Root		42.99157458	-108.3977444
3028	Uranium	8/28/2018	F	0.0261	J		0.0127	mg/kg	Y	Whitetop	Root		42.99171397	-108.3977358
3029	Uranium	8/28/2018	F	0.0273	J		0.0128	mg/kg	Y	Whitetop	Root		42.99154294	-108.3977203
3030	Uranium	8/28/2018	F	0.0218	J		0.0124	mg/kg	Y	Whitetop	Root		42.99145863	-108.3978447
3031	Uranium	8/28/2018	F	0.28		J	0.0129	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3032	Uranium	8/28/2018	F	0.116			0.0123	mg/kg	Y	Gumweed	Root		42.99286844	-108.4053083
3033	Uranium	8/28/2018	F	0.177			0.0122	mg/kg	Y	Gumweed	Root and stem	Whole plant	42.99313776	-108.4052615
3034	Uranium	8/28/2018	F	0.0127	U		0.0127	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3035	Uranium	8/29/2018	F	0.289			0.0122	mg/kg	Y	Licorice Root	Root		42.98937296	-108.4053119
3036	Uranium	8/29/2018	F	0.0326	J		0.0127	mg/kg	Y	Licorice Root	Root		42.98943583	-108.4052381
3037	Uranium	8/29/2018	F	0.95			0.0129	mg/kg	Y	Licorice Root	Root		42.98955353	-108.4054295
3038	Uranium	8/29/2018	F	0.0345	J		0.0133	mg/kg	Y	Licorice Root	Root		42.98938548	-108.404523
3039	Uranium	8/29/2018	F	0.634			0.0129	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98893018	-108.3995946
3040	Uranium	8/29/2018	F	0.243		J	0.0126	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3041	Uranium	8/29/2018	F	0.0845			0.0124	mg/kg	Y	Milkweed	Root and stem	Near 0789	42.98886529	-108.3995744
3042	Uranium	8/29/2018	F	1.15		J	0.0123	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3043	Uranium	8/29/2018	F	0.0848			0.013	mg/kg	Y	Sagebrush	Root		42.99137086	-108.4019706
3044	Uranium	8/29/2018	F	0.147			0.0131	mg/kg	Y	Sagebrush	Root		42.99169601	-108.4009754
3045	Uranium	8/29/2018	F	0.194			0.0129	mg/kg	Y	Sagebrush	Root and stem		42.9918555	-108.4011476
3046	Uranium	8/29/2018	F	0.0404			0.0131	mg/kg	Y	Snakeberry	Branch		42.98939401	-108.3992901
3047	Uranium	8/29/2018	F	0.0137	J	U	0.0126	mg/kg	Y	Snakeberry	Branch		42.98925385	-108.3994524

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3048	Uranium	8/29/2018	F	0.0129	U		0.0129	mg/kg	Y	Snakeberry	Branch		42.98885761	-108.3998798
3049	Uranium	8/29/2018	F	0.0336	J	U	0.0123	mg/kg	Y	Snakeberry	Branch		42.98882206	-108.4000908
3050	Uranium	8/29/2018	F	0.534			0.0124	mg/kg	Y	Licorice Root	Root		42.99918054	-108.3922055
3051	Uranium	8/29/2018	F	0.0216	J	U	0.0126	mg/kg	Y	Sagebrush	Root and branch		42.99924646	-108.3922265
3052	Uranium	8/29/2018	F	0.144		J	0.013	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3053	Uranium	8/29/2018	F	0.421			0.013	mg/kg	Y	Gumweed	Root		42.9985176	-108.4184486
3054	Uranium	8/29/2018	F	0.0462		U	0.0126	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3055	Uranium	8/29/2018	F	0.0892		U	0.0125	mg/kg	Y	Milkweed	Root		42.99821794	-108.418861
3056	Uranium	8/29/2018	F	0.133		J	0.0124	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3057	Uranium	8/30/2018	F	0.013	U		0.013	mg/kg	Y	Snakeberry	Branch		42.98859093	-108.3896948
3058	Uranium	8/30/2018	F	0.0391	J	U	0.013	mg/kg	Y	Snowberry	Root		42.98858762	-108.3894671
3059	Uranium	8/30/2018	F	0.0122	U		0.0122	mg/kg	Y	Milkweed	Root		42.98992737	-108.3891733
3060	Uranium	8/30/2018	F	0.53			0.0123	mg/kg	Y	Sagebrush	Root		42.99154567	-108.3893162
3061	Uranium	8/30/2018	F	0.129			0.0125	mg/kg	Y	Gumweed	Root		42.98850302	-108.3893197
3062	Uranium	8/30/2018	F	1.48			0.0132	mg/kg	Y	Snowberry	Root		42.99018031	-108.393125
3063	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Snakeberry	Branch		42.99015641	-108.3930567
3064	Uranium	8/30/2018	F	0.0337	J	U	0.0127	mg/kg	Y	Milkweed	Root		42.99012225	-108.3923481
3065	Uranium	8/30/2018	F	0.0796		U	0.0128	mg/kg	Y	Whitetop	Root		42.99093689	-108.3932336
3066	Uranium	8/30/2018	F	0.0129	U		0.0129	mg/kg	Y	Whitetop	Root		42.99134549	-108.3929184
3067	Uranium	8/30/2018	F	0.0756			0.0125	mg/kg	Y	Gumweed	Root		42.99069078	-108.3933916
3068	Uranium	8/30/2018	F	0.286			0.0128	mg/kg	Y	Whitetop	Root		43.0015561	-108.3856453
3069	Uranium	8/30/2018	F	0.0575			0.0119	mg/kg	Y	Milkweed	Root		43.00154389	-108.3859518
3070	Uranium	8/30/2018	F	1.06			0.0126	mg/kg	Y	Snowberry	Root		43.00158489	-108.3863229
3071	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Snakeberry	Branch		43.00164215	-108.3864355
3072	Uranium	8/30/2018	F	1.84			0.0131	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3073	Uranium	8/30/2018	F	0.413			0.013	mg/kg	Y	Sagebrush	Root and branch		43.00162384	-108.3868675
3074	Uranium	8/30/2018	F	0.195			0.0132	mg/kg	Y	Gumweed	Root		43.00182771	-108.4049704
3075	Uranium	8/30/2018	F	0.017	J		0.0126	mg/kg	Y	Whitetop	Root		43.00167526	-108.4050328
3076	Uranium	8/30/2018	F	0.438			0.0132	mg/kg	Y	Milkweed	Root		43.00155143	-108.4050764
3077	Uranium	8/30/2018	F	0.014	J		0.013	mg/kg	Y	Snakeberry	Branch		43.00159063	-108.4048772
3078	Uranium	8/30/2018	F	1.14			0.0132	mg/kg	Y	Sagebrush	Root		43.00202029	-108.4042081
3079	Uranium	8/30/2018	F	7.72			0.0132	mg/kg	Y	Snowberry	Root		43.00205733	-108.4042154
3079	Uranium	8/30/2018	R	3.19				mg/kg	Y	Snowberry	Root	Reanalysis on 11/23/2018	43.00205733	-108.4042154
3080	Uranium	8/30/2018	F	0.174			0.0127	mg/kg	Y	Sagebrush	Root		42.99226859	-108.4195675
3081	Uranium	8/30/2018	F	0.0219	J		0.013	mg/kg	Y	Snakeberry	Branch		42.99064427	-108.4185735
3082	Uranium	8/30/2018	F	1.63			0.0126	mg/kg	Y	Snowberry	Root		42.9910979	-108.4187918
3083	Uranium	8/30/2018	F	0.0133	U		0.0133	mg/kg	Y	Whitetop	Root		42.98313719	-108.4140894
3084	Uranium	8/30/2018	F	0.627			0.0129	mg/kg	Y	Snowberry	Root		42.9831361	-108.4139117
3085	Uranium	8/30/2018	F	0.0194	J		0.012	mg/kg	Y	Whitetop	Root		42.98326886	-108.4143452
3086	Uranium	8/30/2018	F	0.0132	U		0.0132	mg/kg	Y	Snakeberry	Branch		42.983393	-108.4144593

