Marietta Canty, LLC
Environmental Consulting

Revised Cleanup Criteria and Risk Assessment Report

Wastewater Facilities Comprising the Closed-Loop System
Units 1 & 2 Stage I and II Evaporation Ponds Area
Colstrip Steam Electric Station
Colstrip, Montana

Project No. 17-1006

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List of Acronyms

ABSd	Dermal Absorption Factor
ABSinh	Inhalation Absorption Factor
ADD	Average Daily Dose
AF	Adherence Factor
AOC	Administrative Order on Consent
ARM	Administrative Rules of Montana
AT	Averaging Time
ATc	Averaging Time – carcinogens
ATnc	Averaging Time – non-carcinogens
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	Area Use Factor
BA	Bioavailability Factor
BCa-UCL	Bias-corrected and accelerated bootstrap Upper Confidence Limit method
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BSL	Background Screening Levels
BTV	Background Threshold Value
BTAG	Biological Technical Assistance Group
bq	Becquerel
BW	Body Weight
C	Concentration
Cal/EPA	California Environmental Protection Agency
Canty	Marietta Canty, LLC
CCR	Coal Combustion Residuals
CCRA	Cleanup Criteria and Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm^2	centimeters squared
COI	Constituent of Interest
COC	Chemical of Concern
COPC	Chemicals of Potential Concern
CR	Contact Rate
DEQ	Montana Department of Environmental Quality
DFSadj	age-adjusted dermal soil exposure factor for carcinogens
DFSMadj	age-adjusted dermal soil exposure factor for mutagenic carcinogens
EC	Exposure Concentration
ED	Exposure Duration
EF	Exposure Frequency
3&4 EHP	Units 3&4 Effluent Holding Pond
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
EU	Exposure Unit
Ford Canty	Ford Canty & Associates, Inc.

List of Acronyms (Continued)

g/g-d	grams per grams of body weight per day
GI ABS	Gastrointestinal Absorption Factor
HAZWOPER	Hazardous Waste Operations and Emergency Response
HBI	Hilsenhoff Biotic Index
HDPE	High Density Polyethylene
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HHS	Human Health Standard
HQ	Hazard Quotient
Hydrometrics	Hydrometrics, Inc.
IFSadj	age-adjusted soil ingestion factor for carcinogens
IFSMadj	age-adjusted soil ingestion factor for mutagenic carcinogens
IRIS	Integrated Risk Information System
IRS	ingestion rate - soil
IUR	Inhalation Unit Risk
K_d	partitioning coefficient
Kg	kilograms
kg/d	kilograms per day
kg/kg-d	kilograms per kilograms of body weight per day
kg/mg	kilograms per milligram
LADD	Lifetime Average Daily Dose
L/cm^3	Liters per cubic centimeter
L/Kg	Liters per kilogram
LANL	Los Alamos National Laboratory
L/d	liters per day
LOAEL	Lowest Observed Adverse Effect Level
MCA	Montana Code Annotated
MCF	mass conversion factor
MCL	Maximum Contaminant Level
mg/cm^2	milligrams per centimeter squared
m^3/kg	cubic meters per kilogram
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MPC	Montana Power Company
MPDES	Montana Pollutant Discharge Elimination System
msl	mean sea level
NCEA	National Center for Environmental Assessment
NJDEP	New Jersey Department of Environmental Protection
Neptune	Neptune and Company, Inc.
NOAEL	No Observed Adverse Effect Level
OEHHA	Office of Environmental Health Hazard Assessment
OSHA	Occupational Safety and Health Administration

List of Acronyms (Continued)

pCi	picoCurie
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PEF	Particulate Emission Factor
pg	picogram
PPLM	PPL Montana, LLC
PPRTV	Provisional Peer Reviewed Toxicity Value
PRG	Preliminary Remediation Goal
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RBCA	Risk-Based Corrective Action
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RfD_i	Reference Dose – inhalation
RfD_o	Reference Dose – oral
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SA	Surface Area
SC	Specific Conductance
SCEM	Site Conceptual Exposure Model
SES	Steam Electric Station
SF	Slope Factor
SLERA	Screening-level Ecological Risk Assessment
SOEP	Stage One Evaporation Pond
SPLP	Synthetic Precipitation Leaching Procedure
SSCL	Site Specific Cleanup Level
SSL	Soil Screening Level
STEP	Stage Two Evaporation Pond
Talen	Talen Montana, LLC
t-UCL	Upper Confidence Limit based on a t distribution
TDS	Total Dissolved Solids
T&E	Threatened and Endangered
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
UTL	Upper Tolerance Level
95 UCL	95 Percent Upper Confidence Limit
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USNRCS	United States Natural Resource and Conservation Service
WECO	Western Energy
yr	year
µg/dl	micrograms per deciliter

List of Acronyms (Continued)

µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter

Executive Summary

Hydrometrics, Inc. (Hydrometrics), on behalf of Talen Montana, LLC (Talen), retained Marietta Canty, LLC (Canty) and Neptune and Company, Inc. (Neptune) to prepare a Cleanup Criteria and Risk Assessment (CCRA) Report for the Wastewater Facilities Comprising the Closed-Loop System at the Units 1 & 2 Stage I Evaporation Pond (SOEP) and Stage II Evaporation Pond (STEP) area of the Colstrip Steam Electric Station (Colstrip SES), the "Facility", located in Colstrip, Montana. A CCRA Work Plan was previously prepared for the SOEP/STEP area of the Facility and submitted to the Montana Department of Environmental Quality (DEQ) in September 2017 (Canty, 2017a). The DEQ provided comments on the CCRA Work Plan on October 20, 2017 (DEQ, 2017d). The SOEP/STEP CCRA was submitted to the DEQ on December 19, 2017 (Canty, 2017b) and DEQ provided comments on April 12, 2018 (DEQ, 2018b). The revised SOEP/STEP CCRA was submitted to the DEQ on June 11, 2018 (Canty, 2018b) and DEQ provided comments on August 2, 2018 (DEQ, 2018c), which are addressed within this report. Comment responses for the DEQ comments to the CCRA Work Plan; the December 19, 2017 CCRA; and the June 11, 2018 CCRA are provided within (Appendix J).

To address potential process wastewater migration due to pond seepage and pipeline spills, PPL Montana, LLC (PPLM; Talen's predecessor) and the DEQ entered into an Administrative Order on Consent (AOC) Regarding Impacts Related to Wastewater Facilities Comprising the Closed-Loop System at the Colstrip SES on August 3, 2012, (DEQ/PPLM Montana, 2012). It is important to note that the AOC addresses impacts related to process wastewater and does not address other media (unless impacted by the process wastewater). The SOEP/STEP area is one of three areas at the Colstrip SES identified in the AOC as having groundwater impacts attributable to the process wastewater.

Future pond closure at the SOEP/STEP area will be conducted in accordance with the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Final Rule, and the planned shutdown of Units 1 and 2 at the Plant Site. Because requirements of the CCR Rule have been, or will be, implemented at the SOEP/STEP area under the CCR Rule, additional groundwater data collected as part of the CCR Rule were considered in the preparation of this CCRA Report.

The following general approach for the CCRA Report was followed based on prior discussions with the DEQ:

1. Identification of the SOEP/STEP Constituents of Interest (COIs) beginning with the list of CCR Rule detection and assessment monitoring constituents (Appendices III and IV)
    a. Begin with Source Data (Pond Data), as worst-case data
    b. Consider the CCR Well data, which are also worst-case (if any) because they were collected at the pond boundaries and total metals are analyzed, rather than dissolved
    c. Consider DEQ-7 Standards
    d. Consider USEPA Maximum Contaminant Level (MCL) and USEPA Regional Screening Levels (RSLs) for Tapwater
    e. Consider Background Screening Levels (BSLs)
    f. Consider other constituents potentially posing a Human Health or Ecological Risk

Executive Summary (Continued)

2. Preparation of the Site Conceptual Exposure Model (SCEM), including identification of the following:
    a. Potential Sources
    b. Potential Release Mechanisms
    c. Potential Media
    d. Potential Exposure Pathways
    e. Potential Receptors

3. Assess Human Health and Ecological Risks Associated with the COIs (also referred to as Chemicals of Potential Concern [COPCs] and, if retained after assessment, Chemicals of Concern [COC]) either Qualitatively or Quantitatively, as appropriate, for:
    a. Groundwater
    b. Surface Water
    c. Streambed Sediments
    d. Soil (in spill areas)

4. Development of Cleanup Criteria for COIs/COCs
    a. Review Groundwater and Surface Water Cleanup Criteria (following DEQ guidance and considering that DEQ-7 Values are Cleanup Standards)
    b. Determine Human Health-Based Cleanup Criteria
    c. Determine Ecological-Based Cleanup Criteria
    d. Determine Leaching-Based Cleanup Criteria (Soil)
    e. Compare to Background Screening Levels (BSLs)
    f. Determination of Final Cleanup Criteria

5. Develop Recommendations for the Incorporation of the Cleanup Criteria into the Remedy Evaluation

Using the above described approach, the following groundwater COIs/COCs were identified for the SOEP/STEP area as presented in the Table below.

SOEP/STEP Groundwater COIs/COCs

CCR Appendix III Constituents	CCR Appendix IV Constituents	Other Potential SOEP/STEP Constituents
Boron	Cobalt	Manganese
Sulfate	Lithium	
	Selenium	

Note: Radium was not identified as a COI/COC; however, it will remain a COPC while additional radium groundwater data are collected. Radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring and continue to be evaluated under the AOC.

A SCEM is presented within this CCRA to identify the contaminant sources, affected environmental media, release and transport mechanisms, potential human and ecological receptors, and exposure pathways under the current and reasonably anticipated future uses of the SOEP/STEP area. The preparation of the SCEM is a requirement of the AOC, as well as a required element in conducting a risk assessment.

Executive Summary (Continued)

A Risk Assessment approach was developed and followed based on guidance of the AOC, as well as direction provided by the DEQ (2017a), in which DEQ indicated that risks should be evaluated for the SOEP/STEP area without the operation of the groundwater capture system. This SOEP/STEP CCRA Report presents both a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA) following DEQ's Risk Assessment guidance. The risk assessment process was used to identify COPCs beyond the constituents listed in the Appendices III and IV of the CCR Rule. Depending on the type of media, both quantitative (i.e., forward risk calculations) and qualitative evaluations (i.e., comparison to screening levels or standards) were conducted. Neither human health nor ecological COCs were retained for surface water, sediment, or soil. As a final step in the CCRA, Cleanup Criteria were developed for the identified COIs/COCs. Summaries of the risk assessments and Cleanup Criteria are presented below by medium.

<u>Surface Water (East Fork Armells Creek, the "Creek")</u>
Human health COPCs were not retained in surface water (see Section 10.1). Surface water has the potential to be used for livestock watering along the eastern edge of the SOEP/STEP area. Two ecological COPCs, boron and manganese, were identified in surface water. Manganese concentrations potentially pose a risk to benthic receptors (i.e., benthic macroinvertebrates living in sediment), while boron potentially poses a risk to aquatic life. The ecological COPCs were not found to pose a risk to livestock drinking surface water from the Creek, although the maximum concentrations of sulfate indicate the surface water is "marginal" for livestock watering (see Appendix C). Manganese and boron concentrations in the Creek appear to be consistent with background concentrations originating from regional geology, as well as coal mining and agricultural activities. Cleanup of surface water would be ineffective as background sources would continue to affect the Creek at the SOEP/STEP area. Therefore, manganese and boron were not retained as ecological COCs and Cleanup Criteria for surface water were not developed. No action is required in the Remedy Evaluation regarding surface water.

<u>Streambed Sediment</u>
One human health COPC, manganese, was identified in streambed sediments of the Creek at the SOEP/STEP area. However, concentrations in the streambed sediments were not found to pose a human health risk (see Section 9.1) and manganese was not retained as a human health COC. One ecological COPC, manganese, was identified in streambed sediments of the Creek that potentially poses a risk to benthic receptors (see Appendix C). However, manganese concentrations in streambed sediments appear to have originated from background sources (see Section 10.1). In addition, an aquatic habitat assessment and benthic community survey was conducted in upstream areas of the Creek (Arcadis, 2014) that indicated the lowest ratings of "fairly poor" to "poor" on the Hilsenhoff Biotic Index (HBI; see Section 6.1.3). The likely HBI would be similar for the Creek at the SOEP/STEP area. Cleanup of sediments would be ineffective as background sources would continue to affect the Creek at the SOEP/STEP area. Therefore, manganese was not retained as an ecological COC and Cleanup Criteria for streambed sediments were not developed. No action is required in the Remedy Evaluation regarding streambed sediments.

<u>Soil</u>

One human health COPC, Radium 226, was identified at the former spill sites at the SOEP/STEP area (see Section 6.3), but not retained as a human health COC (see Section 10.4). Ecological COPCs were

Executive Summary (Continued)

identified in the spill areas at the SOEP/STEP area at the screening phase of the Ecological Risk Assessment, but not retained as COCs in the Baseline Ecological Risk Assessment (see Appendix C). Therefore, soil was not found to pose either a human health or ecological risk. Leaching COPCs were evaluated by conducting Synthetic Precipitation Leaching Procedure (SPLP) analyses and calculating site-specific soil standards following DEQ guidance (NJDEP, 2013; DEQ, 2016). Leaching COIs/COCs were not retained for the spill areas of the SOEP/STEP area (see Section 10.2). No action is required in the Remedy Evaluation regarding soil in the spill areas.

Groundwater

Following DEQ guidance, human health risks were not forward calculated for groundwater. Rather, groundwater concentrations were compared to the DEQ-7 Standards as a qualitative evaluation of risk. If a DEQ-7 Standard was not available, groundwater concentrations were compared to the USEPA Maximum Contaminant Levels (MCL; if available) and the USEPA Tapwater RSL (if available) in accordance with the AOC.

Forward risk calculations were performed for ecological (livestock) risks associated with a groundwater stock well (901D) located near the northern border of the SOEP/STEP boundary. Groundwater pumped from Well 901D into a stock tank was not found to pose an unacceptable risk to livestock (see Appendix C). In addition, per DEQ's request, ecological (livestock) Cleanup Criteria for groundwater were also developed. Ecological (livestock) Cleanup Criteria for groundwater were limited to one scenario (livestock consumption via groundwater pumping into stock tanks). Table ES-1 below presents the groundwater COIs/COCs, DEQ-7 Standards, screening levels, BSLs, and proposed Cleanup Criteria by hydrostratigraphic unit.

The groundwater Cleanup Criteria should be used in the Remedy Evaluation to develop remedial alternatives to address COI/COC groundwater concentrations that exceed these values, including after the capture system is shut down. In addition, the remedial actions should address all the regulated substances listed in the AOC Control Action definition (Section IV.B.; DEQ/PPLM, 2012), which include three of the COIs/COCs (sulfate, boron, selenium), as well as potassium, sodium, magnesium, Total Dissolved Solids (TDS), and salinity. Radium concentrations in groundwater at the SOEP/STEP area appear to be consistent with background levels and radium was not identified as a groundwater COI/COC. However, because a radium groundwater BSL was not available for comparison, as a conservative measure radium will remain a COPC while additional groundwater data are collected. Radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring and continue to be evaluated under the AOC.

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Table ES-1 Groundwater Standards, Screening Levels and Proposed Cleanup Criteria – SOEP/STEP Area

COI/COC	Ground-water DEQ-7/MCL (mg/L)	USEPA Tapwater RSL (mg/L)	BSL Range (mg/L)	Ecological (Livestock) Cleanup Criterion (mg/L)	Cleanup Criterion Source	Proposed Cleanup Criteria: Alluvium (mg/L)	Spoils (mg/L)	Clinker (mg/L)	Coal-Related (mg/L)	SubMcKay (mg/L)
CCR Appendix III Constituents										
Boron	NA(6)	4	0.8 – 3.9	39 (1)	RSL	4 (RSL)	4 (RSL)	4 (RSL)	4 (RSL)	4 (RSL)
Sulfate	NA(6)	NA	2,150 – 3,140	3,000 (2)	Livestock/ BSL	3,000 (livestock)	3,000 (livestock)	3,140 (BSL)	3,000 (livestock)	3,000 (livestock)
CCR Appendix IV Constituents										
Cobalt	NA(6)	0.006	0.00066 – 0.0232	0.03 (1)	RSL/BSL	0.02 (BSL)	0.0232 (BSL)	0.0232 (4) (BSL)	0.006 (RSL)	0.006 (RSL)
Lithium	NA(6)	0.04	0.072 – 0.12	NA (3)	BSL	0.12 (BSL)	0.09 (BSL)	0.09 (4) (BSL)	0.072 (BSL)	0.072 (4) (BSL)
Selenium	0.05(7)	0.1	0.0024 – 0.01	0.28 (1)	DEQ-7	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)
Other Potential SOEP/STEP Constituents										
Manganese	NA(6)	0.43	0.26 – 2.48	61 (1)	RSL/BSL	0.61 (BSL)	2.48 (BSL)	0.67 (BSL)	0.48 (BSL)	0.43 (RSL)

Notes:

BSL Background Screening Level (Neptune, 2017)
CCR Coal Combustion Residual
COI Constituent of Interest
COC Chemical of Concern
MCL Maximum Contaminant Level
mg/L Milligrams per liter
NA Not available/not applicable
RSL Regional Screening Level

(1) Calculated Cleanup Criterion protective of livestock (calf), see Appendix C
(2) Upper limit of “marginal” sulfate range for livestock (USDA-ARS, 2009)
(3) Cleanup Criterion could not be calculated – no mammalian Toxicity Reference Value (TRV) available, see Appendix C
(4) BSL not available. BSL for adjacent hydrostratigraphic layer used as a proxy value.
(5) BSL not available. RSL assumed to be applicable.
(6) Neither a DEQ-7, nor an MCL has been established.
(7) Value is both the DEQ-7 and the MCL.

Executive Summary (Continued)

In addition, a comparison was made between the groundwater BSLs used in the preparation of the SOEP/STEP CCRA and for the Plant Site CCRA. At the time the groundwater BSLs were revised in 2017 (Neptune), the Plant Site CCRA Report (Canty, 2018a) had already been prepared and submitted to DEQ. As such, it was agreed that the 2016 BSLs would apply to the Plant Site CCRA and the 2017 BSLs would apply to the SOEP/STEP and 3&4 EHP CCRA Reports (DEQ, 2017e). Table ES-2 below compares the 2016 BSLs and the revised 2017 BSLs for the SOEP/STEP groundwater COIs/COCs. The revisions to the 2017 BSLs in comparison to the 2016 BSLs for the COIs/COCs were minimal (if at all).

Table ES-2 BSL Comparison for the SOEP/STEP Groundwater COIs/COCs

COI/COC	Alluvium (mg/L)		Spoils* (mg/L)		Clinker (mg/L)		Coal-Related (mg/L)		SubMcKay (mg/L)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
CCR Appendix III Constituents										
Boron	1.6	1.6	0.818	0.8	4	3.9	1.1	1	1.3	1.2
Sulfate	2,600	2,530	3,045	2,841	3,160	3,140	2,061	2,150	2,200	2,190
CCR Appendix IV Constituents										
Cobalt	0.02	0.02	0.0232	0.0232	NA	NA	0.0034	0.0034	0.00066	0.00066
Lithium	0.092	0.12	0.09	0.09	NA	NA	0.072	0.072	NA	NA
Selenium	0.009	0.009	0.0023	0.0024	0.01	0.01	0.005	0.01	0.005	0.005
Other Potential SOEP/STEP Constituents										
Manganese	0.6	0.61	2.79	2.48	0.67	0.67	0.54	0.48	0.27	0.26

Notes:

2016 Neptune, 2016. BSLs prepared in 2016 and used for the Plant Site CCRA (DEQ, 2017e).
2017 Neptune, 2017. Revised BSLs and used for the SOEP/STEP CCRA (DEQ, 2017e).
CCR Coal Combustion Residuals
COC Chemical of Concern
COI Constituent of Interest
mg/L milligrams per liter
NA Not analyzed
spoils* Spoils not present at the SOEP/STEP area.

The BSLs were used in the development of the groundwater Proposed Cleanup Criteria for instances when the DEQ-7 standard, or other appropriate screening levels, were lower than background levels. Under the AOC, cleanup criteria may not be more stringent than background (DEQ/PPLM, 2012). As a result of the 2017 revisions to the BSLs, the groundwater Proposed Cleanup Criteria varied slightly for three of the SOEP/STEP COIs/COCs in comparison to the Plant Site, as shown in Table ES-3.

Executive Summary (Continued)

Table ES-3 Groundwater Proposed Cleanup Criteria Comparison for the SOEP/STEP and Plant Site

COI/COC	Alluvium (mg/L)		Spoils* (mg/L)		Clinker (mg/L)		Coal-Related (mg/L)		SubMcKay (mg/L)	
	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP
CCR Appendix III Constituents										
Boron	4	4	4	4	4	4	4	4	4	4
Sulfate	3,000	3,000	**3,045**	**3,000**	**3,160**	**3,140**	3,000	3,000	3,000	3,000
CCR Appendix IV Constituents										
Cobalt	0.02	0.02	0.0232	0.0232	0.0232	0.0232	0.006	0.006	0.006	0.006
Lithium	**0.092**	**0.12**	0.09	0.09	0.09	0.09	0.072	0.072	0.072	0.072
Selenium	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Other Potential SOEP/STEP Constituents										
Manganese	**0.6**	**0.61**	**2.79**	**2.48**	0.67	0.67	**0.54**	**0.48**	0.43	0.43

Notes:
Bold SOEP/STEP Groundwater Proposed Cleanup Criterion differed from the Plant Site.
CCR Coal Combustion Residuals
COC Chemical of Concern
COI Constituent of Interest
mg/L milligrams per liter
spoils* Spoils not present at the SOEP/STEP area

1.0 INTRODUCTION AND PURPOSE

Hydrometrics, Inc. (Hydrometrics), on behalf of Talen Montana, LLC (Talen), retained Marietta Canty, LLC (Canty) and Neptune and Company, Inc. (Neptune) to prepare a Cleanup Criteria and Risk Assessment (CCRA) Report for the Wastewater Facilities Comprising the Closed-Loop System at the Units 1 & 2 Stage I Evaporation Pond (SOEP) and Stage II Evaporation Pond (STEP) area of the Colstrip Steam Electric Station (Colstrip SES), the "Facility", located in Colstrip, Montana (see Figure 1).

A CCRA Work Plan was previously prepared for the SOEP/STEP area of the Facility and submitted to the Montana Department of Environmental Quality (DEQ) in September 2017 (Canty, 2017a). The DEQ provided comments on the CCRA Work Plan on October 20, 2017 (DEQ, 2017d). The SOEP/STEP CCRA was submitted to the DEQ on December 19, 2017 (Canty, 2017b) and DEQ provided comments on April 12, 2018 (DEQ, 2018b). The revised SOEP/STEP CCRA was submitted to the DEQ on June 11, 2018 (Canty, 2018b) and DEQ provided comments on August 2, 2018 (DEQ, 2018c), which are addressed within this report. Comment responses for the DEQ comments to the CCRA Work Plan; the December 19, 2017 CCRA; and the June 11, 2018 CCRA are provided within (Appendix J).

1.1 FACILITY BACKGROUND

The Colstrip SES Facility is a zero-discharge facility. As such, there are no direct wastewater discharge points from the Plant Site to surface water. East Fork Armells Creek (the "Creek") runs through the eastern edge of the SOEP/STEP area adjacent to Highway 39 and downgradient of the SOEP/STEP area. Seepage losses from the SOEP and STEP ("ponds") have migrated from the ponds to shallow groundwater. In addition, because the shallow groundwater gradient is toward the "Creek", constituents in groundwater could potentially migrate toward Creek alluvium. Facility-related wastewater constituents are anticipated to be largely derived from constituents that occur naturally in the coal formations. To mitigate migration of the seepage losses, numerous capture wells have been placed at the SOEP/STEP area that provide ongoing groundwater capture, and to contain the potential migration of groundwater constituents toward Creek alluvium.

In addition, some pond liner systems have been upgraded or replaced to reduce seepage, additional site awareness training has been conducted, and more efficient reuse of water is being implemented.

1.2 REGULATORY HISTORY

1.2.1 Administrative Order on Consent

To address seepage losses from the SOEP/STEP ponds and potential wastewater migration, PPL Montana, Inc. (PPLM; Talen's predecessor) and the DEQ entered into an Administrative Order on Consent (AOC) Regarding Impacts Related to Wastewater Facilities Comprising the Closed-Loop System at the Colstrip SES on August 3, 2012, (DEQ/PPLM, 2012). It is important to note that the AOC addresses impacts related to wastewater and does not address other media (unless impacted by the wastewater).

As part of the AOC, PPLM committed to prepare Site Reports for the three Colstrip SES Areas, as follows: (1) the Plant Site, (2) the SOEP/STEP, and (3) the Units 3&4 Effluent Holding Pond (3&4 EHP) areas (see Figure 1 for a depiction of these areas). These site reports are the basis for further remedial activities under the AOC. A fourth category of reporting, involving area process wastewater pipeline spills or releases not included in one of the previously mentioned areas, and other miscellaneous areas that are mutually agreed upon by the parties to address in the AOC, was also defined. All past process wastewater spills and releases have fallen into one of the three areas defined earlier in this paragraph.

The development of cleanup criteria, as well as human health and ecological risk assessments, associated with the wastewater of the SOEP/STEP area, are included within this report. A CCRA Report has been prepared for the Plant Site and submitted to the DEQ (Canty, 2018a). The cleanup criteria and human health and ecological risk assessments for the wastewater associated with the 3&4 EHP area of the Colstrip SES Facility will be addressed in future documents.

The requirements of the AOC are provided in a detailed summary located in Appendix A. In summary, the AOC requires the CCRA Report to identify, at a minimum, the following (Article VI.B):

- Cleanup Criteria for the Constituents of Interest (COIs[1]);
- Identification of transport mechanisms for the COIs;
- Identification of potential receptors;
- Identification of exposure pathways; and
- If there are COIs, recommendation of additional site characterization needed to determine what, if any, human health or ecological risks are posed by releases from the Site.

Lastly, the AOC indicates:

- If the CCRA identifies one or more COIs that exceed Cleanup Criteria, then remedial measures are necessary and a Remedy Evaluation Report shall be prepared.

- If the CCRA does not identify COIs that exceed Cleanup Criteria, then remedial measures are not needed and there is no need for further action.

1.2.2 USEPA Coal Combustion Residuals Rule

Future pond closure at the SOEP/STEP area will be conducted in accordance with the new United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Final Rule, and the planned shutdown of Units 1 and 2 at the Plant Site. The new USEPA CCR Final Rule was initially signed December 19, 2014, was published in the Federal Register on April 17, 2015 (80 FR 21301), and became fully effective in October 2015 (USEPA, 2017a).

The USEPA finalized the CCR regulations to provide comprehensive rules for the safe disposal of coal ash from coal-fired power plants. The rule establishes technical requirements for CCR landfills and surface impoundments under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

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1 *The AOC (DEQ/PPLM, 2012; Article IV.F) defines COIs as those parameters found in soil, groundwater, or surface water that (1) result from Site operations and the wastewater facilities and (2) exceed background or unaffected reference area concentrations. The AOC subsequently defines the development of cleanup criteria for the COIs generally following the DEQ risk assessment process (DEQ, 2017b). The DEQ refers to potential contaminants within their Risk Assessment Scope of Work (DEQ, 2017b) as Chemicals of Potential Concern (COPCs), and, if retained after assessment, Chemicals of Concern (COCs). As part of the risk assessment process, parameters were screened against background concentrations, as well as other appropriate screening levels following the DEQ risk assessment process. As such, the terms COIs and COPCs/COCs have nearly synonymous definitions for the purposes of this CCRA and are, therefore, used interchangeably within this report for practicality.*

Various activities at the SOEP/STEP area will be conducted in accordance with the CCR Rule. Because requirements of the CCR Rule will be implemented at the portions of the SOEP/STEP area under the CCR Rule, the requirements of the CCR Rule should be considered in conjunction with the requirements of the AOC at those areas. As such, requirements of both the CCR Rule and the AOC were considered in the preparation of this CCRA.

1.3 CCRA REPORT APPROACH

The following general approach for the CCRA Report was followed based on prior discussions with the DEQ (DEQ, 2017a):

1. Identification of the SOEP/STEP COIs beginning with the list of CCR Rule detection and assessment monitoring constituents (Appendices III and IV)
    a. Begin with Source Data (Pond Data), as worst-case data
    b. Consider the CCR Well data, which are also worst-case (if any) because they were collected at the pond boundaries and total metals are analyzed, rather than dissolved
    c. Consider DEQ-7 Standards
    d. Consider USEPA Maximum Contaminant Level (MCL) and USEPA Regional Screening Levels (RSLs) for Tapwater
    e. Consider Background Screening Levels (BSLs)
    f. Consider other constituents potentially posing a Human Health or Ecological Risk
2. Preparation of the Site Conceptual Exposure Model (SCEM), including identification of the following:
    a. Potential Sources
    b. Potential Release Mechanisms
    c. Potential Media
    d. Potential Exposure Pathways
    e. Potential Receptors
3. Assess Human Health and Ecological Risks Assessment Associated with the COIs (also referred to as Chemicals of Potential Concern [COPCs], and, if retained after assessment, Chemicals of Concern [COCs]) either Qualitatively or Quantitatively, as appropriate, for:
    a. Groundwater
    b. Surface Water
    c. Streambed Sediments
    d. Soil (in spill areas)
4. Development of Cleanup Criteria for COIs/COCs
    a. Review Groundwater and Surface Water Cleanup Criteria (following DEQ guidance and considering that DEQ-7 Values are Cleanup Standards)
    b. Determine Human Health-Based Cleanup Criteria
    c. Determine Ecological-Based Cleanup Criteria
    d. Determine Leaching-Based Cleanup Criteria (Soil)
    e. Compare to BSLs
    f. Determination of Final Cleanup Criteria
5. Develop Recommendations for the Incorporation of the Cleanup Criteria into the Remedy Evaluation

2.0 FACILITY OPERATION, BACKGROUND AND DESCRIPTION

2.1 FACILITY OPERATION

The Colstrip SES (the Facility) is located in the city of Colstrip, within Rosebud County in the south central area of the State of Montana. The Facility consists of four units: Units 1 and 2 are 333 megawatts each; and Units 3 and 4 are 805 megawatts each. Construction on Units 1 and 2 began in 1972 and they came on-line in the mid-1970s. Units 3 and 4 were constructed later; Unit 3 came on-line in 1983 and Unit 4 came on-line in 1985. Talen is the operator and an owner of the Facility, which is co-owned by PacifiCorp, Puget Sound Energy, Inc., Portland General Electric Company, Avista Corporation, and NorthWestern Corporation (Hydrometrics, 2015).

The Facility generates electricity through the combustion of coal. Fly ash, a by-product of coal combustion, is removed by air scrubber systems to reduce emissions. Bottom ash collects at the bottom of the boiler. Fly ash, bottom ash, and some Facility wastewaters contain constituents of the original coal. A closed-loop process water/scrubber system is used at the Facility to reduce impacts to water resources in the area. Ash and water based liquid wastes from the generating plants are impounded in ponds designed and constructed to control seepage losses. The Plant Site pond system includes ponds that serve all four generating units in various capacities. Fly ash disposal is not currently conducted on the Plant Site, but rather in holding ponds at two locations: (1) to the northwest of the Plant Site at the Units 1&2 SOEP/STEP and (2) to the east of the Plant Site at Units 3&4 EHP. Amounts of fly ash deposited during previous operations remain in the Plant Site Units 1&2 Pond A. Flyash previously routed to the Units 3&4 Wash Tray Pond and Units 3&4 Scrubber Drain Collection pond has been removed from these ponds and each was converted to storm water ponds. Process ponds at the Facility have been servicing Colstrip Units 1&2 since 1975, although locations, function, and pond construction have changed, including closures and reconstruction (Hydrometrics, 2015).

Portions of the Facility pond systems are presently being updated to meet the requirements of the new USEPA CCR Final Rule that was initially signed into effect December 19, 2014 and became fully effective in October 2015 (USEPA, 2017a).

2.2 UNITS 1&2 SOEP/STEP AREA BOUNDARY

The SOEP/STEP area boundary was established and presented in the AOC to include (1) the active operations area, (2) pipelines in the area, and (3) areas influenced by the groundwater capture system. Some of the areas included in the SOEP/STEP area boundary are beyond the property line of areas owned by Talen. Figure 2 presents the boundary of the SOEP/STEP area.

2.2.1 Active Operations Area/Controlled Access Area

The active operations area of the SOEP/STEP is a fenced, controlled access area. The active operations area is co-owned by Talen and Puget Sound Energy. Figure 2 depicts the fencing at the SOEP/STEP area.

2.2.2 Pipeline Areas/Uncontrolled Access Area

Various pipeline areas of the SOEP/STEP area are located outside the fenced area and have uncontrolled access. The pipeline areas may or may not be owned by Talen (and co-owners), but are generally considered to be part of the SOEP/STEP area because of the presence of pipelines.

2.2.3 Groundwater Capture Areas/Uncontrolled Access Area

Portions of the areas affected by the groundwater capture system are located outside the fenced area and also have uncontrolled access. An example is the area west and adjacent to Highway 39 located downgradient and east of the evaporation ponds (see Figures 2 and 3) that was included within the SOEP/STEP area boundary because of the active groundwater capture occurring within that area.

2.3 PHYSICAL CHARACTERISTICS OF THE FACILITY

2.3.1 Regional Geology

Colstrip is located in the northern portion of the Powder River Basin, an asymmetrical basin oriented northwest to southeast. This structural basin is responsible for the general regional orientation of bedding. “In general, Fort Union Strata dip very gently (less than a few degrees) in easterly and southerly orientations from west to east across the coalfield, respectively. Locally, however, dips are steepened by high-angle faults that are present at the Colstrip area” (Roberts, et. al, 1999, as cited in Hydrometrics, 2015).

Stratigraphy in the Colstrip area consists of, in descending order, the Fort Union Formation, Hell Creek/Lance Formation, Fox Hills Sandstone, and Bearpaw Shale. The Fort Union Formation is divided into three members; the upper Tongue River Member, the middle Lebo Shale Member, and the lower Tullock Member. The Tongue River Member is at the surface in the Colstrip area. The deeper Lebo Shale, and then the Tullock Members are exposed to the north. At Colstrip, the total thickness of the Fort Union Formation is about 650 feet. The Lebo Shale is typically about 75-125 feet thick and is found at variable depths in the Colstrip area depending on the amount of erosion that the Tongue River member has undergone (Hydrometrics, 2015).

The Fort Union Formation consists of alternating and intercalated deposits of shale, claystone, mudstone, siltstone, sandstone, carbonaceous shale and coal. The formation was deposited in a fluvial system of meandering, braided, and anastomosed streams near the basin center and by alluvial fans at the margins. The fluvial systems were typically oriented northeast-southwest (Flores and Ethridge, 1985 as cited in Hydrometrics, 2015).

- Anastomosing streams consist of multiple channels within a single drainage. Individual floodplains of an anastomosing system may include braided or meandering, or straight characteristics. Deposition typically occurs under low energy conditions near a local base level (Makaske, 2000 as cited in Hydrometrics, 2015).
- Braided flow systems consist of a network of flow channels within a single floodplain or flow belt (Makaske, 2000 as cited in Hydrometrics, 2015). These channels have multiple thalwegs that branch back and forth from single to multiple channels.

- Meandering streams consist of one or more individual channels that migrate back and forth across a single floodplain. Meandering channels consist of one thalweg.

Numerous coal seams are present in the Tongue River Member of the Fort Union Formation, the result of peat deposits that accumulated in swampy areas and channels. A tropical to sub-tropical climate resulted in thick peat deposits within the swamps and bogs (Nicols and others, 1989, Flores, R.M. and others, 1999 as cited in Hydrometrics, 2015). Because of the depositional setting, the coal beds may pinch out laterally or stop abruptly. The main coal seams of interest near Colstrip are the sub-bituminous Rosebud (~ 24 feet thick) and McKay seams (~ 8-10 feet thick), which can economically be strip-mined. These two coal seams merge into a single seam on the west side of the Little Wolf Mountains near the Absaloka Mine. The Rosebud Coal, however, is the only seam mined in the Colstrip SES Facility area due to quality of the McKay Seam which makes it currently undesirable for use in many coal-fired boilers. Both the Rosebud and McKay coals are generally cleated. That is, they contain natural vertical fracturing generally oriented roughly perpendicular to the bedding plane. Hydraulic conductivity of the coal seams is typically around one to three feet per day, but fluctuates locally.

The Rosebud Coal, and in some places, the McKay Coal has burned. This is most easily identified as red cap rock on hilltops around the region. Burning of the coal baked the overlying strata. As a result of the burning, the coal volume reduced either leaving a void for the overlying rock to collapse in or resulted in slow settling of the overlying rock into the space formerly held by the coal. The thermally altered rock is referred to as clinker or scoria. Collapse of the rock resulted in secondary porosity (fractures).

The depositional setting results in numerous lateral facies changes within the sedimentary rock deposits. Channel sandstones often grade laterally into siltstones or shale (facies changes) resulting in preferential pathways for groundwater flow within the more permeable sandstone. Cementation, or the chemical binding of individual grains to one another, is highly variable within the units, mostly consisting of weak calcium carbonate cement although thin deposits with silica cementation also occur. Localized thin limestone beds may also exist. The combination of the depositional setting of the Fort Union Formation which resulted in lateral facies changes, variations in the lithologies of vertical sequences (sandstone, siltstone, shale), mining disturbances that have interrupted the original depositional setting, formation of highly fracture clinker from in situ coal burning, secondary porosity (minor fractures in bedrock) combined with erosion and deposition from the creek result in vertical and horizontal anisotropy (the condition of having different properties in different directions) and heterogeneities (variations through space within a geologic formation). Although driven by potentiometric heads, because of the anisotropic and heterogeneous nature of the geology, groundwater flow may not always follow a direct path from high potentiometric heads to lower head areas.

Alluvium is present along many of the drainage bottoms. The most prominent deposit at the Colstrip SES Facility is along the Creek. The majority of alluvium in the SOEP/STEP area occurs in the eastern portions along the Creek. In this area, alluvial deposits of clay, silt, sand and gravel reach thickness of 35 feet or more. A basal gravel, comprised of clinker, is often present in the alluvium. Clinker fragments are typically also found throughout finer-grained alluvial deposits. A smaller alluvial deposit is contained in the bottom of the drainage that holds the SOEP/STEP. This deposit is typically finer-grained with thicknesses up to about 18 feet. East of the STEP Main Dam, the alluvium is slightly thicker (about 25 feet) and coarser-grained near the confluence with the East Fork Armells Creek alluvium.

The ancestral East Fork Armells Creek eroded through the shallow bedrock, including the Rosebud and McKay Coals into the sub-McKay deposits. This results in the potential for groundwater flow from the eroded units into the alluvium. The Creek alluvium acts as a hydrologic sink in the vicinity of the Colstrip SES Facility. This "hydrologic sink" tends to collect groundwater limiting, or eliminating, flow from one side of the creek to the other in shallow deposits.

2.3.2 Groundwater

The classification and a description of the groundwater at the Facility are provided below.

Groundwater Classification

The BSLs (Neptune, 2017) calculated that unimpacted background groundwater for all units at the Facility had a specific conductance (SC) greater than 2,500 µmhos/cm (equivalent to microSiemens/cm) ranging from 3,997 to 4,810 µmhos/cm. As such, groundwater at the Facility is a typical Class III water.

According to the Administrative Rules of Montana (ARM) 17.30.1006 Classifications, Beneficial Uses, and Specific Standards for Ground Waters, Class III ground waters are those ground waters with a natural specific conductance that is greater than 2,500 and less than or equal to 15,000 microSiemens/cm at 25°C. Further, ARM 17.30.1006(3) states:

(a) The quality of Class III ground water must be maintained so that these waters are at least marginally suitable for the following beneficial uses:

- (i) Irrigation of some salt tolerant crops;
- (ii) Some commercial and industrial purposes;
- (iii) Drinking water for some livestock and wildlife; and
- (iv) Drinking, culinary, and food processing purposes where the specific conductance is less than 7,000 microSiemens/cm at 25°C.

(b) Except as provided in ARM 17.30.1005(2), a person may not cause a violation of the following specific water quality standards for Class III ground water:

- (i) the human health standards listed in DEQ-7, except that the nitrate and nitrogen and nitrate plus nitrite nitrogen standards listed in DEQ-7 do not apply to groundwaters with specific conductance equal to or greater than 7,000 microSiemens/cm at 25°C. The nitrate nitrogen and nitrate plus nitrite nitrogen standards for these waters are each 50 milligrams per liter (mg/L); and
- (ii) for concentrations of parameters for which human health standards for ground water are not listed in DEQ-7, no increase of a parameter to a level that renders the waters harmful, detrimental, or injurious to the beneficial uses listed for Class III water. The department may use any pertinent credible information to determine these levels.

(c) The nondegradation provisions of 75-5-303, Montana Code Annotated (MCA), do not apply to Class III ground water.

Groundwater Description

Various lithological units are present at the Colstrip SES Facility. These are, in ascending order; sub-McKay, McKay Coal, Rosebud-McKay Interburden (interburden), Rosebud Coal, spoil (laterally equivalent to the Rosebud Coal), overburden, and alluvium. Only the alluvium, McKay Coal, spoil and sub-McKay could accurately be referred to as hydrostratigraphic units. Intervals that are not aquifers include the overburden due to its limited extent and general absence of producible quantities of water; the Rosebud Coal because it is largely mined out, burned, or dry; and the interburden due to its limited water content.

The following groundwater description begins with the deepest formation and proceeds to the shallowest formation. The deepest sub-McKay (lower than about elevation 3,100 feet mean sea level [msl], is generally considered to not be impacted by process water. Deep groundwater in the sub-McKay units generally flows to the northeast under a regional gradient with presumed discharge points located at various locations to the north. Impacts to the shallower sub-McKay have been identified at various locations around the SOEP/STEP area, in particular the north and east sides.

Spoil typically has a higher overall vertical permeability than the undisturbed sedimentary rocks. This is due to the fact that low permeability layers, such as claystone, shale, or clayey siltstone are broken up during mining and are placed back into the pits in random order and orientation. This removes the lateral continuity of confining or semi-confining layers that tend to restrict downward flow. The effect is generally an increase in the overall vertical hydraulic conductivity of the spoil as related to the undisturbed sedimentary rock which results in a thick sequence of spoil that is capable of storing water (little restriction to vertical flow). Spoil is not present in the SOEP/STEP area, but is present a short distance to the southwest of the SOEP.

Shallow groundwater flow directions at the SOEP/STEP area are locally changed by the operation of current capture systems (described in more detail below within this Section). Under non-pumping conditions, shallow groundwater flow is generally expected to mirror the topography with flow toward the east or northeast. Under pumping conditions, overall shallow groundwater flow is locally diverted and interrupted by the capture systems.

It is not uncommon in the Colstrip area to encounter completely dry intervals between hydrostratigraphic units, indicating there is no vertical flow existing at these locations. Actual vertical flow between separate saturated units is controlled by the hydraulic conductivity of the individual units, the hydraulic conductivity of the intermediate unit, and the difference in head between units.

Several indicator parameters are used to evaluate potential process wastewater impacts to groundwater at the SOEP/STEP area. These include SC, dissolved boron, chloride, sulfate, and the ratio of calcium to magnesium. Chloride is considered a secondary indicator parameter due to multiple potential area sources that cause a high degree of concentration variability.

Existing groundwater capture systems in the areas where the highest concentrations of indicator parameters have been observed (both in the shallow units and in the McKay Coal) limit migration of impacted groundwater away from the Colstrip SES Facility. At the SOEP/STEP area, capture wells are located downgradient of the evaporation ponds. Consequently, the SOEP/STEP area capture wells are located between the evaporation ponds and the Creek (see Figure 3). Capture wells are designed to capture shallow groundwater prior to it reaching the Creek. Capture wells are also designed to intercept deeper groundwater.

2.3.3 Surface Water

The classification and a description of the surface water at the Facility are provided below.

Surface Water Classification

The nearest natural surface water is East Fork Armells Creek (the "Creek"). The Creek is part of the Yellowstone River Drainage. The water-use classification listed in ARM 17.30.611 for the Yellowstone River Drainage, described as follows, is subject to C-3 Classification Standards: (c) Yellowstone River Drainage from the Billings water supply intake to the North Dakota state line and including the Big Horn River drainage [except the water listed in (1)(c)(i) through IX-C-3 17.30.629].

The Creek is classified as a C-3 water, which means that the water is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply. A C-3 water generally needs pre-treatment in order to be used as a potable water supply. Specifically, ARM 17.30.629 states:

(1) Waters classified C-3 are to be maintained suitable for bathing, swimming, and recreation, and growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of these waters is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified C-3:

(a) The water quality standard for Escherichia coli bacteria (E-coli) varies according to season, as follows:
(i) from April 1 through October 31, the geometric mean number of E-coli may not exceed 126 colony forming units per 100 milliliters and 10% of the total samples may not exceed 252 colony forming units per 100 milliliters during any 30-day period; and
(ii) from November 1 through March 31, the geometric mean number of E-coli may not exceed 630 colony forming units per 100 milliliters and 10% of the samples may not exceed 1,260 colony forming units per 100 milliliters during any 30-day period.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards specified in department Circular DEQ-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units, except as permitted in 75-5-318, MCA.