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3087	Uranium	8/30/2018	F	0.157			0.0124	mg/kg	Y	Gumweed	Root		42.98336604	-108.4143015
3088	Uranium	8/30/2018	F	0.0265	J		0.0127	mg/kg	Y	Milkweed	Root		42.98326743	-108.4142913
3110	Uranium	8/28/2018	F	0.0131	U		0.0131	mg/kg	Y	Bearberry	Branch		42.9866419	-108.4003338
3111	Uranium	8/28/2018	F	0.0133	U		0.0133	mg/kg	Y	Golden Currant	Branch		42.98665978	-108.4003467
3112	Uranium	8/28/2018	F	0.0131	U		0.0131	mg/kg	Y	Golden Currant	Branch		42.98678087	-108.400302
3113	Uranium	8/28/2018	F	0.012	U		0.012	mg/kg	Y	Golden Currant	Branch		42.9868319	-108.4003566
3114	Uranium	8/28/2018	F	0.0121	U		0.0121	mg/kg	Y	Golden Currant	Branch		42.98686755	-108.4003535
3115	Uranium	8/28/2018	F	0.0131	U		0.0131	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98665973	-108.4013982
3116	Uranium	8/28/2018	F	0.0192	J		0.0125	mg/kg	Y	Whitetop	Root		42.98664176	-108.4013834
3117	Uranium	8/28/2018	F	0.0127	U		0.0127	mg/kg	Y	Willow	Branch		42.99027066	-108.3972593
3118	Uranium	8/28/2018	F	0.0118	U		0.0118	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3119	Uranium	8/28/2018	F	0.013	U		0.013	mg/kg	Y	Willow	Branch		42.99025251	-108.3975823
3120	Uranium	8/28/2018	F	0.0121	U		0.0121	mg/kg	Y	Golden Currant	Branch		42.99040222	-108.3975173
3121	Uranium	8/28/2018	F	0.189			0.0132	mg/kg	Y	Willow	Branch		42.99159623	-108.3976718
3122	Uranium	8/28/2018	F	0.0538			0.013	mg/kg	Y	Willow	Branch		42.99161732	-108.3976773
3123	Uranium	8/28/2018	F	0.0128	U		0.0128	mg/kg	Y	Bearberry	Branch		42.99120462	-108.3975819
3124	Uranium	8/28/2018	F	0.0131	U		0.0131	mg/kg	Y	Bearberry	Branch		42.98906181	-108.3995876
3125	Uranium	8/28/2018	F	0.0578			0.0133	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3126	Uranium	8/28/2018	F	0.0654			0.0123	mg/kg	Y	Licorice Root	Root		42.99050551	-108.3989351
3127	Uranium	8/29/2018	F	0.466		J	0.0122	mg/kg	Y	Gumweed	Root		42.98793759	-108.3999523
3128	Uranium	8/28/2018	F	0.012	U		0.012	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Uranium	8/28/2018	F	0.0121	U	J	0.0121	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Uranium	8/29/2018	F	0.0302	J		0.0129	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3131	Uranium	8/29/2018	F	0.0925			0.0121	mg/kg	Y	Licorice Root	Root		42.98923925	-108.4026445
3132	Uranium	8/29/2018	F	0.0859			0.0131	mg/kg	Y	Gumweed	Root		42.9870639	-108.4052893
3133	Uranium	8/29/2018	F	0.0388			0.0127	mg/kg	Y	Gumweed	Root		42.98702149	-108.4051014
3134	Uranium	8/29/2018	F	0.0541			0.0129	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99074871	-108.398113
3135	Uranium	8/29/2018	F	0.0818			0.0129	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99118736	-108.3977841
3136	Uranium	8/29/2018	F	0.0123	U		0.0123	mg/kg	Y	Bearberry	Branch		42.99120208	-108.3975768
3137	Uranium	8/29/2018	F	0.0155	J		0.0125	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99139446	-108.3978089
3138	Uranium	8/29/2018	F	0.013	U		0.013	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98559863	-108.4032029
3139	Uranium	8/29/2018	F	0.012	U		0.012	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98624442	-108.402547
3140	Uranium	8/29/2018	F	0.0122	U		0.0122	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98620239	-108.4026917
3141	Uranium	8/29/2018	F	0.117			0.0129	mg/kg	Y	Sagebrush	Root and branch		42.99139478	-108.4009542
3142	Uranium	8/29/2018	F	0.275			0.0131	mg/kg	Y	Sagebrush	Root and branch		42.99145482	-108.4012103
3143	Uranium	8/29/2018	F	0.248			0.0122	mg/kg	Y	Sagebrush	Root and branch		42.99140302	-108.4012881
3144	Uranium	8/29/2018	F	0.0821			0.013	mg/kg	Y	Sagebrush	Root and branch		42.99142316	-108.4012815

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3145	Uranium	8/29/2018	F	0.0132	U		0.0132	mg/kg	Y	Snakeberry	Branch		42.98764263	-108.4000412
3146	Uranium	8/29/2018	F	0.0129	U		0.0129	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3147	Uranium	8/29/2018	F	0.0329	J		0.0129	mg/kg	Y	Snakeberry	Branch		42.99054238	-108.3986745
3148	Uranium	8/29/2018	F	0.0277	J		0.013	mg/kg	Y	Snakeberry	Branch		42.99053513	-108.3987845
3149	Uranium	8/29/2018	F	0.216			0.0125	mg/kg	Y	Milkweed	Root		43.00006932	-108.3943489
3150	Uranium	8/29/2018	F	0.0172	J		0.0131	mg/kg	Y	Willow	Branch		42.99999167	-108.3945748
3151	Uranium	8/29/2018	F	0.013	U		0.013	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99986394	-108.3946151
3152	Uranium	8/29/2018	F	0.0121	U		0.0121	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935
3153	Uranium	8/29/2018	F	0.0428		J	0.0132	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Uranium	8/29/2018	F	0.012	U		0.012	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Uranium	8/29/2018	F	0.0129	U		0.0129	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Uranium	8/30/2018	F	0.317		J	0.0121	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Uranium	8/30/2018	F	0.0128	U		0.0128	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3158	Uranium	8/30/2018	F	0.0125	U		0.0125	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98879277	-108.389296
3159	Uranium	8/30/2018	F	0.0131	U		0.0131	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3160	Uranium	8/30/2018	F	0.0306	J		0.0124	mg/kg	Y	Bearberry	Branch		42.98997946	-108.3895909
3161	Uranium	8/30/2018	F	0.0126	U		0.0126	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3162	Uranium	8/30/2018	F	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Branch		42.98994236	-108.3894244
3163	Uranium	8/30/2018	F	0.0941			0.0129	mg/kg	Y	Licorice Root	Root		42.99058769	-108.3935141
3164	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Bearberry	Branch		42.99028744	-108.3936618
3165	Uranium	8/30/2018	F	0.0131	U		0.0131	mg/kg	Y	Bearberry	Branch		42.99024635	-108.3936283
3166	Uranium	8/30/2018	F	0.012	U		0.012	mg/kg	Y	Cottonwood	Trunk	Core sample	42.99005312	-108.3933383
3167	Uranium	8/30/2018	F	0.0184	J		0.0132	mg/kg	Y	Bearberry	Branch		42.99015797	-108.3930447
3168	Uranium	8/30/2018	F	0.0124	U		0.0124	mg/kg	Y	Golden Currant	Branch		42.99020918	-108.3929777
3169	Uranium	8/30/2018	F	0.013	U		0.013	mg/kg	Y	Willow	Branch		42.98921432	-108.3913272
3170	Uranium	8/30/2018	F	0.0131	U		0.0131	mg/kg	Y	Willow	Branch		42.99072666	-108.39431
3171	Uranium	8/30/2018	F	0.0128	U		0.0128	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00167995	-108.385751
3172	Uranium	8/30/2018	F	0.056			0.0127	mg/kg	Y	Licorice Root	Root		43.00167358	-108.3857762
3173	Uranium	8/30/2018	F	0.0129	U		0.0129	mg/kg	Y	Golden Currant	Branch		43.0016122	-108.386048
3174	Uranium	8/30/2018	F	0.0125	U		0.0125	mg/kg	Y	Willow	Branch		43.00163755	-108.3863497
3175	Uranium	8/30/2018	F	0.696			0.0124	mg/kg	Y	Gumweed	Root		43.00162834	-108.3858126
3176	Uranium	8/30/2018	F	0.0123	U		0.0123	mg/kg	Y	Cottonwood	Trunk	Core sample	43.00198465	-108.4042455
3177	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Bearberry	Branch		43.0018071	-108.4045377
3178	Uranium	8/30/2018	F	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Branch		43.00182264	-108.4046925
3179	Uranium	8/30/2018	F	0.201			0.013	mg/kg	Y	Licorice Root	Root		43.00183012	-108.4045152
3180	Uranium	8/30/2018	F	0.0131	U		0.0131	mg/kg	Y	Willow	Branch		43.00259331	-108.4028916
3181	Uranium	8/30/2018	F	0.0123	U		0.0123	mg/kg	Y	Bearberry	Branch		43.00259844	-108.402835

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3182	Uranium	8/30/2018	F	0.0123	U		0.0123	mg/kg	Y	Golden Currant	Branch		42.99071813	-108.4186572
3183	Uranium	8/30/2018	F	0.526			0.0129	mg/kg	Y	Licorice Root	Root		42.99157761	-108.4191177
3184	Uranium	8/30/2018	F	0.466			0.0128	mg/kg	Y	Gumweed	Root		42.9917342	-108.419586
3185	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Willow	Branch		42.99190875	-108.4196497
3186	Uranium	8/30/2018	F	0.0124	U		0.0124	mg/kg	Y	Cottonwood	Trunk	Core sample	42.98286181	-108.4137372
3187	Uranium	8/30/2018	F	0.482			0.0126	mg/kg	Y	Gumweed	Root		42.98275064	-108.413531
3188	Uranium	8/30/2018	F	0.0685			0.0131	mg/kg	Y	Whitetop	Root		42.98275314	-108.4135117
3189	Uranium	8/30/2018	F	0.236			0.0124	mg/kg	Y	Licorice Root	Root		42.98280148	-108.4135542
3190	Uranium	8/30/2018	F	0.0127	U		0.0127	mg/kg	Y	Willow	Branch		42.98269227	-108.413762
3191	Uranium	8/30/2018	F	0.0128	U		0.0128	mg/kg	Y	Bearberry	Branch		42.98054745	-108.4148905
3192	Uranium	8/30/2018	F	0.0124	U		0.0124	mg/kg	Y	Golden Currant	Branch		42.98056162	-108.4149797
3001	Manganese	7/25/2018	D	1.32			0.201	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775		
3017	Manganese	8/28/2018	D	43.6		J	0.196	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3019	Manganese	8/28/2018	D	8.93		J	0.198	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3031	Manganese	8/28/2018	D	12.4		J	0.2	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3034	Manganese	8/28/2018	D	19.2		J	0.192	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3040	Manganese	8/29/2018	D	25.1		J	0.196	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3042	Manganese	8/29/2018	D	32.3		J	0.183	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3052	Manganese	8/29/2018	D	7.72		J	0.186	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3054	Manganese	8/29/2018	D	10.6			0.2	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3056	Manganese	8/29/2018	D	30.8		J	0.194	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3118	Manganese	8/28/2018	D	5.54		J	0.198	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3125	Manganese	8/28/2018	D	33.5		J	0.19	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3128	Manganese	8/28/2018	D	3.49			0.186	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Manganese	8/28/2018	D	35.6		J	0.191	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Manganese	8/29/2018	D	2.77		J	0.196	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3146	Manganese	8/29/2018	D	8.98		J	0.183	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3152	Manganese	8/29/2018	D	256			1.89	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3153	Manganese	8/29/2018	D	21.5		J	0.199	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Manganese	8/29/2018	D	3.75			0.193	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Manganese	8/29/2018	D	63.7			0.186	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Manganese	8/30/2018	D	9.47		J	0.201	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Manganese	8/30/2018	D	12.6		J	0.186	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3159	Manganese	8/30/2018	D	2.19			0.191	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3161	Manganese	8/30/2018	D	1.23			0.193	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3001	Molybdenum	7/25/2018	D	0.0771	U		0.0771	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775		
3017	Molybdenum	8/28/2018	D	0.18	J	J	0.0783	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3019	Molybdenum	8/28/2018	D	1.19			0.0791	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3031	Molybdenum	8/28/2018	D	7.34		J	0.08	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3034	Molybdenum	8/28/2018	D	1.13			0.0769	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3040	Molybdenum	8/29/2018	D	0.11	J		0.0783	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3042	Molybdenum	8/29/2018	D	0.335			0.0731	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3052	Molybdenum	8/29/2018	D	0.206			0.0742	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3054	Molybdenum	8/29/2018	D	0.08	U		0.08	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3056	Molybdenum	8/29/2018	D	0.213			0.0777	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3118	Molybdenum	8/28/2018	D	0.0816	J		0.0792	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3125	Molybdenum	8/28/2018	D	0.0762	U		0.0762	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3128	Molybdenum	8/28/2018	D	0.0745	U		0.0745	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Molybdenum	8/28/2018	D	0.257		U	0.0765	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Molybdenum	8/29/2018	D	0.0786	U		0.0786	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3146	Molybdenum	8/29/2018	D	0.0733	U		0.0733	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3152	Molybdenum	8/29/2018	D	0.0755	U		0.0755	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3153	Molybdenum	8/29/2018	D	0.571		J	0.0795	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Molybdenum	8/29/2018	D	0.0774	U		0.0774	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Molybdenum	8/29/2018	D	0.0742	U		0.0742	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Molybdenum	8/30/2018	D	3.06		J	0.0803	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Molybdenum	8/30/2018	D	0.0745	U		0.0745	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3159	Molybdenum	8/30/2018	D	0.0763	U		0.0763	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3161	Molybdenum	8/30/2018	D	0.0774	U		0.0774	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3001	Sulfate	7/25/2018	D	458		J	6.27	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775		
3017	Sulfate	8/28/2018	D	42.2		J	1.32	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3019	Sulfate	8/28/2018	D	1100		J	13.1	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3031	Sulfate	8/28/2018	D	614		J	12.8	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3034	Sulfate	8/28/2018	D	31.1		J	1.28	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3040	Sulfate	8/29/2018	D	53.5		J	6.65	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3042	Sulfate	8/29/2018	D	138			1.31	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3052	Sulfate	8/29/2018	D	1150		J	13	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3054	Sulfate	8/29/2018	D	69.3		J	1.31	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3056	Sulfate	8/29/2018	D	110		J	1.3	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3118	Sulfate	8/28/2018	D	3.29			1.04	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3125	Sulfate	8/28/2018	D	3.59		J	0.517	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3128	Sulfate	8/28/2018	D	4.06	h	J	0.465	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Sulfate	8/28/2018	D	31.2	h	J	1.2	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Sulfate	8/29/2018	D	7.47	h	J	1.32	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3146	Sulfate	8/29/2018	D	3.97	J		1.33	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528
3152	Sulfate	8/29/2018	D	13.9	h		1.32	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3153	Sulfate	8/29/2018	D	10.7	h	J	1.1	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3154	Sulfate	8/29/2018	D	1.17	Jh	J	0.914	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Sulfate	8/29/2018	D	13			1.32	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Sulfate	8/30/2018	D	25.1		J	1.32	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Sulfate	8/30/2018	D	2.73	J	J	0.989	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3159	Sulfate	8/30/2018	D	1.84	J	J	1.03	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3161	Sulfate	8/30/2018	D	1.09	U	J	1.09	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999
3001	Uranium	7/25/2018	D	0.02	B		0.0127	mg/kg	Y	Asparagus	Root	Duplicate collected @ 1500 ID 2775		
3017	Uranium	8/28/2018	D	0.138		J	0.0129	mg/kg	Y	Snowberry	Root	Duplicate 2771 @ 1125	42.98716512	-108.4002335
3019	Uranium	8/28/2018	D	0.054			0.013	mg/kg	Y	Whitetop	Root and stem	Whole plant. Duplicate 2772 @ 1400	42.98751828	-108.4000385
3031	Uranium	8/28/2018	D	9.27		J	0.0132	mg/kg	Y	Gumweed	Root	Duplicate 2783 @ 1610	42.99069953	-108.4051912
3031	Uranium	8/28/2018	R	0.788				mg/kg	Y	Gumweed	Root	Reanalysis on 11/23/2018	42.99069953	-108.4051912
3034	Uranium	8/28/2018	D	0.035	J		0.0127	mg/kg	Y	Gumweed	Root	Duplicate 2784 @ 1615	42.99332558	-108.4052835
3040	Uranium	8/29/2018	D	0.445		J	0.0129	mg/kg	Y	Milkweed	Root and stem	Near 0789, duplicate 2773 @ 1045	42.98886529	-108.3995744
3042	Uranium	8/29/2018	D	0.404		J	0.0121	mg/kg	Y	Sagebrush	Root	Duplicate 2774 @ 1350	42.99109234	-108.4050079
3052	Uranium	8/29/2018	D	0.43		J	0.0122	mg/kg	Y	Gumweed	Root	Duplicate 2776 @ 1555	42.99911566	-108.3920986
3054	Uranium	8/29/2018	D	0.0632			0.0132	mg/kg	Y	Milkweed	Root	Duplicate 2777 @ 1630	42.99851618	-108.4185837
3056	Uranium	8/29/2018	D	0.543		J	0.0128	mg/kg	Y	Whitetop	Root	Duplicate 2778 @ 1642	42.99843295	-108.418559
3118	Uranium	8/28/2018	D	0.0131	U		0.0131	mg/kg	Y	Golden Currant	Branch	Duplicate 2781 @ 1200	42.99033593	-108.3973584
3125	Uranium	8/28/2018	D	0.101			0.0126	mg/kg	Y	Willow	Branch	Duplicate 2782 @ 1520	42.9889655	-108.3993329
3128	Uranium	8/28/2018	D	0.0123	U		0.0123	mg/kg	Y	Bearberry	Branch	Duplicate 2785 @ 1630	42.98664632	-108.4003399
3129	Uranium	8/28/2018	D	0.226		J	0.0126	mg/kg	Y	Licorice Root	Root	Duplicate 2786 @ 1635	42.98655711	-108.4004364
3130	Uranium	8/29/2018	D	0.013	U		0.013	mg/kg	Y	Cottonwood	Trunk	Duplicate 2787 @ 0800, core sample	42.9904412	-108.3976443
3146	Uranium	8/29/2018	D	0.0167	J		0.0121	mg/kg	Y	Snakeberry	Branch	Duplicate 2775 @ 1502	42.98722117	-108.4002528