(e) A 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 77°F; within the range of 77°F to 79.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 80°F; and where the naturally occurring water temperature is 79.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F. A 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five color units above naturally occurring color.

(h) Concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters may not exceed the applicable standards set forth in Department Circular DEQ-7 and, unless a nutrient standards variance has been granted, Department Circular DEQ-12A.

(i) (j) [Associated with discharge permits – not applicable for the Facility].

(k) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

Surface Water Description

Regionally, the Creek is an intermittent stream, but it generally flows continuously through the town of Colstrip along the western edge of the Plant Site and including the golf course area along the eastern edge of the SOEP/STEP area (see Figures 1, 2, and 3). However, flow in the Creek may be diminished to zero during late summer and early fall, particularly during extended periods of low precipitation and high temperatures. Flow directly upstream and downstream of Colstrip, as well as tributary drainages to the Creek, is ephemeral and is observed only in response to storm water or precipitation runoff events.

At the SOEP/STEP area, the topography slopes downward from the evaporation ponds to the east/northeast toward the Creek. Colstrip SES is a zero-discharge facility, so there are no direct wastewater discharge points from the Facility to the Creek. Shallow groundwater from the SOEP/STEP area flows toward the east/northeast in the direction of the Creek, though as discussed previously, a series of capture wells interrupts the flow of groundwater toward the Creek alluvium.

The City of Colstrip sewage treatment ponds are located adjacent to the west bank of the Creek north and downstream of the Plant Site and east and upstream of the SOEP/STEP area. Facility data indicate the sewage effluent ponds are contributing flow to the Creek. Data suggesting the Creek is receiving water from the treated sewage effluent ponds includes: increases in flow through the reach adjacent to the ponds; field observations; and variations in water quality observed above and below the ponds.

An irrigation pond at a public golf course (Ponderosa Butte) is located along the Creek downstream of the sewage effluent ponds and east of the SOEP/STEP area. Treated water from the Colstrip wastewater treatment pond is pumped to this irrigation pond. Water from the pond is used for golf course irrigation. Castle Rock Lake is located west of the Creek and possibly contributes to flow in the Creek.

Surface water in the Creek varies in depth and flow rate throughout the year. In the area adjacent to the Plant Site and the SOEP/STEP area, the Creek is generally shallow and slow moving with abundant emergent aquatic vegetation present during the summer and fall months. In general, the Creek gains flow through the town of Colstrip. Higher amounts of flow are gained directly downstream of the City of Colstrip Wastewater Treatment Ponds. During the summer months, the Creek also may gain flow in the area of the golf course as a result of irrigation. Note that flow in the Creek decreases directly downstream of the north end of the golf course as surface water infiltrates to groundwater. The variable water levels within the Creek likely limit the types and abundance of aquatic organisms.

2.4 DEMOGRAPHICS AND LAND USE

2.4.1 Demographics

As of the 2010 Census, the population of Colstrip was 2,214 people, which included 863 households and 622 families (United States Census Bureau, 2014). The Colstrip SES Facility employs approximately 360 people (PPLM, 2014).

2.4.2 Past/Current Land Use

Colstrip was established in 1924 by Northern Pacific Railroad to provide coal for steam locomotives. Sub-bituminous coal was/is mined from the Fort Union Formation. In 1958, diesel fuel replaced coal to power the trains and the Montana Power Company (MPC) purchased the rights to the mine.

The Plant Site has been used as the location of a coal-fired power plant since the mid-1970's. A portion of the Plant Site was mined for coal prior to construction of the power plant units that commenced in 1972. In addition, soil, shallow bedrock, and coal were excavated from below the plant itself prior to construction.

The water supply for the Colstrip SES Facility and the town of Colstrip is Castle Rock Lake, which stores water pumped via a 30-mile pipeline from the Yellowstone River located to the north. Groundwater near the SOEP/STEP area is generally not currently used as drinking water; however, one well, PW-739, located near the northern boundary is an operating, private domestic well. Another well, PW-733, located to the northeast of the ponds along Highway 39, is not presently used as a domestic well, but has the potential for domestic use in the future. The locations of the remainder of the domestic wells present in the SOEP/STEP area were conservatively connected to the City of Colstrip water supply system by PPLM. One non-domestic groundwater well, 901D located within the SOEP/STEP area near the northern boundary, is used for livestock watering. Private wells in the SOEP/STEP area are depicted in Figure 4.

Surface water (i.e., East Fork Armells Creek) is currently used for livestock watering in the area between the golf course and the Power Road Overpass.

Figure 5 depicts current land uses at the SOEP/STEP area.

2.4.3 Future Use

The Facility is reasonably anticipated to remain as the location of a coal-fired power plant well into in the future. The SOEP/STEP area is anticipated to remain as the evaporation ponds area for Units 1&2. The associated land use activities in the town and at the SOEP/STEP area are reasonably anticipated to remain into the future.

In the future, groundwater is not anticipated to be used as drinking water, except for well PW-739 and possibly well PW-733, because PPLM facilitated the connection of the remaining private properties with wells to the City of Colstrip water supply. One well, 901D, is anticipated to be periodically used for livestock watering. Future drilling of the domestic wells in the SOEP/STEP Area is not anticipated to be allowed based on previous PPLM actions (i.e., facilitated connection of private wells to City water). However, institutional controls are not in place to prevent the future domestic use of groundwater.

In the SOEP/STEP area, limited use of groundwater for irrigation or livestock watering is expected. However, the potential for future use as irrigation water is limited by yield and quality. Institutional controls are not in place to prevent irrigation/livestock use of groundwater.

DEQ-7 Standards apply to all groundwater in Montana and, hence, all groundwater at the Facility regardless of usage. Again, no institutional controls are in place to prevent the domestic or irrigation/livestock use of groundwater. It should be noted that if a remedial action includes institutional controls, that determination will not occur until DEQ chooses the final site remedy.

In the future, surface water (i.e., East Fork Armells Creek) may be used for livestock watering, particularly in the area between the golf course and the Power Road Overpass.

3.0 IDENTIFICATION OF CONSTITUENTS OF INTEREST

The AOC applies to wastewater at the Colstrip SES, which is a closed-loop system that does not discharge wastewater. To identify the SOEP/STEP COIs/COPCs as required by the AOC, data from the primary source of the potential constituents (i.e., the SOEP/STEP ponds) were used. The constituents present in the SOEP/STEP ponds in the dissolved state have the potential for migration into groundwater.

As a first step in the identification of the COIs/COPCs, the dissolved pond water concentrations (i.e., filtered samples) presented in the Units 1 & 2 SOEP/STEP AOC Site Report (Hydrometrics, 2017b) for the constituents listed in Appendices III and IV of the CCR Rule (USEPA, 2017a) were compared to the standards and screening levels presented in the AOC. Data were not available in the SOEP/STEP AOC Site Report (Hydrometrics, 2017b) for two Appendix IV constituents, lithium and Radium 226/228. Recognizing this data gap, Hydrometrics collected STEP water samples on April 27, 2017 that were analyzed for these two constituents (Hydrometrics, 2017c).

As a second step in the identification of the COIs/COPCs, available data from numerous CCR wells installed around the perimeters of the STEP ponds (Units 1&2 Step E Cell, Stage II Evaporation Pond, Old Clearwell, New Clearwell B Cell, Units 1&2 Step D Cell) were compared to the standards and screening levels presented in the AOC. However, the CCR well data are generally total recoverable concentrations and, therefore, not directly comparable to groundwater standards and screening levels that are based on dissolved concentrations. Consequently, the CCR well data were used as a secondary, qualitative screening approach if concentrations of the CCR Appendices III and IV constituents if the pond water samples exceeded standards and screening levels. Because the CCR well data are generally total recoverable concentrations, comparisons of CCR well data to screening levels based on dissolved concentrations results in a conservative bias. However, screening levels for radium are based on total concentrations and, therefore, a conservative bias does not apply to radium. A total of 26 groundwater wells are used at the SOEP/STEP area to collect data required by the CCR Rule. Figure 6 depicts the locations of the CCR wells. CCR well data used in the COI/COPC identification process are presented in Appendix F.

In addition to the CCR Appendices III and IV constituents, additional constituents were assessed as potential COIs/COPCs that are present in the wastewater and had the potential to cause a human health or ecological risk.

Table 3-1 presents various standards and screening levels for the CCR Appendix III and Appendix IV constituents, as well as other potential constituents identified in the risk assessment process.

Table 3-1 Potential SOEP/STEP Wastewater COIs/COPCs

Constituent	Groundwater DEQ-7 Standard (mg/L)	MCL (mg/L)	USEPA Tapwater RSL (mg/L)	BSL Range (mg/L)	Toxicity (in water)
CCR Rule Appendix III Constituents					
Boron	NA	NA	4	0.8 – 3.9	non-carc
Calcium	NA	NA	NA	303 -477	non-carc*
Chloride*	NA	NA	NA	21-52	NA
Fluoride	4	4	0.8	0.4 – 2.11	non-carc
Sulfate	NA	NA	NA	2,150 – 3,140	non-carc*
pH (lab)	NA	NA	NA	7.8 – 8.27 s.u.	NA
TDS	NA	NA	NA	3,445 – 5,010	NA
CCR Rule Appendix IV Constituents					
Antimony	0.006	0.006	0.0078	0.15 – 0.4	non-carc
Arsenic	0.01	0.01	5.2×10^{-5}	0.005	carc
Barium	1	2	3.8	0.024 – 0.27	non-carc
Beryllium	0.004	0.004	0.025	0.0002 – 0.02	non-carc
Cadmium	0.005	0.005	0.0092	0.002 – 0.01	non-carc
Chromium	0.1	0.1 (a)	NA	0.0146 – 0.1	non-carc
Cobalt	NA	NA	0.006	0.00066 – 0.0232	non-carc
Fluoride	4	4	0.8	0.4 – 2.11	non-carc
Lead	0.015	0.015 (b)	0.015	0.01 – 0.08	non-carc
Lithium	NA	NA	0.04	0.072 – 0.12	non-carc
Mercury	0.002	0.002 (c)	6.3×10^{-4}	0.001 – 0.005	non-carc
Molybdenum	NA	NA	0.1	0.004 – 0.1	non-carc
Radium 226/228	5 pCi/L	5 pCi/L	NA	NA	carc
Selenium	0.05	0.05	0.1	0.0024 – 0.01	non-carc
Thallium	0.002	0.002	0.0002	0.0003 – 0.05	non-carc
Other Potential SOEP/STEP Constituents (Identified in the Risk Assessment Process)					
Manganese	NA	NA	0.43	0.26 – 2.48	non-carc

Notes:

(a)	value for total chromium
(b)	lead treatment technology action level is 0.015 mg/L
(c)	value for inorganic mercury
Chloride*	Chloride is a secondary indicator parameter
BSL	Background Screening Level (Neptune, 2017)
DEQ-7	Montana Numeric Water Quality Standard (DEQ, 2017c)
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
NA	Not Available/Not Applicable
non-carc*	assumed non-carcinogenic, common constituent, human health toxicity data not available
pCi/L	picocuries per liter
RSL	Regional Screening Level (USEPA, 2017b)
s.u.	Standard Units

Tables 1A through 1C, located in the Tables section, present a summary of the SOEP/STEP pond water data for the potential COIs that were presented in the Units 1 & 2 SOEP/STEP AOC Site Report (Hydrometrics, 2017b). Table 1A presents a summary of the CCR Appendix III constituents. Table 1B presents a summary of the CCR Appendix IV constituents. Table 1C presents a summary of other potential groundwater SOEP/STEP constituents that were selected based on the human health and ecological risk assessments.

Please note that the pH of the pond samples was routinely measured in the laboratory, rather than in the field (Hydrometrics, 2017b). The DEQ (2018) commented that field pH measurements should be used when possible, rather than laboratory pH measurements. Although this may be true in some instances, overall the data are comparable. Comparability is the expression of the degree of confidence with which one data set can be compared with another (USEPA, 2017d). The limited field pH measurements available for the STEP ponds are presented in Table 3-2 below for the purpose of comparison to laboratory pH measurements. A comparison between laboratory and field pH measurements shows a low relative percent difference. Based on this limited dataset, the laboratory and field pH values are comparable.

Table 3-2 Comparison of Laboratory and Field pH Measurements - STEP Ponds

STEP Pond	Sampling Date	pH –Lab (s.u.)	pH – Field (s.u.)	Relative Percent Difference (%)
STEP	4/27/2017	5.2	4.91	3.86
STEP	12/18/2002	4.9	5.0	1.34
STEP	3/14/2007	6.7	6.5	2.03
STEP	3/14/2007	6.5	6	5.41
STEP Cell A	8/22/2000	7.3	7.2	0.92
STEP Cell A	7/18/2012	6.4	6.35	0.52
STEP Cell D	4/27/2017	4.2	4.35	2.33
STEP Cell D	7/18/2012	4.9	4.83	0.96
STEP Cell E	4/27/2017	5.1	4.5	8.51
STEP Cell E	3/14/2017	5.2	5.2	0.0
STEP Cell E	3/14/2007	5.0	6	11.76
STEP Cell E	7/19/2012	7	6.84	1.55
Average Relative Percent Difference				**3.27**

Table 2, located in the Tables section, presents the groundwater BSLs (Neptune, 2017) by hydrostratigraphic layer for the CCR Appendices III and IV Constituents, as well as the other potential SOEP/STEP constituents.

Table 3, located in the Tables section, presents the screening for the identification of COIs/COPCs. The rationale for selection or deletion of a potential COI/COPC is presented in the table; however, the following general points should be noted:

- To identify COIs/COPCs, the SOEP/STEP pond water (wastewater) was considered the source (worst-case) of potential constituents.
- Migration of the COIs/COPCs from the SOEP/STEP ponds to groundwater was considered the pathway of concern.
- Maximum dissolved concentrations of potential COIs/COPCs in the SOEP/STEP pond water data were used for comparison against the standards and screening levels because the COIs/COPCs

could potentially migrate to groundwater if pond seepage occurs. The DEQ-7 Standards for groundwater (DEQ, 2017c) are reported in dissolved concentrations, where applicable (e.g., metals), and particulates would not migrate through the bottom liners of the ponds. The groundwater BSLs (Neptune, 2017) also represent dissolved concentrations because constituents are expected to be present in the dissolved phase in groundwater due to slow velocities and filtering characteristics of most strata.

- If dissolved concentrations were not available in the SOEP/STEP pond water data for a given potential COI/COPC, then the total concentrations were used.
- Maximum total concentrations of Radium 226/228 in the SOEP/STEP pond water data were used for comparison against standards and screening levels because both the DEQ-7 standard and the MCL are based on total concentrations.
- For some potential COIs, the SOEP/STEP pond water data were not presented as either dissolved or total concentrations (e.g., fluoride, sulfate).
- Groundwater samples collected from the CCR wells were analyzed for total recoverable concentrations as required by the Federal CCR Rule. (In certain instances where turbidity is high, dissolved concentrations were also analyzed). As such, total recoverable concentrations reported in the CCR well data were used as proxy values for dissolved concentrations. Total recoverable concentrations are not directly comparable to groundwater standards and screening levels that are based on dissolved concentrations and, therefore, such comparisons add a conservative bias and should be made with careful consideration.

From the COPCs identified following the above described screening process, the following chemicals were retained as groundwater COCs presented in Table 3-3 below.

Table 3-3 SOEP/STEP Groundwater COIs/COCs

CCR Rule Appendix III Constituents	CCR Rule Appendix IV Constituents	Other Potential SOEP/STEP Constituents
Boron	Cobalt	Manganese
Sulfate	Lithium	
	Selenium	

Note: Radium was not identified as a COI/COC; however, it will remain a COPC while additional radium groundwater data are collected. Radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring and continue to be evaluated under the AOC.

3.1 AOC CONTROL ACTIONS AND REGULATED SUBSTANCES

The AOC (DEQ/PPLM, 2012) defines “Control Actions” (Section IV.B.) as “remedial actions directed toward reducing, containing or controlling the seepage or migration of regulated substances including but not limited to sulfate, boron, selenium, potassium, sodium, magnesium, total dissolved solids, and salinity measured by specific electrical conductance through the environment. Control actions shall include affirmative source mitigation measures.”

Of the regulated substances listed in the Control Action definition of the AOC (DEQ/PPLM, 2012), sulfate, boron, and selenium were selected as COIs/COCs. Potassium, sodium, magnesium, total dissolved solids (TDS), and salinity were not selected as COIs/COCs through the screening process described above and presented in Table 3. Although not all of the regulated substances listed in the Control Action definition were selected as COIs/COCs, all listed constituents will be addressed in the remedial action development. In most instances, remedial actions designed to directly mitigate the COIs/COCs will indirectly mitigate the remainder of the regulated substances, as well.

4.0 SITE CONCEPTUAL EXPOSURE MODEL

A Site Conceptual Exposure Model (SCEM) was prepared to identify the contaminant sources, affected environmental media, release and transport mechanisms, potential human receptors, exposure points and pathways under the current and reasonably anticipated future uses of the SOEP/STEP area (see also Sections 2.4.2 and 2.4.3 above). The preparation of the SCEM is requested in the AOC, as well as a required element in conducting a risk assessment. The SCEM is presented as Figure 7.

4.1 SOURCES OF FACILITY CHEMICALS AND AFFECTED ENVIRONMENTAL MEDIA

The following potential sources of chemicals from SOEP/STEP wastewater were identified:

- Water based liquid waste (wastewater) that has been and is stored in the SOEP/STEP area ponds and has seeped from the ponds.
- Water based liquid slurry waste (wastewater) that was accidentally released from pipeline/pipe spills.
- (Although not a source directly from wastewater) - background-related chemicals in geological strata, such as rock, coal, spoils, previously burned coal seams, which may be leaching chemicals into groundwater.

Seepage from the SOEP/STEP ponds was assumed to have primarily affected groundwater. Potential groundwater migration and diffuse seepage are assumed to flow toward Creek alluvium. The pipeline/pipe spills were assumed to have primarily affected soil and (potentially) secondarily affected creek water and sediments via over land flow.

Background-related chemicals in geological strata were assumed to have primarily affected groundwater and surface water. The area upstream of Colstrip and the Facility has undergone extensive coal mining, which has the potential to affect the quality of the surface water and sediment (i.e., the Creek) and the groundwater that flows into the Plant Site and the SOEP/STEP area. In addition, activities associated with the upstream coal mining, such as road maintenance of the mine haul roads, access roads, and local highways, may also affect the quality of the surface water and sediment in the Creek, as well as the groundwater at the Plant Site and SOEP/STEP area.

Wind suspension from the soil areas in the SOEP/STEP area was assumed to have the potential to affect outdoor air (particulates) in the spill areas (if COIs/COCs were to be retained in soil).

The potential COIs originating from the SOEP/STEP wastewater were evaluated using several data sources, but primarily the following:

- The Units 1 & 2 SOEP/STEP Site Report, prepared as a requirement of the AOC, summarizes the SOEP/STEP pond data and investigations that have been conducted at the SOEP/STEP area relating to the ponds, spills associated with the pipelines, or changes in water quality identified in operational groundwater monitoring (Hydrometrics, 2017b). Table 2-3 of the Units 1 & 2 SOEP/STEP Site Report presents the evaporation pond chemical profiles. Table 3-1 of that report presents a summary of releases at the SOEP/STEP area and actions taken. Table 3-2 of that report contains a list of the reports, dates of the reports, and short summaries of the work conducted and findings of the investigations or studies.

- The data collected from the numerous wells at the SOEP/STEP area pursuant to the Federal CCR Rule (see Appendix F.)

- The Synoptic Run data that included both surface water data and, selectively, streambed sediment data over a period of several years (Hydrometrics, 2016b).

- The soil investigation data from identified pipeline/pipe release areas (Hydrometrics, 2017d, 2018b).

4.1.1 Anthropogenic Chemical Sources

The AOC addresses impacts related to the Colstrip SES Facility wastewater and does not address other media (unless impacted by the wastewater). As such, contaminants that have the potential to be present at the SOEP/STEP area that originated from sources other than the wastewater system, such as highway maintenance, residential lawn maintenance and other urban activities, or upstream mining areas, and for which little or no data are available, were not assessed within this CCRA Report. Several anthropogenic contaminants have the potential to impact surface water and sediment in the Creek throughout the reach that passes through the town of Colstrip. However, it should be noted that contaminants in the Creek upgradient of the Facility, as well as in the Colstrip area, were considered background concentrations for the Creek (see Sections 6.1.3 and 10.1). The source of background constituents are unknown, but may be present as a result of regional geology and mining activities.

4.2 CHEMICAL RELEASE MECHANISMS AND TRANSPORT PATHWAYS

Chemical releases and transport mechanisms are depicted in Figure 7, the SCEM. Primary chemical releases were assumed to occur by the following mechanisms:

- Pond seepage
- Pipeline/pipe releases
- Background-related geologic strata leaching, including upstream mining areas, and leaching/erosion from other anthropogenic background sources

The specific chemical transport pathways identified for the SOEP/STEP area and the identified transport mechanisms (i.e., migration) are discussed in the following sections. It should be noted that the AOC (Article VI.B) requires the CCRA Report to identify transport mechanisms for the COIs.

4.2.1 Pond Seepage and Groundwater Migration

Seepage losses from the ponds at the SOEP/STEP area have historically impacted primarily shallow groundwater. However, numerous capture wells have been placed at the SOEP/STEP area downgradient of the ponds that actively limit advective migration of impacted groundwater. The capture system continues to be evaluated and upgraded so that migration is limited to the extent practicable. Additional groundwater capture wells have been added as recently as 2017.

In the area of the pond seepage losses, COIs could have been transported toward surface water in the alluvium via the shallow groundwater. Again, at present, an ongoing groundwater capture system limits migration of groundwater to the alluvium, but the future need of the capture system should be considered.

During meetings with the DEQ, the DEQ indicated that the CCRAs, as well as the Remedy Evaluation Reports, should consider conditions at the Facility if the capture well system was not operational (DEQ, 2017a).

4.2.2 Surface Releases to Soil and Subsequent Migration

Surface releases to soil in the SOEP/STEP area are summarized below. Table 3-1 in the Units 1 & 2 SOEP/STEP AOC Site Report (Hydrometrics, 2017b) presents a summary of the known releases in the SOEP/STEP area. Releases of substantial magnitude are summarized below:

- Winter 1997 – STEP Cell A Liner Failure

  The liner of STEP Cell A failed and an unknown volume of wastewater was released beneath the liner. Tears appeared in the liner that extended across the air-water interface and several feet of the tear was submerged. Repair of the liner was delayed by weather and high water conditions, but the tear was repaired in the spring/summer of 1997. The volume of release wastewater is unknown, but was believed to be a significant amount (URS, 2000). Sampling to assess potential soil impacts is not possible as the spill location is beneath the new liner.

- March 13, 2000 – PPLM Units 1 and 2 Fly Ash Pipeline near the Power Road Overpass

  The location of this spill is on the border of the Plant Site and the SOEP/STEP area. Soil samples were collected in this area and potential human health or ecological risks were addressed in the Plant Site CCRA Report (Canty, 2018a).

  Approximately 400 gallons of fly ash slurry water were released from a leak in the pipeline. Approximately 200 gallons were recovered (pumped from a low area) and 30 cubic yards of soil and fly ash were hauled from the site and disposed in the Evaporation Holding Ponds. The majority, if not all of the spilled slurry, was believed to be recovered (PPLM, 2000).

  The location of this spill is not immediately adjacent to East Fork Armells Creek. Slurry water was not reported to have reached the Creek; rather, the slurry ponded in a low area from which it was pumped. Migration of the spill was assumed to have penetrated into the soil and, therefore, impacted soil was excavated. It is unlikely that significant migration was associated with this spill. As requested by the DEQ (2015), additional surface and subsurface soil samples were collected in the area of this former spill and remediated area in April 2016 (Hydrometrics, 2016a).

- February 6, 2002 – Surface Release to Soil Southeast of the North 1AD Pipeline Drain Pond

  A loose flange near an isolation valve on the Units 1&2 fly ash slurry line resulted in the loss of approximately 1,000 gallons of return water from the STEP at an area southeast of the North 1AD Pipeline Drain Pond. The leaking flange was caused by contraction of the high density polyethylene (HDPE) pipe. The spill collected in a low area between the road and the railroad tracks. The area of the spill was dammed and the water was pumped into the North 1AD Pipeline Drain Pond. Approximately 50-75% of the water was recovered. Approximately eight cubic yards of soil that was impacted with scrubber slurry was excavated and disposed. PPLM indicated the spill was cleaned up (PPLM, 2002).

- June 13, 2002 - Surface Release to Soil near North 1 AD Pipeline Drain Pond

  A valve was inadvertently left open at the North 1 AD Pipeline Drain Pond causing a surface release. The North 1 AD Pipeline Drain Pond collects return water and, as such, does not contain fly ash. PPLM contained and recovered water released to the ground surface. Water within the drain pond was pumped to lower the water level. A shallow trench pit was then excavated near the area where the release water had accumulated and the released water was then pumped back into the drain pond. Five shallow, small diameter, groundwater monitoring points were subsequently installed to evaluate and monitor the quality of the groundwater in the area where the release occurred.

  Groundwater concentrations of dissolved constituents in the trench pit were monitored and continued to drop over time. In 2012, the specific conductance (SC) was near 4,000 micromhos per centimeter (µmhos/cm), sulfate concentrations were near 2,500 milligrams per liter (mg/L), chloride concentrations were near 250 mg/L, boron concentrations were 1.5 mg/L, and calcium to magnesium ratios were near one. Capture of the shallow groundwater in this area was subsequently stopped due to the improved quality. Water quality graphs and Stiff diagrams associated with the monitored spill area are included in the Units 1&2 Stage I and II Evaporation Ponds Site Report (Hydrometrics, 2017b).

- December 31, 2008 – Capture Well 932D - East of STEP Main Dam

  An estimated 2,000 gallons of captured groundwater was released from the manhole at capture well 932D. The captured groundwater spilled out of the top of the manhole and flowed over land across the fence line onto the adjacent land owner's property. The release was caused by a broken pipeline in the bottom of the collection well manhole likely caused by freeze up. The pipes were repaired, insulation was applied to the manhole, and heat tracing was added to the piping. It was estimated that less than 1,000 gallons of captured water flowed off-site (PPLM, 2009).

- November 21, 2016 – STEP Main Dam

  A spill occurred in the area at the base of the 1&2 STEP Main Dam on November 21, 2016. The 1&2 STEP Flyash Paste Pipeline broke loose from its secured location, which resulted in a spill of about 31 cubic yards of flyash paste. The paste pumps were immediately shutdown. This spill of flyash paste flowed down the 1&2 STEP Main Dam and along the toe of the dam where it collected on an access road to the 1&2 STEP Main Dam Valley Drain Sump. The entire spill was contained on Talen Property and did not come into contact with any surface water. The flyash paste was deposited over a distance of about 400 yards by 5-20 feet wide at a depth of ½ to 2 inches. There was very little water associated with the flyash paste and the solids were cleaned up on November 22, 2016 and returned to the 1&2 STEP. Because of the lack of water associated with the paste and collection of all the spilled material, impacts from this spill were expected to be minimal or non-existent. Specific conductance of groundwater in several monitoring wells in the area was checked on a regular basis and no effects from the spill were observed. Additionally, several groundwater capture wells are present in this area. The area of the spill is also coincident with location of the STEP Main Dam toe drains and valley drain pipe.

These collection pipes provide for capture of shallow water and route it to the 1&2 STEP Main Dam Sump where it is pumped back to the 1&2 STEP. Vegetation will be monitored during 2017 in the area of the spill and reseeding will be conducted as needed (Hydrometrics, 2017a).

4.3 WIND SUSPENSION (FUGITIVE DUST)

In the surface spill areas at the SOEP/STEP area, the potential exists for wind to suspend dry soil impacted with COIs/COPCs, if present, from liquid waste, into the air as particulates (fugitive dust).

4.4 POTENTIALLY EXPOSED HUMAN RECEPTORS

Potential human receptors at the SOEP/STEP area were identified that might be exposed to constituents from the Colstrip SES Facility that originated from wastewater releases (see also Figure 7, the SCEM). Potential human receptors were limited to: (1) individuals who may potentially be exposed at the SOEP/STEP area outside of the active operations area and, therefore, beyond the controlled access (fenced) areas and (2) individuals with permission to use select controlled access areas (i.e., hunters). Figure 2 depicts the fence line/controlled access areas of the SOEP/STEP area.

Within the active operations/controlled access area, current potential worker exposures to constituent residuals in the SOEP/STEP area ponds would predominantly fall under the Occupational Safety and Health Administration (OSHA). At present, Talen has a robust worker safety program, including awareness training, spill response training, Hazardous Waste Operations and Emergency Response (HAZWOPER) training (for select employees), etc. As such, potential human exposures to constituent residuals in the SOEP/STEP area ponds are presently managed through Talen's worker safety program and were not addressed in this CCRA.

Figure 4 identifies current land uses and areas at the SOEP/STEP area at which receptors could potentially be exposed. Predominantly, the eastern side of the SOEP/STEP area, along both western and eastern sides of Highway 39, contains areas outside the controlled access areas of the active operations with potential exposures to receptors from wastewater releases. Current and reasonably anticipated future uses of the uncontrolled access areas of the SOEP/STEP area were considered when identifying potential receptors. The following table presents the identified potential human receptors:

Table 4-1 Receptors Identified and Evaluated in the CCRA

Land Use	Receptor	On-Site*	
		Current	Future
Residential	Resident (Child*)	X	X
Industrial	Outdoor Worker	X	X
Construction	Construction Worker	X	X
Recreational Receptor	Child	X	X

Notes:
On-Site* Potential receptors on the uncontrolled access areas of the SOEP/STEP area, i.e., outside of the controlled-access (fenced) areas, but within the SOEP/STEP boundary.
Child* For non-carcinogenic COPCs, the DEQ indicates that child receptors should be evaluated, as they are protective of adult exposures.

- Child Residents (children residing in the uncontrolled access areas of the SOEP/STEP area, e.g., the residential area located along the western side of Highway 39 to the east of the ponds).
- Adult Industrial Outdoor Workers (adults working outdoors in the uncontrolled access areas of the SOEP/STEP area, e.g., the light industrial area located along the western side of Highway 39 and the golf course located on the eastern side of Highway 39).
- Adult Construction Workers (adults performing construction work in the uncontrolled access areas of the SOEP/STEP area, e.g., trench workers).
- Recreational Users (children recreating, such as playing in the Creek, in the uncontrolled access areas of the SOEP/STEP area. This area is also used recreationally by adults, particularly archery hunters, specifically in the various areas where hunting with permission is allowed).

4.5 POTENTIALLY COMPLETE EXPOSURE PATHWAYS

USEPA guidance (USEPA, 1989) defines a complete exposure pathway as consisting of four elements:

- A source and mechanism of chemical release
- A retention or transport medium (or media in cases involving transfer of chemicals)
- A point of potential human contact with the contaminated medium (referred to as an exposure point)
- An exposure route (such as ingestion or inhalation) at the contact point

An exposure pathway is considered complete when it has all four factors. Designation of an exposure pathway as complete indicates that human exposure is possible, but does not necessarily mean that exposure will occur, or that exposure will occur at the levels to be estimated in this CCRA. When any one of the factors is missing in the pathway, it is considered incomplete. Incomplete exposure pathways do not pose a health hazard and were not evaluated further. A key step of the exposure analysis was to determine whether there were plausible routes of human exposure to COIs/COPCs at the SOEP/STEP area.

The SCEM for the SOEP/STEP area summarizes the information on sources of COIs/COPCs, affected environmental media, COI/COPC release and transport mechanisms, potentially exposed receptors, and potential exposure pathways for each potential receptor (see Figure 7). Figure 7 includes information on both human and ecological receptors and exposure pathways. The discussion of the SCEM presented in this Section primarily includes potential human exposures. Ecological pathways and exposures are discussed in detail in the Ecological Risk Assessment presented in Appendix C of this Report.

Potentially complete human exposure pathways associated with surface soil in the former spill areas and streambed sediments within the Creek were identified in the SCEM:

- Surface Soil
  - Incidental ingestion
  - Dermal contact
  - Inhalation (particulates)

- Creek sediments
    - Incidental ingestion
    - Dermal contact

The surface soil exposure pathways were subsequently eliminated because no human health COIs/COCs were retained in surface soil. The dermal contact and incidental ingestion exposure pathways for sediment for the construction worker receptor was not evaluated. Per discussions with DEQ, it is not necessary to evaluate construction worker exposure to sediment as it is an infrequent exposure pathway (DEQ, 2017d). Dermal contact and incidental ingestion exposure pathways for sediment for the child receptor were evaluated (see Section 7.0).

Potentially complete exposure pathways associated with groundwater and surface water were identified for the SOEP/STEP area and selected for comparison with DEQ-7 standards (DEQ, 2017c):

- Surface water
    - Ingestion
    - Dermal contact

- Groundwater
    - Ingestion
    - Dermal contact

DEQ-7 Standards apply to all state groundwaters and will, therefore, apply to all aquifers at the Facility. Dermal contact with groundwater was considered for instances in which a construction worker may have contact with shallow groundwater. However, per discussions with DEQ, the DEQ-7 Standards are considered protective of this infrequent exposure pathway (DEQ, 2017a).

Bioconcentration of surface water COPCs in fish tissue was not identified as an exposure pathway because East Fork Armells Creek does not sustain a fish population that would provide for recreational fishing.

The basis for identifying each exposure pathway as complete or incomplete is summarized in Tables B-1.1 through B-1.4 of Appendix B (i.e., RAGS Part D Table 1).

5.0 RISK ASSESSMENT APPROACH AND GUIDELINES

Following the guidance of the AOC (DEQ/PPLM, 2012), as well as direction provided by DEQ in meetings (2017a), in which DEQ indicated that risks should be evaluated for the SOEP/STEP area without the operation of the capture well system, the following Risk Assessment approach was followed:

Human Health Risk Assessment

- Groundwater – forward calculations of human health risks associated with groundwater were not conducted for two main reasons. First, the capture well system presently prevents migration of groundwater from the SOEP/STEP area and modeling of groundwater migration without the capture well system would need to be conducted adding substantial uncertainty into the forward calculation of human health risks associated with groundwater. Second, DEQ guidance indicates that groundwater risks should be evaluated qualitatively through the comparison to DEQ-7 Standards, rather than quantitatively through the forward calculation of human health risks. DEQ requested that human health Cleanup Criteria for groundwater be developed following the above described approach. Cleanup Criteria will be used in the Remedy Evaluation. Human health-based Cleanup Criteria for groundwater are discussed in Section 12.5.1.

- Surface water – similar to groundwater, forward calculations of human health risks associated with surface water were not conducted.

- Streambed Sediment – forward risk calculations of human health risks were calculated.

- Soil – forward risk calculations of human health risks were not calculated because human health COIs/COCs were not retained in soil.

Ecological Risk Assessment

- Groundwater – one pathway was considered for ecological (livestock) exposure to groundwater, which is the potential future pathway of livestock consumption (i.e., pumping groundwater into a stock tank), as agreed to in DEQ meetings (DEQ, 2017a). Forward risk calculations were performed for this pathway because one well (902D) is currently used for livestock watering. In addition, ecological (livestock)-based Cleanup Criteria for groundwater were developed for this potential future pathway (see Section 12.5.2).

- Surface Water, streambed sediment, and soil – forward risk calculations for ecological risks were calculated.

5.1 HUMAN HEALTH RISK ASSESSMENT APPROACH

As previously described in Section 1.0, the DEQ requested that the CCRA include DEQ's new Risk Assessment Scope of Work guidance. This SOEP/STEP CCRA Report follows DEQ's Risk Assessment guidance for both the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA). DEQ's Risk Assessment guidance largely follows the USEPA Risk Assessment guidance.

Overviews of the frameworks for both the USEPA and DEQ Human Health Risk Assessment Process are presented in the following sections.

5.1.1 Framework of the USEPA Human Health Risk Assessment Process

The methods used to conduct the HHRA are based on USEPA guidance (USEPA, 1989, 2001, 2009 et al.) and DEQ guidance (DEQ, 2016, 2017b). The framework for a HHRA is presented in "Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A; USEPA, 1989) and consists of the following six main steps:

- Conceptual Site Exposure Model (also referred to as the Site Conceptual Exposure Model [SCEM] by DEQ) – during this step, contaminant sources, affected environmental media, release and transport mechanisms, potential human receptors and exposure pathways to the COPCs are identified for current and future site conditions.

- Data Evaluation and Selection of COPCs – during this step, the analytical data are evaluated for usability in the HHRA. In addition, the data are grouped by location and medium and COPCs are selected for each applicable site media.

- Exposure Assessment – during this step, exposures for identified potentially complete exposure pathways to the COPCs are quantified. Exposure Point Concentrations (EPCs) are estimated, generally using a statistical approach, for each of the COPCs in each media. Pathway-specific intakes are estimated using human exposure parameters for the current and future potential human receptors.

- Toxicity Assessment – during this step, toxicity values that characterize potential adverse health effects for the COPCs are compiled.

- Risk Characterization – during this step, information from the previous steps is used to characterize potential risks to human health associated with exposure to COPCs. Both potential cancer risks and non-cancer hazard indices are evaluated.

- Uncertainly Analysis - during this final step, the major uncertainties associated with the risks are evaluated.

5.1.2 Framework of DEQ's Human Health Risk Assessment Process

For the risk assessment portion of the CCRA, DEQ requested that the DEQ's new Risk Assessment Scope of Work guidance be followed (DEQ, 2017b). The DEQ has defined the following required components of a Risk Assessment:

1. History and setting of the Facility, including demographic information
2. Data evaluation and selection of COPCs
    a. Data Summary
    b. Data Evaluation
    c. Selection of COPC(s) for each media

3. Human health risk assessment
    a. Exposure assessment
        i. Site conceptual exposure model
        ii. Potential receptors and exposure pathways
        iii. Exposure assumptions
        iv. Definitions of exposure areas and calculations of exposure point concentrations
        v. Calculations of chronic daily intakes
    b. Toxicity assessment
        i. Definitions of carcinogenic and non-carcinogenic risks
        ii. Carcinogenic slope factors and inhalation unit risks
        iii. Non-carcinogenic reference doses and reference concentrations
        iv. Uncertainties associated with toxicity assessment
    c. Risk characterization
        i. Calculation and discussion of the carcinogenic risk estimates
        ii. Calculation and discussion of the non-carcinogenic risk estimates
        iii. Evaluation and discussion of uncertainties
    d. Ecological risk assessment
4. Fate and Transport Analysis
5. Calculation of Site-Specific Cleanup Levels (SSCLs)
    a. Human health-based SSCLs
    b. SSCLs based on groundwater protection
    c. Ecological risk-based SSCLs
6. Completed tables 1-10 of EPA's Risk Assessment Guidance for Superfund (RAGS) Part D.
7. Summary table and figure of media, receptors, and exposure areas that exceed SSCLs. (This information will be presented in the Remedy Evaluation as it requires groundwater modeling).

Per DEQ guidance, the following steps should be included within the CCRA Work Plan and are presented herein:

- SCEM
- Data Evaluation and Selection of COPCs
- Exposure Assessment
- Toxicity Assessment

Within this CCRA Report, the remaining steps of the HHRA were completed and are presented herein.

The data, assumptions, and calculations associated with steps are provided in Appendix B of this CCRA Report in RAGS Part D tabular format, Tables 1 through 10 (USEPA, 2001).

The Human Health Risk Assessment is presented in Sections 6.0 thru 9.0.

5.2 ECOLOGICAL RISK ASSESSMENT APPROACH

Montana DEQ follows the 8-Step Ecological Risk Assessment (ERA) process developed by USEPA and detailed in *Ecological Risk Assessment Process for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (USEPA, 1997b) and *Guidelines for Ecological Risk Assessment*

(USEPA, 1998). Montana DEQ recognizes that not all sites will need to utilize the full 8-Step process identified by USEPA, and has further tailored the process to identify four different levels of ecological risk assessment based on site location, activities, habitats, and chemicals potentially present at the Site (DEQ, 2017b). The simplest of these, a Level 1 ERA, is for sites where no long-term ecological habitat is present, and simply requires documentation of site conditions (e.g., lack of ecological habitat) and consideration of future site use. The most complex, a Level 4 ERA, is for sites that represent critical ecological habitat, and requires the implementation of the full 8-Step Process.

Steps 1 and 2 of the USEPA process represent the screening phase of the ecological risk assessment. Step 1 is the Screening Level Problem Formulation and Ecological Effects Evaluation to identify site ecological receptors, exposure pathways, endpoints for evaluation, and ecological toxicity information, while Step 2 provides the Screening-level Exposure Estimates and Risk Calculations. The screening-level ecological risk assessment (SLERA) for the SOEP/STEP area is included as part of this CCRA Report and is presented herein.

Steps 3 through 8 comprise the baseline ecological risk assessment (BERA), though an informal "Step 3a", in which the list of COPCs identified in Step 2 is refined prior to development of the BERA problem formulation, is often included as part of the SLERA. The steps of the BERA are:

- Step 3: BERA Problem Formulation
- Step 4: Study Design and Data Quality Objectives
- Step 5: Field Verification of Sampling Design
- Step 6: Site Investigation
- Step 7: Risk Characterization
- Step 8: Risk Management

Because of the presence of aquatic and wetland features (the Creek) at the SOEP/STEP area, a Level 3 Ecological Risk Assessment was assumed to be required, at a minimum. The results of the SLERA indicated a Level 4 Assessment was not necessary.

The Ecological Risk Assessment is presented in Appendix C.

6.0 HUMAN HEALTH DATA EVALUATION, DATA GROUPING, AND CHEMICALS OF POTENTIAL CONCERN

Within this section, the process used to evaluate and group the analytical data for both quantitative and qualitative evaluation in this CCRA is presented. This section also discusses the process used to identify additional COIs/COPCs beyond the constituents listed in Appendices III and IV of the Federal CCR Rule.

6.1 EVALUATION OF SITE DATA

Data were available from the following media:

- Surface water (the Creek)
- Streambed sediment (the Creek)
- Soil (associated with remediated areas of former pipeline/pipe releases)
- Groundwater

Potential sources of contaminants were identified and discussed in Section 4.1.

The available surface water, streambed sediment, soil, and groundwater data for the SOEP/STEP area were reviewed, as well as the list of Appendices III and IV CCR constituents, and used in the identification of Exposure Units (EUs) and additional COIs/COPCs.

6.1.1 Description of an Exposure Unit

A location at which a human receptor may be exposed to a medium, such as soil, streambed sediment, surface water or groundwater, is referred to as an Exposure Unit (EU). EUs were defined using the following information:

- SOEP/STEP area Land Use (specifically in the uncontrolled access areas, see Figure 4)
- Identified Potential Receptors (see Figure 7)
- Potential Chemical Releases and Migration from the Facility Wastewater System
- Available Site Data

The identified EUs for the SOEP/STEP area are presented in Table 6-1 below and depicted in Figure 8. It should be noted that an Exposure Unit for groundwater was not defined as forward risk calculations were not prepared for groundwater exposure, excluding for livestock consumption from well 901D (stock tank). Rather, as directed by DEQ (2017a), Cleanup Criteria for groundwater were developed for use in the Remedy Evaluation.

Table 6-1 SOEP/STEP Area Exposure Units

Exposure Unit	Description
EU5	East Fork Armells Creek in the SOEP/STEP area (surface water and streambed sediments)
EU6	Former Spill Sites near North 1 AD Pipeline Drain Pond
EU7	Former Spill Site at the STEP Main Dam
EU8	Former Spill Site near Capture Well 932D

6.1.2 Description of Data used in the HHRA, by Exposure Unit

Data for each of the EUs are described in Table 6-2 below. The human health risk assessment data are summarized in Tables B-2.1 through B-2.5 (RAGS Part D Table 2) located in Appendix B. In addition, tables of the data used in the risk assessment are presented in Appendix E.

Table 6-2 Data Description by Exposure Unit

Exposure Unit	Media	Sample Locations	Sampling Dates	Description
EU5 East Fork Armells Creek SOEP/STEP Area	Surface Water	AR-1, AR-6 thru AR-9, AR-10PBR, AR-11 (Figure 9; Tables E-1 & E-2, Appendix E)	Spring 2014 through Fall 2015	Synoptic Run sampling data collected from 4 sampling events in spring and fall 2014 and spring and fall 2015. The sampling points are located in East Fork Armells Creek in the SOEP/STEP Area.
	Streambed Sediment			
EU6 Former Spill Site near North 1AD Pipeline Drain Pond	Soil	DP1AD-1 through DP1AD-26 (Figure 10; Table E-3, Appendix E)	August 2017	Soil samples collected from various intervals* from surface to 7 feet below ground surface (bgs)
EU7 Former Spill Site at the STEP Main Dam	Soil	MDE-29 through MDE-33 (Figure 11; Table E-4, Appendix E)	August 2017	Soil samples collected from various surface intervals* from surface to 2 feet bgs
EU8 Former Spill Site near Capture Well 932D	Soil	932D-S-27 and 932D-S-28 (Figure 11; Table E-5, Appendix E)	August 2017	Soil samples collected from various surface intervals* from surface to 2 feet bgs

Notes:

* Soil sampling depth intervals were selected based on the type of spill. The spill near North 1AD Pipeline Drain Pond was collected in an excavated shallow trench and the release was, therefore, more likely to infiltrate into deeper soil. The spills at the STEP Main Dam and near Capture Well 932D were spills followed by overland flow with less likelihood to infiltrate into deeper soils.