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3152	Uranium	8/29/2018	D	0.0125	U		0.0125	mg/kg	Y	Cottonwood	Trunk	Duplicate 2788 @ 1640, core sample	42.9987304	-108.4185935
3153	Uranium	8/29/2018	D	2.39		J	0.0131	mg/kg	Y	Sagebrush	Root and branch	Duplicate 2789 @ 1650	42.99800001	-108.4191406
3153	Uranium	8/29/2018	R	0.102				mg/kg	Y	Sagebrush	Root and branch	Reanalysis on 11/23/2018	42.99800001	-108.4191406
3154	Uranium	8/29/2018	D	0.0128	U		0.0128	mg/kg	Y	Snakeberry	Branch	Duplicate 2790 @ 1700	42.99916046	-108.4181127
3155	Uranium	8/29/2018	D	0.0122	U		0.0122	mg/kg	Y	Snowberry	Root and branch	Duplicate 2779 @ 1705	42.99871658	-108.4185272
3156	Uranium	8/30/2018	D	0.0327	J	J	0.0133	mg/kg	Y	Licorice Root	Root	Duplicate 2780 @ 0825	42.98871375	-108.3901004
3157	Uranium	8/30/2018	D	0.0123	U		0.0123	mg/kg	Y	Willow	Branch	Duplicate 2791 @ 0830	42.98872883	-108.3901436
3159	Uranium	8/30/2018	D	0.0126	U		0.0126	mg/kg	Y	Bearberry	Branch	Duplicate 2792 @ 0855	42.98938019	-108.3892968
3161	Uranium	8/30/2018	D	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Branch	Duplicate 2793 @ 0912	42.98999923	-108.3896999

[a] Lab Qualifiers

Qualifier	Qualifier Description
*	Replicate analysis not within control limits.
+	Correlation coefficient for method of standard addition (MSA) < 0.995.
>	Result above upper detection limit.
A	Tentatively identified compound (TIC) is a suspected aldol-condensation product.
B	Inorganic: Result is between the IDL and CRDL. Organic and radiochemistry: Analyte also found in method blank.
C	Pesticide result confirmed by GC-MS.
D	Analyte determined in diluted sample.
E	Inorganic: Estimated value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
H	Holding time expired, value suspect.
I	Increased detection limit due to required dilution.
J	Estimated value
M	GFAA duplicate injection precision not met.
N	Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: TIC.
P	> 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
S	Result determined by MSA.
U	Parameter analyzed for but not detected.
W	Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
X	Laboratory-defined qualifier, see case narrative.
Y	Laboratory-defined qualifier, see case narrative.
Z	Laboratory-defined qualifier, see case narrative.

[b] Data Qualifiers

Qualifier	Qualifier Description
F	Low flow sampling method used.
G	Possible grout contamination, pH > 9.
J	Estimated value
L	Less than 3 bore volumes purged prior to sampling.
N	TIC
Q	Qualitative result due to sampling technique
R	Unusable result
U	Parameter analyzed for but not detected.
X	Location is undefined.

TABLE B-2 Plant Data Collected in 2020

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3201	Manganese	8/18/2020	F	12.7			0.192	mg/kg	Y	Gumweed	Root		43.03714933	-108.77474355
3202	Manganese	8/18/2020	F	5.18			0.192	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3203	Manganese	8/18/2020	F	13.5			0.184	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3204	Manganese	8/18/2020	F	10.7			0.196	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3205	Manganese	8/18/2020	F	6.42			0.184	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3206	Manganese	8/18/2020	F	5.47			0.195	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3207	Manganese	8/18/2020	F	3.75			0.176	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3208	Manganese	8/18/2020	F	28.9			0.195	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3209	Manganese	8/18/2020	F	27.9			0.189	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3210	Manganese	8/18/2020	F	32			0.19	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3211	Manganese	8/18/2020	F	7.64			0.199	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3212	Manganese	8/18/2020	F	36.9			0.188	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3213	Manganese	8/18/2020	F	4.15			0.197	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3214	Manganese	8/18/2020	F	35.9			0.193	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3215	Manganese	8/18/2020	F	3.69			0.198	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3216	Manganese	8/18/2020	F	4.46			0.192	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3217	Manganese	8/18/2020	F	9.75			0.2	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3218	Manganese	8/18/2020	F	22.8			0.196	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3219	Manganese	8/18/2020	F	6.19			0.187	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3220	Manganese	8/18/2020	F	11.5			0.187	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3221	Manganese	8/18/2020	F	3.95			0.18	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3222	Manganese	8/18/2020	F	5.64			0.195	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3223	Manganese	8/18/2020	F	4.64			0.201	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3224	Manganese	8/18/2020	F	6.31			0.193	mg/kg	Y	Gumweed	Root		43.03685290	-108.77417118
3225	Manganese	8/18/2020	F	7.57			0.191	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3226	Manganese	8/18/2020	F	18.3			0.191	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3227	Manganese	8/18/2020	F	7.52			0.188	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3228	Manganese	8/18/2020	F	5.07			0.196	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3229	Manganese	8/18/2020	F	3.76			0.194	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Manganese	8/18/2020	F	6.23			0.186	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3231	Manganese	8/18/2020	F	5.42			0.193	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3232	Manganese	8/18/2020	F	4.31			0.185	mg/kg	Y	Gumweed	Root		43.03772140	-108.77443006
3233	Manganese	8/18/2020	F	3.18			0.196	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3234	Manganese	8/18/2020	F	12.2			0.196	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3235	Manganese	8/18/2020	F	9.09			0.192	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3236	Manganese	8/18/2020	F	28			0.198	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3237	Manganese	8/18/2020	F	18			0.197	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3238	Manganese	8/18/2020	F	5.62			0.181	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3239	Manganese	8/18/2020	F	10.1			0.196	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3240	Manganese	8/18/2020	F	32.1			0.2	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3241	Manganese	8/19/2020	F	18.7			0.182	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3242	Manganese	8/19/2020	F	12.6			0.178	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3243	Manganese	8/19/2020	F	15.1			0.198	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3244	Manganese	8/19/2020	F	21.4			0.19	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3245	Manganese	8/19/2020	F	11.2			0.187	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3246	Manganese	8/19/2020	F	11.1			0.189	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3247	Manganese	8/19/2020	F	25.2			0.197	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3248	Manganese	8/19/2020	F	42.4			0.188	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3249	Manganese	8/18/2020	F	2.32			0.185	mg/kg	Y	Cottonwood	Trunk		43.03724979	-108.77432226
3250	Manganese	8/18/2020	F	1.5			0.189	mg/kg	Y	Cottonwood	Trunk		43.03732005	-108.77423308
3251	Manganese	8/18/2020	F	3.4			0.2	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3252	Manganese	8/18/2020	F	3.13			0.181	mg/kg	Y	Cottonwood	Trunk		43.03743300	-108.77438910
3253	Manganese	8/18/2020	F	1.9			0.177	mg/kg	Y	Cottonwood	Trunk		43.03718742	-108.77421429
3254	Manganese	8/18/2020	F	3.18			0.179	mg/kg	Y	Cottonwood	Trunk		43.03724983	-108.77410602
3255	Manganese	8/18/2020	F	4.84			0.182	mg/kg	Y	Cottonwood	Trunk		43.03758264	-108.77312232
3256	Manganese	8/18/2020	F	2.31			0.192	mg/kg	Y	Cottonwood	Trunk		43.03758889	-108.77303708
3257	Manganese	8/19/2020	F	2.89			0.191	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3258	Manganese	8/19/2020	F	5.21			0.196	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3259	Manganese	8/19/2020	F	1.55			0.2	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3260	Manganese	8/19/2020	F	1.68			0.197	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3261	Manganese	8/19/2020	F	2.7			0.185	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3262	Manganese	8/19/2020	F	4.22			0.193	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3263	Manganese	8/19/2020	F	9.13			0.194	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3264	Manganese	8/19/2020	F	1.1			0.195	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3265	Manganese	8/19/2020	F	4.32			0.183	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3266	Manganese	8/19/2020	F	3.07			0.194	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3267	Manganese	8/19/2020	F	3.01			0.187	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3268	Manganese	8/19/2020	F	2.74			0.196	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3269	Manganese	8/19/2020	F	2.97			0.193	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3270	Manganese	8/19/2020	F	2.7			0.194	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3271	Manganese	8/19/2020	F	2.87			0.195	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3272	Manganese	8/19/2020	F	3.03			0.183	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3273	Manganese	8/19/2020	F	3.2			0.183	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3274	Manganese	8/19/2020	F	2.46			0.196	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3275	Manganese	8/19/2020	F	2.76			0.196	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3276	Manganese	8/19/2020	F	5.49			0.198	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3277	Manganese	8/19/2020	F	3.36			0.198	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3278	Manganese	8/19/2020	F	3.01			0.182	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3279	Manganese	8/19/2020	F	2.42			0.176	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3280	Manganese	8/19/2020	F	3.14			0.177	mg/kg	Y	Buffalo Bull/Bearberry	Core		43.03724766	-108.77401498
3201	Molybdenum	8/18/2020	F	0.949			0.0768	mg/kg	Y	Gumweed	Root		43.03714933	-108.77474355
3202	Molybdenum	8/18/2020	F	0.131	B		0.0768	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3203	Molybdenum	8/18/2020	F	0.0735	U		0.0735	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3204	Molybdenum	8/18/2020	F	0.0784	U		0.0784	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3205	Molybdenum	8/18/2020	F	0.0735	U		0.0735	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3206	Molybdenum	8/18/2020	F	0.0781	U		0.0781	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3207	Molybdenum	8/18/2020	F	0.0704	U		0.0704	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3208	Molybdenum	8/18/2020	F	0.206			0.0781	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3209	Molybdenum	8/18/2020	F	0.148	B		0.0755	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3210	Molybdenum	8/18/2020	F	0.624			0.0762	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3211	Molybdenum	8/18/2020	F	0.0795	U		0.0795	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3212	Molybdenum	8/18/2020	F	0.48			0.075	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3213	Molybdenum	8/18/2020	F	0.0787	U		0.0787	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3214	Molybdenum	8/18/2020	F	0.867			0.0772	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3215	Molybdenum	8/18/2020	F	0.13	B		0.0792	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3216	Molybdenum	8/18/2020	F	0.0766	U		0.0766	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3217	Molybdenum	8/18/2020	F	0.153	B		0.08	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3218	Molybdenum	8/18/2020	F	0.0804	B		0.0783	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3219	Molybdenum	8/18/2020	F	0.224			0.0746	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3220	Molybdenum	8/18/2020	F	0.106	B		0.0749	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3221	Molybdenum	8/18/2020	F	0.0721	U		0.0721	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3222	Molybdenum	8/18/2020	F	0.078	U		0.078	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3223	Molybdenum	8/18/2020	F	0.0803	U		0.0803	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3224	Molybdenum	8/18/2020	F	0.0772	U		0.0772	mg/kg	Y	Gumweed	Root		43.03685290	-108.77417118
3225	Molybdenum	8/18/2020	F	0.0763	U		0.0763	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3226	Molybdenum	8/18/2020	F	0.0765	U		0.0765	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3227	Molybdenum	8/18/2020	F	0.0752	U		0.0752	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3228	Molybdenum	8/18/2020	F	0.0786	U		0.0786	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3229	Molybdenum	8/18/2020	F	0.0775	U		0.0775	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Molybdenum	8/18/2020	F	0.0743	U		0.0743	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3231	Molybdenum	8/18/2020	F	0.0771	U		0.0771	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3232	Molybdenum	8/18/2020	F	0.0792	B		0.0738	mg/kg	Y	Gumweed	Root		43.03772140	-108.77443006
3233	Molybdenum	8/18/2020	F	0.0783	U		0.0783	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3234	Molybdenum	8/18/2020	F	0.0786	U		0.0786	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3235	Molybdenum	8/18/2020	F	0.0768	U		0.0768	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3236	Molybdenum	8/18/2020	F	0.0791	U		0.0791	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3237	Molybdenum	8/18/2020	F	0.0787	U		0.0787	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3238	Molybdenum	8/18/2020	F	0.0726	U		0.0726	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3239	Molybdenum	8/18/2020	F	0.126	B		0.0783	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3240	Molybdenum	8/18/2020	F	0.0798	U		0.0798	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3241	Molybdenum	8/19/2020	F	0.303			0.0727	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3242	Molybdenum	8/19/2020	F	0.297			0.0713	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3243	Molybdenum	8/19/2020	F	0.101	B		0.0794	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3244	Molybdenum	8/19/2020	F	0.08	B		0.0762	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3245	Molybdenum	8/19/2020	F	0.0749	U		0.0749	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3246	Molybdenum	8/19/2020	F	0.337			0.0758	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3247	Molybdenum	8/19/2020	F	0.0789	U		0.0789	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3248	Molybdenum	8/19/2020	F	0.0816	B		0.075	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3249	Molybdenum	8/18/2020	F	0.0739	U		0.0739	mg/kg	Y	Cottonwood	Trunk		43.03724979	-108.77432226
3250	Molybdenum	8/18/2020	F	0.0758	U		0.0758	mg/kg	Y	Cottonwood	Trunk		43.03732005	-108.77423308
3251	Molybdenum	8/18/2020	F	0.08	U		0.08	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3252	Molybdenum	8/18/2020	F	0.0723	U		0.0723	mg/kg	Y	Cottonwood	Trunk		43.03743300	-108.77438910
3253	Molybdenum	8/18/2020	F	0.0707	U		0.0707	mg/kg	Y	Cottonwood	Trunk		43.03718742	-108.77421429
3254	Molybdenum	8/18/2020	F	0.0717	U		0.0717	mg/kg	Y	Cottonwood	Trunk		43.03724983	-108.77410602
3255	Molybdenum	8/18/2020	F	0.073	U		0.073	mg/kg	Y	Cottonwood	Trunk		43.03758264	-108.77312232
3256	Molybdenum	8/18/2020	F	0.0768	U		0.0768	mg/kg	Y	Cottonwood	Trunk		43.03758889	-108.77303708
3257	Molybdenum	8/19/2020	F	0.0765	U		0.0765	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3258	Molybdenum	8/19/2020	F	0.0786	U		0.0786	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3259	Molybdenum	8/19/2020	F	0.0798	U		0.0798	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3260	Molybdenum	8/19/2020	F	0.0789	U		0.0789	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3261	Molybdenum	8/19/2020	F	0.0739	U		0.0739	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3262	Molybdenum	8/19/2020	F	0.0771	U		0.0771	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3263	Molybdenum	8/19/2020	F	0.0775	U		0.0775	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3264	Molybdenum	8/19/2020	F	0.0781	U		0.0781	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3265	Molybdenum	8/19/2020	F	0.0733	U		0.0733	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3266	Molybdenum	8/19/2020	F	0.0775	U		0.0775	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3267	Molybdenum	8/19/2020	F	0.0748	U		0.0748	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3268	Molybdenum	8/19/2020	F	0.0786	U		0.0786	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3269	Molybdenum	8/19/2020	F	0.0774	U		0.0774	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3270	Molybdenum	8/19/2020	F	0.0777	U		0.0777	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3271	Molybdenum	8/19/2020	F	0.0781	U		0.0781	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3272	Molybdenum	8/19/2020	F	0.0734	U		0.0734	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3273	Molybdenum	8/19/2020	F	0.219			0.0731	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3274	Molybdenum	8/19/2020	F	0.101	B		0.0783	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3275	Molybdenum	8/19/2020	F	0.269			0.0783	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3276	Molybdenum	8/19/2020	F	0.324			0.0792	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3277	Molybdenum	8/19/2020	F	0.0792	U		0.0792	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3278	Molybdenum	8/19/2020	F	0.217			0.0729	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3279	Molybdenum	8/19/2020	F	0.0704	U		0.0704	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3280	Molybdenum	8/19/2020	F	0.0709	U		0.0709	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3201	Sulfate	8/18/2020	F	17.2			1.36	mg/kg	Y	Gumweed	Root		43.03714933	-108.77474355