Surface water and streambed sediment data were limited to the two previous two years (i.e., 2014 and 2015) from the time the Work Plan for the Plant Site was initiated (Canty, 2017a) for the following reasons:

(1) As a flowing surface water body, East Fork Armells Creek is expected to be very dynamic. COI/COPC concentrations in surface water and streambed sediment are expected to change frequently.

(2) The effectiveness of the capture well system is evaluated regularly with additional capture wells added, as needed. Capture wells have been added as recently as 2017 that function to improve capture and further limit migration of groundwater that has seeped from the process ponds toward the creek. (It should be noted that the DEQ requested evaluation of the SOEP/STEP area considering the absence of the capture wells system [DEQ, 2017a].

The development of groundwater cleanup criteria [see Section 12.5] will be used in the Remedy Evaluation to address potential COI/COC migration).

(3) Comprehensive Synoptic Run data sets were available for this time period.

Soil data were limited to those collected during the August 2017 investigation of the former spill areas (Hydrometrics, 2018b).

Groundwater data were not directly used as forward calculations of human health risks associated with groundwater were not performed. Rather, per DEQ's request, human health and ecological (livestock) Cleanup Criteria for groundwater were developed (see Section 12) for use in the Remedy Evaluation. Ecological (livestock) Cleanup Criteria for groundwater were limited to one scenario (livestock consumption via groundwater pumping into stock tanks).

6.1.3 Reference/Background Samples

Surface Water

Various reference/background surface water sample data were available for comparison to the East Fork Armells Creek surface water data at the SOEP/STEP area, as summarized below:

- Upstream surface water background data were available to estimate the Background Screening Levels (BSLs) for the Colstrip SES (Neptune, 2017). The surface water BSLs were based on three upstream sampling locations (AR-12, SW-55, and SW-75) over a temporal span from February 1981 to October 2014. The sampling locations for the estimation of surface water BSLs were limited to three locations because the statistical approach required a sufficient number of unfiltered (i.e., total) samples be available over time from each location, as well as continuous creek flow. In addition, spring water monitoring sites were not included in the calculation of the surface water BSLs; rather, spring water monitoring sites were included in the groundwater BSL calculations (Neptune, 2017). Please refer to the BSL document (Neptune, 2017) for a detailed discussion of the surface water BSLs. Surface water sampling locations AR-12 and SW-55 are located immediately upstream of the Plant Site AOC boundary, while SW-75 is located approximately 8 miles upstream of the boundary (see Figure 12). The surface water BSLs were included as background/reference data in Table B-2.1 (Appendix B).

- An upgradient surface water Background Threshold Value (BTV) based on the estimation of the 95/90 Upper Tolerance Level (UTL) for manganese in surface water upgradient of the Plant Site was developed following discussions with the DEQ (2018b). The 95/90 UTL is defined as the 95% confidence limit on the 90th percentile (see Appendix D). The surface water BTV for manganese was based on five surface water sampling locations upgradient of the Plant Site, for which total manganese concentrations were available over a temporal span from 1977 to 2015. The five upgradient surface water sampling locations included in the calculation estimation of the surface water manganese BTV are from synoptic run sites, AR-5 and AR-12, and from Western Energy (WECO) sites, SW-03, SW-55, and SW-75. Surface water sampling locations AR-12, SW-55, and SW-03 are located near the upstream Plant Site AOC boundary. AR-5 is located immediately downstream of the Plant Site AOC boundary, but hydrologically upgradient of the Plant Site itself (DEQ, 2018a). SW-75 is located approximately 8 miles upstream of the Plant Site AOC boundary (see Figure 13). The surface water manganese BTV was included as a background/reference data point in Table B-2.1 (Appendix B).

- The upstream surface water data from sampling points AR-12 and AR-5, which are the closest upgradient sampling points, were considered to be a primary background data points. Upstream samples are affected by the Rosebud Mine. In discussions with the DEQ (DEQ, 2017a; DEQ, 2018a), AR-12 and AR-5, were determined to be the primary background data points for surface water data comparisons because of influence of upstream activities including coal mining and the lack of potential impacts from process waters. The surface water data from sampling points AR-12 and AR-5 are included as background/reference data in Table B-2.1 (Appendix B).

- Surface water background data were also available from a very large surface water sampling dataset compiled and statistically summarized by WECO for the preparation of the "Comprehensive Evaluation of Probable Hydrologic Consequences document prepared to support the permitting process for the expansion of mining in Area B of the Rosebud Mine" (Nicklin Earth & Water, 2014). However, the compiled dataset statistics were not limited to upgradient surface water locations. Rather, the dataset statistics included numerous downstream sampling locations in East Fork Armells Creek, as well as in adjacent drainages, over a temporal span of approximately 40 years. As such, the Rosebud Mine dataset statistics were not an appropriate comparison.

Sediment

Streambed sediment data were available from the primary upgradient background sampling points, AR-12 and AR-5. Considering the limited stretch of the Creek, streambed sediment background data were limited and streambed sediment BSLs were not generated. Upstream sediment data were not available from the Rosebud Mine (Nicklin Earth & Water, 2014). The sediment data from sampling points AR-12 and AR-5 were included as background/reference data in Table B-2.2 (Appendix B).

An aquatic habitat assessment and benthic community survey were conducted in upstream areas of the Creek at the Rosebud Mine. The locations of the assessment/survey were at approximately 1 mile and 2 miles upstream of the AOC Plant Site boundary. Following DEQ protocols, a community indicator metric (Hilsenhoff Biotic Index [HBI]) was calculated using Montana-specific tolerance values for identified taxa. The assessment indicated that upstream conditions of the Creek were "fairly poor" to "poor" (the lowest ratings of the HBI; Arcadis, 2014).

Soil

Soil background data, referred to as the BTVs for Inorganics in Montana Soils, were available from DEQ (Project Report Background Concentrations of Inorganic Constituents in Montana Surface Soils, 2013). The BTVs for Inorganics in Montana Soils were included as background/reference data in Tables B-2.3 through B-2.5 (Appendix B). For radium, typical background concentrations in soil were available from the Toxicology Profile prepared by the Agency for Toxic Substances and Disease Registry (ATSDR, 1990).

Groundwater

Groundwater background data were available from the 2017 BSL Report for the Colstrip SES (Neptune, 2017). BSLs were not available for all of the Federal CCR Rule constituents (e.g., Radium 226/228). The BSLs developed in 2016 (Neptune) were revised in 2017 (Neptune) to incorporate comments following DEQ's review. At the time the BSLs were revised, the Plant Site CCRA Report (Canty, 2018a) had already been prepared and submitted to DEQ. As such, in a meeting held on June 29, 2017 between DEQ and Talen, it was discussed and agreed that the 2016 BSLs would apply to the Plant Site CCRA and the 2017

BSLs would apply to the SOEP/STEP and 3&4 EHP CCRA Reports (DEQ, 2017e). Table 6-3 below compares the 2016 and 2017 BSLs for the groundwater COIs/COCs.

Table 6-3 BSL Comparison for the SOEP/STEP Groundwater COIs/COCs

COI/COC	Alluvium (mg/L)		Spoils* (mg/L)		Clinkers (mg/L)		Coal-Related (mg/L)		SubMcKay (mg/L)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
CCR Appendix III Constituents										
Boron	1.6	1.6	0.818	0.8	4	3.9	1.1	1	1.3	1.2
Sulfate	2,600	2,530	3,045	2,841	3,160	3,140	2,061	2,150	2,200	2,190
CCR Appendix IV Constituents										
Cobalt	0.02	0.02	0.0232	0.0232	NA	NA	0.0034	0.0034	0.00066	0.00066
Lithium	0.092	0.12	0.09	0.09	NA	NA	0.072	0.072	NA	NA
Selenium	0.009	0.009	0.0023	0.0024	0.01	0.01	0.005	0.01	0.005	0.005
Other Potential SOEP/STEP Constituents										
Manganese	0.6	0.61	2.79	2.48	0.67	0.67	0.54	0.48	0.27	0.26

Notes:
2016 Neptune, 2016. BSLs prepared in 2016 and used for the Plant Site CCRA (DEQ, 2017e).
2017 Neptune, 2017. Revised BSLs and used for the SOEP/STEP CCRA (DEQ, 2017e).
CCR Coal Combustion Residuals
COC Chemical of Concern
COI Constituent of Interest
mg/L milligrams per liter
NA Not analyzed
spoils* Spoils not present at the SOEP/STEP area.

Overall, the changes to the revised 2017 BSLs in comparison to the 2016 BSLs for the COIs/COCs were minimal (if at all). For example, the 2016 and 2017 BSLs for cobalt were the same in all the hydrostratigraphic units. For several COIs/COCs the changes to the revised 2017 BSLs were very minor with the difference similar to merely significant digits (e.g., boron in the clinkers layer of 4 mg/L and 3.9 mg/L). The largest BSL change was for selenium in the coal-related layer of 0.005 mg/L (2016) to 0.01 mg/L (2017).

6.2 DATA GROUPING

Data were grouped by each EU (e.g., EU5 data were grouped separately from EU6 data) and sample medium (e.g., surface water data were grouped separately from streambed sediment data).

6.3 IDENTIFYING HUMAN HEALTH COPCS

Data were screened using the flow charts and screening process described by the DEQ (2017b). Data were also screened against background concentrations described in Section 6.1.3. Specifically, data for each media were screened as summarized in Table 6-4 below to further identify COIs/COPCs, beyond the list of COIs identified thru screening of the Federal CCR Rule Appendices III and IV (see Report Table 3, located in the Tables section).

Table 6-4 Summary of Screening Values and Human Health COPCs

Media	Screening Values	Identified Human Health COPCs/ Rationale
Surface Water	• DEQ-7, which include MCLs (DEQ, 2017c) • If no DEQ-7 (DEQ, 2017c), USEPA Regional Screening Level (RSL) for Tapwater was used • Primary Upgradient Background Data Points (AR-12 and AR-5) • BSLs (Neptune, 2017) • BTV (for manganese)	None
Streambed Sediments	• USEPA RSLs (USEPA, 2017b) for Residential and Industrial Soil (following the DEQ screening process in which non-carcinogenic RSLs are reduced by a factor of 10 to account for cumulative health effects, [DEQ,2017b]) • Primary Upgradient Background Data Points (AR-12 and AR-5) • BTVs for Inorganics in Montana Soils (DEQ, 2013)	Manganese: > USEPA RSLs > Background (AR-12) > BTV (soil)
Soil	• USEPA RSLs (USEPA, 2017b) for Residential and Industrial Soil (following the DEQ screening process in which non-carcinogenic RSLs are reduced by a factor of 10 to account for cumulative health effects, [DEQ, 2017b]) • BTVs for Inorganics in Montana Soils (DEQ, 2013) • Calculated Preliminary Remediation Goals (PRGs) for radium (USDOE RAIS, 2018) • USEPA Remediation Goals for Radionuclides (PRGs; USEPA, 2000)	Radium 226: > PRGs > USEPA Remediation Goals

Data screening is presented in Tables B-2.1 through B-2.5 (RAGS Part D Table 2) located in Appendix B. The COPC column flags chemicals with either a “Y” for yes or an “N” for no. The chemicals flagged with an “N” were excluded from further human health risk evaluation.

No surface water chemicals were flagged with a “Y” in the COPC column. Therefore, no surface water COPCs were identified.

If sediments or soil chemicals were flagged with a “Y” in the COPC column, they were identified as COPCs and retained for further evaluation. For the human health portion of the risk evaluation, streambed sediment and soil data were compared to direct contact screening levels (i.e., 1/10th the USEPA Regional Screening Level for residential and industrial soils (RSLs; USEPA, 2017b) following DEQ’s screening process (DEQ, 2017b) to identify potential human health COPCs. One human health COPC, manganese, was identified in streambed sediment and was quantitatively evaluated for health risks (see Section 9.0) and not retained as a COC. One human health COPC, radium, was identified in soil, but not retained as a COC (see Section 10.4 and Appendix B, Tables B-2.3 through B-2.5).

6.3.1 Groundwater COIs/COPCs

As previously presented in Section 3.0, the SOEP/STEP area groundwater COIs/COPCs were identified through a screening process of the constituents listed in Appendices III and IV of the Federal CCR Rule (USEPA, 2015). The identified SOEP/STEP area groundwater COIs/COPCs are presented in Table 3, located in the Tables section.

In addition, groundwater data for one SOEP/STEP Area well (Wells 901D) that is presently used for livestock watering was reviewed for identification of COIs/COPCs (see Appendix C).

6.3.2 Uncertainties in Identifying Human Health COIs/COPCs

The following uncertainties in the identification of human health COIs/COPCs are as follows:

- The AOC (DEQ/PPLM, 2012) regulated substances include sulfate, boron, selenium, potassium, sodium, magnesium, TDS, and salinity. Human health toxicity values have not been established for sulfate, potassium, sodium, magnesium, TDS, and salinity. These constituents were not identified as human health COPCs. (Sulfate was identified as an ecological [livestock] COPC). Uncertainty exists regarding the potential toxicity of constituents without human toxicity values to human receptors.

- Similarly, human health toxicity values have not been established for the following Appendix III and Appendix IV CCR Rule constituents: calcium, sulfate, TDS, and pH. These constituents were not identified as human health COPCs. Uncertainty exists regarding the human health concerns potentially posed by these constituents.

- True background samples and sampling locations for surface water and streambed sediments were not available because the Creek is intermittent and upstream and regional locations have been affected by mining and other anthropogenic activities. Uncertainty exists regarding the comparison of sediment and surface water data to “background” concentrations.

- The CCR well data was used in the screening process to assist in the identification of COIs/COPCs. However, the CCR well data are total recoverable concentrations as required by the Federal CCR Rule. Total recoverable concentrations are not directly comparable to groundwater standards and screening levels that are based on dissolved concentrations. Uncertainty exists in using total recoverable concentrations as proxy dissolved concentrations. Specifically, because the CCR well data are generally total recoverable concentrations, comparisons of CCR well data to screening levels based on dissolved concentrations results in a conservative bias.

6.4 IDENTIFYING LEACHING COI/COPCS

Soil chemicals were also compared to the USEPA Soil Screening Levels (SSLs) for groundwater protection (USEPA, 2017b) that were modified following the DEQ Soil Screening Process (DEQ, 2017b) to identify leaching COPCs. If soil chemicals were flagged with a “Y” in the Leaching COPC column, they were identified as a potential leaching COPC. Four chemicals, barium, cobalt, manganese and Radium 226, were identified as leaching COPCs (see Tables B-2.3 and B-2.4 in Appendix B). However, after further evaluation, these chemicals were not retained as leaching COCs. Please see Section 10.2 for additional information regarding leaching COIs/COPCs.

6.4.1 Vertical Connectivity between Hydrostratigraphic Units

As described previously in Section 2.3.2, various lithological units are present at the SOEP/STEP Area. These are, in ascending order; sub-McKay, McKay Coal, Rosebud-McKay Interburden (interburden), Rosebud Coal, spoil and clinker (laterally equivalent to the Rosebud Coal), overburden, and alluvium. Only the alluvium, McKay Coal, spoil and sub-McKay could accurately be referred to as aquifers. In addition, spoil is limited in the SOEP/STEP Area. Intervals that are not aquifers include the overburden due to its limited extent and general absence of producible quantities of water; the Rosebud Coal because it is largely mined out; and the interburden and clinker due to its limited water content.

The interburden which underlies the former Rosebud Coal is comprised of very fined grained rock (e.g. siltstone and claystone or shale). These sedimentary rocks exhibit low permeability. Even though the permeability of the interval is low, the vertical permeability is even lower due to anisotropy caused during deposition and subsequent loading. Flatter elongated grains tend to lay flat creating preferential flow in the horizontal direction. Loading from increased sediment deposition further exaggerates this condition. The permeability of the units is very low which inhibits horizontal flow and renders vertical flow negligible. The interburden contains very little water and would not sustain production as an aquifer.

The McKay Coal is a cleated coal. Cleats are basically joints that form perpendicular to the bedding planes. Groundwater flows through the cleats with hydraulic conductivity being determined by the size and interconnectivity of the cleats. In general, the hydraulic conductivity of the coal is between about 1 and 3 feet per day. Strata immediately below the coal is typically comprised of clayey siltstone to mudstone. The fine-grained nature of the sedimentary rock below the McKay Coal limits vertical flow of groundwater to the deeper sub-McKay strata.

Groundwater at the SOEP/STEP Area generally flows east towards East Fork Armells Creek. The ancestral creek eroded through the McKay Coal and into the sub-McKay. The eroded interval was replaced by alluvium raising it to its current level. Groundwater flows into the alluvium, mainly through the McKay Coal, interburden, and in some cases unconsolidated sediment above the interburden.

The McKay Coal is absent east of the Creek at the SOEP/STEP area; so the shallow sub-McKay is in contact with the alluvium. Potentiometric heads in the shallow sub-McKay east of the Creek are higher than those in the alluvium. This results in flow from the sub-McKay to the alluvium. The exception is near capture wells where heads may be reduced in the sub-McKay, resulting in flow from the alluvium into the deeper strata. Overall, however, flow in the sub-McKay is from west to east-northeast either where it either discharges to the alluvium (in the case of shallow bedrock) or continues to flow eastward past the creek (deeper alluvium).

7.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The Human Health Exposure Assessment provides a description of the potential human health exposure to wastewater-related chemicals in the uncontrolled access areas of the SOEP/STEP area, including exposure routes, magnitudes, frequencies, and durations for both current and future Facility use. The exposure assessment identifies the reasonable maximum exposures (RME) that are reasonably expected to occur at the uncontrolled access areas of the SOEP/STEP area (USEPA, 1989).

7.1 EXPOSURE POINTS AND EXPOSURE POINT CONCENTRATIONS

Present and anticipated future land use and human activity patterns are used to identify potential exposure points for human receptors and contaminated media. The exposure point is the location at which a human receptor might contact contaminated media. Potential exposures to identified COPCs are assumed to occur uniformly throughout each exposure point (or EU).

The concentration of a COPC at an exposure point is referred to as an Exposure Point Concentration (EPC). The description of the approach used to statistically assess the data and calculate EPCs is included in Appendix D. Tables B-3.1 through B-3.4 in Appendix B present data used to calculate EPCs.

Two human health COPCs, manganese and radium, were identified in streambed sediment and soil, respectively. Neither were retained as human health COCs (see Sections 9.1 and 12.2 for manganese and Section 10.4 for radium).

7.2 CHEMICAL INTAKE ESTIMATES

Calculations of the non-carcinogenic average daily dose (ADD) and the carcinogenic lifetime average daily doses (LADD) for the HHRA are performed for complete exposure pathways using the equations available from the USEPA (1989, 2004, and 2009). Numerous updates have been made to the intake equations and exposure parameters since the initial publication of USEPA's Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A (RAGS; USEPA, 1989), including, but not limited to, those listed below:

- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, 2004).

- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment, 2009).

- Exposure Factors Handbook: 2011 Edition (USEPA, 2011).

- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, 2014.

In addition, DEQ has specific guidance for risk assessments available on their web-page (DEQ, 2017b).

The EPCs, scenario-specific assumptions, and intake parameters are used to estimate exposures (or intakes), which are expressed in terms of milligrams of chemical per kilogram body weight per day (mg/kg-day). Intakes are calculated for the RME, which is the highest exposure reasonably expected to occur.

The USEPA (1989) defines the generic equation for calculating human non-carcinogenic ADDs as follows:

$$Average\ Daily\ Dose\ (ADD) = \frac{C \times CR \times EF\ X\ ED}{BW \times ATnc}$$

where:

C	=	COPC concentration
CR	=	contact rate (amount of contact with impacted media per time)
EF	=	exposure frequency
ED	=	exposure duration
BW	=	body weight of the receptor
ATnc	=	averaging time (period over which the exposure is averaged)

Carcinogenic COCs were not retained in the human health risk assessment.

Pathway-specific variations of the generic equations are used for non-carcinogenic COPCs to calculate intakes. The pathway specific variations are discussed in the following sections and presented in Table B-4 located in Appendix B.

7.2.1 Incidental Ingestion of Soil/Sediment for Non-Carcinogens

For non-carcinogenic ADD posed by incidental ingestion of soil/sediment, the childhood exposure is evaluated as it is considered to be protective of adult exposures (DEQ, 2017b).

The ADD for incidental soil/sediment ingestion for non-carcinogenic COPCs is calculated as follows:

$$ADDsoiling = \frac{Cs \times IRSc\ \times BA\ \times\ EF\ \times\ ED\ \times MCF}{BWc\ \times\ ATnc}$$

where:

Cs	=	COPC EPC concentration in soil/sediment (milligrams/kilogram [mg/kg])
IRSc	=	ingestion rate soil (child; milligrams per day [mg/day])
BA	=	bioavailability factor (unitless)
EF	=	exposure frequency (days/year [yr])
ED	=	exposure duration (yrs)
MCF	=	mass conversion factor (1×10^{-6} kilograms per milligram [kg/mg])
BWc	=	body weight (child; kg)
ATnc	=	averaging time non-carcinogens (ED in days)

ADD calculations for incidental ingestion of streambed sediment impacted with the non-carcinogenic COPC (i.e., manganese) were calculated for the various receptors (see Tables B-7.1 through B-7.3 in Appendix B, and Section 9.0).

7.2.2 Dermal Absorption of Soil/Sediment for Non-Carcinogens

For non-carcinogenic ADD posed by dermal absorption of soil/sediment, the childhood exposure was evaluated as it is considered to be protective of adult exposures (DEQ, 2017b).

The ADD for dermal absorption of soil/sediment is calculated as follows:

$$ADDsoil\ dermal = \frac{Cs \times ABS \times SAc \times AF \times EF \times ED \times MCF}{BWc \times ATnc}$$

where:

Cs	=	COPC EPC concentration in soil/sediment (mg/kg)
ABS	=	dermal absorption factor (unitless)
SAc	=	exposed skin surface area (child, square centimeters [cm^2])
AF	=	soil to skin adherence factor (milligrams per square centimeters [mg/cm^2])
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yrs)
MCF	=	mass conversion factor (1×10^{-6} kg/mg)
BWc	=	body weight (child; kg)
ATnc	=	averaging time non-carcinogens (ED in days)

ADD calculations for dermal absorption of soil/sediment impacted with the non-carcinogenic COPC (i.e., manganese) were calculated for the various receptors (see Tables B-7.1 through B- 7.3 in Appendix B, and Section 9.0).

7.2.3 Inhalation of Volatiles or Fugitive Dust Particles

Human health COCs were not retained in soil (fugitive dust particles). Volatile human health COPCs were also not identified.

7.2.4 Lead Exposures

Lead was not identified as a COPC in soil or streambed sediment (see Tables B-2.2 through B-2.5 in Appendix B). Blood lead exposures were not assessed.

7.2.5 General Exposure Assumptions

Human exposure assumptions were based on USEPA and DEQ guidance. For the most part, the exposure parameters recommended by DEQ (and largely based on USEPA guidance) were used (DEQ, 2017b). Several of the exposure parameters recommended by DEQ include conditions, such as climate, specific to Montana. The exposure parameters are presented in Table B-4 located in Appendix B.

7.2.5.1 Exposure Time, Frequency, and Duration

The total extent of an exposure is defined by the exposure time, exposure frequency, and the exposure duration. The exposure frequency is the number of days per year when exposure occurs. Exposure frequencies for the one human health COPC in streambed sediment, manganese, for the various receptors are as follows:

- The exposure frequency for residential receptors was assumed to be 24 days per year, which assumes contact with streambed sediment two times per week during a three month summer, based on professional judgment and discussion with the DEQ (2017a).

- The exposure frequency for industrial receptors was assumed to be 24 days per year. Of the 187 days per year assumed for an industrial receptor (which assumes a standard five-day work week, three months of snow cover, and a two-week vacation [DEQ, 2017b]), an industrial worker was assumed to have contact with streambed sediment two times per week during a three month summer, based on professional judgment and discussion with the DEQ (2017a).

- The exposure duration for recreational user receptors was assumed to be 16 days per year which, based on professional judgment and discussion with the DEQ (2017a), assumes contact with streambed sediment one to two times per week during a three month summer.

The exposure duration is the total number of years over which an exposure occurs. Exposure durations for the various receptors are as follows:

- The exposure durations for the adult and child residential receptors were assumed to be 20 years and 6 years, respectively (DEQ, 2017b). However, when calculating intakes for an exposure to a non-carcinogenic COPC, DEQ guidance indicates the child exposure scenario (i.e., exposure duration of 6 years years) should be evaluated because it is assumed to be protective of the adult exposure scenario.

- The exposure duration for an industrial receptor was assumed to be 25 years (DEQ, 2017b).

- The exposure duration for the child recreational receptors was assumed to be 6 years (DEQ, 2017b).

Please note that the above exposure parameters, as well as other DEQ recommended exposure parameters (DEQ, 2017b), were also used to calculate the radium Preliminary Remediation Goals (PRGs; see Section 10.4).

7.2.5.2 Body Weight

Default body weights of 80 kilograms for adults and 15 kilograms for children were used in the assessment (USEPA, 2014; DEQ, 2017b).

7.2.5.3 Averaging Time

For non-cancer health effects, the averaging time is equal to the exposure duration (in years) multiplied by 365 days per year (USEPA, 1989). The averaging time for cancer risk estimation is the number of days in a 78-year lifetime or 28,470 days (DEQ, 2017b). The averaging time for oral and dermal exposures is expressed in days.

7.2.6 Pathway-Specific Exposure Factors

Pathway-specific exposure factors, which are unique to each exposure pathway, are summarized in Table B-4 (RAGS Table 4) located in Appendix B. Professional judgment was used to define exposure factors for which neither the USEPA nor the DEQ has established specific exposure assumptions.

7.2.6.1 Exposure Parameters for Incidental Ingestion of Streambed Sediment

Receptors may be exposed to COPCs in soil/sediment through inadvertent, or incidental ingestion. One human health COPC, manganese, was identified in streambed sediment. No human health COCs were retained in soil.

Incidental streambed sediment ingestion rates for the various receptors are presented below.

- Child Resident – 200 mg/day
- Industrial Worker – 100 mg/day
- Recreational Receptor (child) - 200 mg/day

The exposure assumptions for assessing incidental streambed sediment ingestion, including rationales for selection of values, are summarized in Table B-4 located in Appendix B.

A bioavailability value for manganese in soil is not available (ATSDR, 2012). Therefore, following USEPA guidance, the bioavailability value for manganese was conservatively assumed to be one (100%, see Table 7-1 below).

Table 7-1 Bioavailability

COPC	Bioavailability	Reference
Manganese	NA	ATSDR, 2012

NA - not available, assumed to be 1.0.

7.2.6.2 Exposure Parameters for Dermal Contact with Streambed Sediment

Receptors may be exposed to COPCs through dermal absorption from direct contact with impacted streambed sediment. The dermal intake is an estimated absorbed dose (i.e., the amount of the COPC that crosses the skin and subsequently enters the human bloodstream). Parameters specific to the streambed sediment dermal pathway include the following:

1. the skin surface area (amount of skin in contact with the soil/sediment, cm^2).
2. amount of soil/sediment that adheres to the skin (adherence factor, AF, unitless).
3. the chemical-specific dermal absorption factor (ABSd, unitless).

Dermal exposure parameters for the various receptors are presented below.

- The child resident receptor was assumed to have 2,373 cm^2 of exposed skin surface area and a soil to skin AF of 0.2 mg/cm^2.
- The industrial worker receptor was assumed to have 3,527 cm^2 of exposed skin surface area and a soil to skin AF of 0.12 mg/cm^2.
- The child recreational receptor was assumed to have 2,373 cm^2 of exposed skin surface area and a soil to skin AF of 0.2 mg/ cm^2.

The exposure assumptions for assessing dermal exposures, including rationales for selection of values, are summarized in Table B-4 located in Appendix B.

The USEPA indicates that dermal exposures to sediments should be treated the same as dermal exposures to soil. The USEPA indicates that adherence factors are perhaps the most uncertain parameter in estimating dermal exposures to sediments, but does not provide AFs specific to sediments (USEPA, 2004).

A dermal absorption factor for manganese is not available from the USEPA (2017b) and, therefore, following USEPA guidance was assumed to be one (100%, see Table 7-2 below).

Table 7-2 Dermal Absorption Factor

COPC	Dermal Absorption Factor	Reference
Manganese	NA	USEPA, 2017b

NA - not available, assumed to be 1.0.

7.2.7 Exposure Point Concentrations/ 95 UCLs

Exposure Point Concentrations (also referred to as 95^{th} Upper Confidence Limits on the mean [95 UCLs]) were calculated for the COPC, manganese, in streambed sediment. Please see Appendix D for the Statistical Summary. Table 7-3 below presents the EPC.

Table 7-3 Exposure Point Concentration (95 UCL)

COPC	Media	Minimum Value	Maximum Value	Average	EPC (95 UCL)
Manganese	Streambed Sediment (mg/kg)	175	5,580	882	1,523

8.0 TOXICITY ASSESSMENT

The Toxicity Assessment follows the USEPA recommended approach (USEPA, 1989, et al). The toxicity assessment identifies, as necessary, the Reference Doses (RfDs), the Reference Concentrations (RfCs), cancer Slope Factors (SFs), and Inhalation Unit Risks (IURs) that will be used to evaluate adverse non-cancer health effects and cancer risks. Toxicity values for COPCs follows the hierarchy of human health toxicity (USEPA, 2003), which is also recommended by DEQ (2017b), as described below with the highest priority source listed first:

1. USEPA's Integrated Risk Information System (IRIS). IRIS is an on-line database that presents the latest EPA-approved RfDs, RfCs, SFs, and IURs as well as uncertainty and modifying factors (USEPA, 2017c). The toxicity values available from IRIS are recognized as USEPA-wide consensus information.

2. USEPA's Provisional Peer Reviewed Toxicity Values (PPRTV) Database. Similar to IRIS, the PPRTVs are USEPA-approved RfDs, RfCs, SFs, and IURs that have undergone peer review and recognized as consensus information (USEPA, 2013).

3. Other USEPA and non-USEPA toxicity values, such as:

    a. USEPA's Health Effects Assessment Summary Tables (HEAST; USEPA, 1997a).
    b. USEPA's National Center for Environmental Assessment (NCEA) papers, which are chemical-specific references (USEPA, 2013)
    c. California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) on-line database, which contains approved, peer-reviewed toxicity criteria (Cal/EPA OEHHA, 2017)

One non-carcinogenic human health COPC, manganese, was identified in streambed sediment for which forward risk calculations were performed (see Section 9.1) Manganese was ultimately not retained as a COC. One carcinogenic human health COPC, radium, was identified in soil, but forward risk calculations were not necessary as further evaluation of radium through comparison to several screening levels and remediation goals indicated it should not be retained as a COC (see Section 10.4).

8.1 REFERENCE DOSE

The non-carcinogen RfDs for manganese was used in the preparation of this CCRA to estimate potential non-cancer health hazards to receptors resulting from potential exposures. An RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of harmful effects (USEPA, 1989). An RfD has an uncertainty that spans perhaps an order of magnitude (USEPA, 1989). RfDs are chemical-specific and expressed as milligrams per kilogram-day (mg/kg-day). Oral RfDs are typically used to assess dermal exposures in the absence of route-specific dermal RfDs (USEPA, 1989). RfCs were not used as the inhalation pathway was not identified as a potentially complete pathway (USEPA, 2009).

Relevant human and animal studies are used to derive RfDs. Specifically, measured or observed No Observed Adverse Effect Levels (NOAEL) are typically used in the derivation, which correspond to the dose that can be administered without inducing observable adverse effects. If a NOAEL cannot be established, the Lowest Observed Adverse Effect Level (LOAEL) is used, which corresponds the lowest daily dose administered that induces an observable adverse effect (the “critical effect”).

The manganese RfD used in the toxicity assessment is a chronic RfD, as few subchronic RfDs are available. A chronic RfD is intended for chronic exposures (i.e., exposures greater than seven years). Subchronic RfDs are intended for subchronic exposures (i.e., exposures less than seven years). Using a chronic RfD for all exposure durations, which for this assessment ranged from one to 25 years, is expected to result in conservative estimates of potential human health hazards.

Because NOAELs and LOAELs are typically established based on experimental animal studies, uncertainty factors are applied to be protective of human health. Uncertainty factors usually occur in multiples of 10 and account for the following:

- Extrapolation of data from animals to humans, known as interspecies extrapolation.
- Variation in human sensitivity to the toxic effect of the COPC, known as intraspecies extrapolation.
- Derivation of a chronic RfD based on subchronic data, rather than chronic data.
- Derivation of an RfD based on the LOAEL, rather than the NOAEL.

Modifying factors between 0 and 10 may also be applied in addition to uncertainty factors to accommodate for other additional uncertainty factors.

A summary of the non-cancer toxicity information is presented in Table B-5 (RAGS Part D Table 5) located in Appendix B.

The following RfD was identified for manganese (Table 8-1).

Table 8-1 COPC Reference Dose

COPC	RfD (mg/kg-day)	Source	Reference
Manganese	2.4E-02	IRIS*	USEPA, 2017b

IRIS* - The IRIS RfD of 0.14 mg/kg-day includes manganese from all sources. IRIS recommends an RfD of 0.071 mg/kg-day for non-food items; however, the IRIS explanatory text recommends using a modifying factor of three when calculating risks associated with non-food sources because of a number of uncertainties, resulting in an RfD of 0.024 mg/kg-day (USEPA, 2017b).

8.2 ROUTE-TO-ROUTE EXTRAPOLATION

Because toxicity criteria were not available for the dermal exposure route, route-to-route extrapolations of oral toxicity criteria were used to evaluate dermal exposures for the identified COPC.

8.3 TOXICITY PROFILE - MANGANESE

Manganese is a naturally occurring metal that makes up about 0.10 percent of the earth’s crust. Manganese is typically found combined with other substances, such as oxygen, sulfur, or chlorine. Manganese is also found in anthropogenic organic compounds, such as pesticides (maneb and mancozeb) and a fuel additive known as methylcyclopentadienyl manganese tricarbonyl.

Manganese is also an essential trace element that is nutritionally necessary for good health. Manganese nutritional requirements are typically satisfied through the diet with minor contributions arising from water and air. Manganese can be found in several food items, including grains, cereals, and tea. The National Research Council recommends a dietary allowance of 2-5 mg/day of manganese for an adult human for a safe and adequate intake.

If humans are exposed on a prolonged basis to elevated concentrations, manganese can elicit a variety of serious toxic responses with the central nervous system being the primary target. Headache, insomnia, disorientation, anxiety, lethargy, and memory loss are initial symptoms. With continued exposure, the initial symptoms progress to include motor disturbances, tremors, and difficulty in walking. These motor difficulties are similar to those seen with Parkinsonism and are often irreversible. This combination of symptoms is a disease called “manganism.”

No human cancer data are available for manganese. The USEPA weight-of-evidence classification is D, not classifiable as to human carcinogenicity, based on no evidence in humans and inadequate evidence in animals. However, some conflicting data exists on possible carcinogenesis in mice (USEPA, 2017b).

The toxicity criteria used in the HHRA to quantify risks for exposure to manganese are summarized in Table B-5 in Appendix B. This table includes information on the primary target organ, and the uncertainty and modifying factors associated with toxicity criteria used to evaluate systemic (noncancer) effects.

8.4 UNCERTAINTIES ASSOCIATED WITH TOXICITY ASSESSMENT

The following uncertainties associated with the Toxicity Assessment were identified:

- A modifying factor of three was used in the development of the oral RfD (non-diet) for manganese because of a number of IRIS-identified uncertainties (USEPA, 2017b).
- The manganese RfD is intended for chronic exposures. One of the receptors, the construction worker, is a subchronic exposure. The use of a chronic RfD for a subchronic exposure is expected to overestimate potential health risks.
- A dermal RfD for manganese was not available and the oral RfD was used based on route-to-route extrapolation. Generally, the use of an oral RfD for a dermal exposure is expected to overestimate potential health risks.

9.0 RISK CHARACTERIZATION

For complete exposure pathways, risk characterization was performed to combine the exposure and toxicity assessments to produce quantitative estimates of potential non-cancer health hazards associated with the identified streambed sediment COPC, manganese. As previously mentioned, one carcinogenic human health COPC, radium, was identified in soil, but forward risk calculations were not necessary as further evaluation of radium through comparison to several screening levels and remediation goals indicated it should not be retained as a COC (see Section 10.4).

9.1 CHARACTERIZATION OF NON-CANCER HEALTH HAZARDS

Non-carcinogenic health hazards can be described as the potential of a receptor developing non-cancer health concerns around the time of an exposure to non-cancer causing compounds.

Non-cancer hazard quotients (HQ) were calculated according to the USEPA (1989) equation as presented below:

$$Hazard\ Quotient\ (HQ) = \frac{ADD}{RfDi\ or\ RfDo}$$

where:

ADD = Average Daily Dose
RfD_i = inhalation Reference Dose
RfD_o = oral Reference Dose

HQ's that affect the same target organ are summed together to form the Hazard Index. However, this step was unnecessary as forward risk calculations were performed on solely one COPC. The non-cancer hazard index is based on a comparison of the estimated site-related dose to the USEPA acceptable dose. The USEPA (2001) has indicated that a hazard index of less than 1.0 indicates an acceptable potential for non-cancer health hazards (USEPA, 2001). Similarly, the DEQ (2017b) has indicated that a total hazard index for non-carcinogenic compounds may not exceed 1.0 for each target organ. As such, the hazard indices (hazard quotients in this case) were compared to 1.0 as a not-to-exceed value.

Hazard quotients for the various receptors for the one non-carcinogenic COPC were calculated and are summarized in Table 9-1 below, as well as in Tables B-7.1 through B-10 located in Appendix B. No hazard quotients exceeded 1.0 indicating that non-cancer health effects are not expected to occur as a result of potential human exposures to the one identified COPC in streambed sediment, manganese. As such, manganese was not retained as a COC.

Table 9-1 Non-Cancer Hazard Quotients/Indices

COPC	Receptor	EPC (mg/kg)	Hazard Quotient (unitless)
Manganese (non-carcinogen)	Current/Future Child Resident	1,523	0.2
	Current/Future Industrial Worker		0.03
	Current/Future Child Recreational Receptor		0.1

9.2 EVALUATION OF UNCERTAINTIES

The following uncertainties associated with the Risk Characterization were identified:

- Uncertainties exist regarding the exposure parameters. However, the majority of exposure parameters were either USEPA or DEQ defined values that are expected to be conservative.
- Exposure parameters based on professional judgment also have uncertainty; however, they were conservatively selected.
- Human toxicity values have not been established for various constituents listed in the AOC, as well as in Appendices III and IV of the Federal CCR Rule. These constituents were not identified as COPCs/COIs. Uncertainties exist regarding potential human health concerns potentially posed by these constituents.
- Various uncertainties regarding the toxicity of the one identified COPC, manganese, exist as presented in Section 8.4.
- Uncertainties are intrinsically inherent in the intake and hazard quotient calculations.

Overall, uncertainties in the risk characterization are expected to originate from a cumulative effect of the uncertainties in the Exposure Assessment, the Toxicity Assessment, and the Characterization of Risk. Based on the conservative nature of the various assumptions used to characterize risk, the uncertainties are not expected to underestimate human health risks.

9.3 RISK ASSESSMENT GUIDANCE FOR SUPERFUND PART D TABLES

Following DEQ Guidance (DEQ, 2017b), the table format from RAGS Part D are used for the risk assessment tables. This CCRA includes RAGS Part D Tables 1 through 10, which are included in Appendix B.

10.0 COMPARISON OF DATA TO MEDIUM-SPECIFIC STANDARDS AND SCREENING LEVELS

10.1 COMPARISON OF SURFACE WATER COPC CONCENTRATIONS TO DEQ-7 STANDARDS

DEQ guidance (2017b) indicates surface water concentrations of COPCs should be compared to DEQ-7 standards, rather than being quantitatively evaluated in the HHRA. DEQ-7 (2017c) indicates that for metals in surface water, total recoverable concentrations (excluding aluminum) should be used in the comparison. Surface water concentrations from the Creek in the SOEP/STEP area were compared to DEQ-7 standards, or other appropriate screening levels if DEQ-7 standards were not available, and are presented in Table B-2.1 (RAGS Table 2) in Appendix B. Following DEQ guidance (DEQ, 2017c) and the AOC (DEQ/PPLM, 2012), if a DEQ-7 Human Health Standard (HHS) was not available, the USEPA MCL, or the USEPA Tapwater RSL (Traditional RSL Tables) was used.

The maximum total manganese concentration in the Creek at the SOEP/STEP area (AR-9, 2.85 mg/L) was greater than the USEPA Tapwater RSL (0.43 mg/L), but not the BSL (3.68 mg/L), the BTV (5.08 mg/L), or the upgradient maximum concentration (AR-5, 11.6 mg/L). A DEQ-7 Standard for manganese has not been established. To further evaluate manganese concentrations in surface water, various reference/background data were used for comparison (see Section 6.1.3 for a detailed description of the available surface water reference/background data). Manganese was not identified as a surface water human health COPC (see Table B-2.1, Appendix B) as summarized in Table 10-1 below. However, manganese was identified as a surface water ecological COPC (see Appendix C).

Table 10-1 Comparison of Surface Water Manganese Total Concentrations to the Screening Level

COPC	Minimum Value (total, mg/L)	Maximum Value (total, mg/L)	BSL* (total and dissolved, mg/L)	BTV (total, mg/L)	Upgradient Background Maximum (total, mg/L)	Tapwater RSL (mg/L)
Manganese	0.012 AR-9 3/19/2015	2.85 AR-9 10/14/2015	3.68	5.08	11.6 AR-5 10/15/2015	0.43

Notes:
BSL* Upstream Background Screening Level based on total and dissolved concentrations (Neptune, 2017 and Appendix D)
BTV Upgradient Background Threshold Value (see Section 6.1.3 and Appendix D)
COPC Chemical of Potential Concern

An upgradient surface water BTV based on the estimation of the 95/90 UTL for manganese in surface water upgradient of the Plant Site was developed following discussions with the DEQ (2018a). The 95/90 UTL is defined as the 95% confidence limit on the 90th percentile (see summary statistics in Table 10-2 below and Appendix D). The surface water BTV for manganese was based on five surface water sampling locations upgradient of the Plant Site, for which total manganese concentrations were available over a temporal span from 1977 to 2015. The five upgradient surface water sampling locations included in the calculation estimation of the surface water manganese BTV are AR-5, AR-12, SW-03, SW-55, and SW-75 (see Figure 13). The surface water manganese BTV was included as a background/reference data point in Table B-2.1 (Appendix B).

Table 10-2 Summary Statistics and Estimated UTL-95/90 (BTV) for Total Manganese in Surface Water

COPC	Total # of Samples 1977-2015	Minimum Value (total, mg/L)	Median* (total, mg/L)	Average (total, mg/L)	Max Value (total, mg/L)	90th Percentile	95/90 UTL (BTV, mg/L)
Manganese	32	0.028 SW-75 4/25/2001	0.347	1.128	11.6 AR-5 10/15/2015	2.127	**5.08**

Notes:

95/90UTL	Upper Tolerance Level- 95% Confidence Limit on the 90th Percentile
BTV	Background Threshold Value
Median*	A single median value isn't available because the data set has an even number. The median represents an average of the two median values (0.344 mg/L, SW-75, 5/20/2014 and 0.35 mg/L, SW-55, 5/30/2012).

Based on the further evaluation of surface water manganese concentrations in the Colstrip area, manganese concentrations in the Creek appear to be consistent with background concentrations originating from regional geology, as well as coal mining and agricultural activities. In addition, the Creek is not used as a potable drinking water source. The Creek is classified as a C-3 water, which means that the water is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply. A C-3 water generally needs pre-treatment in order to be used as a potable water supply. Considering the above assessment of background surface water manganese concentrations in the Colstrip area, manganese was not selected as a surface water human health COPC (nor retained as a COC). Manganese was also not retained as a surface water ecological COC (see Appendix C).

10.2 EVALUATION OF LEACHING COPCS

Four soil chemicals were identified as leaching COPCs (see Tables B-2.3 through B-2.5 in Appendix B), as follows:

- Barium
  - EU6 (Former Spill Site North 1AD Pipeline Drain Pond)
  - EU7 (Former Spill Site STEP Main Dam)
- Cobalt
  - EU6 (Former Spill Site North 1AD Pipeline Drain Pond)
- Manganese
  - EU6 (Former Spill Site North 1AD Pipeline Drain Pond)
  - EU7 (Former Spill Site STEP Main Dam)
- Radium 226
  - EU6 (Former Spill Site North 1AD Pipeline Drain Pond)

A BTV has not been established for Radium 226 (DEQ, 2013). The BTVs for the remaining three identified leaching COPCs were greater than their respective USEPA SSLs Groundwater Protection, as summarized in Table 10-3 below. However, for each of the three leaching COPCs for which a BTV has been established, the maximum measured concentrations were greater than the BTVs. Conservatively, the three metals were identified as leaching COPCs, as well as Radium 226, and further evaluated.