3202	Sulfate	8/18/2020	F	2.67	J		1.28	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3203	Sulfate	8/18/2020	F	3.69	J		1.33	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3204	Sulfate	8/18/2020	F	1.94	J		1.35	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3205	Sulfate	8/18/2020	F	3.25	J		1.36	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3206	Sulfate	8/18/2020	F	4.47			1.3	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3207	Sulfate	8/18/2020	F	6.13			1.33	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3208	Sulfate	8/18/2020	F	2.73	J		1.39	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3209	Sulfate	8/18/2020	F	3.5	J		1.27	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3210	Sulfate	8/18/2020	F	5.75			1.29	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3211	Sulfate	8/18/2020	F	8.09			1.74	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3212	Sulfate	8/18/2020	F	5.38			1.19	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3213	Sulfate	8/18/2020	F	6.62			1.11	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3214	Sulfate	8/18/2020	F	4.99			1.35	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3215	Sulfate	8/18/2020	F	5.07			0.861	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3216	Sulfate	8/18/2020	F	3.46			0.969	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3217	Sulfate	8/18/2020	F	11.5			1.42	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3218	Sulfate	8/18/2020	F	23.2			1.35	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3219	Sulfate	8/18/2020	F	46.5			1.36	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3220	Sulfate	8/18/2020	F	49			1.3	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3221	Sulfate	8/18/2020	F	2.4	J		1.11	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3222	Sulfate	8/18/2020	F	3.94	J		1.39	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3223	Sulfate	8/18/2020	F	1.64	U		1.64	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3224	Sulfate	8/18/2020	F	41.7			1.51	mg/kg	Y	Gumweed	Root		43.03685290	-108.77417118
3225	Sulfate	8/18/2020	F	1.11	U		1.11	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3226	Sulfate	8/18/2020	F	5.19			1.15	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3227	Sulfate	8/18/2020	F	1.56	J		1.05	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3228	Sulfate	8/18/2020	F	2.12	J		1.05	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3229	Sulfate	8/18/2020	F	24.3			1.32	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Sulfate	8/18/2020	F	5.03			1.34	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3231	Sulfate	8/18/2020	F	18.4			1.44	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3232	Sulfate	8/18/2020	F	1.43	U		1.43	mg/kg	Y	Gumweed	Root		43.03772140	-108.77443006
3233	Sulfate	8/18/2020	F	6.8			1.45	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3234	Sulfate	8/18/2020	F	2.99	J		1.12	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3235	Sulfate	8/18/2020	F	0.77	U		0.77	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3236	Sulfate	8/18/2020	F	4.97			0.77	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3237	Sulfate	8/18/2020	F	6.46			0.94	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3238	Sulfate	8/18/2020	F	13.3			1.74	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3239	Sulfate	8/18/2020	F	8.05			1.38	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3240	Sulfate	8/18/2020	F	5.37			0.516	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3241	Sulfate	8/19/2020	F	42.3		J	0.969	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3242	Sulfate	8/19/2020	F	35.8			1.23	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3243	Sulfate	8/19/2020	F	1.36	U		1.36	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3244	Sulfate	8/19/2020	F	5.5			1.09	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3245	Sulfate	8/19/2020	F	3.97			1.17	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3246	Sulfate	8/19/2020	F	16.3			1.46	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3247	Sulfate	8/19/2020	F	3.6	J		1.45	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3248	Sulfate	8/19/2020	F	3.22			0.654	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3249	Sulfate	8/18/2020	F	10			1.08	mg/kg	Y	Cottonwood	Trunk		43.03724979	-108.77432226
3250	Sulfate	8/18/2020	F	12.1			1.39	mg/kg	Y	Cottonwood	Trunk		43.03732005	-108.77423308
3251	Sulfate	8/18/2020	F	40.1			1.52	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3252	Sulfate	8/18/2020	F	10.7			1.29	mg/kg	Y	Cottonwood	Trunk		43.03743300	-108.77438910
3253	Sulfate	8/18/2020	F	12.3			1.34	mg/kg	Y	Cottonwood	Trunk		43.03718742	-108.77421429
3254	Sulfate	8/18/2020	F	17.8			1.29	mg/kg	Y	Cottonwood	Trunk		43.03724983	-108.77410602
3255	Sulfate	8/18/2020	F	6.9			1.5	mg/kg	Y	Cottonwood	Trunk		43.03758264	-108.77312232
3256	Sulfate	8/18/2020	F	7.19			1.49	mg/kg	Y	Cottonwood	Trunk		43.03758889	-108.77303708
3257	Sulfate	8/19/2020	F	0.854	U		0.854	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3258	Sulfate	8/19/2020	F	0.944	J		0.752	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3259	Sulfate	8/19/2020	F	1.37	J	J	0.94	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3260	Sulfate	8/19/2020	F	2.26	J		1.59	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3261	Sulfate	8/19/2020	F	0.683	U		0.683	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3262	Sulfate	8/19/2020	F	1.63	J		0.982	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3263	Sulfate	8/19/2020	F	1.31	J		1.06	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3264	Sulfate	8/19/2020	F	3.02			0.651	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3265	Sulfate	8/19/2020	F	1.1	J		0.634	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3266	Sulfate	8/19/2020	F	1.98			0.425	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3267	Sulfate	8/19/2020	F	2.37			0.745	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3268	Sulfate	8/19/2020	F	0.966	J		0.592	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3269	Sulfate	8/19/2020	F	3.3	J		1.12	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3270	Sulfate	8/19/2020	F	3.16			0.906	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3271	Sulfate	8/19/2020	F	1.26	U		1.26	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3272	Sulfate	8/19/2020	F	0.927	U		0.927	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3273	Sulfate	8/19/2020	F	52.8			1.05	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3274	Sulfate	8/19/2020	F	1.47	J		0.618	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3275	Sulfate	8/19/2020	F	1.67	U		1.67	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3276	Sulfate	8/19/2020	F	1.24	J		0.864	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3277	Sulfate	8/19/2020	F	1.39	U		1.39	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3278	Sulfate	8/19/2020	F	3.15	J		1.41	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3279	Sulfate	8/19/2020	F	0.741	U		0.741	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3280	Sulfate	8/19/2020	F	1.39	J		0.836	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3201	Uranium	8/18/2020	F	0.0499			0.0127	mg/kg	Y	Gumweed	Root		43.03714933	-108.77474355
3202	Uranium	8/18/2020	F	0.237			0.0127	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3203	Uranium	8/18/2020	F	0.0708			0.0121	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3204	Uranium	8/18/2020	F	0.0129	U		0.0129	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3205	Uranium	8/18/2020	F	0.202			0.0121	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3206	Uranium	8/18/2020	F	0.0809			0.0129	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3207	Uranium	8/18/2020	F	0.171			0.0116	mg/kg	Y	Licorice root	Root		43.03721584	-108.77446065
3208	Uranium	8/18/2020	F	0.493			0.0129	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3209	Uranium	8/18/2020	F	0.368			0.0125	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3210	Uranium	8/18/2020	F	2.1			0.0126	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3211	Uranium	8/18/2020	F	0.0728			0.0131	mg/kg	Y	Licorice root	Root		43.03717562	-108.77447114
3212	Uranium	8/18/2020	F	1.6			0.0124	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3213	Uranium	8/18/2020	F	0.088			0.013	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3214	Uranium	8/18/2020	F	1.98			0.0127	mg/kg	Y	Snowberry	Root		43.03725020	-108.77446511
3215	Uranium	8/18/2020	F	0.042			0.0131	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3216	Uranium	8/18/2020	F	0.0946			0.0126	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3217	Uranium	8/18/2020	F	0.128			0.0132	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3218	Uranium	8/18/2020	F	0.0264	B		0.0129	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3219	Uranium	8/18/2020	F	0.075			0.0123	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3220	Uranium	8/18/2020	F	0.142			0.0124	mg/kg	Y	Gumweed	Root		43.03709773	-108.77470194
3221	Uranium	8/18/2020	F	0.0119	U		0.0119	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3222	Uranium	8/18/2020	F	0.0129	U		0.0129	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3223	Uranium	8/18/2020	F	0.0133	U		0.0133	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3224	Uranium	8/18/2020	F	0.0639			0.0127	mg/kg	Y	Gumweed	Root		43.03685290	-108.77417118
3225	Uranium	8/18/2020	F	0.0126	U		0.0126	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3226	Uranium	8/18/2020	F	0.0262	B		0.0126	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3227	Uranium	8/18/2020	F	0.0288	B		0.0124	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3228	Uranium	8/18/2020	F	0.013	U		0.013	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3229	Uranium	8/18/2020	F	0.0128	U		0.0128	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Uranium	8/18/2020	F	0.0126	B		0.0123	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3231	Uranium	8/18/2020	F	0.0195	B		0.0127	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3232	Uranium	8/18/2020	F	0.0122	U		0.0122	mg/kg	Y	Gumweed	Root		43.03772140	-108.77443006
3233	Uranium	8/18/2020	F	0.0569			0.0129	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3234	Uranium	8/18/2020	F	0.0639			0.013	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3235	Uranium	8/18/2020	F	0.101			0.0127	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3236	Uranium	8/18/2020	F	0.248	*	J	0.013	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3237	Uranium	8/18/2020	F	0.107	*		0.013	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3238	Uranium	8/18/2020	F	0.105	*		0.012	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3239	Uranium	8/18/2020	F	0.473	*		0.0129	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3240	Uranium	8/18/2020	F	0.262	*		0.0132	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3241	Uranium	8/19/2020	F	0.611	*		0.012	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3242	Uranium	8/19/2020	F	0.309	*		0.0118	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3243	Uranium	8/19/2020	F	0.0728	*		0.0131	mg/kg	Y	Sage Brush	Root	Single Sage Brush	43.03710830	-108.77466540
3244	Uranium	8/19/2020	F	0.0181	B*		0.0126	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3245	Uranium	8/19/2020	F	0.0124	U*		0.0124	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3246	Uranium	8/19/2020	F	0.0794	*		0.0125	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3247	Uranium	8/19/2020	F	0.013	B*		0.013	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3248	Uranium	8/19/2020	F	0.0276	B*		0.0124	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3249	Uranium	8/18/2020	F	0.0122	U*		0.0122	mg/kg	Y	Cottonwood	Trunk		43.03724979	-108.77432226
3250	Uranium	8/18/2020	F	0.0125	U*		0.0125	mg/kg	Y	Cottonwood	Trunk		43.03732005	-108.77423308
3251	Uranium	8/18/2020	F	0.0132	U*		0.0132	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3252	Uranium	8/18/2020	F	0.0119	U*		0.0119	mg/kg	Y	Cottonwood	Trunk		43.03743300	-108.77438910
3253	Uranium	8/18/2020	F	0.0117	U*		0.0117	mg/kg	Y	Cottonwood	Trunk		43.03718742	-108.77421429
3254	Uranium	8/18/2020	F	0.0118	U*		0.0118	mg/kg	Y	Cottonwood	Trunk		43.03724983	-108.77410602
3255	Uranium	8/18/2020	F	0.012	U*		0.012	mg/kg	Y	Cottonwood	Trunk		43.03758264	-108.77312232
3256	Uranium	8/18/2020	F	0.0127	U		0.0127	mg/kg	Y	Cottonwood	Trunk		43.03758889	-108.77303708
3257	Uranium	8/19/2020	F	0.0126	U		0.0126	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3258	Uranium	8/19/2020	F	0.013	U		0.013	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3259	Uranium	8/19/2020	F	0.0132	U		0.0132	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3260	Uranium	8/19/2020	F	0.013	U		0.013	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3261	Uranium	8/19/2020	F	0.0122	U		0.0122	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3262	Uranium	8/19/2020	F	0.0127	U		0.0127	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3263	Uranium	8/19/2020	F	0.0128	U		0.0128	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3264	Uranium	8/19/2020	F	0.0129	U		0.0129	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3265	Uranium	8/19/2020	F	0.0121	U		0.0121	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3266	Uranium	8/19/2020	F	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3267	Uranium	8/19/2020	F	0.0123	U		0.0123	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3268	Uranium	8/19/2020	F	0.013	U		0.013	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3269	Uranium	8/19/2020	F	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3270	Uranium	8/19/2020	F	0.0128	U		0.0128	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3271	Uranium	8/19/2020	F	0.0129	U		0.0129	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3272	Uranium	8/19/2020	F	0.0121	U		0.0121	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3273	Uranium	8/19/2020	F	0.0121	U		0.0121	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3274	Uranium	8/19/2020	F	0.0129	U		0.0129	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3275	Uranium	8/19/2020	F	0.0129	U		0.0129	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3276	Uranium	8/19/2020	F	0.0131	U		0.0131	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3277	Uranium	8/19/2020	F	0.0131	U		0.0131	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3278	Uranium	8/19/2020	F	0.012	U		0.012	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3279	Uranium	8/19/2020	F	0.0116	U		0.0116	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498