Table 10-3 Comparison of Leaching COPC Concentrations
Sample Date: 8/16/2017

COPC	Min Value (mg/kg)	Average (mg/kg)	Max Value (mg/kg)	Concentrations in Other Soil Intervals at Max Conc. Location (mg/kg)	BTV (mg/kg)	USEPA SSL for Groundwater Protection (mg/kg)
EU6 – Former Spill Site near North 1AD Pipeline Drain Pond						
Ba	91 (DP1AD-2) 5-6 ft	184	1,300 (DP1AD-4) 0-6 in	188 (DP1AD-4) 6-12 in	429	421
Co	4 (DP1AD-3) 12-24 in (DP1AD-17) 0-6 in	6	13 (DP1AD-17) 6-7 ft	4 (DP1AD-17) 0-6 in 6 (DP1AD-17) 12-24 in	10	2.7
Mn	180 (DP1AD-16) 12-24 in	356	1,830 (DP1AD-17) 6-7 ft	490 (DP1AD-17) 0-6 in 325 (DP1AD-17) 12-24 in	880	280
Ra 226 (pCi/g)	0.4 several	1.4	25.3 (DP1AD-13) 5-6 ft	0.5 (DP1AD-13) 0-6 in 0.6 (DP1AD-13) 12-24 in	NA	NA
EU7 – Former Spill Site near STEP Main Dam						
Ba	86 (MDE-29) 12-24 in	285	731 (MDE-33) 0-6 in	246 (MDE-33) 12-24 in	429	421
Mn	247 (MDE-29) 12-24 in	377	691 (MDE-33) 12-24 in	335 (MDE-33) 0-6 in	880	280

Notes:
pCi/g picoCurie per gram
mg/kg milligrams per kilogram
NA Not Available

To further evaluate the leaching COPCs, Synthetic Precipitation Leaching Procedure (SPLP) analyses were performed on select soil samples and site-specific standards were calculated following DEQ guidance (NJDEP, 2013; DEQ, 2016). DEQ guidance refers to the New Jersey Department of Environmental Protection (NJDEP) guidance for evaluating soil leaching through SPLP analysis (NJDEP, 2013). The NJDEP guidance includes an Excel© worksheet that calculates Site-Specific Impact to

Groundwater Soil Remediation Standards and determines if individuals samples pass or fail the Standard. The worksheet calculation outputs are presented in Appendix H. The SPLP analytical results are presented in Appendix I.

Various soil samples were selected for SPLP analysis. Generally, as a worst-case evaluation, samples with the highest leaching COPC concentrations were selected, which (generally) exceeded their respective BTVs. In addition, samples were selected at locations for which deeper soil interval samples were not available to assess if leaching were occurring. For Radium 226, a USEPA SSL for Groundwater Protection, nor a BTV has been established. As such, the samples with the highest measured Radium 226 concentrations were selected for SPLP analysis. Lastly, it should be noted that SPLP results for at least three samples were necessary to run the SPLP worksheet calculations. Table 10-4 below presents a summary of the SPLP analyses and site-specific standards.

Table 10-4 Summary of SPLP Analyses for Leaching COPCs

Leaching COPC	Sample Field ID	Soil Interval	Soil Concentration (mg/kg)	SPLP Result* (mg/L)	DAF	Leachate Criterion µg/L	Site-Specific* Standard (mg/kg)	Pass or Fail
Barium	DP1AD-4	0-6 in	1,300	0.85	10	6.00E+04	1,300	Pass
	MDE-30	0-6 in	608	<0.05				Pass
	MDE-30 (dup)	0-6 in	540	<0.05				Pass
	MDE-33	0-6 in	731	0.08				Pass
Cobalt	DP1AD-17	6-7 ft	13	<0.005	10	1.00E+03	13	Pass
	MDE-30	0-6 in	5	<0.005				Pass
	MDE-33	0-6 in	5	<0.005				Pass
Manganese	DP1AD-17	6-7 ft	1,830	<0.002	10	5.00E+02	1,830	Pass
	MDE-30	12-24 in	575	<0.002				Pass
	MDE-30 (dup)	12-24 in	497	<0.004				Pass
	MDE-33	12-24 in	691	0.090				Pass
Radium 226*	DP1AD-10	0-6 in	6.1E-06	3.0E-07	10	5.00E-05	2.53E-05 (25.3 pCi/g)	Pass
	DP1AD-10	12-24 in	3.5E-06	1.0E-07				Pass
	DP1AD-13	5-6 ft	2.53E-05	2.0E-07				Pass

Notes:

DAF — Dilution Attenuation Factor – DEQ default (DEQ, 2017b).

Radium 226* — Radium 226 soil concentrations were measured in pCi/g and SPLP leachate concentrations in pCi/L. Radium 226 radioactivity concentrations were converted to mass units using the following activity-to-mass conversion 1 pCi = 1 picogram (pg)[2].
The site-specific standard for Radium 226 was calculated conservatively assuming the DEQ-7 Standard of 5 pCi/L is based solely on Radium 226.
Radium 226 does not have chemical-specific constants built-in to the NJDEP worksheet (2013). Constants were located in the literature and are presented in Appendix H.

Site-Specific* — Site-Specific Impact to Groundwater Soil Remediation Standard based on NJDEP guidance (2013) per DEQ guidance (2016). In all cases the Site-Specific Standard is the maximum measured soil concentration for each leaching COPC.

SPLP Result* — The SPLP Result is the leachate concentration measured in the SPLP method. For non-detects, the laboratory reporting limit was conservatively used as a proxy value.

µg/L — micrograms per liter

In summary, the SPLP results indicate that the leaching COPCs do not pose a leaching to groundwater concern. Specifically, the Site-Specific Impact to Groundwater Soil Remediation Standards defaulted to the maximum measured soil concentrations for the four leaching COPCs. In other words, the model-predicted site-specific soil concentrations for the four leaching COPCs that could potentially result in leaching to groundwater are estimated to be values greater than the measured soil concentrations. As such, the leaching COPCs were not retained as leaching COCs.

2 The unit of “curie” (Ci) was originally defined as the amount of radioactivity measured from 1 gram of Radium 226, which is presently defined as 3.7E+10 nuclear disintegrations per second (becquerels [bq]). Therefore, 1 curie = 1 gram of Radium 226. Similarly, 1 pCi = 1 pg of Radium 226. The USEPA allows for the conversion of radioactivity to mass by dividing the measured radioactivity by the radionuclide’s “Specific Activity” with the units of Ci/g (a conversion parameter relative to Radium 226). Because the COPC of question is Radium 226 (the radionuclide upon which the measurement of curie is based), the division step is unnecessary (the Specific Activity of Radium 226 is 1 Ci/g; USEPA, 2012).

10.3 COMPARISON OF GROUNDWATER COPC CONCENTRATIONS TO DEQ-7 STANDARDS

DEQ guidance (2017b) indicates groundwater concentrations should be compared to DEQ-7 Standards, rather than being quantitatively evaluated in the human health risk assessment. DEQ-7 (2017c) indicates that for metals, dissolved concentrations (i.e., the portion that passes through a 0.45 micron filter) should be used in the comparison. In addition, DEQ-7 (2017d) indicates that for alpha emitters, beta emitters and gamma emitters (such as radium), unfiltered samples should be used for comparison.

As previously described in Section 5.0, forward calculations of human health risks associated with groundwater were not conducted. Instead, the DEQ requested that human health Cleanup Criteria for groundwater be developed, which involved the comparison of source concentrations (i.e., SOEP/STEP Area pond data) and groundwater data from the CCR wells to DEQ-7 Standards, as well as other screening levels (see Table 3 located behind the Tables tab). Human health-based Cleanup Criteria for groundwater are discussed in Section 12.5.1.

10.4 EVALUATION OF RADIUM CONCENTRATIONS IN SOIL

DEQ guidance (2017b) indicates soil concentrations for carcinogens should be compared to the USEPA Residential and Industrial Soil RSLs (USEPA, 2017b). However, the USEPA has not established RSLs for Radium 226/228. Rather, the USEPA provides a Preliminary Remediation Goal (PRG) calculator to develop screening levels for radionuclides (USEPA, 2018). Similarly, the United States Department of Energy (USDOE) Risk Assessment Information System (RAIS) provides the USEPA's PRG calculator, but includes additional receptor scenarios (e.g., excavation worker scenario; USDOE RAIS, 2018). The default exposure frequencies used in the PRG calculator were modified to the Montana-specific exposure frequencies provided by DEQ (2017b). The PRG calculation worksheets are presented in Appendix G.

BTVs for Inorganics in Montana Soils (DEQ/Hydrometrics, 2013) have not been established for Radium 226/228. In addition, USEPA protection of groundwater Soil Screening Levels (SSLs) have not been established for Radium 226/228 (USEPA, 2017b).

To evaluate Radium 226/228 soil concentrations in the SOEP/STEP spill areas, the screening levels, remediation goals, and background concentrations presented in Table 10-5 below were identified.

Table 10-5 Radium Comparison Concentrations

	Radium 226	Radium 228
USDOE RAIS PRG Calculator (DOE RAIS, 2018)	**Screening Level* (pCi/g)**	
Residential PRG	0.124	0.147
Outdoor Worker PRG	4.73	10.0
Excavation PRG	71.2	38.6
USEPA Remediation Goals for Radioactively Contaminated CERCLA Sites (USEPA, 2000)	**Remediation Goal (pCi/g)**	
Surface Soil (0 to 15 cm, 6 inches)	5	5
Subsurface Soil (below 15 cm, 6 inches)	15	15
Background	**Background Concentrations (pCi/g)**	
Surface Soil (0 to 6 cm; Myrick et al., 1981 as cited in ATSDR, 1990)	1.1	NA
Surface and Subsurface Soil (ATSDR, 1990)	1.0	1.0

Notes:

ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
pCi/g	picoCuries per gram
PRG	Preliminary Remediation Goal
Screening Level*	Site-specific screening levels were calculated using Montana-specific exposure frequencies (DEQ, 2017b). Use of site-specific exposure frequencies in the PRG model requires the use of a site-specific area correction factor from the model's default of an "infinite slab". Per EPA guidance (2018), an aerial extent of 1,000 m^2 was used, which the USEPA considers comparable to that of an infinite slab.
USDOE RAIS	United States Department of Energy Risk Assessment Information System

Based on the identified background concentrations, the USDOE RAIS Residential PRGs appear to be concentrations less than background concentrations. Radium 226 soil concentrations at the former North 1AD Pipeline Drain Pond spill area were identified as concentrations potentially greater than background as present in Table 10-6 below. (See Appendix B, Tables B-2.3 through B-2.5, for summaries of the Radium 226/228 soil data. See Appendix E, Tables E-3 through E-5, for the complete Radium 226/228 soil datasets).

Table 10-6 Comparison of Radium 226 Soil Concentrations to Screening Levels and Remediation Goals

Sample	Sample* Depth Interval	Radium 226 (pCi/g)	Outdoor Worker PRG (pCi/g)	Excavation Worker PRG (pCi/g)	USEPA Remediation Goal – Surface Soil* (pCi/g)	USEPA Remediation Goal – Subsurface Soil* (pCi/g)
DP1AD-10	0-6 in	6.1	**4.73**	71.2	**5**	15
DP1AD-10	12-24 in	3.5	4.73	71.2	5	15
DP1AD-13	5-6 ft	25.3	**4.73**	71.2	**5**	**15**
DP1AD	Surface Soil (0-24 in)	95 UCL* 1.52	4.73	71.2	5	15
DP1AD	Surface Soil (0-6 in)	95 UCL* 1.76	4.73	71.2	5	15
DP1AD	Subsurface Soil (> 12 in)	95 UCL* 3.17	4.73	71.2	5	15
DP1AD	Entire Soil Column	95 UCL* 2.40	4.73	71.2	5	15

Notes:

Bold	Soil concentration exceeds screening level or remediation goal
pCi/g	picoCuries/gram
PRG	Preliminary Remediation Goal
Sample*	Samples were composite samples collected over the specified sample depth interval.
Surface soil*	The USEPA (2000) Remediation Goal for radium defines surface soil as 0-15 cm (6 inches).
Subsurface soil*	The USEPA (2000) Remediation Goal for radium defines subsurface soil as > 15 cm (6 inches). Subsurface soil samples, by this definition, were collected at depth intervals > 12 inches.
95 UCL*	95% Upper Confidence Level on the Mean (see Appendix D)

The maximum surface soil concentration of Radium 226 (6.1 pCi/g) measured in sample DP1AD-10 in the 0-6 inch soil depth interval exceeded the Outdoor Worker PRG of 4.73 pCi/g and the USEPA Surface Soil Remediation Goal of 5 pCi/g. However, the 95 UCLs for Radium 226 of 1.52 pCi/g in surface soil (0 to 2 feet, DEQ definition [2017b]) and 1.76 pCi/g (0 to 6 inches, USEPA definition [2000]) at the former North 1AD Pipeline Drain Pond spill area did not exceed the screening levels or remediation goals. In addition, the 95 UCLs for Radium in 226 were approximately the background definitions provided by ATSDR (1990) of "about" 1.0 pCi/g. As such, Radium 226 concentrations in surface soil at the former North 1AD Pipeline Drain Pond spill area were determined to be within background concentrations and Radium 226 was not retained as a surface soil COC.

The maximum subsurface soil concentration of Radium 226 (25.3 pCi/g) measured in sample DP1AD-13 in the 5-6 feet depth interval exceeded the USEPA Subsurface Soil Remediation Goal of 15 pCi/g, but did not exceed the Excavation Worker PRG of 71.2 pCi/g. The 95 UCL for Radium 226 of 3.17 pCi/g in subsurface soil (>12 inches bgs per the USEPA Remediation Goal definition [USEPA, 2000]) at the former North 1AD Pipeline Drain Pond spill area did not exceed the USEPA Subsurface Soil Remediation Goal or the Excavation Worker PRG. The 95 UCL for Radium 226 of 2.40 pCi/g in the entire soil column (0-7 feet bgs) at the former North 1AD Pipeline Drain Pond spill area did not exceed the USEPA

Subsurface Soil Remediation Goal or the Excavation Worker PRG. Radium 226 was not retained as a subsurface soil COC.

10.5 EVALUATION OF RADIUM CONCENTRATIONS IN GROUNDWATER

Radium was initially flagged as a groundwater COPC during the screening process for COIs (see Sections 1.3 and 3.0 and Table 3). Radium concentrations in two sets of water samples from the STEP process ponds were well below the DEQ-7 standard of 5 pCi/L for total recoverable concentrations of Radium 226/228 (the MCL is also 5 pCi/L for Radium 226/228). However, various groundwater samples collected from wells located around the process pond perimeters and used as part of the Federal CCR Rule compliance monitoring had concentrations of Radium 226/228 that were above the DEQ-7 standard. Subsequently, radium was further evaluated as presented within this section.

Previous Evaluation and Approval of Radiological Content in Ash

In 2004, an Environmental Assessment was prepared and approved by the DEQ for the use of Units 1&2 and 3&4 bottom ash for on- and off-site construction projects (DEQ, 2004). The Environmental Assessment concluded the following:

- The measured radiological content of bottom ash (alpha, beta, and gamma radiological characteristics) was within the range of naturally occurring soil and geological materials in the Colstrip area. Please note that radium was only one contributor to the total radiological content.
- No land-use controls over development, population, waste disposal, or special safeguards or monitoring were required for radiation impacts associated with the ash.

Evaluation of Radium under the Federal CCR Rule

As previously described in Section 1.2.2, the Colstrip SES must meet several requirements under the new USEPA CCR Rule. To meet the requirements of the CCR Rule, 26 wells have been used for groundwater monitoring that are located around the perimeters of the process ponds. In addition, four upgradient/background wells are used in the STEP area as part of the CCR Rule (see Figure 6). Groundwater samples have been collected from the CCR wells regularly since February 2016. Radium 226/228 is an Appendix IV constituent under the CCR Rule and was routinely analyzed in the CCR well groundwater samples at the SOEP/STEP area to establish baseline conditions.

The Federal CCR Rule includes rigorous statistical analyses of the groundwater data for the purpose of identifying constituents requiring corrective action. Based on the analytical results of the groundwater samples collected from the CCR wells, as well as the preliminary statistical evaluation, Radium 226/228 does not appear to be a constituent requiring corrective action at the SOEP/STEP area under the CCR Rule.

Radium 226/228 Concentrations in STEP Process Pond Water

Following the COI/COPC identification approach described in Section 3.0, STEP process pond water Radium 226/228 concentrations were assumed to be the source, as a worst-case scenario, of Radium 226/228 in groundwater surrounding the ponds. Pond water samples were collected from the STEP process ponds using a depth-integrated sampling technique to allow for the collection of samples representative of the water column (Hydrometrics, 2017c).

Radium 226/228 concentrations measured in the STEP process ponds were well below the DEQ-7/MCL of 5 pCi/L; (a summary, which includes CCR Well data, is presented in Table 10-7 below).

Table 10-7 Summary of Radium Concentrations for the STEP Pond Water and Groundwater

	Radium 226+228 Maximum (pCi/L)	Radium 226+228(1) Average (pCi/L)
Units 1&2 Stage II FAEP Clearwell	1.1	0.8
Units 1&2 FAEP D Cell	0.2	0.2
Units 1&2 Stage II FAEP E Cell	1.7	1.3
Units 1&2 Stage II FAEP Clearwell North	0.8	0.4
CCR Wells		
Units 1&2 CCR Wells	**12.0**	3.81
Units 1&2 CCR Background Wells	**5.6**	3.30
Groundwater Standards		
DEQ-7/MCL	5.0	5.0

Notes:

BOLD	Measured concentration exceeds relevant screening level or standard.
DEQ-7	Montana Department of Environmental Quality Water Quality Standards
FAEP	Fly Ash Evaporation Pond
MCL	Maximum Contaminant Level
NA	Not Applicable
pCi/L	picoCuries per liter
(1)	If Ra 226 or Ra 228 concentration was less than zero (negative value), then zero used as a proxy value.

<u>Radium 226/228 Concentrations in Colstrip SES Pond Solids (Fly Ash) and Paste</u>

Because the radium concentrations measured in the STEP process pond water were well below the DEQ-7/MCL of 5 pCi/L, radium concentrations measured in groundwater were not sourced from the process ponds. In June 2018, a meeting was held with DEQ to discuss the radium in groundwater issue (DEQ, 2018d). DEQ subsequently requested that samples be collected and analyzed for radium from the following locations to evaluate the source of the radium:

1. Pond solids (fly ash) from the bottom of the Colstrip SES ponds (i.e., Plant Site ponds, STEP ponds and the 3&4 EHP ponds).
2. Paste from the Paste Plants.

On July 10, 2018, samples of the pond solids and plant paste were collected at the Facility, as described below.

Pond Solids

Five-part composite samples were collected from various Plant Site ponds, STEP ponds, and the 3&4 EHP cells as follows:

Plant Site

- Units 1&2 Bottom Ash Pond – bottom ash is directed to this pond and solids are periodically removed and placed in the 3&4 EHP. Solids drop out quickly and the water decants to the adjacent clearwell. Samples were collected at five locations from below the water level at the edge of the water.
- Units 1&2 B Pond – B Pond receives return water from the STEP Clearwell. Flyash is only placed in B Cell during upset conditions. As such, flyash is limited to the NW corner of the pond. Samples were collected from below the water at five locations.

- Units 3&4 Bottom Ash Pond – Bottom ash is directed to one of two active cells. Solids quickly drop out and the water is decanted to adjacent cells. Bottom ash is periodically removed and placed in the 3&4 EHP. Samples were collected with a shovel by digging at five locations around the perimeter of the active cell.

STEP

- STEP A Cell – A Cell no longer receives scrubber slurry. Samples were collected from near the surface at five locations by excavating into the flyash at five locations.
- STEP E Cell – E Cell is the current active cell. Samples were collected by digging to below the water level at five locations along the edge of the ponded area.

3&4 EHP

- 3&4 EHP C Cell – samples were collected by digging holes below the water level and collecting a saturated sample.
- 3&4 EHP B Cell (New Clearwell) – B Cell has been used as a clearwell. However, a minor amount of paste was directed to B Cell during upset conditions. This flyash is limited to near the discharge point in the northeast corner of the cell. Samples were collected from five locations from below the water level.
- 3&4 EHP G Cell – A small amount of water is present in the southwest corner of G Cell. This water is contained within a small berm and is periodically pumped into C Cell. Solids samples were collected from below water along the inside of the north side of the berm

Solids collected at each of the areas were mixed thoroughly, placed in sample containers, and shipped to Energy Laboratories for analysis.

Paste Plants

Solids in scrubber slurry are concentrated to develop a “paste” for placement in the disposal cells. Samples can be collected in the Paste Plant from a hopper (referred to as Gob Hopper) after the paste has been formed and prior to pumping it to the destination cell. Samples were collected as “grab” samples from the hopper, placed in sample bottles, and delivered to Energy Laboratories for analysis from the two paste plants:

- 3&4 EHP Paste Plant
- STEP Paste Plant

Radium concentrations measured in the pond solids and paste were all very low (< 1.0 picoCuries per gram [pCi/g]). The background radium concentration in United States soils is approximately 2 pCi/g for Radium 226 + 228 (ATSDR, 1990), indicating that the measured concentrations in the fly ash and paste are well below background. A summary of the radium concentrations in solids is presented in Table 10-8 below.

Table 10-8 Summary of Radium Concentrations in the Colstrip SES Pond Solids and Paste

	Radium 226	Radium 228
Pond Solids (Fly Ash)	**pCi/g**	
Plant Site – Units 1&2 Bottom Ash Pond	0.2	0.2
Plant Site – Units 1&2 B Pond	0.09	0.2
Plant Site – Units 3&4 Bottom Ash Pond	0.2	0.2
STEP A Cell	0.2	0.2
STEP E Cell	0.2	0.4
3&4 EHP B Cell	0.2	0.3
3&4 EHP C Cell	0.2	0.4
3&4 EHP G Cell	0.2	0.4
Paste		
STEP Paste Plant	0.2	0.4
3&4 EHP Paste Plant	0.2	0.02
Soil Standards		
USDOE RAIS PRG Calculator (DOE RAIS, 2018)	**Screening Level* (pCi/g)**	
Outdoor Worker PRG	4.73	10.0
Excavation PRG	71.2	38.6
USEPA Remediation Goals for Radioactively Contaminated CERCLA Sites (USEPA, 2000)	**Remediation Goal (pCi/g)**	
Surface Soil (0 to 15 cm, 6 inches)	5	5
Subsurface Soil (below 15 cm, 6 inches)	15	15
Background	**Background Concentrations (pCi/g)**	
Surface Soil (0 to 6 cm; Myrick et al., 1981 as cited in ATSDR, 1990)	1.1	NA
Surface and Subsurface Soil (ATSDR, 1990)	1.0	1.0

Notes:
Pond Solids and Plant Paste Samples were collected in July 2018.

BOLD	Measured concentration exceeds relevant screening level or standard.
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
pCi/g	picoCuries per gram
PRG	Preliminary Remediation Goal
Residential PRG	Calculated Residential PRGs were concentrations below background – Ra 226 (0.124 pCi/g), Ra 228 (0.147 pCi/g)
Screening Level*	Site-specific soil screening levels were calculated using Montana-specific exposure frequencies (DEQ, 2017b). Use of site-specific exposure frequencies in the PRG model requires the use of a site-specific area correction factor from the model's default of an "infinite slab". Per USEPA guidance (2017b), an aerial extent of 1,000 m^2 was used, which the USEPA considers comparable to that of an infinite slab.
USDOE RAIS	United States Department of Energy Risk Assessment Information System

Summary

Based on further evaluation of Radium 226/228 groundwater concentrations presented within this section, Radium 226/228 groundwater concentrations at the STEP area appear to be consistent with background concentrations. Consequently, Radium 226/228 was not retained as a groundwater COI; however, it will remain a COPC while additional radium groundwater data are collected. The further evaluation of Radium 226/228 groundwater concentrations is summarized below:

- A previous Environmental Assessment concluded the radiological content of the Units 1&2 and 3&4 bottom ash was within background for soil and geological materials in the Colstrip area.

- Following the COI/COPC identification approach, the Radium 226/228 concentrations in the process ponds were assumed to be the source, as a worst-case scenario, of Radium 226/228 in groundwater surrounding the STEP process ponds. The scrubber slurry that is piped to the ponds is well mixed having been subjected to physical mixing, pressure, and temperature changes. Furthermore, the process water is continuously circulated through the scrubber process under these conditions (i.e., process water is circulated from the scrubbers through the pipelines to the ponds and then back to the scrubbers). Hence, the process water through its exposure to these conditions numerous times results in a “worst-case” condition. Radium 226/228 concentrations in the scrubber slurry, and in free water derived from the scrubber slurry, are expected to be uniform and representative of maximum possible levels.

    - The Radium 226/228 concentrations measured in the STEP ponds (assumed worst-case concentrations) were generally less than groundwater concentrations and well below the DEQ-7 standard. Therefore, pond water does not appear to be the source of radium concentrations measured in groundwater.
    - Radium 226/228 concentrations measured in ponds solid samples (i.e., fly ash) collected from the Colstrip SES Process Ponds, as well as the Paste Plant samples, were very low at concentrations below appropriate soil screening levels and well below background. Therefore, the fly ash does not appear to be the source of radium measured in groundwater.
    - The assumption that Radium 226/228 concentrations in groundwater were attributable to seepage from the process ponds was not validated.

In conclusion, there is no evidence to substantiate that the source of radium in groundwater is the process pond water, bottom ash, fly ash, or plant paste. Radium concentrations in groundwater at the STEP area appear to be consistent with background levels and radium was not identified as a groundwater COI. However, because a radium groundwater BSL was not available for comparison, as a conservative measure radium will remain a COPC while additional groundwater data are collected. Radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring and continue to be evaluated under the AOC.

11.0 FATE AND TRANSPORT ANALYSIS

The AOC (Article VI.B) requires the CCRA Report to identify transport mechanisms for the COIs (COPCs). In Section 4.2 Chemical Releases and Transport Mechanisms, various transport mechanisms were discussed that largely consisted of the following:

- Seepage losses from the SOEP/STEP ponds that are presently mitigated by an extensive capture well system. Comprehensive groundwater sampling is conducted regularly to evaluate groundwater quality trends and evaluate the effectiveness of the capture well system. Groundwater analytical results are compared to the BSLs as part of this evaluation. The groundwater BSLs are not clean-up levels, but are used as one criterion for evaluating capture well or monitoring well data when baseline specific data are not available.

- Historical surface releases to soil (pipeline/pond releases and subsequent remediation).

A fate and transport analysis of COIs/COPCs potentially leaching through the soil column was performed through the comparison of soil chemicals (i.e., metals) to the USEPA SSLs for Groundwater Protection (USEPA, 2017b) that were modified following the DEQ Soil Screening Process (DEQ, 2017b). Leaching COPCs were further evaluated by conducting SPLP analyses and calculating site-specific soil standards following DEQ guidance (NJDEP, 2013; DEQ, 2016). Leaching COPCs were not retained as COCs (see Section 10.2). In addition, extensive fate and transport modeling will be conducted in support of the SOEP/STEP Remedy Evaluation.

12.0 DEVELOPMENT OF CLEANUP CRITERIA

The methods used to develop the Cleanup Criteria (also referred to as Site-Specific Cleanup Levels [SSCL]) are described in the sections below.

12.1 SURFACE WATER CLEANUP CRITERIA

Human health COPCs were not identified in surface water at the SOEP/STEP area (see Section 10.1). Two ecological COPCs, boron and manganese, were identified in surface water. Manganese concentrations potentially pose a risk to benthic receptors (i.e., benthic macroinvertebrates living in sediment), while boron potentially poses a risk to aquatic life. The ecological COPCs were not found to pose a risk to livestock drinking surface water from the Creek, although the maximum concentrations of sulfate indicate the surface water is "marginal" for livestock watering (see Appendix C). Manganese and boron concentrations in the Creek appear to be consistent with background concentrations originating from regional geology, as well as coal mining and agricultural activities. Cleanup of surface water would be ineffective as background sources would continue to affect the Creek at the SOEP/STEP area. Therefore, manganese and boron were not retained as ecological COCs and Cleanup Criteria for surface water were not developed.

12.2 STREAMBED SEDIMENT CLEANUP CRITERIA

One human health COPC, manganese, was identified in streambed sediments of the Creek at the SOEP/STEP area. However, concentrations in the streambed sediments were not found to pose a human health risk (see Section 9.1) and manganese was not retained as a human health COC. One ecological COC, manganese, was identified in streambed sediments of the Creek that potentially poses a risk to benthic receptors (see Appendix C). However, manganese concentrations in streambed sediments appear to have originated from background sources. In addition, an aquatic habitat assessment and benthic community survey was conducted in upstream areas of the Creek (Arcadis, 2014) that indicated the lowest ratings of "fairly poor" to "poor" on the HBI (see Section 6.1.3). The likely HBI would be similar for the Creek at the SOEP/STEP area. Cleanup of sediments would be ineffective as background sources would continue to affect the Creek at the SOEP/STEP area. Therefore, manganese was not retained as an ecological COC and Cleanup Criteria for streambed sediments were not developed.

12.3 SOIL CLEANUP CRITERIA

One human health COPC, Radium 226, was identified at the former spill sites at the SOEP/STEP area (see Section 6.3), but not retained as a human health COC (see Appendix B, Tables B-2.3 through B-2.5 and Section 10.4). Ecological COPCs were identified in the spill areas of the SOEP/STEP area at the screening phase of the Ecological Risk Assessment, but not retained as COCs in the Baseline Ecological Risk Assessment (see Appendix C). Therefore, Cleanup Criteria for soil were not developed.

12.4 LEACHING TO GROUNDWATER CLEANUP CRITERIA

Leaching COIs/COPCs were identified at two of the former spill sites at the SOEP/STEP area (EU6, Former Spill Site North 1AD Pipeline Drain Pond; EU7, Former Spill Site STEP Main Dam; see Sections

6.4 and 10.2), but none were retained as leaching COCs. Therefore, leaching to groundwater Cleanup Criteria were not developed.

12.5 GROUNDWATER CLEANUP CRITERIA

The groundwater COCs/COIs were identified through a detailed screening process presented in Section 3.0 and shown in Table 3, located in the Tables section. Both human health and ecological (livestock) risks were considered for the development of the groundwater Cleanup Criteria. Groundwater standards, screening levels, and proposed Cleanup Criteria by hydrostratigraphic layer are presented in Table 12-1 below.

12.5.1 Groundwater Human Health Cleanup Criteria

Following DEQ guidance, human health risks were not forward calculated for groundwater. Rather, groundwater concentrations were compared to the DEQ-7 Standards as a qualitative evaluation of risk. If a DEQ-7 Standard was not available, groundwater concentrations were compared to the USEPA MCL (if available) and the USEPA Tapwater RSL (if available) in accordance with the AOC. In addition, the AOC indicates that Cleanup Criteria may not be more stringent than background concentrations (i.e., the BSLs).

12.5.2 Groundwater Ecological (Livestock) Cleanup Criteria

Groundwater data were not directly used for forward calculations of human health risks associated with groundwater. Forward risks were evaluated for livestock as one well, 901D, located at the northern end of the SOEP/STEP boundary, is currently used to water livestock (stock well; see Appendix C). Per DEQ's request, human health and ecological (livestock) Cleanup Criteria for groundwater were developed. Ecological (livestock) Cleanup Criteria for groundwater were limited to one scenario (livestock consumption via groundwater pumping into stock tanks; see Appendix C).

12.5.3 Cleanup Criteria Discussion

The proposed Cleanup Criteria are discussed within this section.

Boron

A DEQ-7 Standard has not been established for boron. A USEPA Tapwater RSL for boron of 4 mg/L is available, which is a conservative value as the groundwater is classified as Class III and pre-treatment would be necessary for the groundwater to be potable. An ecological (livestock) Cleanup Criterion for boron of 39 mg/L was calculated, which is conservatively based on the protection of the most sensitive livestock receptor (calves) using the NOAEL (the level at which no adverse effects have been observed in the livestock receptor).

The proposed groundwater Cleanup Criterion for boron in all hydrostratigraphic units at the SOEP/STEP area was selected as 4 mg/L, which is the USEPA Tapwater RSL.

Sulfate

Neither a DEQ-7 Standard, nor a USEPA Tapwater RSL has been established for sulfate. An ecological (livestock) Cleanup Criterion for sulfate was established at 3,000 mg/L, which represents the upper end of the "marginal" sulfate range of 1,500 to 3,000 mg/L for livestock as established by United States Department of Agriculture (USDA) and Montana State University Agricultural Experiment Station (USDA-ARS, 2009). The "marginal" sulfate range was selected because the groundwater is classified as Class III indicating it must be maintained at least marginally suitable as drinking water for some livestock.

The proposed groundwater Cleanup Criterion for sulfate was selected as either the livestock Cleanup Criterion of 3,000 mg/L or the BSL, depending on the hydrostratigraphic unit at the SOEP/STEP area. According to the AOC (DEQ/PPLM, 2012), a Cleanup Criterion may not be more stringent than background. For hydrostratigraphic units in which the BSL is less than the livestock Cleanup Criterion, then the livestock Cleanup Criterion was selected as the proposed Cleanup Criterion. Conversely, for hydrostratigraphic units in which the BSL is greater than the livestock Cleanup Criterion, then the BSL was selected as the proposed Cleanup Criterion.

Cobalt

A DEQ-7 Standard has not been established for cobalt. A USEPA Tapwater RSL for cobalt of 0.006 mg/L has been established, which is a conservative value as the groundwater is classified as Class III and pre-treatment would be necessary for the groundwater to be potable. An ecological (livestock) Cleanup Criterion for cobalt of 0.03 mg/L was calculated, which is conservatively based on the protection of the most sensitive livestock receptor (calves) using the NOAEL (the level at which no adverse effects have been observed in the livestock receptor).

The proposed groundwater Cleanup Criterion for cobalt was selected as either the USEPA Tapwater RSL of 0.006 mg/L or the BSL, depending on the hydrostratigraphic unit at the SOEP/STEP area. According to the AOC (MDEQ/PPLM, 2012), a Cleanup Criterion may not be more stringent than background. For hydrostratigraphic units in which the BSL is less than the RSL, then the USEPA Tapwater RSL was selected as the proposed groundwater Cleanup Criterion. Conversely, for hydrostratigraphic units in which the BSL is greater than the RSL, then the BSL was selected as the proposed groundwater Cleanup Criterion.

Lithium

A DEQ-7 Standard has not been established for lithium. A USEPA Tapwater RSL for lithium of 0.04 mg/L has been established, which is a conservative value as the groundwater is classified as Class III and pre-treatment would be necessary for the groundwater to be potable. The RSL of 0.04 mg/L is more stringent than background. According to the AOC (DEQ/PPLM, 2012), a Cleanup Criterion may not be more stringent than background. An ecological (livestock) Cleanup Criterion could not be calculated because a mammalian Toxicity Reference Value (TRV) has not been established for lithium.

The proposed groundwater Cleanup Criterion for lithium was selected as the BSL for all hydrostratigraphic units at the SOEP/STEP area.

Table 12-1 Groundwater Standards, Screening Levels and Proposed Cleanup Criteria – SOEP/STEP Area

COI/COC	Ground-water DEQ-7/MCL (mg/L)	USEPA Tapwater RSL (mg/L)	BSL Range (mg/L)	Ecological (Livestock) Cleanup Criterion (mg/L)	Cleanup Criterion Source	Proposed Cleanup Criteria				
						Alluvium (mg/L)	Spoils (mg/L)	Clinker (mg/L)	Coal-Related (mg/L)	SubMcKay (mg/L)
CCR Appendix III Constituents										
Boron	NA (6)	4	0.8 – 3.9	39 (1)	RSL	4 (RSL)	4 (RSL)	4 (RSL)	4 (RSL)	4 (RSL)
Sulfate	NA (6)	NA	2,150 – 3,140	3,000 (2)	Livestock/ BSL	3,000 (livestock)	3,000 (livestock)	3,140 (BSL)	3,000 (livestock)	3,000 (livestock)
CCR Appendix IV Constituents										
Cobalt	NA (6)	0.006	0.00066 – 0.0232	0.03 (1)	RSL/BSL	0.02 (BSL)	0.0232 (BSL)	0.0232 (4) (BSL)	0.006 (RSL)	0.006 (RSL)
Lithium	NA (6)	0.04	0.072 – 0.12	NA (3)	BSL	0.12 (BSL)	0.09 (BSL)	0.09 (4) (BSL)	0.072 (BSL)	0.072 (4) (BSL)
Selenium	0.05 (7)	0.1	0.0024 – 0.01	0.28 (1)	DEQ-7	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)	0.05 (DEQ-7)
Other Potential SOEP/STEP Area Constituents										
Manganese	NA (6)	0.43	0.26 – 2.48	61 (1)	RSL/BSL	0.61 (BSL)	2.48 (BSL)	0.67 (BSL)	0.48 (BSL)	0.43 (RSL)

Notes:

BSL	Background Screening Level (Neptune, 2017)	(1)	Calculated Cleanup Criterion protective of livestock (calf), see Appendix C
CCR	Coal Combustion Residual	(2)	Upper limit of "marginal" sulfate range for livestock (USDA-ARS, 2009)
COI	Constituent of Interest	(3)	Cleanup Criterion could not be calculated – no mammalian Toxicity Reference Value (TRV) available, see Appendix C
COC	Chemical of Concern		
MCL	Maximum Contaminant Level	(4)	BSL not available. BSL for adjacent hydrostratigraphic layer used as a proxy value.
mg/L	Milligrams per liter	(5)	BSL not available. RSL assumed to be applicable.
NA	Not available/not applicable	(6)	Neither a DEQ-7, nor an MCL has been established.
RSL	Regional Screening Level	(7)	Value is both the DEQ-7 and the MCL.

Selenium

DEQ-7 Standards apply to all waters of the State of Montana. According to the AOC (MDEQ/PPLM, 2012), a Cleanup Criterion may not be more stringent than background. The DEQ-7 for selenium is not more stringent than the BSLs. A USEPA Tapwater RSL for selenium of 0.1 mg/L has been established, which is a conservative value as the groundwater is classified as Class III and pre-treatment would be necessary for the groundwater to be potable. An ecological (livestock) Cleanup Criterion for selenium of 0.28 mg/L was calculated, which is conservatively based on the protection of the most sensitive livestock receptor (calves) using the NOAEL (the level at which no adverse effects have been observed in the livestock receptor).

The proposed groundwater Cleanup Criterion for selenium was selected as the DEQ-7 Standard of 0.05 mg/L for all hydrostratigraphic units at the SOEP/STEP area.

Manganese

A DEQ-7 Standard has not been established for manganese. A USEPA Tapwater RSL for manganese of 0.43 mg/L has been established, which is a conservative value as the groundwater is classified as Class III and pre-treatment would be necessary for the groundwater to be potable. An ecological (livestock) Cleanup Criterion for manganese of 61 mg/L was calculated, which is conservatively based on the protection of the most sensitive livestock receptor (calves) using the NOAEL (the level at which no adverse effects have been observed in the livestock receptor).

The proposed groundwater Cleanup Criterion for manganese was selected as either the USEPA Tapwater RSL or the BSL, depending on the hydrostratigraphic unit at the SOEP/STEP area. According to the AOC (MDEQ/PPLM, 2012), a Cleanup Criterion may not be more stringent than background. For hydrostratigraphic units in which the BSL is less than the RSL, then the USEPA Tapwater RSL was selected as the proposed groundwater Cleanup Criterion. Conversely, for hydrostratigraphic units in which the BSL is greater than the RSL, then the RSL was selected as the proposed groundwater Cleanup Criterion.

12.5.4 Cleanup Criteria Comparison of the SOEP/STEP and Plant Site Areas

As previously discussed in Section 6.1.3, the groundwater BSLs (Neptune, 2016) were revised in 2017 (Neptune). Per a discussion and agreement between DEQ and Talen (DEQ, 2017e), the 2016 BSLs were applicable to the Plant Site CCRA, while the revised 2017 BSLs were applicable to the SOEP/STEP CCRA (as well as the 3&4 EHP CCRA). The BSLs were used in the development of the groundwater Proposed Cleanup Criteria for instances when the DEQ-7 standard, or other appropriate screening levels, were lower than background levels. Under the AOC, cleanup criteria may not be more stringent than background (DEQ/PPLM, 2012). As a result of the 2017 revisions to the BSLs, the groundwater Proposed Cleanup Criteria varied slightly for three of the SOEP/STEP COIs/COCs in comparison to the Plant Site as shown in Table 12-2 below.

Table 12-2 Groundwater Proposed Cleanup Criteria Comparison for the SOEP/STEP and Plant Site

COI/COC	Alluvium (mg/L)		Spoils* (mg/L)		Clinkers (mg/L)		Coal-Related (mg/L)		SubMcKay (mg/L)	
	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP	Plant Site	SOEP/ STEP
CCR Appendix III Constituents										
Boron	4	4	4	4	4	4	4	4	4	4
Sulfate	3,000	3,000	**3,045**	**3,000**	**3,160**	**3,140**	3,000	3,000	3,000	3,000
CCR Appendix IV Constituents										
Cobalt	0.02	0.02	0.0232	0.0232	0.0232	0.0232	0.006	0.006	0.006	0.006
Lithium	**0.092**	**0.12**	0.09	0.09	0.09	0.09	0.072	0.072	0.072	0.072
Selenium	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Other Potential SOEP/STEP Constituents										
Manganese	**0.6**	**0.61**	**2.79**	**2.48**	0.67	0.67	**0.54**	**0.48**	0.43	0.43

Notes:
Bold SOEP/STEP Groundwater Proposed Cleanup Criterion differed from the Plant Site.
CCR Coal Combustion Residuals
COC Chemical of Concern
COI Constituent of Interest
mg/L milligrams per liter
spoils* Spoils not present at the SOEP/STEP area

In summary, the groundwater proposed cleanup criteria for three of the COIs/COCs varied slightly between the Plant Site and the SOEP/STEP area as follows:

- **Sulfate** - slightly lower proposed cleanup criteria in SOEP/STEP area for two hydrostratigraphic units.
  - Spoils: 3,045 mg/L (Plant Site) versus 3,000 mg/L (SOEP/STEP area); however, spoils are generally not present at the SOEP/STEP area.
  - Clinkers: 3,160 mg/L (Plant Site) versus 3,140 mg/L (SOEP/STEP area)

- **Lithium** – slightly higher proposed cleanup criteria in the SOEP/STEP area for one hydrostratigraphic unit.
  - Alluvium: 0.092 mg/L (Plant Site) versus 0.12 mg/L (SOEP/STEP area)

- **Manganese** - slightly higher and lower proposed cleanup criteria in SOEP/STEP area for three hydrostratigraphic units.
  - Alluvium: 0.6 mg/L (Plant Site) versus 0.61 mg/L (SOEP/STEP area)
  - Spoils: 2.79 mg/L (Plant Site) versus 2.48 mg/L (SOEP/STEP area); however, spoils are generally not present at the SOEP/STEP area.
  - Coal-Related: 0.54 mg/L (Plant Site) versus 0.48 mg/L (SOEP/STEP area)

13.0 APPLICATION OF THE CCRA RESULTS TO THE REMEDY EVALUATION

Within this section, the CCRA results are discussed as they apply to the remedial evaluation.

13.1 SURFACE WATER

No action is required in the Remedy Evaluation regarding surface water.

13.2 STREAMBED SEDIMENT

No action is required in the Remedy Evaluation regarding streambed sediment.

13.3 SOIL

No action is required in the Remedy Evaluation regarding soil in the former spill areas.

13.4 GROUNDWATER

Cleanup Criteria for the groundwater COIs/COPCs were presented in Section 12.5. The groundwater Cleanup Criteria should be used in the Remedy Evaluation to develop remedial alternatives to address COI/COPC groundwater concentrations that exceed these values, including after the capture system is shut down. In addition, the remedial actions should include all the regulated substances listed in the AOC Control Action definition (Section IV.B.; DEQ/PPLM, 2012), which include three of the COIs/COPCs (sulfate, boron, selenium), as well as potassium, sodium, magnesium, TDS, and salinity. Radium concentrations in groundwater at the SOEP/STEP area appear to be consistent with background levels and radium was not identified as a groundwater COI/COC. However, because a radium groundwater BSL was not available for comparison, as a conservative measure radium will remain a COPC while additional radium groundwater data are collected. Radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring and continue to be evaluated under the AOC.

CLEANUP CRITERIA AND RISK ASSESSMENT REPORT

Wastewater Facilities Comprising the Closed-Loop System
SOEP/STEP Area
COLSTRIP STEAM ELECTRIC STATION

Pursuant to: ADMINISTRATIVE ORDER ON CONSENT REGARDING IMPACTS RELATED TO WASTEWATER FACILITIES COMPRISING THE CLOSED-LOOP SYSTEM AT COLSTRIP STEAM ELECTRIC STATION, COLSTRIP, MONTANA SECTION XI – SUBMISSIONS

CERTIFICATION:
I, the undersigned, hereby certify that this document was prepared under my direction and to the best of my knowledge the information contained herein is correct and accurate.

Kardell Stephens   Compliance Professional   10/29/18
Name   Title   Date

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TABLES

Table 1A

Preliminary Screening of SOEP/STEP Wastewater CCR Rule Appendix III Constituents

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	Boron (Dissolved)		Boron (Total)		Calcium (Dissolved)		Calcium (Total)		Fluoride		Sulfate (SO_4)		pH (lab)*		Total Dissolved Solids (TDS)	
Groundwater DEQ-7 (mg/L)		NA		NA		NA		NA		4		NA		NA		NA	
MCL (mg/L)		NA		NA		NA		NA		4		NA		NA		NA	
RSL (mg/L)		4		4		NA		NA		0.8		NA		NA		NA	
BSL (mg/L)		0.8 - 3.9		0.8 - 3.9		303 - 477		303 - 477		0.4 - 2.11		2,150 - 3,140		7.8 - 8.27 s.u.		3,445 - 5,010	
Values (units)		Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (s.u.)	Mean (s.u.)	Max (mg/L)	Mean (mg/L)
Site Descriptor																	
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	105	77.5	NA	NA	602	483	NA	NA	3.9	2.36	13,300	10,071	8.5	7.46	19,400	14,633
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	167	167	149	149	578	533	NA	NA	1.5	1.5	33,800	33,000	7.8	6.45	45,200	40,400
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	198	108	116	107	507	414	340	338	1.42	1.25	42,100	20,392	8.2	6.43	48,200	29,117
Evaporation Pond Cell E	6/2002 - 5/2015	230	182	166	162	518	432	428	377	1.57	1.47	38,300	33,800	7	5.51	54,500	46,457
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	36.9	18.7	32	31.6	639	471	492	489	1.3	0.413	10,900	6,518	8	7.57	14,100	9,737
Evaporation Pond Cell A	5/1996 - 5/2015	599	211	642	642	556	490	NA	NA	1.9	1.9	155,000	59,543	7.9	6.7	209,000	64,657
1&2 Stage II FAEP-D	7/2012 - 5/2015	172	172	203	203	514	514	NA	NA	1.4	1.4	43,400	40,500	5.4	5.15	60,100	44,450

Notes:

* - pH measurement reported in standard units (s.u.). Field pH data limited. See Section 3.0 for a comparison of laboratory and field pH measurements. The relative percent difference is within acceptable limits.

NA - Not Available/Not Applicable

DEQ - Montana Department of Environmental Quality (2017c)

MCL - Maximum Contaminant Level

RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)

BSL - Background Screening Level (Neptune, 2017)

mg/L - milligrams per liter

Table 1B

Preliminary Screening of SOEP/STEP Wastewater CCR Rule Appendix IV Constituents

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	**Antimony (Dissolved)**		**Antimony (Total)**		**Arsenic (Dissolved)**		**Arsenic (Total)**		**Barium (Dissolved)**		**Barium (Total)**		**Beryllium (Total)**	
Groundwater DEQ-7		**0.006**		**0.006**		**0.01**		**0.01**		**1**		**1**		**0.004**	
MCL (mg/L)		**0.006**		**0.006**		**0.01**		**0.01**		**2**		**2**		**0.004**	
RSL (mg/L)		**0.0078**		**0.0078**		**$5.2X10^{-5}$**		**$5.2X10^{-5}$**		**3.8**		**3.8**		**0.025**	
BSL (mg/L)		**0.15 - 0.4**		**0.15 - 0.4**		**0.005**		**0.005**		**0.024 - 0.27**		**0.024 - 0.27**		**0.0002 - 0.02**	
Values (units)		Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)
Site Descriptor															
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	NA	NA	0.008	0.008	NA	NA	0.004	0.004	NA	NA	0.09	0.09	<0.001	<0.001
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	0.006	0.006	0.05	0.021	0.003	0.003	0.005	0.004	0.066	0.063	0.1	0.082	0.007	0.007
Evaporation Pond Cell E	6/2002 - 5/2015	0.009	0.009	0.009	0.008	0.006	0.005	0.006	0.005	0.091	0.087	0.131	0.123	<0.001	<0.001
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.01	0.01	0.011	0.011	NA	NA
Evaporation Pond Cell A	5/1996 - 5/2015	NA	NA	0.007	0.007	NA	NA	0.012	0.012	NA	NA	<0.05	<0.05	<0.001	<0.001
1&2 Stage II FAEP-D	7/2012 - 5/2015	NA	NA	0.009	0.009	NA	NA	0.005	0.005	NA	NA	0.08	0.08	0.003	0.003

Notes:

* - pH measurement reported in standard units (s.u.)

**- Sum total of Radium 226 and 228

NA - Not Available/Not Applicable

(1) Samples for lithium and radium collected only on 4/27/2017

(a) lead treatment technology action level is 0.015 mg/L

(b) value for inorganic mercury

DEQ - Montana Department of Environmental Quality (2017c)

MCL - Maximum Contaminant Level

RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)

BSL - Background Screening Level (Neptune, 2017)

mg/L - milligrams per liter

Table 1B (Cont'd)

Preliminary Screening of SOEP/STEP Wastewater CCR Rule Appendix IV Constituents

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	Cadmium (Dissolved)		Cadmium (Total)		Chromium (Total)		Cobalt (Total)		Fluoride		Lead (Dissolved)		Lead (Total)	
Groundwater DEQ-7		**0.005**		**0.005**		**0.1**		**NA**		**4**		**0.015**		**0.015**	
MCL (mg/L)		**0.005**		**0.005**		**0.1**		**NA**		**4**		**0.015(a)**		**0.015(a)**	
RSL (mg/L)		**0.0092**		**0.0092**		**NA**		**0.006**		**0.8**		**0.015**		**0.015**	
BSL (mg/L)		**0.002 - 0.01**		**0.002 - 0.01**		**0.0146 - 0.1**		**0.00066 - 0.0232**		**0.4 - 2.11**		**0.01 - 0.08**		**0.01 - 0.08**	
Values (units)		Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)
Site Descriptor															
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	0.006	0.005	NA	NA	NA	NA	NA	NA	3.9	2.36	0.68	0.112	NA	NA
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	NA	NA	0.039	0.039	<0.005	<0.005	0.386	0.386	1.5	1.5	NA	NA	NA	NA
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	0.032	0.032	0.033	0.027	0.011	0.01	0.13	0.13	1.42	1.25	0.006	0.006	0.009	0.008
Evaporation Pond Cell E	6/2002 - 5/2015	0.05	0.049	0.066	0.055	0.018	0.017	0.547	0.547	1.57	1.47	0.003	0.003	0.003	0.003
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	0.005	0.002	<0.001	<0.001	<0.01	<0.006	NA	NA	1.3	0.413	0.02	0.009	<0.001	<0.001
Evaporation Pond Cell A	5/1996 - 5/2015	NA	NA	0.196	0.196	<0.005	<0.005	0.638	0.638	1.9	1.9	NA	NA	NA	NA
1&2 Stage II FAEP-D	7/2012 - 5/2015	NA	NA	0.077	0.077	<0.005	<0.005	0.566	0.566	1.4	1.4	NA	NA	NA	NA

Notes:

* - pH measurement reported in standard units (s.u.)

**- Sum total of Radium 226 and 228

NA - Not Available/Not Applicable

(1) Samples for lithium and radium collected only on 4/27/2017

(a) lead treatment technology action level is 0.015 mg/L

(b) value for inorganic mercury

DEQ - Montana Department of Environmental Quality (2017c)

MCL - Maximum Contaminant Level

RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)

BSL - Background Screening Level (Neptune, 2017)

mg/L - milligrams per liter

Table 1B (Cont'd)
Preliminary Screening of SOEP/STEP Wastewater CCR Rule Appendix IV Constituents
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	Lithium(1) (Dissolved)		Lithium(1) (Total)		Mercury (Dissolved)		Mercury (Total)		Molybdenum (Dissolved)		Molybdenum (Total)	
Groundwater DEQ-7		**NA**		**NA**		**0.002**		**0.002**		**NA**		**NA**	
MCL (mg/L)		**NA**		**NA**		**0.002 (b)**		**0.002 (b)**		**NA**		**NA**	
RSL (mg/L)		**0.04**		**0.04**		**$6.3X10^{-4}$**		**$6.3X10^{-4}$**		**0.1**		**0.1**	
BSL (mg/L)		**0.072 - 0.12**		**0.072 - 0.12**		**0.001 - 0.005**		**0.001 - 0.005**		**0.004 - 0.1**		**0.004 - 0.1**	
Values (units)		Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)
Site Descriptor													
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	NA	NA	NA	NA	<0.001	<0.001	NA	NA	NA	NA	NA	NA
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	5.5	5.5	5.6	5.6	<0.0001	<0.0001	NA	NA	NA	NA	0.124	0.124
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	7.8	7.8	7.6	7.6	<0.001	<0.001	<0.001	<0.001	0.1	0.1	0.121	0.11
Evaporation Pond Cell E	6/2002 - 5/2015	6.1	6.1	6.3	6.3	<0.001	<0.001	<0.001	<0.001	0.17	0.16	0.17	0.16
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	NA	NA	NA	NA	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01
Evaporation Pond Cell A	5/1996 - 5/2015	NA	NA	NA	NA	<0.001	<0.001	0.001	0.001	NA	NA	0.71	0.71
1&2 Stage II FAEP-D	7/2012 - 5/2015	6.9	6.9	6.5	6.5	NA	NA	<0.0001	<0.0001	NA	NA	0.121	0.121

Notes:
* - pH measurement reported in standard units (s.u.)
**- Sum total of Radium 226 and 228
NA - Not Available/Not Applicable
(1) Samples for lithium and radium collected only on 4/27/2017
(a) lead treatment technology action level is 0.015 mg/L
(b) value for inorganic mercury

DEQ - Montana Department of Environmental Quality (2017c)
MCL - Maximum Contaminant Level
RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)
BSL - Background Screening Level (Neptune, 2017)
mg/L - milligrams per liter

Table 1B (Cont'd)

Preliminary Screening of SOEP/STEP Wastewater CCR Rule Appendix IV Constituents

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	Radium 226/228[(1)] (Total)		Selenium (Dissolved)		Selenium (Total)		Thallium (Dissolved)		Thallium (Total)	
Groundwater DEQ-7		5 pCi/L**		0.05		0.05		0.002		0.002	
MCL (mg/L)		5 pCi/L**		0.05		0.05		0.002		0.002	
RSL (mg/L)		NA		0.1		0.1		0.0002		0.0002	
BSL (mg/L)		NA		0.0024 - 0.01		0.0024 - 0.01		0.0003 - 0.05		0.0003 - 0.05	
Values (units)		Max (pCi/L)	Mean (pCi/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)
Site Descriptor											
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	NA	NA	0.16	0.024	NA	NA	NA	NA	NA	NA
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	0.8	0.8	0.468	0.468	0.314	0.314	NA	NA	0.002	0.002
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	0.4	0.4	0.505	0.184	0.16	0.13	NA	NA	<0.1	<0.1
Evaporation Pond Cell E	6/2002 - 5/2015	1.7	1.7	0.441	0.328	0.36	0.281	NA	NA	0.005	0.005
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	NA	NA	0.024	0.009	0.007	0.005	NA	NA	NA	NA
Evaporation Pond Cell A	5/1996 - 5/2015	NA	NA	0.453	0.193	0.892	0.892	0.096	0.096	0.011	0.011
1&2 Stage II FAEP-D	7/2012 - 5/2015	0.1	0.1	0.416	0.416	0.413	0.413	NA	NA	0.007	0.007

Notes:
- * - pH measurement reported in standard units (s.u.)
- **- Sum total of Radium 226 and 228
- NA - Not Available/Not Applicable
- (1) Samples for lithium and radium collected only on 4/27/2017
- (a) lead treatment technology action level is 0.015 mg/L
- (b) value for inorganic mercury

DEQ - Montana Department of Environmental Quality (2017c)
MCL - Maximum Contaminant Level
RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)
BSL - Background Screening Level (Neptune, 2017)
mg/L - milligrams per liter

Table 1C

Preliminary Screening of Other Potential SOEP/STEP Constituents

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

	Sampling Period	Manganese (Dissolved)		Manganese (Total)	
Groundwater DEQ-7		**NA**		**NA**	
MCL (mg/L)		**NA**		**NA**	
RSL (mg/L)		**0.43**		**0.43**	
BSL (mg/L)		**0.26 - 2.48**		**0.26 - 2.48**	
Values (units)		Max (mg/L)	Mean (mg/L)	Max (mg/L)	Mean (mg/L)
Site Descriptor					
Units 1&2 Stage 1 Evaporation Pond	11/1976 - 10/1987	29.9	16.5	NA	NA
Units 1&2 State II Flyash Evaporation Pond Clearwell - New	7/2012 - 5/2015	NA	NA	101	101
Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	5/1996 - 5/2015	73.5	73.2	75.9	60.7
Evaporation Pond Cell E	6/2002 - 5/2015	109	109	123	114
Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	1/1984 - 8/2015	0.21	0.039	<0.005	<0.005
Evaporation Pond Cell A	5/1996 - 5/2015	NA	NA	454	454
1&2 Stage II FAEP-D	7/2012 - 5/2015	NA	NA	151	151

Notes:
NA - Not Available/Not Applicable

DEQ - Montana Department of Environmental Quality (2017c)
MCL - Maximum Contaminant Level
RSL - USEPS Tapwater Regional Screening Level (USEPA, 2017b)
BSL - Background Screening Level (Neptune, 2017)
mg/L - milligrams per liter

Table 2
Summary of Background Screening Levels for Potential Constituents of Interest
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

Constituent	Alluvium (mg/L)		Spoils* (mg/L)		Clinker (mg/L)		Coal-Related (mg/L)		SubMcKay (mg/L)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
CCR Appendix III Constituents										
Boron	1.6	1.6	0.818	0.8	4	3.9	1.1	1	1.3	1.2
Calcium	378	379	495	477	367	367	351	360	313	303
Chloride	45	49	62	52	34	30	20	21	24	23
Fluoride	0.65	0.63	0.4	0.4	0.81	0.81	0.51	0.49	2.1	2.11
Sulfate	2,600	2,530	3,045	2,841	3,160	3,140	2,061	2,150	2,200	2,190
pH (lab)	7.8	7.8	7.88	7.8	8.2	8.2	7.8	8	8.2	8.27
Total Dissolved Solids	4,000	4,120	4,930	4,738	5,170	5,010	3,160	3,445	3,710	3,670
CCR Appendix IV Constituents										
Antimony	0.15	0.2	0.45	0.4	---	---	0.39	0.2	0.15	0.15
Arsenic	0.01	0.005	0.005	0.005	---	---	0.005	0.005	0.005	0.005
Barium	0.022	0.024	0.27	0.27	---	---	0.111	0.128	0.09	0.09
Beryllium	0.003	0.005	0.01	0.02	---	---	0.005	0.0005	0.003	0.0002
Cadmium	0.005	0.005	0.005	0.006	0.01	0.01	0.002	0.002	0.003	0.003
Chromium	0.1	0.1	0.0215	0.025	---	---	0.0146	0.0146	0.1	0.1
Cobalt	0.02	0.02	0.0232	0.0232	---	---	0.0034	0.0034	0.00066	0.00066
Fluoride	0.65	0.63	0.4	0.4	0.81	0.81	0.51	0.49	2.1	2.11
Lead	0.01	0.01	0.05	0.08	0.02	0.02	0.01	0.01	0.01	0.01
Lithium	0.092	0.12	0.09	0.09	---	---	0.072	0.072	---	---
Mercury	0.001	0.001	0.005	0.005	0.001	0.001	0.001	0.001	0.001	0.001
Molybdenum	0.04	0.1	0.048	0.059	---	---	0.02	0.02	0.004	0.004
Radium 226/228	---	---	---	---	---	---	---	---	---	---
Selenium	0.009	0.009	0.0023	0.0024	0.01	0.01	0.005	0.01	0.005	0.005
Thallium	0.5	0.0005	0.05	0.05	---	---	0.005	0.0003	0.5	0.0003
Other Potential Plant Site Groundwater Constituents										
Barium	0.022	0.024	0.27	0.27	NA	---	0.111	0.128	0.09	0.09
Manganese	0.6	0.61	2.79	2.48	0.67	0.67	0.54	0.48	0.27	0.26

Notes:

2016	Neptune, 2016. BSLs prepared in 2016 and used for the Plant Site CCRA (DEQ, 2017e)
2017	Neptune, 2017. Revised BSLs and used for the SOEP/STEP and 3&4 EHP Areas CCRA (DEQ, 2017e).
Spoils *	Spoils not present at the SOEP/STEP Area

--- Not Analyzed

CCR - Coal Combustion Residuals

mg/L - milligrams per liter

BSL - Background Screening Level (Neptune, 2017)

Table 3
Screening for the Identification of Groundwater Constituents of Interest
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

Chemical	SOEP/STEP Pond Data				CCR Data					DEQ-7 Ground-water Standard (Dissolved) (mg/L)	MCL (mg/L)	USEPA Tapwater RSL (mg/L)	Background Screening Level Range [3] (Dissolved) (mg/L)	COI? (Y/N)	Rationale for Selection or Deletion
					CCR Wells			Background/ Upgradient CCR Wells							
	Sampling Period (Maximum Concentration Location)	Pond (Maximum Concentration Location)	Maximum Dissolved [1] Conc (mg/L)	Mean Dissolved [1] Conc (mg/L)	Sampling Period	Total [2] Conc Range (mg/L)	Frequency of Detection	Total [2] Conc Range (mg/L)	Frequency of Detection						
CCR Rule Appendix III Constituents															
Boron	5/1996 - 5/2015	Evaporation Pond Cell A	599	211	2/2/2016 - 11/16/2017	0.13 - 31.7 Tot 0.26 - 3.05 Dis	247/247 7/7	0.39 - 0.52 0.72 - 3.26	9/9 27/27	NA	NA	4	0.8 to 3.9	Y	Ponds: >RSL, >BSL CCR Wells: <RSL, <BSL
Calcium	1/1984 - 8/2015	Units 1&2 Stage II Flyash Evaporation Pond STEP Sump	639	471	2/2/2016 - 11/16/2017	21 - 613 Tot 26 - 378 Dis	246/246 7/7	132 - 201 88 - 380	9/9 27/27	NA	NA	NA	303 to 477	N	No standards or screening levels. No human health or ecological toxicity values
Fluoride [4]	11/1976 - 10/1987	Units 1&2 Stage I Evaporation Pond	3.9	2.36	2/2/2016 - 11/16/2017	0.1 - 2.9	237/247	0.2 - 0.3 0.1 - 0.3	9/9 17/27	4	4	0.8	0.4 to 2.11	N	Ponds: <DEQ-7, >BSL CCR Wells: <DEQ-7, =BSL
Sulfate [4]	5/1996 - 5/2015	Evaporation Pond Cell A	155,000	59,543	2/2/2016 - 11/16/2017	1,090 - 8,130	246/246	1,110 - 1,490 539 - 3,050	9/9 27/27	NA	NA	NA	2,150 to 3,140	Y	Ponds: >BSL CCR Wells: >BSL No standards or screening levels. No human health toxicity values, but ecological toxicity values available.
pH (s.u.)	11/1976 - 10/1987	Units 1&2 Stage I Evaporation Pond	8.5	7.46	2/2/2016 - 11/16/2017	6.9 - 8.2	246/246	7.3 - 7.5 7.0 - 7.6	9/9 27/27	NA	NA	NA	7.8 to 8.27	N	Ponds: =BSL CCR Wells: =BSL No standards or screening levels.
TDS	5/1996 - 5/2015	Evaporation Pond Cell A	209,000	64,657	2/2/2016 - 11/16/2017	2,050 - 12,200	246/246	2,050 - 2,350 1,090 - 4,670	9/9 27/27	NA	NA	NA	3,445 to 5,010	N	Ponds: >BSL CCR Wells: >BSL No standards or screening levels. No human health or ecological toxicity values available.
CCR Rule Appendix IV Constituents															
Antimony	6/2002 - 5/2015	Evaporation Pond Cell E	0.009	0.009	2/2/2016 - 11/16/2017	0.001-0.004 Tot 0.002 Dis	11/247 1/7	<0.001 <0.001	0/9 0/27	0.006	0.006	0.0078	0.15 to 0.4	N	Ponds: >DEQ-7, <BSL CCR Wells: <DEQ-7, <BSL Pond data and CCR Well data below background
Arsenic	6/2002 - 5/2015	Evaporation Pond Cell E	0.006	0.005	2/2/2016 - 11/16/2017	0.001-0.02 Tot 0.002-0.004 Dis	40/247 4/7	0.002 <0.001 - <0.002	1/9 0/27	0.01	0.01	5.2×10^{-5}	0.005	N	Ponds: <DEQ-7, =BSL CCR Wells: <DEQ-7, <BSL
Barium	6/2002 - 5/2015	Evaporation Pond Cell E	0.091	0.087	2/2/2016 - 11/16/2017	0.05 - 0.09 Tot <0.05 Dis	3/247 0/7	<0.05 <0.05	0/9 0/27	1	2	3.8	0.024 to 0.27	N	Ponds: <DEQ-7, <BSL CCR Wells: <DEQ-7, <BSL
Beryllium	5/1996 - 5/2015	Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	0.007 (total)	0.007 (total)	2/2/2016 - 11/16/2017	0.001 - 0.003 Tot <0.001 Dis	3/247 0/7	<0.001 0.002	0/9 1/27	0.004	0.004	0.025	0.0002 to 0.02	N	Ponds: >DEQ-7, <BSL CCR Wells: <DEQ-7, <BSL Pond data and CCR Well data below background
Cadmium	6/2002 - 5/2015	Evaporation Pond Cell E	0.05	0.049	2/2/2016 - 11/16/2017	0.001 - 0.002 Tot <0.001 Dis	3/247 0/7	<0.001 0.001	0/9 1/27	0.005	0.005	0.0092	0.002 to 0.01	N	Ponds: >DEQ-7, >BSL CCR Wells: <DEQ-7, <BSL CCR data indicate Cd not migrating (detection frequency 3/247)
Chromium	6/2002 - 5/2015	Evaporation Pond Cell E	0.017	0.016	2/2/2016 - 11/16/2017	0.005 - 0.031 Tot <0.005 Dis	3/247 0/7	<0.005 <0.005	0/9 0/27	0.1	0.1	NA	0.0146 to 0.1	N	Ponds: <DEQ-7, <BSL CCR Wells: <DEQ-7, <BSL
Cobalt	5/1996 - 5/2015	Evaporation Pond Cell A	0.638 (total)	0.638 (total)	2/2/2016 - 11/16/2017	0.006 - 0.023 Tot <0.005 Dis	9/247 0/7	<0.005 0.006 to 0.007	0/9 2/27	NA	NA	0.006	0.00066 to 0.0232	Y	Ponds: >RSL, >BSL CCR Wells:>RSL, =BSL

Table 3
Screening for the Identification of Groundwater Constituents of Interest
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

Chemical	SOEP/STEP Pond Data				CCR Data					DEQ-7 Ground-water Standard (Dissolved) (mg/L)	MCL (mg/L)	USEPA Tapwater RSL (mg/L)	Background Screening Level Range (3) (Dissolved) (mg/L)	COI? (Y/N)	Rationale for Selection or Deletion
					CCR Wells			Background/ Upgradient CCR Wells							
	Sampling Period (Maximum Concentration Location)	Pond (Maximum Concentration Location)	Maximum Dissolved (1) Conc (mg/L)	Mean Dissolved (1) Conc (mg/L)	Sampling Period	Total (2) Conc Range (mg/L)	Frequency of Detection	Total (2) Conc Range (mg/L)	Frequency of Detection						
CCR Rule Appendix IV Constituents (continued)															
Fluoride (4)	11/1976 - 10/1987	Units 1&2 Stage 1 Evaporation Pond	3.9	2.36	2/2/2016 - 11/16/2017	0.1 - 2.9	237/247	0.2 - 0.3 0.1 - 0.3	9/9 18/27	4	4	0.8	0.4 to 2.11	N	Ponds: <DEQ-7, >BSL CCR Wells: <DEQ-7, =BSL
Lead	11/1976 - 10/1987	Units 1&2 Stage 1 Evaporation Pond	0.68	0.112	2/2/2016 - 11/16/2017	0.001 - 0.006 Tot <0.001 Dis	16/247 0/7	<0.001 <0.001	0/9 0/27	0.015	0.015	0.015	0.01 to 0.08	N	Ponds: >DEQ-7, >BSL CCR Wells: <DEQ-7, <BSL CCR Well data indicate Pb not migrating
Lithium(5)	4/27/2017	Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	7.8	6.6	2/2/2016 - 11/16/2017	0.1 - 0.4 Tot 0.1 Dis	123/247 1/7	<0.1 0.1 - 0.2	0/9 10/27	NA	NA	0.04	0.072 to 0.12	Y(5)	Ponds: >RSL, >BSL CCR Wells: >RSL, >BSL
Mercury	11/1976 - 10/1987 5/1996 - 5/2015 6/2002 - 5/2012 1/1984 - 8/2015 5/1996 - 5/2015	Four Ponds: -Units 1&2 stage 1 Evaporation Pond -Units 1&2 Stage II Flyash Evaporation Pond Clearwell-Old -Evaporation Pond Cell E -Units 1&2 Stage II Flyash Evaporation Pond STEP Sump -Evaporation Pond Cell A	<0.001	<0.001	2/2/2016 - 11/16/2017	<0.0001 Tot <0.0001 Dis	0/247 0/7	<0.0001 <0.0001	0/9 0/27	0.002	0.002	6×10^{-4}	0.001 to 0.005	N	Ponds: <DEQ-7, <BSL CCR Wells: <DEQ-7, <BSL
Molybdenum	6/2002 - 5/2015	Evaporation Pond Cell E	0.17	0.16	2/2/2016 - 11/16/2017	0.001 - 0.028 Tot 0.001 - 0.024 Dis	63/247 5/7	0.001 0.002	8/9 9/27	NA	NA	0.1	0.004 to 0.1	N	Ponds: >RSL, >BSL CCR Wells: <RSL, <BSL CCR Well data indicate Mo not migrating
Radium 226/228(5) (pCi/L)	4/27/2017	Evaporation Pond Cell E	1.7 (total)	0.8 (total)	2/2/2016 - 11/16/2017	-2 to 77	195/195	-0.5 to 3.6 -0.3 to 5.6	9/9 27/27	5 pCi/L	5 pCi/L	NA	NA	N(5)	Ponds: <DEQ-7 CCR Wells: >DEQ-7 BSL not available. Radium initially flagged as a COPC, but not identified as a COI after further evaluation (see Section 10.5).
Selenium	5/1996 - 5/2015	Units 1&2 Stage II Flyash Evaporation Pond Clearwell - Old	0.505	0.184	2/2/2016 - 11/16/2017	0.001 - 0.045 Tot 0.003 - 0.010 Dis	20/247 2/7	0.001 0.002 - 0.007	1/9 17/27	0.05	0.05	0.1	0.0024 to 0.01	Y	Ponds: >DEQ-7, >BSL CCR Wells: <DEQ-7, =BSL Although CCR data indicated Se not leaching, wells outside source area >DEQ-7
Thallium	5/1996 - 5/2015	Evaporation Pond Cell A	0.096	0.096	2/2/2016 - 11/16/2017	0.0005-0.0037 Tot <0.0005 Dis	16/247 0/7	<0.0005 <0.0005	0/9 0/27	0.002	0.002	0.0002	0.0003 to 0.05	N	Ponds: >DEQ-7, >BSL CCR Wells: <DEQ-7, <BSL CCR Well data indicate Tl not migrating

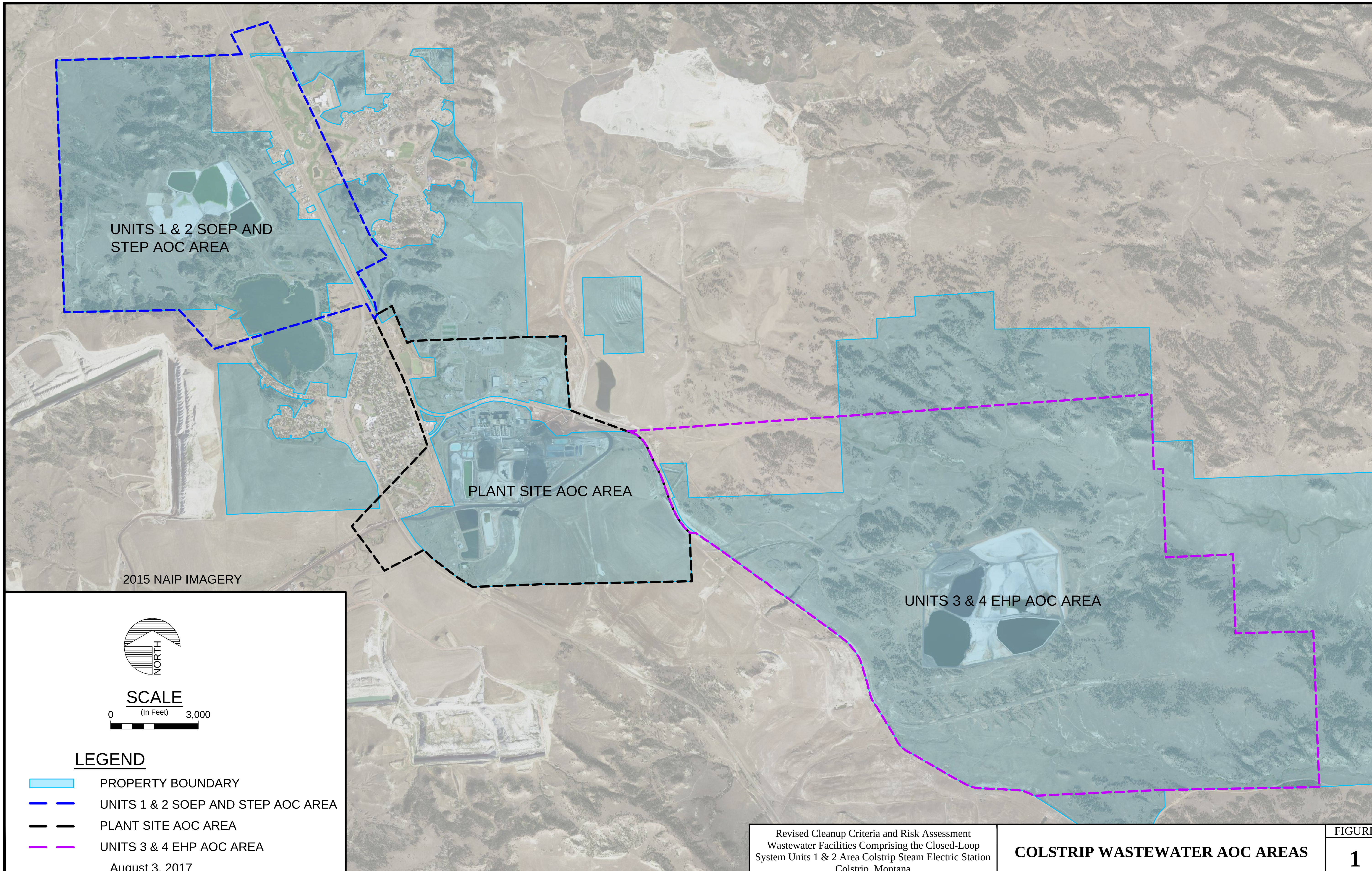
Table 3
Screening for the Identification of Groundwater Constituents of Interest
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Pond Water, Colstrip Steam Electric Station, Colstrip, Montana

Chemical	SOEP/STEP Pond Data				CCR Data					DEQ-7 Ground-water Standard (Dissolved) (mg/L)	MCL (mg/L)	USEPA Tapwater RSL (mg/L)	Background Screening Level Range (3) (Dissolved) (mg/L)	COI? (Y/N)	Rationale for Selection or Deletion
					CCR Wells			Background/ Upgradient CCR Wells							
	Sampling Period (Maximum Concentration Location)	Pond (Maximum Concentration Location)	Maximum Dissolved (1) Conc (mg/L)	Mean Dissolved (1) Conc (mg/L)	Sampling Period	Total (2) Conc Range (mg/L)	Frequency of Detection	Total (2) Conc Range (mg/L)	Frequency of Detection						
Other Potential Plant Site Constituent															
Manganese	6/2002 - 5/2015	Evaporation Pond Cell E	109	109	2/2/2016 - 11/16/2017	0.002 - 1.33 Tot 0.028 - 0.318 Dis	246/247 7/7	0.067 - 0.388 0.001 - 0.21	9/9 21/27	NA	NA	0.43	0.26 to 2.48	Y	Ponds: >RSL, >BSL CCR Wells: <RSL, <BSL Mn also identified as a COI/COPC in the Human Health and Ecological Risk Assessments

Notes:

(1)	Dissolved concentration unless otherwise noted.
(2)	CCR data is reported as total recoverable concentrations, unless otherwise noted.
(3)	Background Screening Levels for Colstrip Steam Electric Station (Neptune 2017).
(4)	Concentration reported as neither dissolved or total recoverable.
(5)	Lithium and Radium 226/228 data were collected on 4/27/2017 (Hydrometrics, 2017c). Lithium and Radium 226/228 data were not available for SOEP/STEP Ponds (Hydrometrics, 2017b) and, therefore, subsequently sampled.
BSL	Background Screening Level (Neptune, 2017)
CCR	Coal Combustion Residual
COI	Constituent of Interest
DEQ-7	Montana Department of Environmental Quality Circular DEQ-7 Numerical Water Quality Standards (DEQ, 2017c)
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
NA	Not Available/Not Applicable
pCi/L	picoCuries per liter
RSL	USEPA Regional Screening Level
s.u.	standard units
TDS	Total Dissolved Solids
USEPA	United States Environmental Protection Agency

FIGURES



Revised Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System Units 1 & 2 Area Colstrip Steam Electric Station Colstrip, Montana

COLSTRIP WASTEWATER AOC AREAS

FIGURE 1

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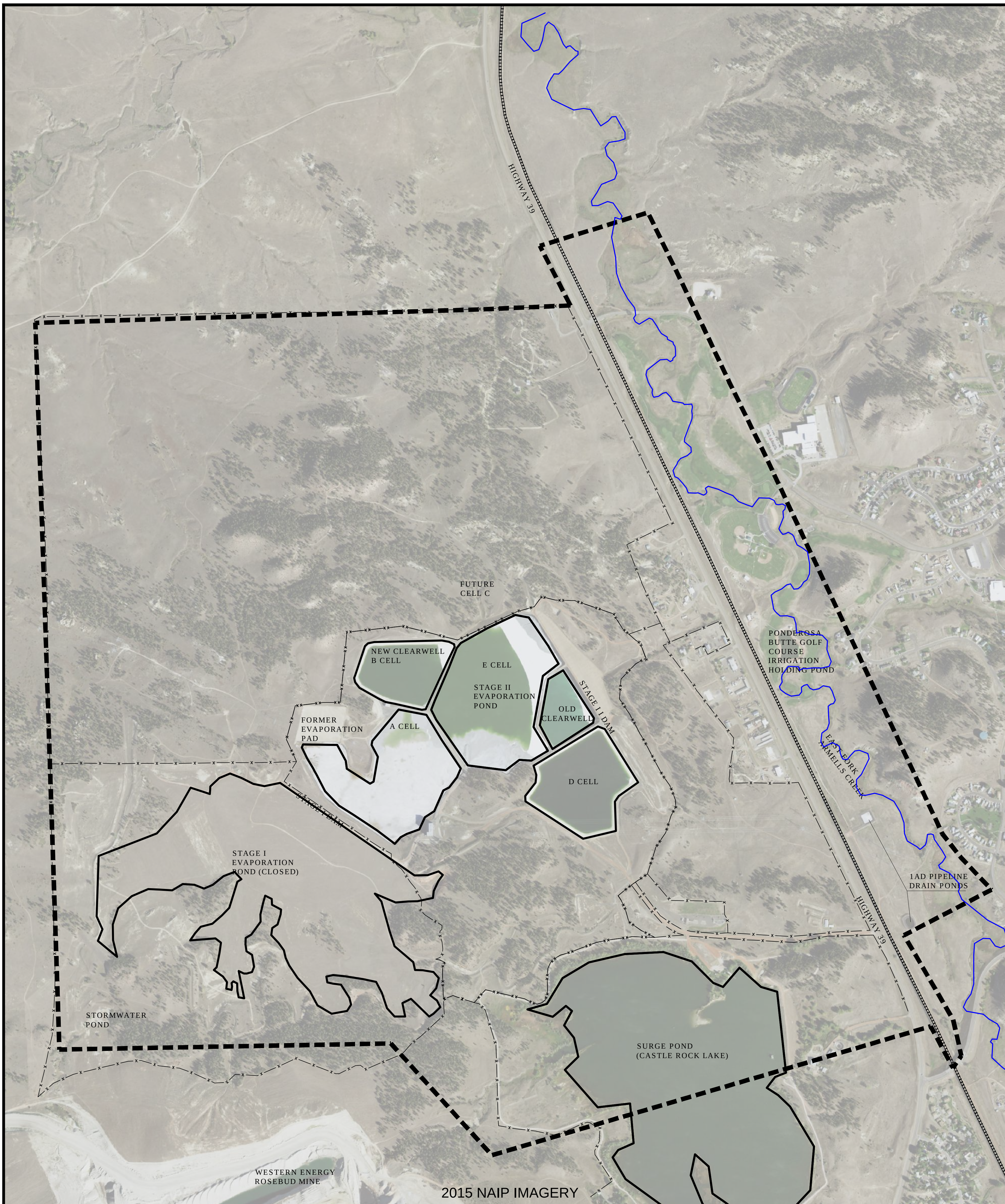

LEGEND

RAILROAD

FENCELINE

STEP AOC BOUNDARY

EAST FORK ARMELLS CREEK

NORTH

SCALE
(In Feet)
0 1200

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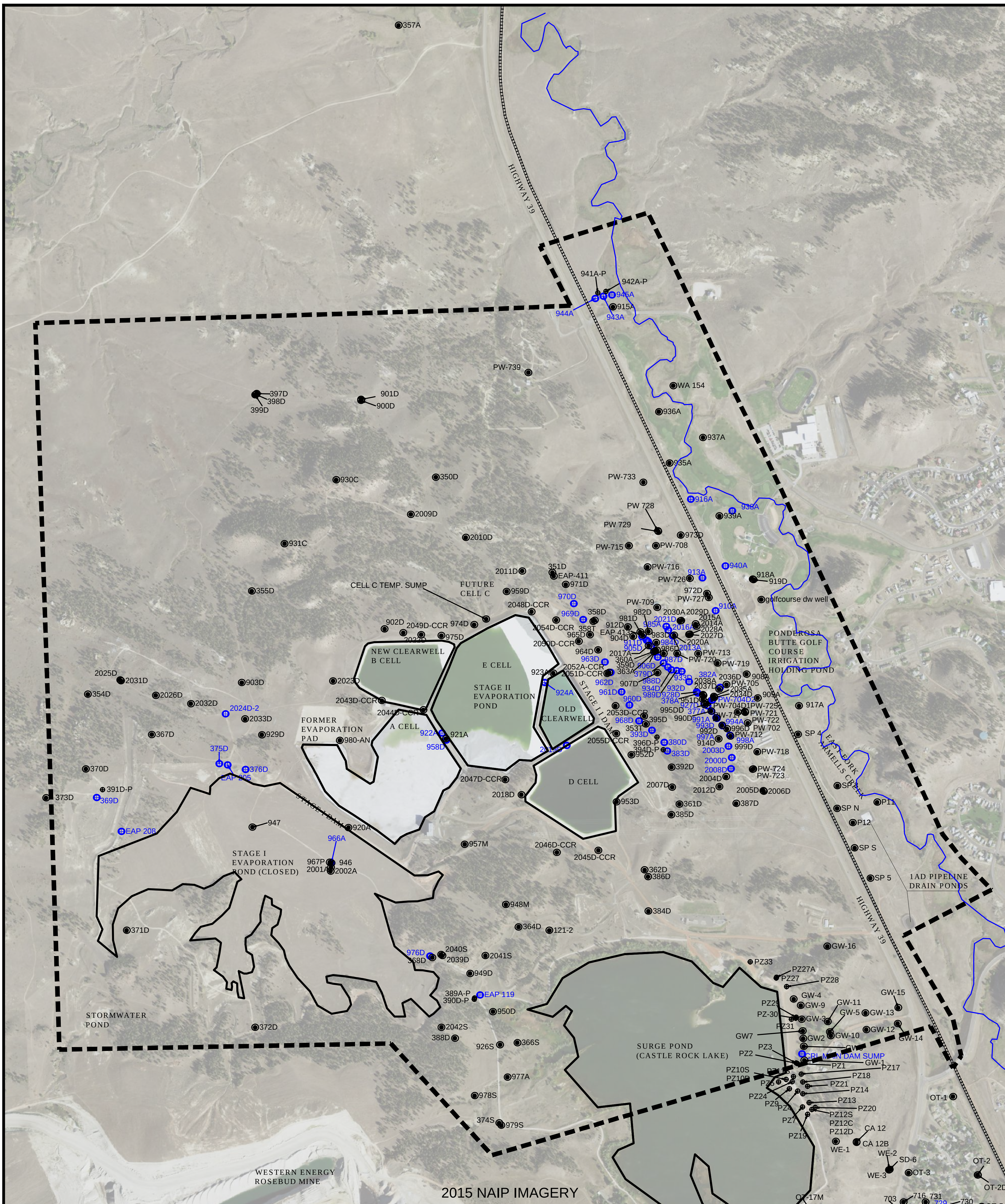
December 18, 2017	Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System STEP 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana	**UNITS 1&2 SOEP/STEP AREA AND FENCELINE**	FIGURE **2**



LEGEND

RAILROAD

STEP AOC BOUNDARY

EAST FORK ARMELLS CREEK

370D MONITORING WELL

369D CAPTURE WELL

391D-P PIEZOMETER

PW-739 PRIVATE WELL (PREFIX "PW")

NORTH

SCALE (In Feet)

0 1200

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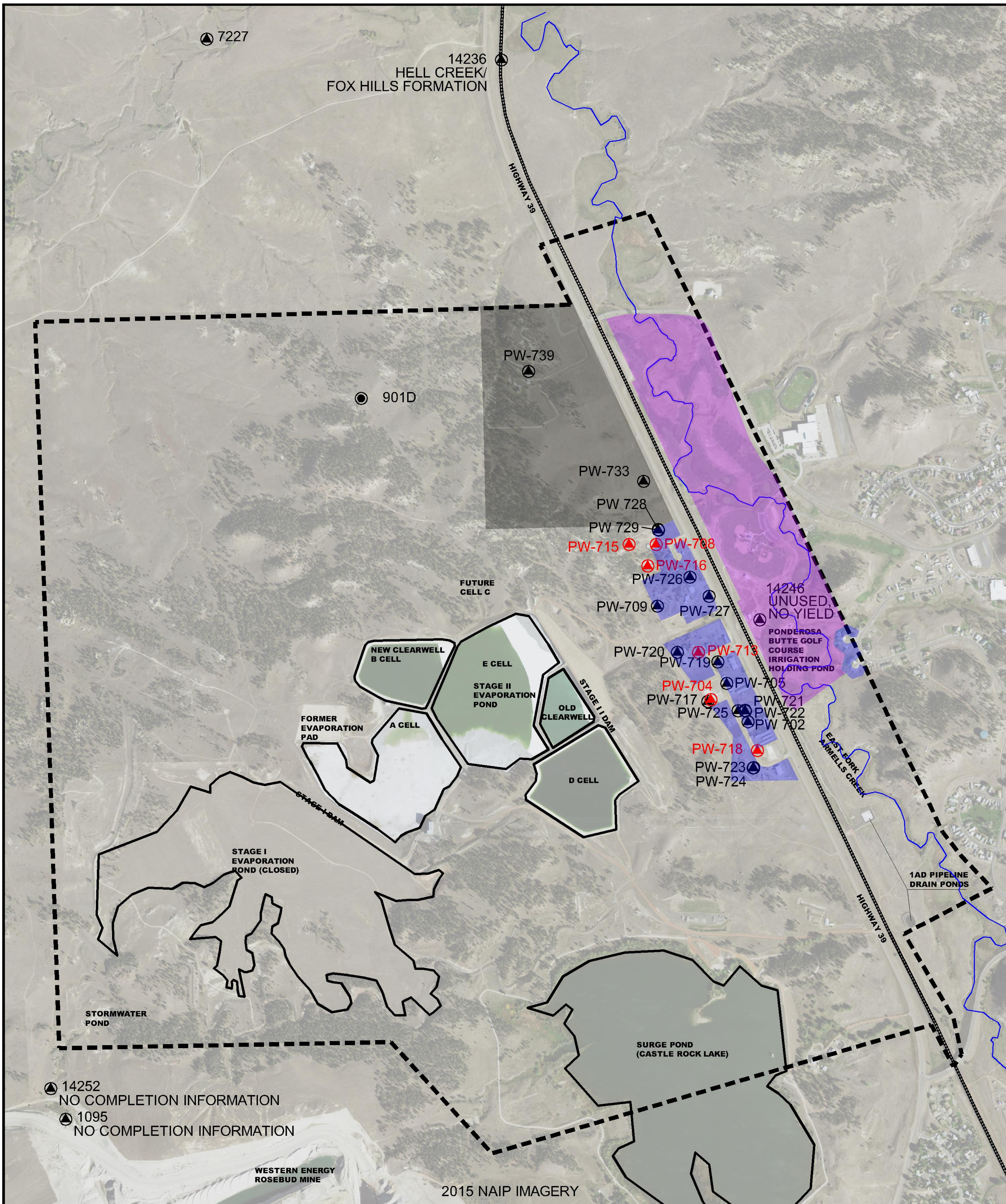
August 3, 2017

Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System STEP 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana

UNITS 1&2 SOEP/STEP AREA GROUNDWATER WELLS

FIGURE 3



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LEGEND

RAIL ROAD

STEP AOC BOUNDARY

EAST FORK ARMELLS CREEK

PRIVATE PROPERTY WITH CITY WATER PROVIDED

PRIVATE PROPERTY WITH SUB-MCKAY WELL WATER

PUBLIC PROPERTY WITH CITY WATER PROVIDED

PW-720 PRIVATE WELL

PW-715 ABANDONED WELL

901D MONITORING/STOCK WATER WELL

NORTH

SCALE
(In Feet)
0 1200

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Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System STEP 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana	UNITS 1&2 SOEP/STEP PRIVATE WELLS	FIGURE 4