Location	Analyte	Sample Date	Sample Type Code	Result	Qualifiers Lab[a]	Qualifiers Data[b]	Detection Limit	Units	Validated	Plant Name	Part Sampled	Comments	Latitude	Longitude
3280	Uranium	8/19/2020	F	0.0117	U		0.0117	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3212	Manganese	8/18/2020	D	33.9			0.179	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3215	Manganese	8/18/2020	D	5.8			0.181	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3225	Manganese	8/18/2020	D	5.13			0.183	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Manganese	8/18/2020	D	5.33			0.191	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3235	Manganese	8/18/2020	D	5.84			0.191	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3248	Manganese	8/19/2020	D	12.2			0.198	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3251	Manganese	8/18/2020	D	5.97			0.198	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3264	Manganese	8/19/2020	D	1.59			0.192	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3272	Manganese	8/19/2020	D	2.63			0.186	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3280	Manganese	8/19/2020	D	3.82			0.197	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3212	Molybdenum	8/18/2020	D	0.442			0.0717	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3215	Molybdenum	8/18/2020	D	0.0723	U		0.0723	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3225	Molybdenum	8/18/2020	D	0.0733	U		0.0733	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Molybdenum	8/18/2020	D	0.0769	B		0.0763	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3235	Molybdenum	8/18/2020	D	0.0763	U		0.0763	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3248	Molybdenum	8/19/2020	D	0.0794	U		0.0794	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3251	Molybdenum	8/18/2020	D	0.0794	U		0.0794	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3264	Molybdenum	8/19/2020	D	0.0769	U		0.0769	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3272	Molybdenum	8/19/2020	D	0.0745	U		0.0745	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3280	Molybdenum	8/19/2020	D	0.0789	U		0.0789	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3212	Sulfate	8/18/2020	D	14.3		J	1.61	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3215	Sulfate	8/18/2020	D	11			1.32	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3225	Sulfate	8/18/2020	D	2.31	J		1.35	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Sulfate	8/18/2020	D	2.04	J		1.32	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3235	Sulfate	8/18/2020	D	4.64			1.35	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3248	Sulfate	8/19/2020	D	8.68			1.21	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3251	Sulfate	8/18/2020	D	34.2			1.14	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3264	Sulfate	8/19/2020	D	0.928	U		0.928	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3272	Sulfate	8/19/2020	D	1.94	J		0.807	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3280	Sulfate	8/19/2020	D	1.97	J		0.971	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498
3212	Uranium	8/18/2020	D	1.59			0.0118	mg/kg	Y	Snowberry	Root		43.03724251	-108.77449548
3215	Uranium	8/18/2020	D	0.101			0.0119	mg/kg	Y	Licorice root	Root		43.03726616	-108.77449388
3225	Uranium	8/18/2020	D	0.0148	B		0.0121	mg/kg	Y	Milkweed	Root		43.03684789	-108.77423278
3230	Uranium	8/18/2020	D	0.0475			0.0126	mg/kg	Y	Gumweed	Root		43.03757583	-108.77483589
3235	Uranium	8/18/2020	D	0.0126	U		0.0126	mg/kg	Y	Snakeberry	Root-Stem		43.03720764	-108.77419122
3248	Uranium	8/19/2020	D	0.022	B		0.0131	mg/kg	Y	Sage Brush	Root		43.03710830	-108.77466540
3251	Uranium	8/18/2020	D	0.0131	U		0.0131	mg/kg	Y	Cottonwood	Trunk		43.03709052	-108.77441594
3264	Uranium	8/19/2020	D	0.0127	U		0.0127	mg/kg	Y	Red Willow	Core		43.03730230	-108.77449016
3272	Uranium	8/19/2020	D	0.0123	U		0.0123	mg/kg	Y	Golden Currant	Core		43.03733436	-108.77417612
3280	Uranium	8/19/2020	D	0.013	U		0.013	mg/kg	Y	Buffalo Bull/ Bearberry	Core		43.03724766	-108.77401498