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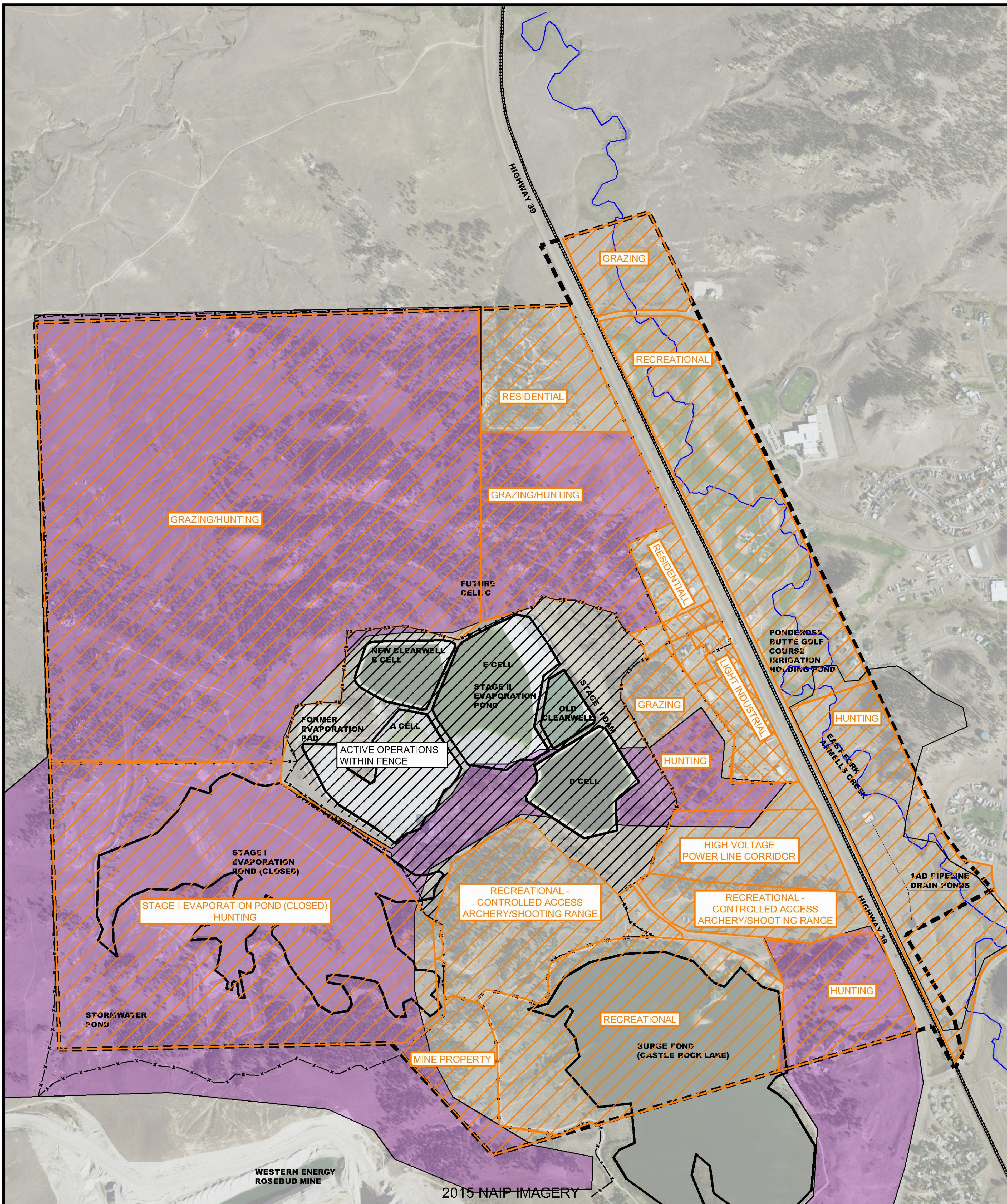

LEGEND

- RAILROAD
- FENCELINE
- ACTIVE OPERATIONS
- NON ACTIVE OPERATION
- LIGHT INDUSTRIAL
- CONTROLLED ACCESS HUNTING AREA
- STEP AOC BOUNDARY
- EAST FORK ARMELLS CREEK

NORTH

SCALE (In Feet)
0 1200

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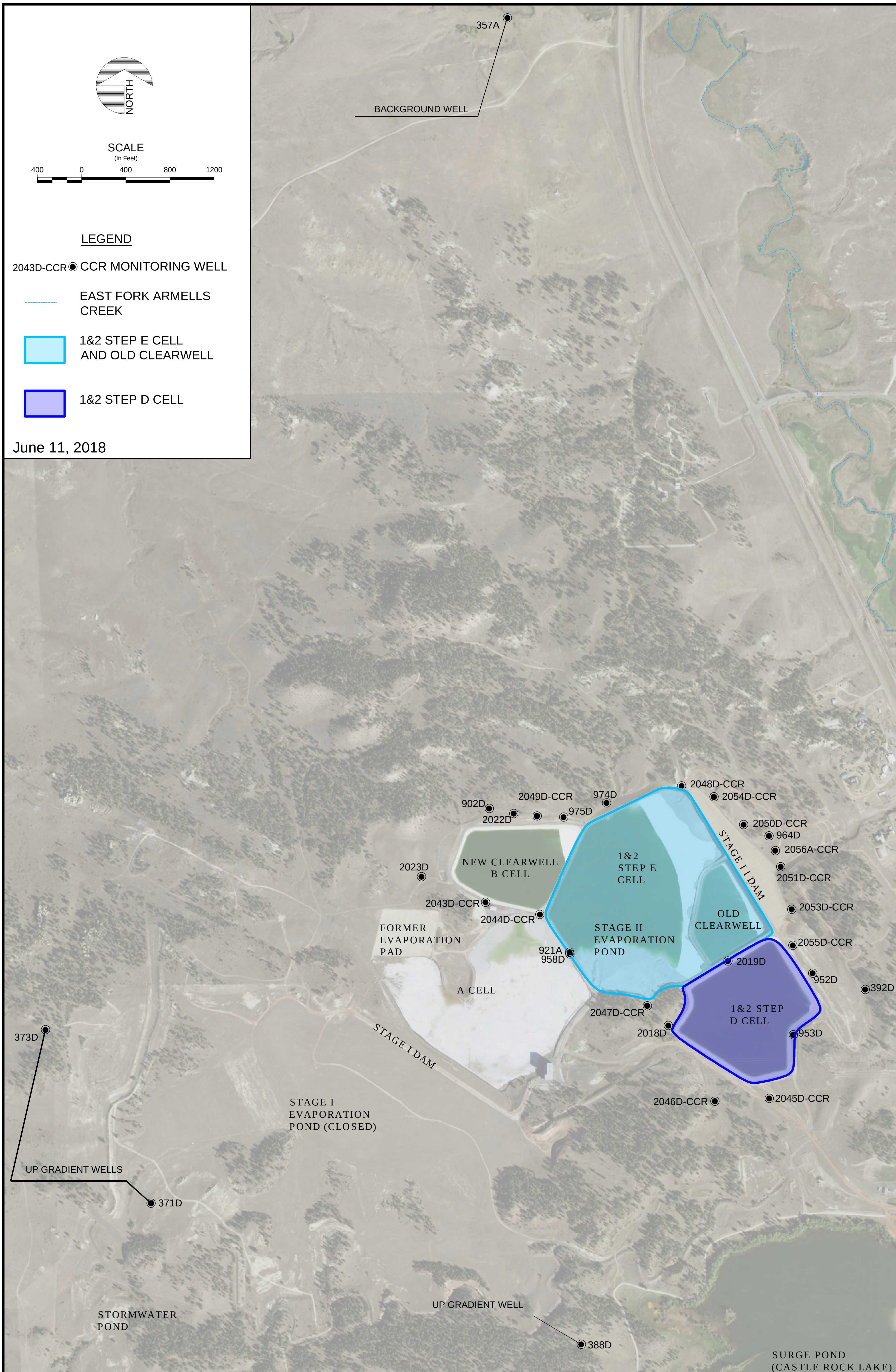
December 8, 2017

Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System STEP 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana	UNITS 1&2 SOEP/STEP AREA CURRENT LAND USE	FIGURE 5



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Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop
System STEP 1&2 SOEP/STEP Area Colstrip
Steam Electric Station Colstrip, Montana

STAGE II EVAPORATION POND
CCR UNITS AND MONITORING WELLS

DRAWING FILE NUMBER
1207216B019
AUTOCAD 2000 DRAWING (DWG)
FIGURE
6

Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Media	Exposure Pathway	Current/Future Land Use: Human Receptors: Current and Future Residents (Adult and Child)	Current and Future Industrial Outdoor Workers	Current and Future Construction Worker	Current and Future Recreational User	Ecological Receptors: Terrestrial Ecological	Aquatic Ecological
Water Based Liquid	Pond Overflow/ Pipeline Releases	Surface Soil	None	Surface Soil	Ingestion	•	•	•	•	•	O
					Dermal	•	•	•	•	•	O
			Migration	East Fork Armells Creek Sediments	Ingestion	•	•	(2)	•	•	•
					Dermal	•	•	(2)	•	†	•
					Inhalation	O	O	O	O	O	O
				East Fork Armells Creek Surface Water	Ingestion	•	~	(2)	~	•	~
					Dermal	•	~	(2)	~	†	~
			Wind	Outdoor Air (Particulates)	Inhalation	•	•	•	•	†	O
	Pond Seepage	Groundwater	None	Groundwater	Ingestion	~	~	~	O	Δ	O
					Dermal	~	~	~	O	O	O
			Migration(1)	East Fork Armells Creek Sediments(1)	Ingestion	•	•	(2)	•	•	•
					Dermal	•	•	(2)	•	†	•
					Inhalation	O	O	O	O	O	O
				East Fork Armells Creek Surface Water(1)	Ingestion	~	~	(2)	~	•	~
					Dermal	~	~	(2)	~	†	~
Background Geology	Leaching	Groundwater	None	Groundwater	Ingestion	~	~	~	O	Δ	O
					Dermal	~	~	~	O	O	O
			Migration	East Fork Armells Creek Sediments	Ingestion	•	•	(2)	•	•	•
					Dermal	•	•	(2)	•	†	•
					Inhalation	O	O	O	O	O	O
				East Fork Armells Creek Surface Water	Ingestion	~	~	(2)	~	•	~
					Dermal	~	~	(2)	~	†	~

Notes:

- • Potentially complete exposure pathway; evaluated quantitatively
- ~ Potentially complete exposure pathway; evaluated qualitatively by comparison to DEQ-7
- † Minor pathway, not quantitatively evaluated
- O Incomplete exposure pathway
- (1) Groundwater migration to the creek is a hypothetical scenario to fulfill DEQ's request to evaluate the Facility without the capture system. At present, the capture system interupts this migration pathway.
- (2) Construction worker exposures to sediment and surface water are not required by DEQ (infrequent, minor pathways)
- Δ Livestock groundwater consumption (pumping of groundwater to stock tanks)

Marietta Canty, LLC
Environmental Consulting

Revised December 4, 2017

Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System Units 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana

SITE CONCEPTUAL EXPOSURE MODEL

FIGURE 7

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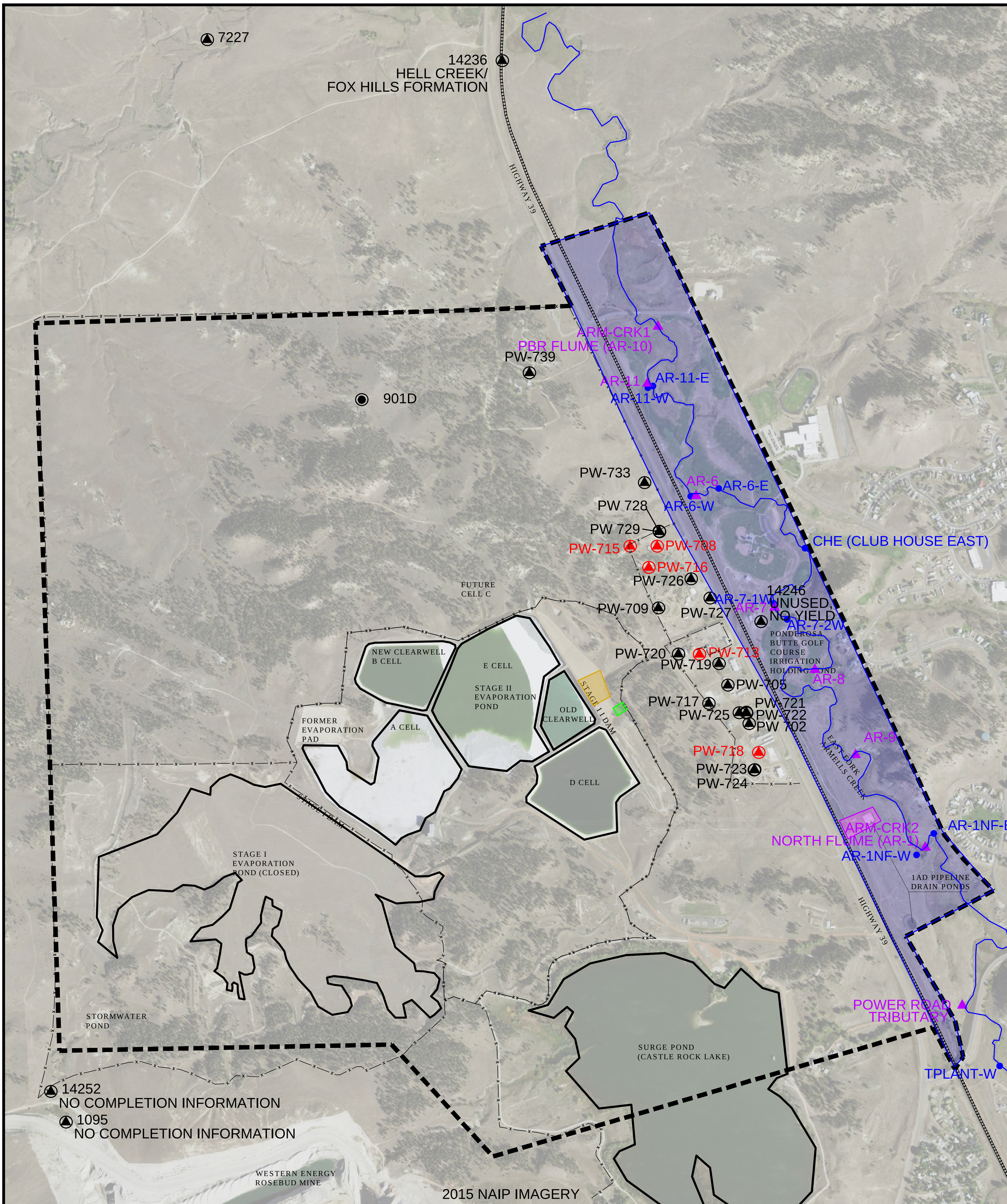

LEGEND

RAILROAD	
FENCELINE	
EXPOSURE UNIT 5 (EU 5)	
EXPOSURE UNIT 6 (EU 6)	
EXPOSURE UNIT 7 (EU 7)	
EXPOSURE UNIT 8 (EU 8)	
STEP AOC BOUNDARY	
EAST FORK ARMELLS CREEK	
PW-720	PRIVATE WELL
PW-715	ABANDONED WELL
AR-3P-E	BANK GROUNDWATER SAMPLE LOCATION
AR-3	SYNOPTIC RUN SITE

NORTH

SCALE
0 (In Feet) 1200

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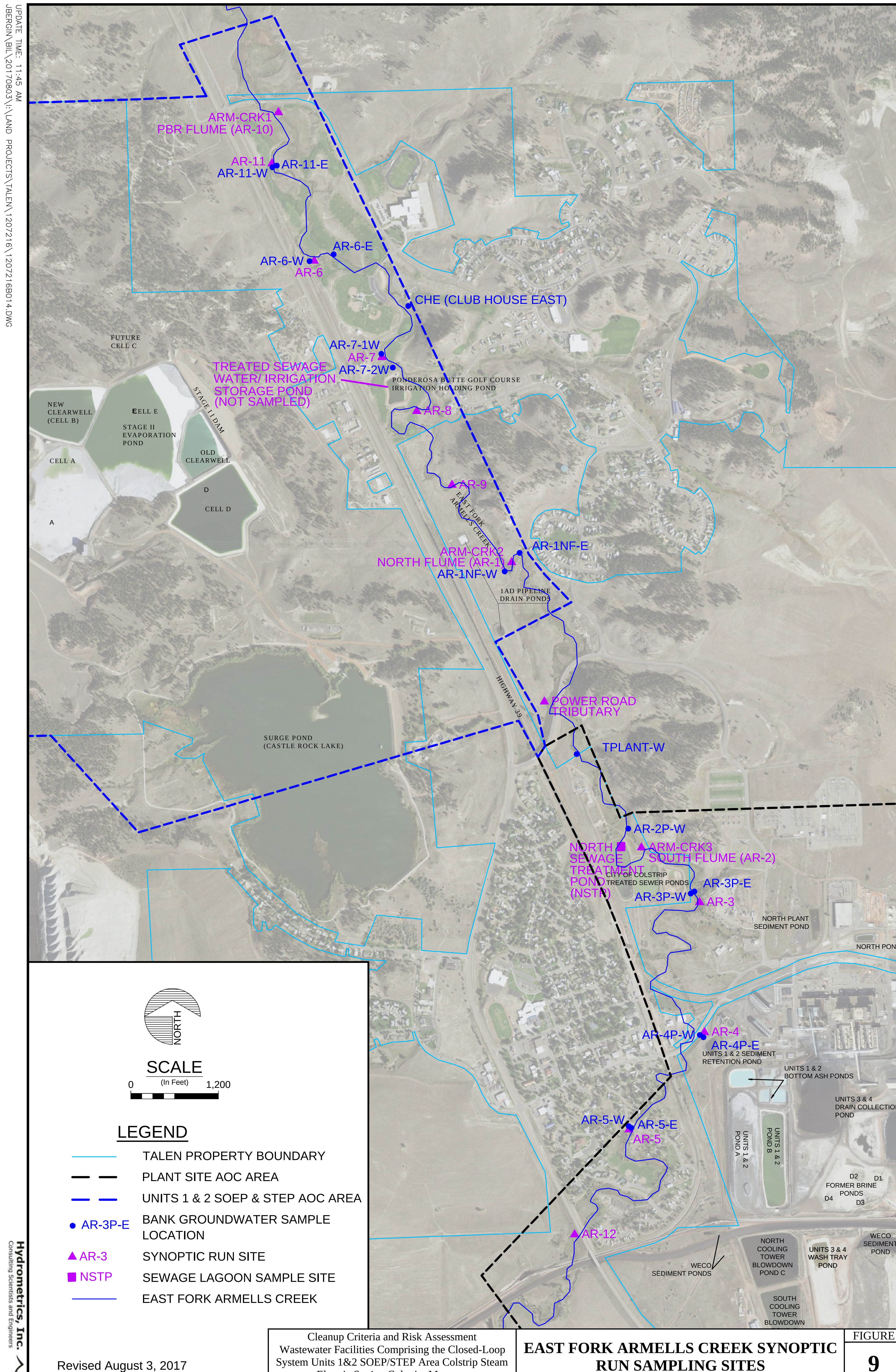
August 3, 2017

Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop
System STEP 1&2 SOEP/STEP Area Colstrip Steam
Electric Station Colstrip, Montana

EXPOSURE UNITS

FIGURE
8

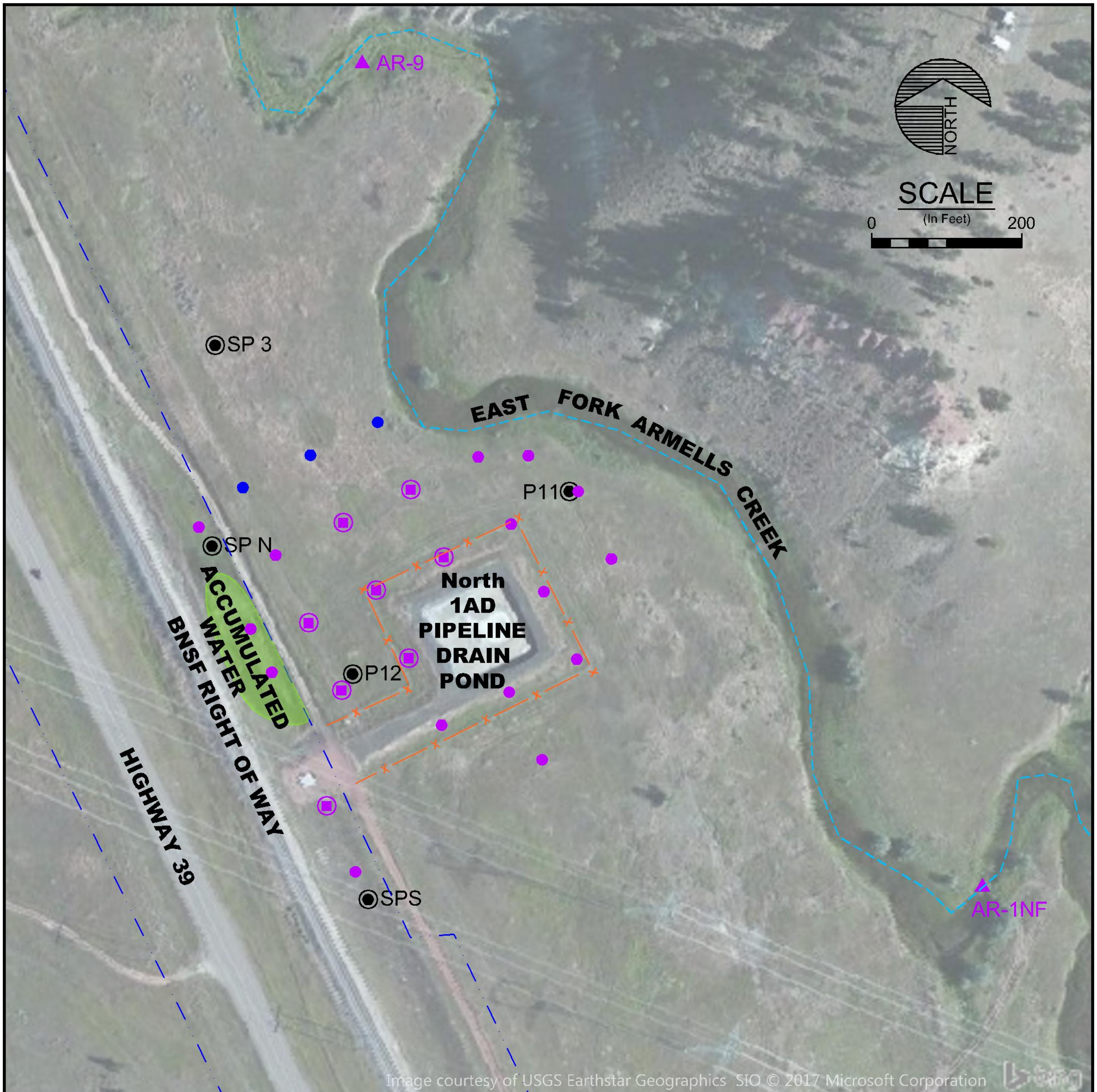


Revised August 3, 2017

Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop
System Units 1&2 SOEP/STEP Area Colstrip Steam
Electric Station Colstrip, Montana

EAST FORK ARMELLS CREEK SYNOPTIC RUN SAMPLING SITES

FIGURE 9



LEGEND

SP5	MONITORING WELL		SHALLOW SOIL SAMPLE
AR-9	SURFACE WATER MONITORING SITE		SHALLOW AND DEEP SOIL SAMPLE
	FENCELINE		SHALLOW SOIL SAMPLE (SAMPLES COLLECTED, BUT NOT ANALYZED)
	APPROXIMATE PROPERTY BOUNDARY		

Cleanup Criteria and Risk Assessment Wastewater Facilities Comprising the Closed-Loop System Units 1&2 SOEP/STEP Area Colstrip Steam Electric Station Colstrip, Montana	**BORING LOCATIONS - FORMER SPILL AT NORTH 1AD PIPELINE DRAIN POND (EU6)**	FIGURE **10**

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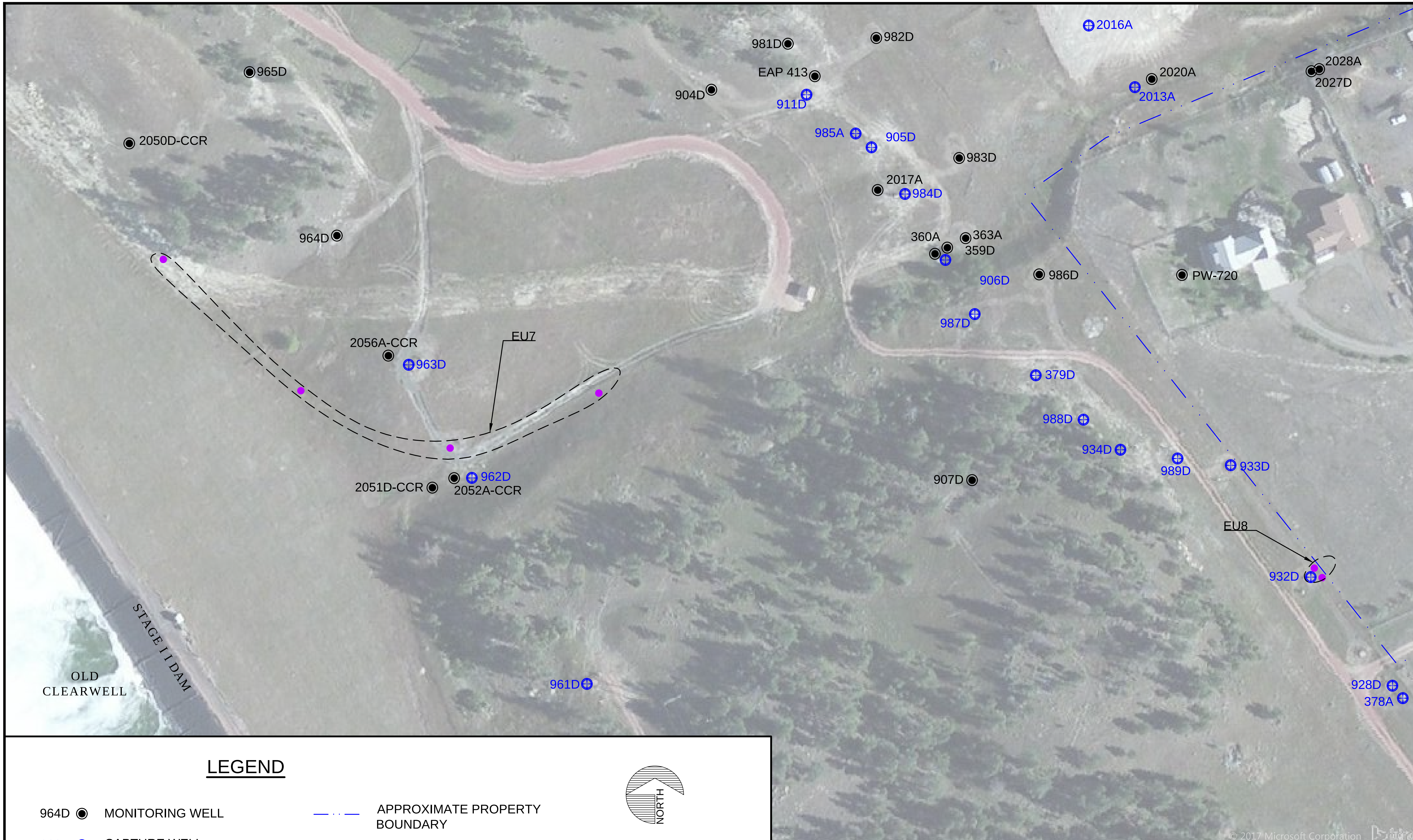

LEGEND

964D MONITORING WELL

963D CAPTURE WELL

SHALLOW SOIL SAMPLE

APPROXIMATE PROPERTY BOUNDARY

APPROXIMATE EXTENT OF POTENTIALLY IMPACTED SOIL

NORTH

SCALE
0 (In Feet) 100

Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop System Units 1&2 SOEP/STEP Area
Colstrip Steam Electric Station Colstrip, Montana

BORING LOCATION - FORMER SPILLS AT STEP MAIN DAM (EU7) AND CAPTURE WELL 932D (EU8)

FIGURE 11

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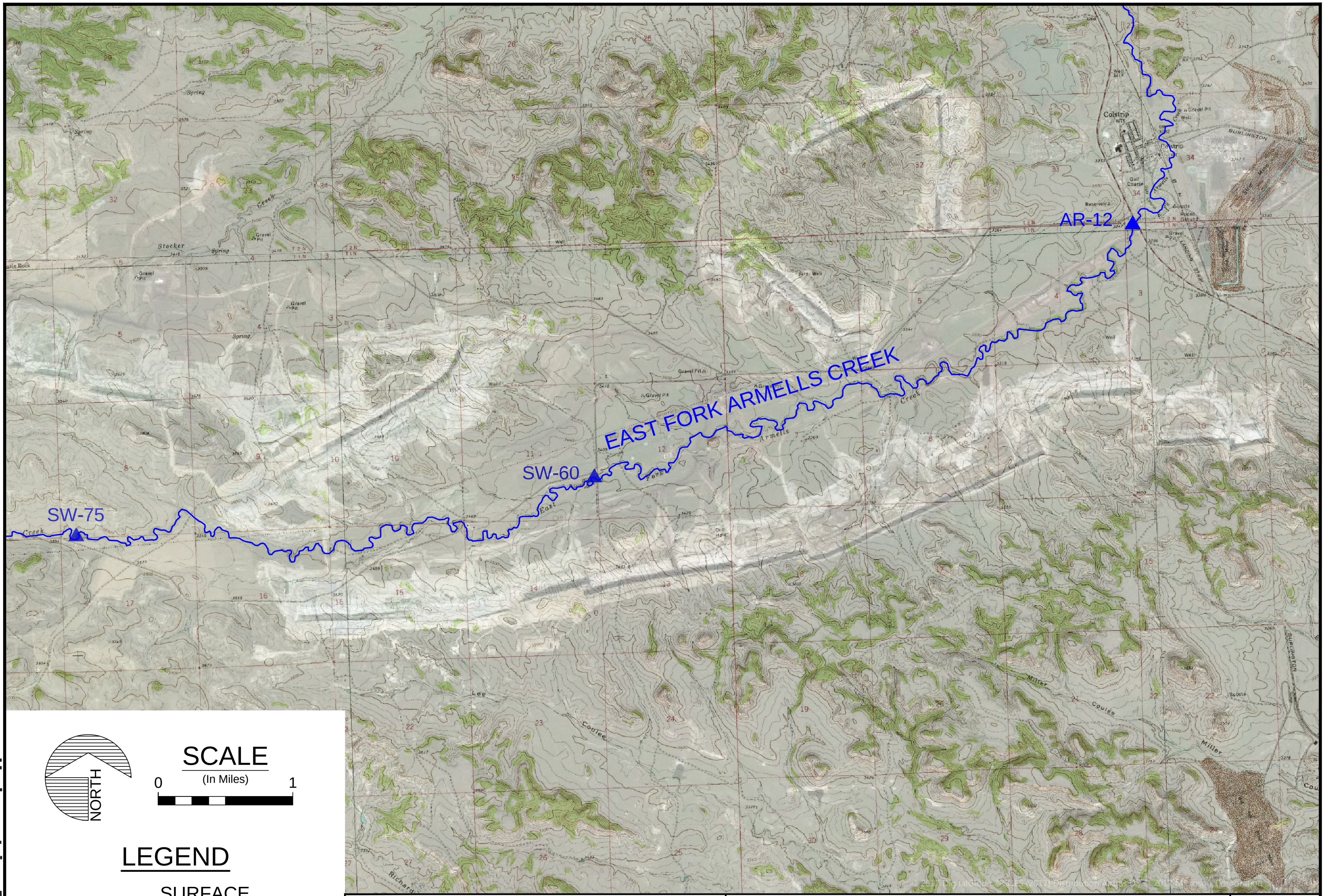

Revised December 7, 2017

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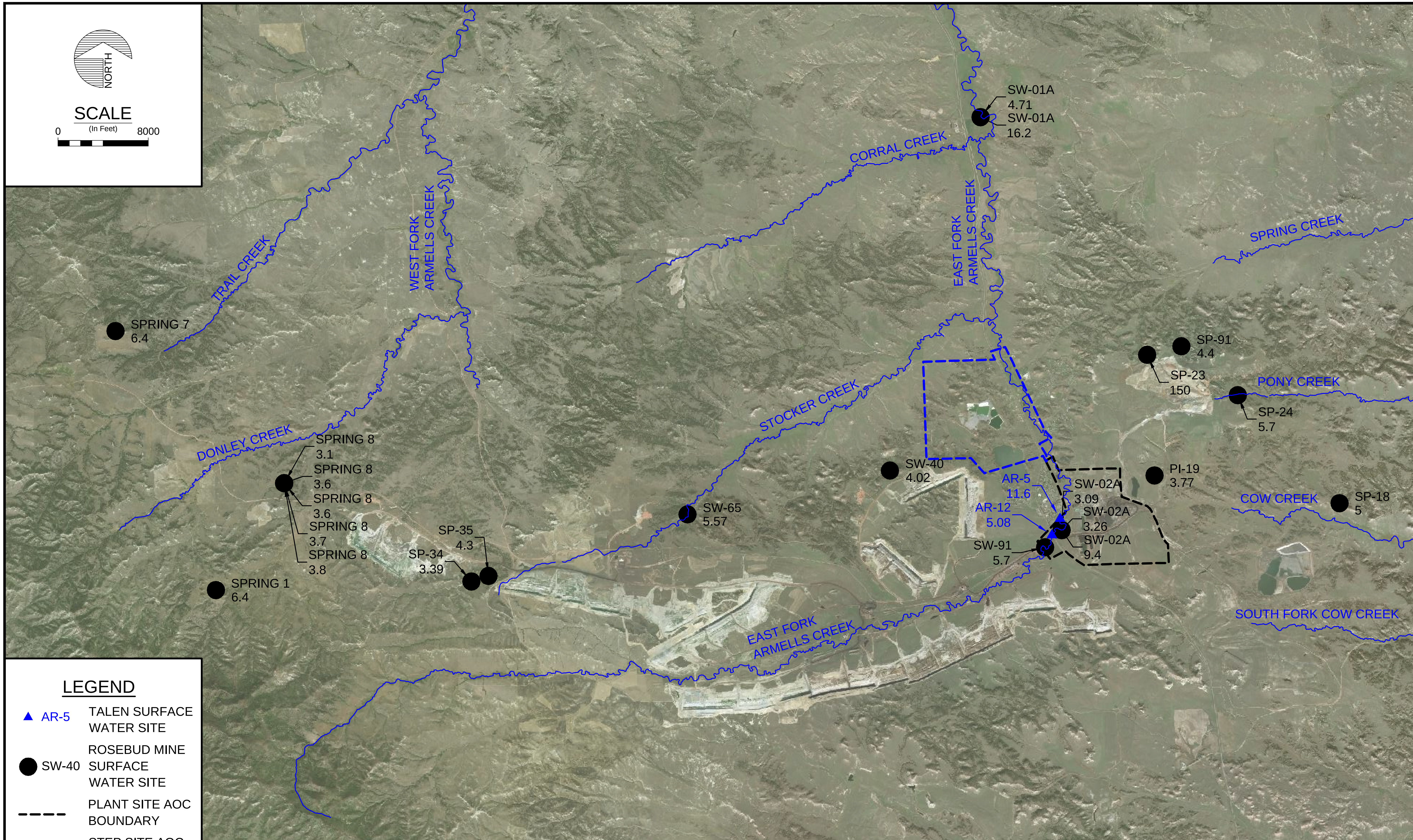
Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop System
Units 1&2 SOEP/STEP Area Colstrip Steam Electric Station
Colstrip, Montana

BSL UPSTREAM SURFACE WATER SAMPLE LOCATIONS

FIGURE

12



Revised Cleanup Criteria and Risk Assessment
Wastewater Facilities Comprising the Closed-Loop System
Units 1 & 2 Area
Colstrip Steam Electric Station Colstrip, Montana

HIGHEST MANGANESE SURFACE WATER SAMPLE LOCATIONS - ROSEBUD MINE DATASET

FIGURE
13

UPDATE TIME: 9:22 AM
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APPENDIX A

Administrative Order on Consent Summary

A. SUMMARY OF THE ADMINISTRATIVE ORDER ON CONSENT

The proposed approach for the selection of the Constituents of Interest (COIs) is presented in the following sections.

A.1 AOC DEFINITION OF COI AND CONTROL ACTIONS

The AOC (MDEQ/PPLM, 2012; Article IV.F) defines Constituents of Interest (COI) as those parameters found in soil, groundwater, or surface water that (1) result from Site operations and the wastewater facilities and (2) exceed background or unaffected reference area concentrations.

The AOC (MDEQ/PPLM, 2012; Article IV.B) defines Control Actions as remedial actions directed exclusively toward reducing, containing or controlling the seepage or migration of regulated substances including but not limited to sulfate, boron, selenium, potassium, sodium, magnesium, total dissolved solids, and salinity measured by specific electrical conductance through the environment. Control actions shall include affirmative source mitigation measures.

Based on the above AOC definitions, COIs and regulated substances may overlap. The regulated substances listed in the Control Action definition (sulfate, boron, selenium, potassium, sodium, magnesium, total dissolved solids, and salinity) are interpreted as the minimum required constituents that should be included in the remedial action development. The COIs are interpreted as constituents beyond the minimum required constituents that may be identified in soil, groundwater, or surface that resulted from Site operations and exceed background concentrations. Both the regulated substances and the COIs are interpreted to require inclusion in the remedial action development. Remedial actions designed to directly mitigate certain constituents will indirectly mitigate other constituents, as well.

A.2 AOC DEFINITION OF CLEANUP CRITERIA

The AOC (MDEQ/PPLM, 2012; Article IV.G) defines the following Cleanup Criteria for the COIs:

1. For each COI in ground or surface water, except for the evaluation for ecological receptors, the applicable standard contained in the most current version of Circular DEQ-7 Montana Numeric Water Quality Standards ("DEQ-7"), the USEPA maximum contaminant level, the risk-based screening level contained in the most current version of Montana Risk-Based Guidance for Petroleum Releases, *whichever* is more stringent; and, for COIs for which there is not a DEQ-7 standard, a maximum contaminant level, or a risk-based screening level contained in the Montana Risk-Based Guidance for Petroleum Releases, the tap water screening level contained in the most current version of USEPA Regional Screening Levels for Chemical Constituents at Superfund Sites, except that no criterion may be more stringent than the background or unaffected reference areas concentrations; and

2. For each COI in ground or surface water that may impact an ecological receptor, an acceptable ecological risk determined using the most current versions of standard USEPA ecological risk assessment guidance if the criteria set pursuant to (1) above are

not adequate to protect ecological receptors, except that no criterion may be more stringent than the background or unaffected reference areas concentrations;

3. For each COI in soil, the more stringent of:

(a) A cumulative human health risk of 1 x 10^{-5} for carcinogens or a cumulative hazard index of 1 for non-carcinogenic COIs, except that no criterion may be more stringent than the background or unaffected reference areas concentrations;

(b) An acceptable ecological risk, determined using the most current versions of standard USEPA ecological risk assessment guidance if the criteria set pursuant to (a) above are not adequate to protect ecological receptors, except that no criterion may be more stringent than the background or unaffected reference areas concentrations; or

(c) The risk-based screening level contained in the most current version of Montana Risk-Based Guidance for Petroleum Releases, except that no criterion may be more stringent than the background or unaffected reference areas concentrations.

A.2.1 Groundwater Cleanup Criteria

According to the AOC, the Cleanup Criteria for each groundwater COI, except for the evaluation for ecological receptors, is the most stringent of the following:

- The applicable standard contained in the most current version of Circular DEQ-7 Montana Numeric Water Quality Standards ("DEQ-7"). It should be noted, in addition, that the MDEQ considers the DEQ-7 Standards to be clean-up values for groundwater, rather than screening levels (MDEQ, 2014).

- The USEPA maximum contaminant level (MCL)

- The risk-based screening level (RBSL) contained in the most current version of Montana Risk-Based Guidance for Petroleum Releases

In addition, for COIs for which there is not a DEQ-7 standard, a maximum contaminant level, or a risk-based screening level contained in the Montana Risk-Based Guidance for Petroleum Releases, the cleanup criteria will be the tap water screening level contained in the most current version of the USEPA Regional Screening Levels (RSLs) for Chemical Constituents at Superfund Sites. No cleanup criterion, however, may be more stringent than the background or unaffected reference areas concentrations.

A.2.2 Surface Water Cleanup Criteria

According to the AOC, the Cleanup Criteria for each COI in surface water, except for the evaluation for ecological receptors, is the most stringent of the following:

- The applicable standard contained in the most current version of the DEQ-7 Circular. It should be noted, in addition, that the MDEQ considers the DEQ-7 Standards to be clean-up values for groundwater, rather than screening levels (MDEQ, 2014).
- The USEPA MCL.
- The RBSL contained in the most current version of Montana Risk-Based Guidance for Petroleum Releases.

In addition, for COIs for which there is not a DEQ-7 standard, a MCL, or a RBSL contained in the Montana Risk-Based Guidance for Petroleum Releases, the cleanup criteria will be the tap water screening level contained in the most current version of the EPA RSLs for Chemical Constituents at Superfund Sites. No cleanup criterion, however, may be more stringent than the background or unaffected reference areas concentrations. Note also, that some special cases may exist due to geospatial variations, in which ambient water at one site is naturally above background screening levels. Such cases will require examination on an individual basis in conjunction with the MDEQ.

A.2.3 Soil Cleanup Criteria

According to the AOC, the cleanup criteria for each COI in soil (soil data is available for areas of surface releases and sediment data is available for the Creek) is the most stringent of the following:

(a) A cumulative human health risk of 1×10^{-5} for carcinogens or a cumulative hazard index of 1 for non-carcinogenic constituents of interest, except that no criterion may be more stringent than the background or unaffected reference areas concentrations;

(b) An acceptable ecological risk, determined using the most current versions of standard USEPA ecological risk assessment guidance if the criteria set pursuant to (a) above are not adequate to protect ecological receptors, except that no criterion may be more stringent than the background or unaffected reference areas concentrations; or

(c) The risk-based screening level contained in the most current version of Montana Risk-Based Guidance for Petroleum Releases, except that no criterion may be more stringent than the background or unaffected reference areas concentrations.

Note: The AOC does not specifically define sediment cleanup criteria separately from soil cleanup criteria. However, according to DEQ guidance (2017b), sediment concentrations should be compared to the following ecological screening levels.

- USEPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks.

APPENDIX B

USEPA RAGS Part D Tables 1 through 10

Table B-1.1 USEPA RAGS Part D Table 1 , Selection of Exposure Pathways for Surface Water

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip Montana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rational for Selection or Exclusion of Exposure Path
Current and Future	Surface Water	Surface Water	EU5 East Fork Armells Creek SOEP/STEP Area	Resident	Adult and Child	Dermal and Incidental Ingestion	Qual.	East Fork Armells Creek runs along the east side of the SOEP/STEP Area.
				Industrial Outdoor Worker	Adult		Qual.	In the commercial/industrial areas of the Creek, industrial outdoor workers may be exposed (e.g., Golf Course area).
				Construction* Worker	Adult		None	Infrequent minor exposure.
				Recreational User	Adult and Child		Qual.	Adults and children may use the creek recreationally. Particularly children may play in the Creek. The creek, however, does not support a fishing resource.

Notes:

Construction*	DEQ does not require evaluation of the construction worker receptor to surface water as it is an infrequent minor exposure.
EU	Exposure unit
RAGS	Risk Assessment Guidance for Superfund
Qual.	Qualitative; this scenario qualitatively assessed through comparison (as appropriate) to DEQ-7 standards, MCLs, Tapwater RSLs and BSLs. No surface water COPCs identified.
Quan.	Quantitative; this scenario was quantitatively assessed in the human health risk assessment.
USEPA	United States Environmental Protection Agency

Table B-1.2 USEPA RAGS Part D Table 1 , Selection of Exposure Pathways for Sediment 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip Montana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rational for Selection or Exclusion of Exposure Path
Current and Future	Sediment	Sediment	EU5 East Fork Armells Creek SOEP/STEP Area	Resident	Adult and Child	Dermal and Incidental Ingestion	Quan.	East Fork Armells Creek runs along the east side of the SOEP/STEP Area.
				Industrial Outdoor Worker	Adult		Quan.	In the commercial/industrial areas of the Creek, industrial outdoor workers may be exposed (e.g., Golf Course area).
				Construction* Worker	Adult		None	Infrequent minor exposure.
				Recreational User	Adult and Child		Quan.	Adults and children may use the creek recreationally. Particularly children may play in the Creek.
Current and Future	Sediment	Sediment	EU5 East Fork Armells Creek SOEP/STEP Area	Resident	Adult and Child	Inhalation	None	Sediments within East Fork Armells Creek are saturated in the Exposure Unit with significant vegetation along the streambanks. As such, inhalation via fugitive dust emissions are unlikely making it an incomplete pathway.
				Industrial Outdoor Worker	Adult		None	
				Construction* Worker	Adult		None	
				Recreational User	Adult and Child		None	

Notes:

Construction*	DEQ does not require evaluation of the construction worker receptor to sediment as it is an infrequent minor exposure.
EU	Exposure unit
RAGS	Risk Assessment Guidance for Superfund
Quan.	Quantitative; this scenario was quantitatively assessed in the human health risk assessment.
USEPA	United States Environmental Protection Agency

Table B-1.3 USEPA RAGS Part D Table 1 , Selection of Exposure Pathways for Soils 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip Montana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rational for Selection or Exclusion of Exposure Path
Current and Future	Soil	Soil	EU6, 7 & 8 SOEP/STEP Area	Resident	Adult and Child	Dermal and Incidental Ingestion	Quan.	One former spill area near Capture Well 932D (EU8) borders a residence.
				Industrial Outdoor Worker	Adult		Quan.	In the commercial/ industrial areas, industrial outdoor workers may be exposed.
				Construction Worker	Adult		Quan.	Construction work may occur in the former spill areas.
				Recreational User	Adult and Child		Quan.	Adults and children may recreationally use the area of one of the former spills (EU6).
Current and Future	Soil	Soil	EU6, 7 & 8 Units 1&2 SOEP/STEP Area	Resident	Adult and Child	Inhalation of Soil Particulates	None	One former spill area near Capture Well 932D (EU8) borders a residence.
				Industrial Outdoor Worker	Adult		Quan.	In the commercial/ industrial areas, industrial outdoor workers may be exposed
				Construction Worker	Adult		Quan.	Construction work may occur in the former spill areas.
				Recreational User	Adult and Child		Quan.	Adults and children may recreationally use the area of one of the former spills (EU6).

Notes:

EU Exposure unit

RAGS Risk Assessment Guidance for Superfund

Quan. Quantitative; if soil COCs are retained, this scenario will be quantitatively assessed in the human health risk assessment.

USEPA United States Environmental Protection Agency

Table B-1.4 USEPA RAGS Part D Table 1 , Selection of Exposure Pathways for Groundwater 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip Montana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rational for Selection or Exclusion of Exposure Path
Current and Future	Groundwater	Groundwater	Groundwater SOEP/STEP Area	Resident	Adult and Child	Ingestion and Dermal	Qual.	All locations with private groundwater wells, except for two wells located near the northern boundary, have been switched to city water. No current restrictions prevent groundwater from being used as drinking water.
				Industrial Outdoor Worker	Adult		Qual.	All locations with private groundwater wells, except for two wells located near the northern boundary, have been switched to city water. No current restrictions prevent groundwater from being used as drinking water.
				Construction Worker	Adult		Qual.	Construction workers may come into contact with shallow groundwater. DEQ-7 standards are considered protective of this infrequent exposure.
				Recreational User	Adult and Child		None	Recreational users do not have groundwater access and, thus, there is no potential exposure for these receptors.

Notes:

RAGS Risk Assessment Guidance for Superfund

Qual. Qualitative; this scenario qualitatively assessed through comparison (as appropriate) to DEQ-7 standards, MCLs, Tapwater RSLs and BSLs.

Quan. Quantitative; this scenario was quantitatively assessed in the human health risk assessment.

USEPA United States Environmental Protection Agency

Table B-2.1 USEPA RAGS Part D Table 2, Data Summary for Surface Water, EU5, mg/L
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Surface Water Sampling Locations	CAS Number	Chemical*	Data Time Range	Minimum [6] Concentration/ Location/ Date	Maximum [6] Concentration/ Location/Date	Detection Frequency [6]	Range of Detection Limits for Non-Detects	Most Recent Concentration Maximum/ Location/ 10/14/2015	Maximum Upgradient Concentration/ AR-12 or AR-5 / Date [7]	Background Screening Level (2017)	Background Threshold Value*	Screening Value DEQ-7	COPC? (Y/N)	Rationale for Selection or Deletion
EU5 East Fork Armells Creek SOEP/STEP Area	AR-1, AR-6 to AR-11	7429-90-5	Aluminum Dissolved	4/8/2014 - 10/16/2014 [1]	0.195 AR-11 10/16/2014	0.195 AR-11 10/16/2014	1/14	<0.009 to <0.05	0.195 AR-11 10/16/2014 [1]	0.015 AR-12 10/16/2014	NA	NA	No HHS[2] NC 20 Tap Water RSL	N	High % of ND BSL BB
	AR-1, AR-6 to AR-11	7429-90-5	Aluminum Total	4/8/2014 - 10/14/2015	0.009 AR-9 10/14/2015	0.991 AR-6 10/16/14	17/28	<0.009 to <0.05	0.54 AR-10PBR	24 AR-12 10/15/2015	42.1	NA	No HHS[2] NC 20 Tap Water RSL	N	BSL BB
	AR-1, AR-6 to AR-11	7440-38-2	Arsenic Total	4/8/2014 - 10/14/2015	0.001 several	0.002 AR-6, 10/16/2014 AR-10PBR, 10/16/2014 AR-11, 10/16/2014 & 3/19/2015	17/28	<0.001	0.001 AR-9, AR-8 & AR-6	0.058 AR-5 10/15/2015	0.056	NA	0.010 [3] C	N	BSL BB
	AR-1, AR-6 to AR-11	7440-41-7	Beryllium Total	4/8/2014 - 10/14/2015	<0.001 several	<0.002 several	0/28	<0.001 to <0.002	<0.002 All locations	<0.002 AR-12/AR-5 10/15/2015	NA	NA	0.004[2] C	N	All ND DL is BSL
	AR-1, AR-6 to AR-11	7440-42-8	Boron Total	4/8/2014 - 10/14/2015	0.78 AR-9 3/19/2015	1.45 AR-11 10/14/2015	28/28	NA	1.45 AR-11	2.06 AR-5 10/15/2015	0.88	NA	No HHS[2] NC 4.0 Tapwater RSL	N[8]	No HHS (DEQ-7) BSL BB
	AR-1, AR-6 to AR-11	7440-43-9	Cadmium Total	4/8/2014 - 10/14/2015	0.00003 AR-11 10/16/2014	0.00005 AR-10PBR 3/19/2015 & 10/14/2015	3/28	<0.00003 to <0.0005	0.00005 AR-10PBR	0.0006 AR-12 10/15/2015	0.005	NA	0.005 [3] NC	N	High % of ND BSL BB
	AR-1, AR-6 to AR-11	7440-70-2	Calcium Dissolved	4/8/2014 - 10/14/2015	232 AR-1 3/19/2015	342 AR-1 9/3/2014	34/34	NA	317 AR-1(dup) & AR-10PBR	397 AR-5 10/15/2015	NA	NA	NA	N	BB
	AR-1, AR-6 to AR-11	16887-00-6	Chloride	4/8/2014 - 10/14/2015	47 AR-10PBR 3/19/2015	95 AR-6 10/16/2014	34/34	NA	77 AR-10PBR	239 AR-12 10/15/2015	NA	NA	NA	N	BB
	AR-1, AR-6 to AR-11	7440-50-8	Copper Total	4/8/2014 - 10/14/2015	0.002 AR-10PBR 10/16/2014	0.003 AR-6 10/16/2014	2/28	<0.002	<0.002 All locations	0.032 AR-12 10/15/2015	0.21	NA	1.3 [4] NC	N	High % of ND BSL BB
	AR-1, AR-6 to AR-11	16984-48-8	Fluoride	4/8/2014 - 10/14/2015	0.2 several	0.4 AR-10PBR 10/14/2015	28/28	NA	0.4 AR-10PBR 10/14/2015	0.3 AR-12 10/16/2014	0.44	NA	4.0 [3] NC	N	BSL BB
	AR-1, AR-6 to AR-11	7439-92-1	Lead Total	4/8/2014 - 10/14/2015	0.0006 AR-10PBR 10/14/2015	0.0009 AR-10PBR 10/16/2014	3/28	<0.0003	0.0006 AR-10PBR	0.0233 AR-12 10/15/2015	0.13	NA	0.015 [3] C	N	High % of ND BSL BB
	AR-1, AR-6 to AR-11	7439-96-5	Manganese Total	4/8/2014 - 10/14/2015	0.012 AR-9 3/19/2015	2.85 AR-9 10/14/2015	28/28	NA	2.85 AR-9	11.6 AR-5 10/15/2015	3.68	5.08	No HHS[2] NC 0.43 Tap Water RSL	N[8]	BB

Table B-2.1 USEPA RAGS Part D Table 2, Data Summary for Surface Water, EU5, mg/L
Human Health Risk Assessment 5/21/2018
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Surface Water Sampling Locations	CAS Number	Chemical*	Data Time Range	Minimum (6) Concentration/ Location/ Date	Maximum (6) Concentration/ Location/Date	Detection Frequency (6)	Range of Detection Limits for Non-Detects	Most Recent Concentration Maximum/ Location/ 10/14/2015	Maximum Upgradient Concentration/ AR-12 or AR-5 / Date (7)	Background Screening Level (2017)	Background Threshold Value*	Screening Value DEQ-7	COPC? (Y/N)	Rationale for Selection or Deletion
EU5 East Fork Armells Creek SOEP/STEP Area	AR-1, AR-6 to AR-11	7439-97-6	Mercury Total	4/8/2014 - 10/14/2015	<0.00005 all samples	<0.00005 all samples	0/28	<0.00005 to <0.0002	<0.00005 all samples	<0.0002 AR-12 10/15/2015	0.001	NA	0.00005 (4) NC	N	All ND DL is BSL DL is BB
	AR-1, AR-6 to AR-11	7440-02-0	Nickel Total	4/8/2014 - 10/14/2015	0.002 several	0.008 AR-1 10/16/2014	27/28	<0.002	0.004 AR-1, AR-1(dup), AR-11 & AR-10PBR	0.064 AR-12 10/15/2015	0.064	NA	0.1 (5) NC	N	BB BSL
	AR-1, AR-6 to AR-11	NA	pH	4/8/2014 - 10/14/2015	7.53 AR-10PBR 10/16/2014	10.1 AR-6 3/19/2015	28/28	NA	8.44 AR-8 & AR-6	7.97 AR-12 10/15/2015	8.206	NA	NA	N	No DEQ-7 No Tox Values
	AR-1, AR-6 to AR-11	7782-49-2	Selenium Total	4/8/2014 - 10/14/2015	0.001 AR-10PBR 10/16/2014, 3/19/2015, 10/14/2015	0.002 AR-10PBR, 4/8/2014 AR-1, 3/19/2015 AR-10PBR(dup), 3/19/2015	5/28	<0.001 to <0.002	0.001 AR-10PBR	0.004 AR-5 10/15/2015	0.01	NA	0.050 (3) NC	N	High % of ND BSL BB
	AR-1, AR-6 to AR-11	7447-24-6	Strontium Total	4/8/2014 - 10/14/2015	5.64 AR-9 3/19/2015	7.93 AR-10PBR 10/14/2015	28/28	NA	7.93 AR-10PBR	11.8 AR-12 10/15/2015	NA	NA	4.0 (5) NC	N	BB
	AR-1, AR-6 to AR-11	14808-79-8	Sulfate	4/8/2014 - 10/14/2015	1,440 AR-8 3/19/2015	2,670 AR-10 8/28/2015	34/34	NA	2,480 AR-10PBR	2,800 AR-5 10/15/2015	2,090 (dissolved)	NA	NA	N	No Tox Values BB
	AR-1, AR-6 to AR-11	7440-28-0	Thallium Total	4/8/2014 - 10/14/2015	<0.0003 several	<0.0005 AR-11 10/14/2015	0/28	<0.0003 to <0.0005	<0.0003 several	0.0006 AR-12 10/15/2015	NA	NA	0.00024 (4) NC	N	All ND DL is BB
	AR-1, AR-6 to AR-11	NA	Total Dissolved Solids (TDS)	4/8/2014 - 10/14/2015	2,630 AR-1, AR-9 & AR-8 3/19/2015	4,190 AR-10 8/28/2015	34/34	NA	4,050 AR-10PBR	6,590 AR-12 10/15/2015	NA	NA	NA	N	No Tox Values BB
	AR-1, AR-6 to AR-11	7440-62-2	Vanadium Total	4/8/2014 - 10/14/2015	<0.01 all samples	<0.01 all samples	0/28	<0.01	<0.01 all samples	0.18 AR-12 10/15/2015	1	NA	No HHS(2) NC 0.086 Tap Water RSL	N	All ND DL is BB DL is BSL
	AR-1, AR-6 to AR-11	7440-66-6	Zinc Total	4/8/2014 - 10/14/2015	0.009 AR-8 4/8/2014	0.030 AR-10PBR(dup) 3/19/2015	1/28	<0.008	<0.008 all samples	0.706 AR-12 10/15/2015	0.64	NA	7.4 (5) NC	N	High % of ND BSL BB

Table B-2.1 USEPA RAGS Part D Table 2, Data Summary for Surface Water, EU5, mg/L
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Exposure Unit	Surface Water Sampling Locations	CAS Number	Chemical*	Data Time Range	Minimum (6) Concentration/ Location/ Date	Maximum (6) Concentration/ Location/Date	Detection Frequency (6)	Range of Detection Limits for Non-Detects	Most Recent Concentration Maximum/ Location/ 10/14/2015	Maximum Upgradient Concentration/ AR-12 or AR-5 / Date (7)	Background Screening Level (2017)	Background Threshold Value*	Screening Value DEQ-7	COPC? (Y/N)	Rationale for Selection or Deletion

Notes:

DEQ-7	Screening Levels are based on DEQ-7 values (DEQ, 2017c) and DEQ guidance if DEQ-7 values are not available (DEQ, 2017b). DEQ-7 values are total recoverable concentrations in groundwater, except for aluminum (DEQ, 2017c).
Background Screening Level	Background Screening Levels for Colstrip Steam Electric Station (Neptune 2017)
Neptune 2017	Final Report on Updated Background Screening Levels, Plant Site, 1&2 SOEP and STEP, and 3&4 EHP, Colstrip Steam Electric Station, Colstrip, Montana.
Background Threshold Value*	Background Threshold Value (BTV) calculated for manganese in surface water in the Creek upgradient of the Plant Site (see Section 6.1.3 and Appendix D).
(1)	Dissolved concentrations not measured during 2015 sampling events.
(2)	No Human Health Standard (HHS) available from DEQ-7 and no MCL available. Tap Water RSL (traditional tables) was used as the screening value (DEQ, 2017c).
(3)	DEQ-7, Human Health Surface Water, based on the MCL
(4)	DEQ-7, Human Health Surface Water, based on Priority Pollutant (PP) Criteria
(5)	DEQ-7, Human Health Surface Water, based on health advisory (HA) from EPA's "Drinking Water Standards and Health Advisories" October 1996
(6)	Minimum and maximum concentrations and detection frequencies may differ in comparison to the Statistical Analysis (App D) as samples were averaged with their duplicates in the statistical analysis.
(7)	Given the limited background surface water data available, data from the closest upgradient data points, AR-5 and AR-12, are appropriate primary upgradient (background) data points (DEQ, 2017a, 2018a).
(8)	Please see Section 10.1 for further discussion regarding manganese in surface water.
Chemical*	Chemical lists vary between media because they were established at different times and for different objectives, but all were approved by DEQ. Some of the analyte lists were developed prior to the establishment of the Federal CCR Appendices III and IV lists.

Definitions:

AB	Above Background
ASL	Above Screening Level
BB	Below background
BSL	Below screening level
C	Carcinogen
CAS	Chemical Abstract Service
COPC	Chemical of Potential Concern
DL	Detection Level
mg/L	milligrams per liter
NA	Not Available/Not Applicable
NB	Near Background, essentially background
NC	Non-Carcinogen
ND	Non-detect
HHS	Human Health Standard
No Tox Values	No Human Health Toxicity Values available

Table B-2.2 USEPA RAGS Part D Table 2, Data Summary for Sediment, EU5, mg/kg, except where noted
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Exposure Unit	Sediment Sampling Locations	CAS Number	Chemical*	Data Time Range	Minimum (1) Concentration/ Location/ Date	Maximum (1) Concentration/ Location/Date	Detection Frequency (1)	Range of Detection Limits for Non-Detects	Most Recent Concentration Maximum/ Location/ 10/15/2015	Maximum Upgradient Concentration/ AR-12 or AR-5 / Date (2)	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion
EU5 East Fork Armells Creek SOEP/STEP Area	AR-1, AR-6 to AR-11	7429-90-5	Aluminum	4/8/2014 - 10/15/2015	1,550 AR-1 3/19/2015	5,910 AR-7 3/19/2015	28/28	NA	5,270 AR-1	9,840 AR-12 4/25/2007	NA	7,700 110,000	25,941	N	BSL BB
	AR-1, AR-6 to AR-11	7440-38-2	Arsenic	4/8/2014 - 10/15/2015	0.5 AR-8, 4/8/2014 AR-8, 10/16/2014	3.5 AR-1(dup) 10/15/2015	27/28	<0.2	3.5 AR-1 (dup)	16.6 AR-5 4/25/2007	NA	NA	22.5	N	BSL BB
	AR-1, AR-6 to AR-11	7440-41-7	Beryllium	4/8/2014 - 10/15/2015	0.10 AR-8, 10/16/2014 AR-8, 10/15/2015	0.46 AR-7 3/19/2015	28/28	NA	0.33 AR-1	0.59 AR-12 4/25/2007	NA	16 230	1.1	N	BSL BB
	AR-1, AR-6 to AR-11	7440-42-8	Boron	4/8/2014 - 10/15/2015	3.2 AR-7 3/19/2015	15.5 AR-6 10/16/2014	28/28	NA	13.4 AR-10PBR	56.0 AR-5 4/25/2007	NA	1,600 23,000	NA	N	BSL BB
	AR-1, AR-6 to AR-11	7440-43-9	Cadmium	4/8/2014 - 10/15/2015	0.07 AR-1 3/19/2015	0.22 AR-1(dup) 10/15/2015	15/28	<0.05	0.22 AR-1(dup)	0.37 AR-5 4/25/2007	NA	7.1 98	0.7	N	BSL BB
	AR-1, AR-6 to AR-11	7440-70-2	Calcium (meq/L) sat. paste	4/8/2014 - 10/15/2015	24.8 AR-10PBR 10/15/2015	30.9 AR-10PBR 10/16/2014	28/28	NA	29.4 AR-8	32.0 AR-5 3/19/2015	NA	NA	NA	N	BB No Tox Values
	AR-1, AR-6 to AR-11	16887-00-6	Chloride (mg/L) sat. paste	4/8/2014 - 10/15/2015	52 AR-1(dup) 10/15/2015	202 AR-7 10/16/2014	28/28	NA	144 AR-11	324 AR-12 10/15/2015	NA	NA	NA	N	BB No Tox Values
	AR-1, AR-6 to AR-11	7440-50-8	Copper	4/8/2014 - 10/15/2015	3.9 AR-1 3/19/2015	12.5 AR-7 3/19/2015	28/28	NA	9.5 AR-1(dup)	127.0 AR-5 4/25/2007	NA	310 4,700	165	N	BSL BB
	AR-1, AR-6 to AR-11	16984-48-8	Fluoride (mg/L) sat. paste	4/8/2014 - 10/15/2015	10 AR-9 4/8/2014	21 AR-8 4/8/2014	6/28	<5 to <50	<10 several	<20 AR-5, AR-12 all	NA	310 4,700	NA	N	BSL
	AR-1, AR-6 to AR-11	7439-92-1	Lead	4/8/2014 - 10/15/2015	2.52 AR-1 3/19/2015	8.04 AR-7 3/19/2015	28/28	NA	7.91 AR-1	4.71 AR-12 10/16/2014	400 800	NA	29.8	N	BSL BB
	AR-1, AR-6 to AR-11	7439-96-5	Manganese	4/8/2014 - 10/15/2015	175 AR-6 4/8/2014	5,580 AR-1 10/16/2014	28/28	NA	939 AR-9	5,910 AR-5 10/162014	NA	180 2,600	880	Y(3)	ASL
	AR-1, AR-6 to AR-11	7439-97-6	Mercury	4/8/2014 - 10/15/2015	<0.02 several	<0.1 several	0/28	<0.02 to <0.1	<0.1 all samples	0.03 AR-5 4/25/2007	NA	1.1 4.6	<0.05	N	All ND BSL
	AR-1, AR-6 to AR-11	7440-02-0	Nickel	4/8/2014 - 10/15/2015	2.9 AR-8 10/16/2014	11.2 AR-1(dup) 10/15/2015	28/28	NA	11.2 AR-1(dup)	39.8 AR-5 4/25/2007	NA	150 2,200	31.4	N	BSL BB
	AR-1, AR-6 to AR-11	NA	pH std sat. paste	4/8/2014 - 10/15/2015	7.3 AR-11, 10/16/2014 AR-10PBR, 10/16/2014	7.7 AR-6, 4/8/2014 AR-9, 10/16/2014 AR-1(dup), 10/15/2015	28/28	NA	7.7 AR-1 (dup)	7.7 10/16/2014 10/15/2015	NA	NA	NA	N	NB No Tox Values
	AR-1, AR-6 to AR-11	7782-49-2	Selenium	4/8/2014 - 10/15/2015	0.2 several	0.7 AR-10PBR 10/16/2014	20/28	<0.2	0.3 AR-10PBR	6 AR-5 4/25/2007	NA	39 580	0.7	N	BSL
	AR-1, AR-6 to AR-11	7440-24-6	Strontium	4/8/2014 - 10/15/2015	74.6 AR-6 3/19/2015	637 AR-8 10/15/2015	28/28	NA	637 AR-8	786 AR-5 4/25/2007	NA	4,700 70,000	NA	N	BSL BB
	AR-1, AR-6 to AR-11	14808-79-8	Sulfate mg/L sat. paste	4/8/2014 - 10/15/2015	3,220 AR-6 3/19/2015	6,200 AR-10PBR 10/15/2015	28/28	NA	6,200 AR-10PBR	6,050 AR-5 4/8/2014	NA	NA	NA	N	NB No Tox Values

Table B-2.2 USEPA RAGS Part D Table 2, Data Summary for Sediment, EU5, mg/kg, except where noted
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Exposure Unit	Sediment Sampling Locations	CAS Number	Chemical*	Data Time Range	Minimum (1) Concentration/ Location/ Date	Maximum (1) Concentration/ Location/Date	Detection Frequency (1)	Range of Detection Limits for Non-Detects	Most Recent Concentration Maximum/ Location/ 10/15/2015	Maximum Upgradient Concentration/ AR-12 or AR-5 / Date (2)	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion
EU5 East Fork Armells Creek SOEP/STEP Area	AR-1, AR-6 to AR-11	7440-28-0	Thallium	4/8/2014 - 10/15/2015	0.06 several	0.22 AR-1 4/8/2014	25/28	<0.05	0.14 AR-11	0.07 AR-12 10/16/2014	NA	0.078 1.2	0.41	N	BB
	AR-1, AR-6 to AR-11	7440-62-2	Vanadium	4/8/2014 - 10/15/2015	3.9 AR-1, 3/19/2015 AR-8, 10/15/2015	15.2 AR-1 10/15/2015	28/28	NA	15.2 AR-1	16.8 AR-5 10/16/2014	NA	39 580	52.6	N	BSL BB
	AR-1, AR-6 to AR-11	7440-66-6	Zinc	4/8/2014 - 10/15/2015	14.8 AR-11 10/15/2015	42 AR-8 3/19/2015	28/28	NA	19.6 AR-10PBR	127 AR-12 10/16/2014	NA	2,300 35,000	118	N	BSL BB

Notes:

(1) Minimum and maximum concentrations and detection frequencies may differ in comparison to the Statistical Analysis (App D) as samples were averaged with their duplicates in the statistical analysis.

(2) Given the limited background sediment data available, data from the closest upgradient data points, AR-5 and AR-12, are appropriate primary upgradient (background) data points (DEQ, 2017a, 2018a).

(3) Although manganese was initially flagged as a COPC, it was not retained as a COC (please see Sections 9.1 and 12.2 for further discussion).

DEQ, 2013 Project Report Background Concentrations of Inorganic Constituents in Montana Surface Soils. Prepared for DEQ by Hydrometrics, Inc. Available on-line at http://deq.mt.gov/StateSuperfund/background.mcpx September.

Chemical* Chemical lists vary between media because they were established at different times and for different objectives, but all were approved by DEQ. Some of the analyte lists were developed prior to the establishment of the Federal CCR Appendices III and IV lists.

Definitions:

ASL	Above Screening Level
BB	Below Background
BSL	Below Screening Level
BTV	Background Threshold Value for Inorganics in Montana Soils (DEQ, 2013)
CAS	Chemical Abstract Service
COPC	Chemical of Potential Concern
meq/L	milliequivalents per liter
NA	Not Available/Not Applicable
NB	Near Background Concentration, maximum concentration near background concentration, and contaminant not specific to wastewater.
ND	Not Detected
NS	No Standard
RSL	USEPA Regional Screening Level May 2016
S.U.	Standard Units

Table B-2.3 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near North 1AD Pipeline Drain Pond, EU6, mg/kg, except where noted 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum [3] Concentration/ Location/Depth	Maximum [3] Concentration/ Location/Depth	Detection Frequency [3]	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL [1]	Leaching COPC Flag (Y/N)
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-36-0	Antimony	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	3.1 47	0.4	N	All ND DL is BSL	2.7	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-38-2	Arsenic	8/16/2017	0 to 7 feet	<20 several	<40 several	0/54	<20 - <40	NA	NA	22.5	N	All ND	22.5 [2]	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-39-3	Barium	8/16/2017	0 to 7 feet	91 DP1AD-2 5 to 6 feet	1,300 DP1AD-4 0 to 6 inches	54/54	NA	NA	1,500 22,000	429	N	BSL	421	Y[4]
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-41-7	Beryllium	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	16 230	1.1	N	All ND DL is BSL	32	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-42-8	Boron	8/16/2017	0 to 7 feet	2 DP1AD-2, 5to 6 feet DP1AD-20, 12 to 24 inches & 5 to 6 feet DP1AD-22, 12 to 24 inches	31 DP1AD-2 12 to 24 inches	54/54	NA	NA	1,600 23,000	NA	N	BSL	130	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-43-9	Cadmium	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	7.1 98	0.7	N	All ND DL is BSL	3.8	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-70-2	Calcium (meq/L) sat. paste	8/16/2017	0 to 7 feet	4.33 DP1AD-4 0 to 6 inches	30.7 DP1AD-2 0 to 6 inches	54/54	NA	NA	NA	NA	N	NS	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	16887-00-6	Chloride (mg/L) sat. paste	8/16/2017	0 to 7 feet	11 DP1AD-2 12 to 24 inches	108 DP1AD-13 12 to 24 inches	54/54	NA	NA	NA	NA	N	NS	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-47-3	Chromium	8/16/2017	0 to 7 feet	10 DP1AD-20 12 to 24 inches	20 DP1AD-4 0 to 6 inches	54/54	NA	NA	12,000 180,000	41.7	N	BSL BB	4×10^8	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-48-4	Cobalt	8/16/2017	0 to 7 feet	4 DP1AD-3 12 to 24 inches DP1AD-17 0 to 6 inches	13 DP1AD-17 6 to 7 feet	38/54	<5 - <6	NA	2.3 35	10.0	N[5]	ASL	2.7	Y[4]
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	16984-48-8	Fluoride (mg/L) sat. paste	8/16/2017	0 to 7 feet	<1 several	<10 several	0/54	<1 - <10	NA	310 4,700	NA	N	All ND NS	1,200	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7439-92-1	Lead	8/16/2017	0 to 7 feet	<20 several	<40 several	0/54	<20 - <40	NA	400 800	29.8	N	All ND DL is BSL	140	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7439-95-4	Magnesium	8/16/2017	0 to 7 feet	3.26 DP1AD-10 0 to 6 inches	155 DP1AD-13 12 to 24 inches	54/54	NA	NA	NA	NA	N	NS	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7439-96-5	Manganese	8/16/2017	0 to 7 feet	180 DP1AD-16 12 to 24 inches	1,830 DP1AD-17 6 to 7 feet	54/54	NA	NA	180 2,600	880	N[5]	ASL	280	Y[4,6]

Table B-2.3 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near North 1AD Pipeline Drain Pond, EU6, mg/kg, except where noted 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7439-97-6	Mercury	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	1.1 4.6	<0.05	N	All ND DL is BSL	1.0	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7439-98-7	Molybdenum	8/16/2017	0 to 7 feet	1 several	1 several	12/54	<1 - <8	NA	39 580	NA	N	BSL	20	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	NA	pH std sat. paste	8/16/2017	0 to 7 feet	7.0 DP1AD-13 0 to 6 inches	8.5 DP1AD-9, DP1AD-13, DP1AD-19 & DP1AD-21, all at 12 to 24 inches	54/54	NA	NA	NA	NA	N	NS	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-14-4	Ra 226(7) (pCi/g)	8/16/2017	0 to 7 feet	0.4 several	25.3 DP1AD-13 5 to 6 feet	54/54	NA	0.124 4.73 71.2	NA	NA	Y(8)	ASL	NA	Y(4)
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-14-4	Ra 228(7) (pCi/g)	8/16/2017	0 to 7 feet	-0.6 DP1AD-16 0 to 6 inches	3.0 DP1AD-22 12 to 24 inches	54/54	NA	0.147 10.0 38.6	NA	NA	Y(8)	ASL	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7782-49-2	Selenium	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	39 580	0.7	N	All ND DL is BSL	2.6	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	14808-79-8	Sulfate mg/L sat. paste	8/16/2017	0 to 7 feet	29 DP1AD-20 0 to 6 inches	13,300 DP1AD-3 12 to 24 inches	54/54	NA	NA	NA	NA	N	NS	NA	N
EU6 Spill Site North 1AD	DP1AD-1 to DP1AD-22, DP1AD-26	7440-28-0	Thallium	8/16/2017	0 to 7 feet	<1 all samples	<1 all samples	0/54	<1	NA	0.078 1.2	0.41	N	All ND	1.4	N

Table B-2.3 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near North 1AD Pipeline Drain Pond, EU6, mg/kg, except where noted 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)

Notes:

(1)	Value derived following DEQ Soil Screening Process, Part 2 - Leaching to Groundwater, 2017b
(2)	Background Threshold Value for arsenic in Montana was used rather than SSL based on MCL
(3)	Minimum and maximum concentrations and detection frequencies may differ in comparison to the Statistical Analysis (App D) as samples were averaged with their duplicates in the statistical analysis.
(4)	Although initially flagged as a leaching COPC, chemical was ultimately not identified as a leaching COC based on a more detailed evaluation (please see Section 10.2 for further discussion).
(5)	Maximum concentration exceeds residential RSL, but not Industrial RSL. Sample located at depth (6-7' bgs) where only construction worker exposures expected. Industrial RSL is protective of construction worker exposures.
(6)	BTV exceeds Protection of Groundwater SSL.
(7)	Radium screening levels are calculated PRGs for residential, outdoor worker, and excavation worker in pCi/g (USDOE RAIS, 2017).
(8)	Although radium was initially flagged as a human health COPC, it was ultimately not retained as a COC based on a more detailed evaluation (please see Section 10.4 for further discussion).
DEQ, 2013	Project Report Background Concentrations of Inorganic Constituents in Montana Surface Soils. Prepared for DEQ by Hydrometrics, Inc. Available on-line at http://deq.mt.gov/StateSuperfund/background.mcpx September.
Chemical*	Chemical lists vary between media because they were established at different times and for different objectives, but all were approved by DEQ. Some of the analyte lists were developed prior to the establishment of the Federal CCR Appendices III and IV lists.

Definitions:

ASL	Above Screening Level
BB	Below Background
BSL	Below Screening Level
BTV	Background Threshold Value for Inorganics in Montana Soils (DEQ, 2013)
CAS	Chemical Abstract Service
COPC	Chemical of Potential Concern
MCL	Maximum Contaminant Level
meq/L	milliequivalents per liter
mg/kg	milligrams per kilogram
NA	Not Available/ Not Applicable
ND	Not Detected
NS	No Standard
pCi/g	picoCuries per gram
PRG	Preliminary Remediation Goal
RSL	USEPA Regional Screening Level May 2016
SSL	USEPA Soil Screening Level for Groundwater Protection 2016

Table B-2.4 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near STEP Main Dam, EU7, mg/kg, except where noted

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-36-0	Antimony	8/16/2017	0 to 24 inches	<1 several	<20 MDE-30 12 to 24 inches	0/10	<1 - <20	NA	3.1 47	0.4	N	All ND	2.7	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-38-2	Arsenic	8/16/2017	0 to 24 inches	<20 all samples	<20 all samples	0/10	<20	NA	NA	22.5	N	All ND DL is BSL	22.5 (2)	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-39-3	Barium	8/16/2017	0 to 24 inches	86 MDE-29 12 to 24 inches	731 MDE-33 0 to 6 inches	10/10	NA	NA	1,500 22,000	429	N	BSL	421	Y (4)
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-41-7	Beryllium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/10	<1	NA	16 230	1.1	N	All ND DL is BSL	32	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-42-8	Boron	8/16/2017	0 to 24 inches	1 MDE-29 12 to 24 inches	33 MDE-33 0 to 6 inches	10/10	NA	NA	1,600 23,000	NA	N	BSL	130	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-43-9	Cadmium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/10	<1	NA	7.1 98	0.7	N	All ND DL is BSL	3.8	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-70-2	Calcium (meq/L) sat. paste	8/16/2017	0 to 24 inches	2.57 MDE-29 12 to 24 inches	28.6 MDE-32 0 to 6 inches	10/10	NA	NA	NA	NA	N	NS	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	16887-00-6	Chloride (mg/L) sat. paste	8/16/2017	0 to 24 inches	4 MDE-29 12 to 24 inches	49 MDE-32 0 to 6 inches MDE-33 0 to 6 inches	10/10	NA	NA	NA	NA	N	NS	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-47-3	Chromium	8/16/2017	0 to 24 inches	11 MDE-29 12 to 24 inches MDE-33 0 to 6 & 12 to 24 inches	15 MDE-32 12 to 24 inches	10/10	NA	NA	12,000 180,000	41.7	N	BSL BB	4×10^8	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-48-4	Cobalt	8/16/2017	0 to 24 inches	4 MDE-29 12 to 24 inches	8 MDE-32 12 to 24 inches	10/10	NA	NA	2.3 35	10.0	N	BB	2.7	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	16984-48-8	Fluoride (mg/L) sat. paste	8/16/2017	0 to 24 inches	<0.5 MDE-29 12-24 inches	<5 several	0/10	<0.5 - <5	NA	310 4,700	NA	N	All ND DL is BSL	1,200	N

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7439-92-1	Lead	8/16/2017	0 to 24 inches	12 MDE-32 12 to 24 inches	<20 several	1/10	<20	NA	400 800	29.8	N	BSL	140	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7439-95-4	Magnesium	8/16/2017	0 to 24 inches	1.24 MDE-29 12 to 24 inches	33.7 MDE-30 12 to 24 inches	10/10	NA	NA	NA	NA	N	NS	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7439-96-5	Manganese	8/16/2017	0 to 24 inches	247 MDE-29 12 to 24 inches	691 MDE-33 12 to 24 inches	10/10	NA	NA	180 2,600	880	N	ASL BB	280	Y(4,5)
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7439-97-6	Mercury	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/10	<1	NA	1.1 4.6	<0.05	N	All ND DL is BSL	1.0	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7439-98-7	Molybdenum	8/16/2017	0 to 7 feet	1 several	1 several	4/10	<1 - <4	NA	39 580	NA	N	BSL	20	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	NA	pH std sat. paste	8/16/2017	0 to 24 inches	7.4 several	7.9 MDE-30 12 to 24 inches	10/10	NA	NA	NA	NA	N	NS	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-14-4	Ra 226(6) (pCi/g)	8/16/2017	0 to 24 inches	0.5 MDE-29 12 to 24 inches MDE-30 12 to 24 inches	1.2 MDE-32 12 to 24 inches	10/10	NA	0.124 4.73 71.2	NA	NA	Y(7)	ASL	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-14-4	Ra 228(6) (pCi/g)	8/16/2017	0 to 24 inches	0.5 several	1.1 MDE-31 0 to 6 inches	10/10	NA	0.147 10.0 38.6	NA	NA	Y(7)	ASL	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7782-49-2	Selenium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/10	<1	NA	39 580	0.7	N	All ND DL is BSL	2.6	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	14808-79-8	Sulfate mg/L sat. paste	8/16/2017	0 to 24 inches	34 MDE-29 12 to 24 inches	3,210 MDE-30 12 to 24 inches	10/10	NA	NA	NA	NA	N	NS	NA	N
EU7 Spill Site STEP Main Dam	MDE-29 to MDE-33	7440-28-0	Thallium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/10	<1	NA	0.078 1.2	0.41	N	All ND	1.4	N

Marietta Canty, LLC
Environmental Consulting

Table B-2.4 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near STEP Main Dam, EU7, mg/kg, except where noted

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)

Notes:

(1)	Value derived following DEQ Soil Screening Process, Part 2 - Leaching to Groundwater, 2017b
(2)	Background Threshold Value for arsenic in Montana was used rather than SSL based on MCL.
(3)	Minimum and maximum concentrations and detection frequencies may differ in comparison to the Statistical Analysis (App D) as samples were averaged with their duplicates in the statistical analysis.
(4)	Although initially flagged as a leaching COPC, chemical was ultimately not identified as a leaching COC based on a more detailed evaluation (please see Section 10.2 for further discussion).
(5)	BTV exceeds Protection of Groundwater SSL.
(6)	Radium screening levels are calculated PRGs for residential, outdoor worker, and excavation worker in pCi/g (USDOE RAIS, 2017).
(7)	Although radium was initially flagged as a human health COPC, it was ultimately not retained as a COC based on a more detailed evaluation (please see Section 10.4 for further discussion).
DEQ, 2013	Project Report Background Concentrations of Inorganic Constituents in Montana Surface Soils. Prepared for DEQ by Hydrometrics, Inc. Available on-line at http://deq.mt.gov/StateSuperfund/background.mcpx September.
Chemical*	Chemical lists vary between media because they were established at different times and for different objectives, but all were approved by DEQ. Some of the analyte lists were developed prior to the establishment of the Federal CCR Appendices III and IV lists.

Definitions:

ASL	Above Screening Level
BB	Below Background
BSL	Below Screening Level
BTV	Background Threshold Value for Inorganics in Montana Soils (DEQ, 2013)
CAS	Chemical Abstract Service
COPC	Chemical of Potential Concern
DL	Detection Level
MCL	Maximum Contaminant Level
meq/L	milliequivalents per liter
mg/kg	milligrams per kilogram
NA	Not Available/ Not Applicable
ND	Not Detected
NS	No Standard
pCi/g	picoCuries per gram
PRG	Preliminary Remediation Goal
RSL	USEPA Regional Screening Level May 2016
SSL	USEPA Soil Screening Level for Groundwater Protection 2016

Table B-2.5 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near Capture Well 932D, EU8, mg/kg, except where noted

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-36-0	Antimony	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	3.1 47	0.4	N	All ND DL is BSL	2.7	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-38-2	Arsenic	8/16/2017	0 to 24 inches	<20 all samples	<20 all samples	0/4	<20	NA	NA	22.5	N	All ND DL is BSL	22.5 (2)	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-39-3	Barium	8/16/2017	0 to 24 inches	81 932D-S-28 12 to 24 inches	140 932D-S-27 0 to 6 inches	4/4	NA	NA	1,500 22,000	429	N	BSL BB	421	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-41-7	Beryllium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	16 230	1.1	N	All ND DL is BSL	32	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-42-8	Boron	8/16/2017	0 to 24 inches	3 932D-S-27, 0 to 6 inches & 12 to 24 inches 932D-S-28, 0 to 6 inches	7 932D-S-28 12 to 24 inches	4/4	NA	NA	1,600 23,000	NA	N	BSL	130	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-43-9	Cadmium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	7.1 98	0.7	N	All ND DL is BSL	3.8	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-70-2	Calcium (meq/L) sat. paste	8/16/2017	0 to 24 inches	4.02 932D-S-27 12 to 24 inches	23.3 932D-S-28 12 to 24 inches	4/4	NA	NA	NA	NA	N	NS	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	16887-00-6	Chloride (mg/L) sat. paste	8/16/2017	0 to 24 inches	8 932D-S-27 12 to 24 inches	42 932D-S-28 12 to 24 inches	4/4	NA	NA	NA	NA	N	NS	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-47-3	Chromium	8/16/2017	0 to 24 inches	15 932D-S-27, 0 to 6 inches & 12 to 24 inches 932D-S-28, 12 to 24 inches	16 932D-S-28 0 to 6 inches	4/4	NA	NA	12,000 180,000	41.7	N	BSL BB	4×10^{8}	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-48-4	Cobalt	8/16/2017	0 to 24 inches	6 several	7 932D-S-28 12 to 24 inches	4/4	NA	NA	2.3 35	10.0	N	BB	2.7	N

Table B-2.5 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near Capture Well 932D, EU8, mg/kg, except where noted 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	16984-48-8	Fluoride (mg/L) sat. paste	8/16/2017	0 to 24 inches	<1 932D-S-27, 0 to 6 inches & 12 to 24 inches 932D-S-28, 0 to 6 inches	<5 932D-S-28 12 to 24 inches	0/4	<1 - <5	NA	310 4,700	NA	N	All ND DL is BSL	1,200	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7439-92-1	Lead	8/16/2017	0 to 24 inches	<20 all samples	<20 all samples	0/4	<20	NA	400 800	29.8	N	All ND DL is BSL	140	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7439-95-4	Magnesium	8/16/2017	0 to 24 inches	3.15 932D-S-27 0 to 6 inches	43.2 932D-S-28 12 to 24 inches	4/4	NA	NA	NA	NA	N	NS	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7439-96-5	Manganese	8/16/2017	0 to 24 inches	261 932D-S-28 12 to 24 inches	326 932D-S-27 0 to 6 inches	4/4	NA	NA	180 2,600	880	N	ASL BB	280	N(4)
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7439-97-6	Mercury	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	1.1 4.6	<0.05	N	All ND DL is BSL	1.0	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7439-98-7	Molybdenum	8/16/2017	0 to 24 inches	<1 several	<4 932D-S-28 12 to 24 inches	0/4	<1 - <4	NA	39 580	NA	N	All ND DL is BSL	20	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	NA	pH std sat. paste	8/16/2017	0 to 24 inches	7.5 932D-S-27 0 to 6 inches 932D-S-28 0 to 6 inches	7.7 932D-S-28 12 to 24 inches	4/4	NA	NA	NA	NA	N	NS	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-14-4	Ra 226(5) (pCi/g)	8/16/2017	0 to 24 inches	0.5 932D-S-27 0 to 6 inches 12 to 24 inches	0.8 932D-S-28 0 to 6 inches	4/4	NA	0.124 4.73 71.2	NA	NA	Y(6)	ASL	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-14-4	Ra 228(5) (pCi/g)	8/16/2017	0 to 24 inches	0.4 932D-S-27 0 to 6 inches	1.1 932D-S-28 0 to 6 inches	4/4	NA	0.147 10.0 38.6	NA	NA	Y(6)	ASL	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7782-49-2	Selenium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	39 580	0.7	N	All ND DL is BSL	2.6	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	14808-79-8	Sulfate mg/L sat. paste	8/16/2017	0 to 24 inches	13 932D-S-27, 0 to 6 inches & 12 to 24 inches	3,890 932D-S-28 12 to 24 inches	4/4	NA	NA	NA	NA	N	NS	NA	N
EU8 Spill Site Capture Well 932D	932D-S-27 to 932D-S-28	7440-28-0	Thallium	8/16/2017	0 to 24 inches	<1 all samples	<1 all samples	0/4	<1	NA	0.078 1.2	0.41	N	All ND	1.4	N

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Table B-2.5 USEPA RAGS Part D Table 2, Data Summary for Soil, Former Spill Site near Capture Well 932D, EU8, mg/kg, except where noted

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Exposure Unit	Sampling Location	CAS Number	Chemical*	Date	Depth Range	Minimum (3) Concentration/ Location/Depth	Maximum (3) Concentration/ Location/Depth	Detection Frequency (3)	Range of Detection Limits for Non-Detects	RSLs - Carcinogens Residential Industrial	RSLs - Non-carcinogens Residential Industrial 1/10th	BTV for Inorganics in Montana Soils	COPC? (Y/N)	Rationale for Selection or Deletion	Protection of Groundwater SSL (1)	Leaching COPC Flag (Y/N)

Notes:

(1) Value derived following DEQ Soil Screening Process, Part 2 - Leaching to Groundwater, 2017b

(2) Background Threshold Value for arsenic in Montana was used rather than SSL based on MCL

(3) Minimum and maximum concentrations and detection frequencies may differ in comparison to the Statistical Analysis (App D) as samples were averaged with their duplicates in the statistical analysis.

(4) BTV exceeds Protection of Groundwater SSL.

(5) Radium screening levels are calculated PRGs for residential, outdoor worker, and excavation worker in pCi/g (USDOE RAIS, 2017).

(6) Although radium was initially flagged as a human health COPC, it was ultimately not retained as a COC based on a more detailed evaluation (please see Section 10.4 for further discussion).

DEQ, 2013 Project Report Background Concentrations of Inorganic Constituents in Montana Surface Soils. Prepared for DEQ by Hydrometrics, Inc. Available on-line at http://deq.mt.gov/StateSuperfund/background.mcpx September.