[a] Lab Qualifiers

Qualifier	Qualifier Description
*	Replicate analysis not within control limits.
+	Correlation coefficient for method of standard addition (MSA) < 0.995.
>	Result above upper detection limit.
A	Tentatively identified compound (TIC) is a suspected aldol-condensation product.
B	Inorganic: Result is between the IDL and CRDL. Organic and radiochemistry: Analyte also found in method blank.
C	Pesticide result confirmed by GC-MS.
D	Analyte determined in diluted sample.
E	Inorganic: Estimated value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
H	Holding time expired, value suspect.
I	Increased detection limit due to required dilution.
J	Estimated value
M	GFAA duplicate injection precision not met.
N	Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: TIC.
P	> 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
S	Result determined by MSA.
U	Parameter analyzed for but not detected.
W	Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
X	Laboratory-defined qualifier, see case narrative.
Y	Laboratory-defined qualifier, see case narrative.
Z	Laboratory-defined qualifier, see case narrative.

[b] Data Qualifiers

Qualifier	Qualifier Description
F	Low flow sampling method used.
G	Possible grout contamination, pH > 9.
J	Estimated value
L	Less than 3 bore volumes purged prior to sampling.
N	TIC
Q	Qualitative result due to sampling technique
R	Unusable result
U	Parameter analyzed for but not detected.
X	Location is undefined.