Chemical* Chemical lists vary between media because they were established at different times and for different objectives, but all were approved by DEQ. Some of the analyte lists were developed prior to the establishment of the Federal CCR Appendices III and IV lists.

Definitions:

ASL	Above Screening Level
BB	Below Background
BSL	Below Screening Level
BTV	Background Threshold Value for Inorganics in Montana Soils (DEQ, 2013)
CAS	Chemical Abstract Service
COPC	Chemical of Potential Concern
DL	Detection Level
MCL	Maximum Contaminant Level
meq/L	milliequivalents per liter
mg/kg	milligrams per kilogram
NA	Not Available/ Not Applicable
ND	Not Detected
NS	No Standard
pCi/g	picoCuries per gram
PRG	Preliminary Remediation Goal
RSL	USEPA Regional Screening Level May 2016
SSL	USEPA Soil Screening Level for Groundwater Protection 2016

Table B-3.1 USEPA RAGS Part D Table 3, Exposure Point Concentration Summary, Surface Water, EU5, mg/L

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure:	Incidental Ingestion/Dermal

Exposure Unit	Chemicals of Potential Concern	Detection Frequency	Number of High Censored Results	Mean	95 UCL Distribution	Maximum Concentration	Exposure Point Concentration		
							Value	Statistic	Method
EU5 East Fork Armells Creek Units 1 &2 SOEP/STEP Area	No COPCs identified for surface water.								

Table B-3.2 USEPA RAGS Part D Table 3, Exposure Point Concentration Summary, Sediment, EU5, mg/kg

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure:	Incidental Ingestion/ Dermal

Exposure Unit	Depth Interval (feet bgs)	Chemicals of Potential Concern	Detection Frequency	Number of High Censored Results	Average	95 UCL Distribution	Maximum Concentration	Exposure Point Concentration		
								Value	Statistic	Method
EU5 East Fork Armells Creek Sediment SOEP/STEP Area	Surface	Manganese	28/28 (2)	0	882	t	5,580	1,523	95 UCL	t-corrected (1)

Notes:

(1) t-UCL after correcting for lack of independence due to locations and sampling occasions. See Appendix D for UCL method justification.

(2) Two pairs of field duplicates were collected from AR-10 (on March 19, 2015) and AR-1 (on October 15, 2015). DEQ requires that only the maximum concentration from each field duplicate pair be used for estimation of EPCs. Therefore, only the maximum field duplicate is used, bringing the number of measurements from 30 to 28.

Table B-3.3 USEPA RAGS Part D Table 3, Exposure Point Concentration Summary, Soil, EU6 - EU8, mg/kg 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure:	Incidental Ingestion/ Dermal

Exposure Unit	Depth Interval (feet bgs)	Chemicals of Potential Concern	Detection Frequency (2)	Number of High Censored Results	Average	95 UCL Distribution	Maximum Concentration (2)	Exposure Point Concentration		
								Value	Statistic	Method[1]
EU6-EU8	No COCs retained for soil (samples collected from 3 spill areas) [1].									

Notes:

(1) See Section 10.2 for an evaluation of leaching COPCs and Section 10.4 for an evaluation of radium concentrations in soil.

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure:	Incidental Ingestion, Dermal

Exposure Route	Receptor Population	Receptor Age	Exposure Unit	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Ingestion	Resident	Child	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU documents the rationale	ADD (noncarcinogen) Intake (mg/kg-day) = (CS x IRS x BA x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate - Soil/ Sediment	200	mg/day	USEPA 2014, DEQ 2017b	
				BA	Bioavailability in soil/ sediment	chemical-specific	unitless	chemical-specific	
				EF	Exposure Frequency	24	days/year	Assumes 2 days per week during 3 summer months (DEQ 2017a)	
				ED	Exposure Duration	6	years	Upperbound time estimate for residing in one location and childhood exposure duration (USEPA 2014, DEQ 2017b)	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	15	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	2,190	days	ED x 365 days/year (DEQ 2017b)	
Ingestion	Industrial Worker	Adult	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU documents the rationale	Intake (mg/kg-day) = (CS x IRS x BA x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate - Soil/ Sediment	100	mg/day	USEPA 2014, DEQ 2017b	
				BA	Bioavailability in soil/ sediment	chemical-specific	unitless	chemical-specific	
				EF	Exposure Frequency	24	days/year	Assumes a standard 5-day work week, 3 months of snow cover or frozen ground, and a 2-week vacation (DEQ 2017b). Of the 187 days of outdoor work, 24 days (2x per week during 3 summer months) are assumed to involve contact with creek sediment (DEQ 2017a).	
				ED	Exposure Duration	25	years	USEPA 2014, DEQ 2017b	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	80	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	9,125	days	ED x 365 days/year (DEQ 2017b)	
Ingestion	Recreational Receptor	Child	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU documents the rationale	Intake (mg/kg-day) = (CS x IRS x BA x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate - Soil/ Sediment	200	mg/day	USEPA 2014, DEQ 2017b	
				BA	Bioavailability in soil/ sediment	chemical-specific	unitless	chemical-specific	
				EF	Exposure Frequency	16	days/year	Professional Judgment. Based on 1 to 2X per week during a 3 month summer.	
				ED	Exposure Duration	6	years	Upperbound time estimate for residing in one location and childhood exposure duration (USEPA 2014, DEQ 2017b)	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	15	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	2,190	days	ED x 365 days/year (DEQ 2017b)	

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure:	Incidental Ingestion, Dermal

Exposure Route	Receptor Population	Receptor Age	Exposure Unit	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Dermal	Resident	Child	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU will document the rationale	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	unitless	USEPA 2017b	
				SA	Exposed Skin Surface Area	2,373	cm^2	DEQ 2017b	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2	USEPA 2014, DEQ 2017b	
				EF	Exposure Frequency	24	days/year	Assumes 2 days per week during 3 summer months (DEQ 2017a).	
				ED	Exposure Duration	6	years	Upperbound time estimate for residing in one location and childhood exposure duration (USEPA 2014, DEQ 2017b)	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	15	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	2,190	days	ED x 365 days/year (DEQ 2017b)	
Dermal	Industrial Worker	Adult	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU will document the rationale	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	unitless	USEPA 2017b	
				SA	Exposed Skin Surface Area	3,527	cm^2	DEQ 2017b	
				AF	Soil to Skin Adherence Factor	0.12	mg/cm^2	USEPA 2014, DEQ 2017b	
				EF	Exposure Frequency	24	days/year	Assumes a standard 5-day work week, 3 months of snow cover or frozen ground, and a 2-week vacation (DEQ 2017b). Of the 187 days of outdoor work, 24 days (2x per week during 3 summer months are assumed to involve contact with creek sediment (DEQ 2017a).	
				ED	Exposure Duration	25	years	USEPA 2014, DEQ 2017b	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	80	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	9,125	days	ED x 365 days/year (DEQ 2017b)	
Dermal	Recreational Receptor	Child	EU5 East Fork Armells Creek SOEP/STEP Area	CS	Chemical Concentration	EPC	mg/kg	The RAGS Part D Table 3 series for each EU documents the rationale	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	unitless	USEPA 2017b	
				SA	Exposed Skin Surface Area	2,373	cm^2	Professional judgment. Assume similar exposed skin surface as residential child.	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2	USEPA 2014	
				EF	Exposure Frequency	16	days/year	Professional Judgment. Based on 1 to 2X per week during a 3 month summer.	
				ED	Exposure Duration	6	years	Upperbound time estimate for residing in one location and childhood exposure duration (USEPA 2014, DEQ 2017b)	
				MCF	Mass Conversion Factor	1.00E-06	kg/mg	Not applicable	
				BW	Body Weight	15	kg	USEPA 2014, DEQ 2017b	
				AT-NC	Averaging Time - Noncancer	2,190	days	ED x 365 days/year (DEQ 2017b)	

Table B-4 USEPA RAGS PART D TABLE 4, VALUES USED FOR DAILY INTAKE, RME SEDIMENT EXPOSURE 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure:	Incidental Ingestion, Dermal

Exposure Route	Receptor Population	Receptor Age	Exposure Unit	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name

References:

DEQ 2017a	Meetings held between DEQ, Talen, and Talen's consultants regarding the preparation of the CCRAs for the Colstrip Steam Electric Station under the AOC. February 28 and April 21.
DEQ 2017b	DEQ Remediation Division, State Superfund FAQs. Available on-line at: https://deq.mt.gov/Land/statesuperfund/frequentlyaskedquestions.
USEPA 2004	Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R/99/005 OSWER 9285.7-02EP PB99-963312, July.
USEPA 2014	Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February.
USEPA 2017b	Regional Screening Levels for Chemical Contaminants at Superfund Sites. June. Available on-line at https://www.epa.gov/risk/regional-screening-levels-rsls.

Definitions:

cm^2	square centimeter
DEQ	Montana Department of Environmental Quality
EPC	exposure point concentration
kg	kilogram
kg/mg	kilogram per milligram
mg/cm^2	milligram per square centimeter
mg/day	milligram per day
mg/kg-day	milligram per kilogram per day
mg/kg	milligram per kilogram
RAGS	Risk Assessment Guidance for Superfund
RME	reasonable maximum exposure
USEPA	United States Environmental Protection Agency

Table B-5.1 USEPA RAGS PART D TABLE 5, FEDERAL NON-CANCER TOXICITY DATA - ORAL / DERMAL 5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Chemical of Potential Concern	Chronic / Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Gastro-intestinal Absorption Factor (2)	Absorbed RfD for Dermal		Primary Target Organ(s) (3)	Combined Uncertainty/Modifying Factors	Oral Reference Dose	
		Value	Units			Value	Units			Source(s)	Date(s)
Manganese(4)	Chronic	2.4 E-02 (5)	mg/kg-day	100%	4%	2.4E-02	mg/kg-day	Central Nervous System	1	IRIS (5)	May 2016

Notes:

RfD Reference Dose

IRIS Integrated Risk Information System

mg/kg-day milligrams per kilogram-day

(1) Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), July 2004. If not available, assumed to be 100%. The absorbed dermal RfD is derived by multiplying the oral RfD by the oral absorption efficiency. A manganese dermal ABS is not available (USEPA, 2016); therefore, 100% was assumed.

(2) Gastrointestinal Absorption Factor as presented in the USEPA RSL Tables (USEPA, 2016). The manganese RfD was modified from the IRIS value due to uncertainties discussed in the IRIS file associated with non-diet manganese vs. diet manganese (USEPA 2016).

(3) Primary target(s) listed are those associated with the critical effect(s) on which the RfD was based.

(4) The toxicity value for manganese excludes dietary contribution.

(5) The IRIS RfD is 0.14 mg/kg-day; however, the IRIS explanatory text recommends using a modifying factor of 3 when calculating risks associated with non-food sources because of a number of uncertainties, leading to an RfD of 0.024 mg/kg-day.

Table B-5.2 USEPA RAGS PART D TABLE 5, FEDERAL NON-CANCER TOXICITY DATA - INHALATION
Human Health Risk Assessment 5/21/2018
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Inhalation Reference Concentration	
		Value	Units			Source(s)	Date(s)
No COPCs via the Inhalation Pathway Identified							

Notes:

RAGS Risk Assessment Guidance for Superfund
RfC Reference Concentration
USEPA United States Environmental Protection Agency

Table B-6.1 USEPA RAGS PART D TABLE 5, FEDERAL CANCER TOXICITY DATA - ORAL / DERMAL
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal		Weight of Evidence / Cancer Guidance Description	Oral Cancer Slope Factor	
	Value	Units		Value	Units		Source(s)	Date(s)
No carcinogenic COCs retained								

Notes:

COC Chemical of Concern
RAGS Risk Assessment Guidance for Superfund
USEPA United States Environmental Protection Agency

Table B-6.2 USEPA RAGS PART D TABLE 6, FEDERAL CANCER TOXICITY DATA - INHALATION
Human Health Risk Assessment 5/21/2018
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Chemical of Potential Concern	Unit Risk		Weight of Evidence / Cancer Guidance Description	Unit Risk: Inhalation Cancer Slope Factor	
	Value	Units		Source(s)	Date(s)
No carcinogenic COCs retained.					

Notes:
COC Chemical of Concern
RAGS Risk Assessment Guidance for Superfund
USEPA United States Environmental Protection Agency

Table B-7.1 USEPA RAGS PART D TABLE 7, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, RESIDENT 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Noncancer Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	East Fork Armells Creek Sediment	Ingestion	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-03	mg/kg-day	2.40E-02	mg/kg-day	5.6E-02
			Exposure Route Total								NA					5.6E-02
			Dermal	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-03	mg/kg-day	2.40E-02	mg/kg-day	1.3E-01
			Exposure Route Total								NA					1.3E-01
		Exposure Point Total									NA					
		Outdoor Air	Inhalation (Particulates)	NA	NA	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	NA	mg/kg-day	NA	mg/kg-day	NA
			Exposure Route Total								NA					NA
		Exposure Point Total									NA					NA
	Exposure Medium Total										NA					2E-01
Medium Total											NA					2E-01

Notes:

CSF	Cancer Slope Factor	NA	Not Available/Not Applicable
EPC	Exposure Point Concentration	RAGS	Risk Assessment Guidance for Superfun
EU	Exposure Unit	RfD	Reference Dose
mg/kg	milligrams per kilogram	RfC	Reference Concentration
mg/kg-day	milligrams per kilogram per day	RME	Reasonable Maximum Exposure
		USEPA	United States Environmental Protection Agency

Table B-7.2 USEPA RAGS PART D TABLE 7, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, INDUSTRIAL WORKER 5/21/2018
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Receptor Population:	Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Noncancer Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	East Fork Armells Creek Sediment	Ingestion	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-04	mg/kg-day	2.40E-02	mg/kg-day	5.2E-03
			Exposure Route Total								NA					5.2E-03
			Dermal	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-04	mg/kg-day	2.40E-02	mg/kg-day	2.2E-02
			Exposure Route Total								NA					2.2E-02
		Exposure Point Total									NA					
		Outdoor Air	Inhalation (Particulates)	NA	NA	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	NA	mg/kg-day	NA	mg/kg-day	NA
			Exposure Route Total								NA					NA
		Exposure Point Total									NA					NA
	Exposure Medium Total										NA					3E-02
Medium Total											NA					3E-02

Notes:

CSF	Cancer Slope Factor	NA	Not Available/Not Applicable
EPC	Exposure Point Concentration	RAGS	Risk Assessment Guidance for Superfur
EU	Exposure Unit	RfD	Reference Dose
mg/kg	milligrams per kilogram	RfC	Reference Concentration
mg/kg-day	milligrams per kilogram per day	RME	Reasonable Maximum Exposure
		USEPA	United States Environmental Protection Agency

Table B-7.3 USEPA RAGS PART D TABLE 7, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, RECREATIONAL USER

5/21/2018

Human Health Risk Assessment

Wastewater Facilities Comprising the Closed Loop System

SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

Receptor Population:	Recreational User
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Noncancer Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	East Fork Armells Creek Sediment	Ingestion	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-04	mg/kg-day	2.40E-02	mg/kg-day	3.7E-02
			Exposure Route Total								NA					3.7E-02
			Dermal	Manganese	1,523	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	2.1E-03	mg/kg-day	2.40E-02	mg/kg-day	8.8E-02
			Exposure Route Total								NA					8.8E-02
		Exposure Point Total									NA					
		Outdoor Air	Inhalation (Particulates)	NA	NA	mg/kg	NA	mg/kg-day	NA	(mg/kg-day)-1	NA	NA	mg/kg-day	NA	mg/kg-day	NA
			Exposure Route Total								NA					NA
		Exposure Point Total									NA					NA
	Exposure Medium Total										NA					1E-01
Medium Total											NA					1E-01

Notes:

CSF	Cancer Slope Factor	NA	Not Available/Not Applicable
EPC	Exposure Point Concentration	RAGS	Risk Assessment Guidance for Superfur
EU	Exposure Unit	RfD	Reference Dose
mg/kg	milligrams per kilogram	RfC	Reference Concentration
mg/kg-day	milligrams per kilogram per day	RME	Reasonable Maximum Exposure
		USEPA	United States Environmental Protection Agency

TABLE B-9.1 USEPA RAGS PART D TABLE 9, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, RESIDENT
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Calculations				Noncancer Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	East Fork Armells Creek	Manganese	NA	NA	NA	NA	Central Nervous System	5.6E-02	NA	1.3E-01	2E-01
			Chemical Total	NA	NA	NA	NA		5.6E-02	NA	1.3E-01	2E-01
		Exposure Point Total					NA					2E-01
		Outdoor Air (Particulates)	NA	NA	NA	NA	NA		NA	NA	NA	NA
			Chemical Total	NA	NA	NA	NA		NA	NA	NA	NA
		Exposure Point Total					NA					NA
	Exposure Medium Total						NA					2E-01
Medium Total							NA					2E-01

Notes:

NA Not Available/Not Applicable
RAGS Risk Assessment Guidance for Superfund
RME Reasonable Maximum Exposure
USEPA United States Environmental Protection Agency

Target Organ Hazard Index	
Target Organ	Sediment
Central Nervous System	2E-01
Maximum	2E-01

TABLE B-9.2 USEPA RAGS PART D TABLE 9, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, INDUSTRIAL WORKER
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Receptor Population:	Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Calculations				Noncancer Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	East Fork Armells Creek	Manganese	NA	NA	NA	NA	Central Nervous System	5.2E-03	NA	2.2E-02	3E-02
			Chemical Total	NA	NA	NA	NA		5.2E-03	NA	2.2E-02	3E-02
		Exposure Point Total					NA					3E-02
		Outdoor Air (Particulates)	NA	NA	NA	NA	NA		NA	NA	NA	NA
			Chemical Total	NA	NA	NA	NA		NA	NA	NA	NA
		Exposure Point Total					NA					NA
	Exposure Medium Total						NA					3E-02
Medium Total							NA					3E-02

Notes:

NA Not Available/Not Applicable
RAGS Risk Assessment Guidance for Superfund
RME Reasonable Maximum Exposure
USEPA United States Environmental Protection Agency

Target Organ Hazard Index	
Target Organ	Sediment
Central Nervous System	3E-02
Maximum	3E-02

TABLE B-9.3 USEPA RAGS PART D TABLE 9, CALCULATION OF RME CHEMICAL CANCER RISK AND NONCANCER HAZARDS FOR SEDIMENT EXPOSURE, EU5, RECREATIONAL USER
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Receptor Population:	Recreational User
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Calculations				Noncancer Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	East Fork Armells Creek	Manganese	NA	NA	NA	NA	Central Nervous System	3.7E-02	NA	8.8E-02	1E-01
			Chemical Total	NA	NA	NA	NA		3.7E-02	NA	8.8E-02	1E-01
		Exposure Point Total					NA					1E-01
		Outdoor Air (Particulates)	NA	NA	NA	NA	NA		NA	NA	NA	NA
			Chemical Total	NA	NA	NA	NA		NA	NA	NA	NA
		Exposure Point Total					NA					NA
	Exposure Medium Total						NA					1E-01
Medium Total							NA					1E-01

Notes:

NA Not Available/Not Applicable
RAGS Risk Assessment Guidance for Superfund
RME Reasonable Maximum Exposure
USEPA United States Environmental Protection Agency

Target Organ Hazard Index	
Target Organ	Sediment
Central Nervous System	1E-01
Maximum	1E-01

TABLE B-10 USEPA RAGS PART D TABLE 10, RISK SUMMARY FOR SEDIMENT EXPOSURE, EU5
Human Health Risk Assessment
Wastewater Facilities Comprising the Closed Loop System
SOEP/STEP Area, Colstrip Steam Electric Station, Colstrip, Montana

5/21/2018

Receptor Population:	Resident	Industrial Worker	Construction Worker	Recreational User
Receptor Age:	Child	Adult	Adult	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Calculations				Noncancer Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	East Fork Armells Creek	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Chemical Total	NA	NA	NA	NA		NA	NA	NA	NA
		Exposure Point Total					NA					NA
		Outdoor Air (Particulates)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Chemical Total	-	NA	-	NA		-	NA		NA
		Exposure Point Total					NA					NA
	Exposure Medium Total						NA					NA
Medium Total							NA					NA

This table is intentionally blank - no carcinogenic COPCs were identified and noncancer hazards do not exceed 1.0 for any of the receptors.

Notes:

NA Not Available/Not Applicable

RAGS Risk Assessment Guidance for Superfund

USEPA United States Environmental Protection Agency

APPENDIX C

Ecological Risk Assessment

APPENDIX C: ECOLOGICAL RISK ASSESSMENT FOR THE COLSTRIP POWER PLANT, UNITS 1 & 2 SOEP AND STEP

Prepared for Hydrometrics, Inc.

11 JUNE 2018

Prepared by

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List of Acronyms

ADD	Average Daily Dose
AUF	Area Use Factor
BERA	Baseline ecological risk assessment
bgs	below ground surface
BSL	Background screening level
BTAG	Biological Technical Assistance Group
BTV	Background threshold value
BW	Body weight
CCME	Canadian Council of Ministers of the Environment
CCRA	Cleanup Criteria and Risk Assessment
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CW	Capture Well
DL	Detection Limit
EcoSSL	Ecological Soil Screening Levels
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
HQ	Hazard Quotient
IR	Ingestion rate
LANL	Los Alamos National Laboratory
LOAEL	Lowest Observed Adverse Effect Level
MDEQ	Montana Department of Environmental Quality
NOAEL	No Observed Adverse Effects Level
PAUF	Population Area Use Factor
SCEM	Site conceptual exposure model
SLERA	Screening-level ecological risk assessment
SOEP	Stage I Evaporation Pond
STEP	Stage II Evaporation Pond
T&E	Threatened and endangered
TDS	Total dissolved solids
TRVs	Toxicity Reference Values
UCL	Upper Confidence Level
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

The SLERA was implemented pursuant to the United States Environmental Protection Agency (USEPA) guidance (USEPA, 1993, 1997b, 1998 et al.) and Montana Department of Environmental Quality (MDEQ) guidance (DEQ, 2009, 2016).

This ERA presents an evaluation of the potential for exposure and ecological risks in the East Fork Armells Creek (the Creek) and soil areas adjacent to Units 1&2 SOEP/STEP area. Media included in the risk assessment included sediment and surface water in East Fork Armells Creek adjacent to and extending downstream from the Units 1&2 SOEP/STEP Area; soil in the vicinity of releases/spills that occurred in at North 1 AD Pipeline Drain Pond (hereafter called North 1 AD Soil Area); Capture Well 932D (CW 932D Soil Area); the STEP Main Dam fly ash paste spill area (STEP Soil Area); and groundwater from well 901D, which is being converted for use as a livestock well. The ERA uses environmental data related to present-day concentrations of chemicals in sediment, soil, and surface water adjacent to the Plant Site (the Site) along the Creek.

ES-1 Overview of the Ecological Risk Assessment Process

The ERA for the Plant Site area consists of a screening level ecological risk assessment (SLERA), SLERA refinement, and baseline ecological risk assessment (BERA). An ecological Site Conceptual Exposure Model (SCEM) identified the ecological exposures associated with the Creek and soil spill areas, as well as the Facility-specific contaminant sources, release mechanisms, transport routes and media, and potential receptors. The SLERA (Steps 1 and 2 of the EPA Process) identified preliminary COPCs and conservatively ruled out further evaluation of constituents and media that did not pose an ecological risk. Constituents that remained following the SLERA were carried to the SLERA refinement, which represents Step 3A of the USEPA ERA process. Chemicals of potential concern (COPCs) were carried forward from the SLERA refinement to the BERA, wherein chemicals of concern (COCs) were identified utilizing realistic, site-specific exposure assumptions.

ES-2 Ecological Risk Assessment

Evaluation of the Site for sensitive environments identified wetland areas in and adjacent to the Creek within the investigation area. Delineated wetland types include Palustrine Aquatic Bed Semi-permanently Flooded wetland, and Palustrine Emergent Seasonally Flooded wetland. East Fork Armells Creek and its immediate environs provide habitat for aquatic and terrestrial plants, aquatic and benthic invertebrates, and small fish. Terrestrial habitats adjacent to the Creek are comprised of grasslands with scattered shrubs, which provide habitat for a variety of birds and small mammals. It is assumed that the creek is used by wildlife and livestock as a drinking water source. Therefore, ecological exposure pathways are considered complete for all trophic levels to surface water, sediment, and soil.

Ecological exposure pathways to groundwater are considered complete only for well 901D, which is being converted to a livestock well. Ecological exposure pathways to other groundwater resources are considered incomplete for wildlife receptors incomplete for wildlife receptors.

SLERA Results: The SLERA compared maximum detected concentrations in sediment, surface water and soil to ecological screening levels. Manganese was the only constituent in sediment retained as a preliminary sediment COPC. Boron and manganese were retained as preliminary surface water COPCs. In shallow soils barium, boron, and radium-226 exceeded ecological soil screening levels in the North 1AD soil area; barium and boron exceeded ecological soil screening levels in the Step Main Dam area, and boron exceeded ecological soil screening levels in CW 932D soil. In mid-depth soils boron was retained as a preliminary COPC in all three soil areas, and radium-226 was also retained as a COPC in North 1AD mid-depth soil. No unacceptable risk was posed to livestock from ingestion of East fork Armells Creek surface water, though maximum concentrations of sulfate in the water render the creek marginal for livestock watering.

SLERA refinement results: The SLERA refinement process used the estimated 95% UCL to represent exposure point concentrations for site receptors, and included an expanded screening to focus the list of receptors potentially at risk from Site COPCs. Manganese and boron were both retained as COPCs in surface water after screening refinement based on potential risk to aquatic life. Manganese was also retained as a sediment COPC for the BERA based on potential risk to sediment-dwelling organisms. In shallow and mid-depth soils boron was retained as a COPC in all three soil areas for evaluation in the BERA based on potential risk to herbivorous and insectivorous birds. Barium was retained as a COPC in shallow soil in North 1AD and STEP Main Dam soil areas based on potential risk to plants and soil invertebrates. Radium-226 was retained in North 1 AD surface soil for evaluation in the BERA based on potential risk to soil invertebrates.

BERA results: The BERA risk characterization involved calculation of average daily doses of COPCs to wildlife potentially exposed to Creek sediment and surface water, and Site soils; and comparison of soil, sediment, and water concentrations to low-effects thresholds for plants, invertebrates, and aquatic life.

Boron and manganese in sediment and surface water were found to pose no unacceptable risk to aquatic-dependent wildlife. Though boron concentrations in surface water and manganese concentrations in sediment exceed low-effects thresholds for protection of aquatic life, concentrations of boron and manganese in East Fork Armells Creek surface water and sediment are less than concentrations upstream of the Site, meaning risk cannot be differentiated from that of surface water and sediment entering the site from upstream sources. Modeled doses of boron and manganese to aquatic-dependent wildlife receptors were all less than low-effects TRVs, meaning there was no risk to aquatic dependent wildlife from Creek sediment or surface water.

Barium 95% UCL concentrations in North 1AD and STEP Main Da soil exceeded low-effect thresholds for protection of plants, but concentrations in all but one sample location were less than the Montana background threshold value for barium, indicating potential risk from barium is not discernible from background conditions. The 95% UCL concentrations of radium-226 in North 1AD soil were less than low-effects thresholds, indicating no unacceptable risk to soil invertebrates from radium-226. Modeled doses of boron to herbivorous birds and insectivorous birds were all less than low-effects TRVs in all three areas, indicating no unacceptable risks from boron in Site soil.

Conclusions: Concentrations of both boron and manganese in upstream surface water are higher than maximum Site concentrations. Maximum surface water concentrations of boron at the Site were lower than risk-based levels established through a more recent review of boron aquatic toxicity by CCME (2009b). Manganese in Site sediment is higher than the LOAEL level of 1,100 mg/kg, but is lower than upstream concentrations at AR-5. The LOAEL value of 1,100 mg/kg would serve as the basis for a risk-based sediment clean-up goal for manganese, but the ability to achieve this goal throughout the creek is questionable as long as surface water entering the site from upstream contains high levels of manganese. Therefore, risk-based clean-up levels for manganese and boron in sediment and surface water were not developed. No unacceptable risk is posed to plants, invertebrates, or wildlife from exposure to site soils. No unacceptable risk is posed to livestock from use of either East Fork Armells Creek surface water or groundwater from Well 901D as drinking water sources.

C-1 INTRODUCTION

The Ecological Risk Assessment (ERA) was prepared by Neptune and Company, Inc. The ERA was conducted following USEPA guidance (USEPA, 1993, 1997b, 1998 et al.) and DEQ guidance (DEQ, 2016a, 2016b).

The ERA focused on potential exposure to COPCs in the following areas:

- Surface water and sediment in East Fork Armells Creek adjacent to and extending downstream from the Units 1&2 SOEP/STEP Area, from Power Road to just downstream of Pinebutte Drive, as shown in Figures 7 & 8 of the main report.
- Soil in areas where previous spills/releases have been documented
    - North 1 AD Pipeline Drain Pond (hereafter called North 1 AD Soil Area)
    - Soil around Capture Well 932D (CW 932D Soil Area)
    - STEP Main Dam fly ash paste spill area (STEP Soil Area)
- Groundwater from well 901D, located in the northern portion of the Units 1&2 SOEP/STEP Area, which is used as a livestock well.

Potential ecological risk associated with sediment and water within the actual SOEP/STEP ponds will be addressed as part of the closure process for those ponds.

The ecological risk assessment for the Units 1&2 SOEP/STEP area encompassed several stages. Initially, a screening-level ecological risk assessment (SLERA) was conducted to identify preliminary COPCs and conservatively rule out further evaluation of constituents and media that do not pose an ecological risk. The SLERA represents Steps 1 and 2 of the USEPA ecological risk assessment process (EPA, 1997b). Any constituents that remained following the initial SLERA were carried to the screening refinement, informally known as Step 3A of the EPA ecological risk assessment process. A baseline ecological risk assessment (BERA) was then performed for any COPCs remaining following screening refinement. The BERA replaced the conservative assumptions used in the SLERA with more realistic, site-specific exposure assumptions.

The ecological risk assessment for East Fork Armells Creek was conducted with existing synoptic run data for the Creek. Synoptic run surface water and sediment data used in the ERA were collected seasonally, and data collected in 2014 and 2015 were used to represent current conditions within the Creek. Synoptic run data collected at locations AR-5 and AR-12 were used to represent chemical concentrations present in sediment and surface water upstream of the Units 1&2 SOEP/STEP and Plant Site areas. The ecological risk assessment for the soil areas was conducted using soil data collected in 2017.

C-2 ECOLOGICAL EXPOSURE ASSESSMENT

The Ecological Exposure Assessment provides a description of the environmental exposure to releases or threatened releases of wastewater COPCs from the ponds at the Units 1&2 SOEP/STEP Area based upon the current use of the Facility and adjacent properties and any reasonably anticipated future uses of the Facility and adjacent properties. The Ecological Exposure Assessment was prepared following DEQ and USEPA guidance as described in the following sections.

C-2.1 ECOLOGICAL CONCEPTUAL SITE EXPOSURE MODEL

An ecological Conceptual Site Exposure Model (CSEM) was prepared as the first step in the Exposure Assessment. The ecological CSEM identifies the ecological exposures associated with the Creek, as well as the Facility-specific contaminant sources, release mechanisms, transport routes and media, and potential receptors. The preliminary ecological exposures assessed in the ERA are presented in the CSEM (Figure 7 of the main report).

C-2.2 ASSESSMENT ENDPOINTS, MEASURES OF EFFECT, AND EXPOSURE PATHWAYS

Ecological assessment endpoints represent the ecological values to be protected at the Facility. Potential receptors for the SLERA were selected based on a site visit conducted in July 2014 and information obtained from the Montana Natural Heritage Program. Receptors include the plants, animals and components of the environment (e.g., habitats, populations, communities) that may potentially be exposed to contamination in East Fork Armells Creek, the three SOEP/STEP soil areas, and pumped groundwater from livestock Well 901D. Exposure pathways are identified in the CSEM, and will be revised as needed based upon the results of the SLERA. Preliminary assessment endpoints for the SLERA and screening refinement include protection of:

- populations of aquatic plants exposed to surface water and sediment in East Fork Armells Creek,
- benthic invertebrate communities exposed to surface water and sediment in East Fork Armells Creek,
- populations of riparian birds and mammals exposed to surface water and sediment in East Armells Creek,
- populations of soil invertebrates exposed to upland soil in the soil historic release areas,
- populations of plants exposed to upland soil in the soil historic release areas,
- populations of terrestrial birds and mammals exposed to upland soil in the historic release areas,
- livestock exposed to groundwater from livestock Well 901D, and
- livestock exposed to surface water in East Fork Armells Creek.

Ecological risk assessments focus on the protection of populations of organisms, except when the potential exists for threatened and endangered (T&E) species to occur at the Facility. Protection of individuals of T&E species is a goal of the ERA if such species are known or suspected to occur. Information on the potential for T&E species to be present along the Creek was obtained from the Montana Natural Heritage Program. According to the Species of Concern list updated on 5/3/2016, there are 44 animal species of concern in Rosebud County. Of these, only one, the Pallid Sturgeon, is listed as endangered. The Pallid Sturgeon occurs in large rivers, and would not occur in East Fork Armells Creek. A second species, Yellow-billed Cuckoo, is listed as threatened in the portion of its range that includes the State of Montana. The Yellow-billed Cuckoo inhabits prairie riparian forests and may utilize streamside cottonwoods during migration, but trees are likely too sparse in the area of East Fork Armells Creek and the Units 1&2 SOEP/STEP Area to support breeding yellow-billed cuckoos. A third species, Sprague's Pipit, is a candidate species for listing. Sprague's Pipit inhabits open grassland with no trees or shrubs, and may occur on open grassland portions of the SOEP/STEP area, but would not be expected along East Fork Armells Creek. USFWS published a finding in October 2015 on a petition to list the greater sage grouse as endangered or threatened across its range, including Montana. The 2015 finding concluded that listing of the greater sage grouse was not warranted. Two other species, Bald Eagle and Golden Eagle, receive protection under the Bald and Golden Eagle Protection Act. Bald Eagles normally stay near large bodies of water, while Golden Eagles prefer open country. Of the two, Golden eagles are more likely to occur in open grasslands, where they would be expected to feed on a variety of small mammals. Utilization of East Fork Armells Creek by Bald and Golden Eagles is expected to be minimal. Any exposure to East Fork Armells Creek water and sediment is expected to be limited to surface water ingestion.

According to information, obtained from the Montana Natural Heritage Program's Wetland's Mapper (http://geoinfo.msl.mt.gov/home/msdi/wetlands), approximately 30% of the length of the East Fork Armells Creek between Power Road and Pinebutte Drive is delineated wetland classified as Seasonally Flooded Palustrine Emergent wetland, including areas around sampling locations AR-1NF, AR-6, AR-10PBR, and AR-11. There is a small (< 1 acre) area of Semi-Permanent Flooded Palustrine Aquatic Bed wetland near sampling location AR-8.

Measures of Effect describe how assessment endpoints will be evaluated to determine whether potential risk exists to a specific assessment endpoint. Measures of Effect for the SLERA and screening refinement include:

- comparison of Creek surface water concentrations to chronic aquatic life standards published in Montana DEQ-7,
- comparison of Creek sediment concentrations to EPA Region 3 Biological Technical Assistance Group (BTAG) freshwater sediment screening benchmarks,
- comparison of soil concentrations to EPA Ecological Soil Screening Levels (EcoSSLs) or other ecological soil screening benchmarks if EPA EcoSSLs have not been derived for a given constituent,
- comparison of groundwater concentrations in Well 901D to levels identified as suitable for ingestion by livestock,
- comparison of Creek surface water concentrations to levels identified as suitable for ingestion by livestock,
- and comparison of soil, sediment, and surface water concentrations to appropriate background or reference areas that are not impacted by Units 1&2 SOEP/STEP activities.

Additional Measures of effect for a baseline ecological risk assessment include:

- Food chain modeling to terrestrial birds and mammals utilizing upland soil areas and the Creek as a source of food and drinking water, and comparison of average daily doses to toxicity reference values (TRVs). Food-chain models were constructed for the following representative receptors that may forage in upland soil areas and/or the Creek:

- Raccoon (*Procyon lotor*), representative of omnivorous mammals utilizing East Fork Armells Creek,
- Common yellowthroat (*Geothlypis trichas*), representative of insectivorous birds utilizing East Fork Armells Creek,
- Great blue heron (*Ardea herodias*), representative of piscivorous birds utilizing East Fork Armells Creek,
- Ord's kangaroo rat (*Dipodomys ordii*), representative of herbivorous mammals utilizing upland soil areas at the SOEP/STEP,
- Masked shrew (*Sorex cinereus*), representative of insectivorous mammals utilizing upland soil areas at the SOEP/STEP,
- Lark sparrow (*Chondestes grammacus*), representative of herbivorous birds utilizing upland soil areas at the SOEP/STEP, and
- Sprague's pipit (*Anthus spragueii*), representative of insectivorous birds utilizing upland soil areas at the SOEP/STEP.

Food chain modeling to terrestrial receptors utilizing the Creek as a food/water source was included as part of the BERA because these receptors have exposures across multiple media (soil, sediment, and water).

Following the SLERA and screening refinement, the list of assessment endpoints and the CSEM were refined based upon the results of the screening-level assessment. Current and reasonably anticipated future uses of adjacent properties were also considered when identifying potential receptors and exposure pathways.

East Fork Armells Creek within the investigation area is a generally slow-moving creek containing permanent water and in places, abundant emergent vegetation. East Fork Armells Creek is designated a Class C-3 surface water body under the Montana Water Quality Act. A Class C-3 waterbody is defined as suitable for bathing, swimming, and recreation; and growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of Class C-3 waters is naturally marginal for drinking, culinary, and food processing purposes, agriculture, and industrial water supply.

Wetland areas are present in and adjacent to the Creek within the investigation area. Delineated wetland types are primarily Seasonally Flooded Palustrine Emergent wetland, with a small area of Semi-Permanent Flooded Palustrine Aquatic Bed wetland. East Fork Armells Creek and its immediate environs provide habitat for aquatic and terrestrial plants, aquatic and benthic invertebrates, and small fish. The utility of the creek as a drinking water source for wildlife is uncertain due to the high concentrations of cations and dissolved solids, which make the water in the creek more akin to saltwater than freshwater. However, for risk assessment purposes it is assumed that the creek is used by wildlife and livestock as a potential drinking water source. Terrestrial habitats in the SOEP/STEP area are comprised of grasslands with scattered shrubs. These provide habitat for a variety of birds and small mammals. Some of the surrounding grasslands on and adjacent to the Units 1&2 SOEP/STEP Area are fenced to allow grazing by cattle and horses. Therefore, ecological exposure pathways are considered complete for all trophic levels to surface water, sediment, and soil. Complete exposure pathways for each receptor group are show in Table C-1.

Ecological exposure pathways to groundwater are considered complete only for well 901D, which is used as a livestock well. Ecological exposure pathways to other groundwater resources are considered incomplete for wildlife receptors. Groundwater at the Site is designated Class III under the Montana Water Quality Act. Class III ground waters are those ground waters with a natural specific conductance that is greater than 2,500 and less than or equal to 15,000 microSiemens/cm at 25ºC. Groundwater in Colstrip typically exhibits a specific conductance above 4000 umhos/cm. Class III ground waters are not suitable for potable use without treatment, but must be of at least marginal quality for livestock watering and industrial use. Based on this designation, protective clean-up levels were calculated for chemicals in Site groundwater and presented in the Clean-up Criteria and Risk Assessment Report for the Plant Site Area (Canty, 2017) based upon the assumption that groundwater from other wells could be pumped to provide a drinking water source for livestock. The clean-up criteria developed in that report are also relevant for groundwater in the SOEP/STEP area.

Table C-1. Ecological Exposure Pathways

Ecological Receptor	Exposure Pathway				
	Root Uptake	Dermal Contact	Surface Water Ingestion	Soil/Sediment Ingestion	Food-chain Ingestion
Benthic Invertebrates/Fish	NA	1°	1°	1°	2°
Soil Invertebrates	NA	1°	NA	1°	2°
Aquatic Plants / Terrestrial Plants	1°	2°	NA	NA	NA
Terrestrial Mammals	NA	2°	1°	2°	1°
Terrestrial Birds	NA	2°	1°	2°	1°

1° = Primary or major pathway
2° = Secondary or minor pathway
N/A = Insignificant or Incomplete Pathway

C-2.3 EXPOSURE ASSUMPTIONS

Ecological exposure scenarios are identified based on the current and reasonably anticipated future Facility use (and adjacent areas), the potential receptors, and complete exposure pathways. For the SLERA, conservative exposure assumptions are used to ensure that risk is not underestimated. These assumptions include:

- An Area Use Factor (AUF) of 1 (i.e., an organism gets 100% of its exposure from East Fork Armells Creek or the soil areas),
- 100% bioavailability of chemical constituents in soil, sediment and surface water, and
- Use of No Adverse Effects Level (NOAEL) screening levels and TRVs.

For the BERA food chain modeling of dose to birds and mammals exposed to Creek surface water and sediments, more realistic exposure assumptions are used to represent exposure, and Lowest Observed Adverse Effects Level (LOAEL) TRVs are used. Organism body weights, food ingestion rates, and water ingestion rates for use in the food-chain modeling are shown in Table C-2 and C-3 below. Because no biotic tissue has been analyzed to provide estimates of contaminant concentrations in the food chain, estimates of bioaccumulation into food/prey items were selected from available literature. Bioaccumulation factors used to estimate contaminant concentrations in food items are shown in Tables C-4 and C-5. For contaminants in East Fork Armells Creek, concentrations in aquatic plants and benthic invertebrates are estimated based on bioaccumulation from sediment. Concentrations in fish tissue are estimated based on bioconcentration from surface water.

C-2.4 ECOLOGICAL EXPOSURE AREAS AND EXPOSURE POINT CONCENTRATIONS

The exposure area for surface water and sediment for the ERA is defined as East Fork Armells Creek extending downstream from Power Road to just past the creek's intersection with Pinebutte Drive.

For the initial screening-level assessment, the maximum concentration of each COPC in sediment, surface water, soil and groundwater was used. Data used in the risk assessment are limited to the most recent rounds of sampling (2014 and 2015 for sediment and surface water; 2017 for soil areas). For sediment, surface water, and soil, refinement of the SLERA and the BERA utilized a 95% UCL on the mean to represent a more realistic exposure point concentration (EPC) integrated across time and exposure areas. 95% UCLs were not calculated for groundwater at Well 901D or soil at CW-932D due to insufficient sample size. Because the creek extends across a relatively large area, 95% UCL EPCs in the BERA were calculated differently for the raccoon, which has relatively large home range/foraging area, versus the common yellowthroat and great blue heron, which have relatively small foraging areas. For the raccoon, the 95% UCL was calculated across all sampling locations in the Creek included in this investigation (AR-1, AR-6, AR-7, AR-8, AR-9, AR-10, AR-11), while 95% UCL EPCs for common yellowthroat and great blue heron were calculated for each sampling location. Thus, the 95% UCL EPCs for widely ranging raccoon encompass spatial and temporal variability across the creek, while the EPCs for the smaller ranging receptors encompass only temporal variability at each sampling location. Statistical and graphical summaries of the data to support estimation of EPCs using 95% UCLs for preliminary COPCs are presented in Appendix D. Details of the 95% UCL calculations for surface water, sediment, and soil are presented in Appendix D. For certain data sets with small sample sizes, the calculated 95% UCL may exceed the maximum reported concentration. In the interest of conservatism, the ecological risk assessment used the 95% UCL values even when the UCL was greater than the observed maximum. This conservatism reduces the chance that a COPC will be eliminated from consideration when it should have been retained. 95% UCLs were not calculated for exposure units with fewer than four samples (e.g. soil area CW-932D), and decisions for these areas were based on the maximum measured concentration. Exposure units and type of EPC used for each line of evidence in the SLERA and BERA are shown in Table C-6.

Table C-2. Food Chain Model Exposure Parameters For East Fork Armells Creek Receptors

Parameter	Value	Source
Raccoon		
Body Weight (kg)	6	Average of the mean values provided from studies reporting weights of adult raccoons, reported in Wildlife Exposure Factors Handbook (USEPA, 1993).
Food Ingestion Rate (kg/d dry wt.)	0.3	Calculated using allometric equation for All Mammals (Equation 3-7) from Wildlife Exposure Factors Handbook (USEPA 1993).
Water Ingestion Rate (L/d)	0.5	Based on water ingestion rate of 0.083 grams per grams of body weight per day (g/g-d) as reported in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Sediment Ingestion Rate (k/d dry wt)	0.03	Beyer et al., 1994.
Fraction Plants in Diet (unitless)	0.4	A study of raccoons in bottomland riparian habitat found that plant material made up ~40% of the raccoon diet when averaged across all four seasons, ranging from less than 5% in spring to ~60% in fall and winter (Llewellyn and Uhler as reported in USEPA 1993). Raccoon diets in Spring, Summer, and Fall are dominated by fruits and nuts (Tesky, 1995).
Fraction Invertebrates in Diet (unitless)	0.5	A study of raccoons in bottomland riparian habitat found that invertebrates made up ~50% of the raccoon diet when averaged across all four seasons, ranging from ~25% in fall and winter to 82% in spring (Llewellyn and Uhler as reported in USEPA 1993). According to Tesky (1995), Spring is the only time of year when animal material comprises more than 50% of raccoons diet, with small invertebrates the most important animal foods consumed by raccoons.
Fraction Fish in Diet (unitless)	0.1	A study of raccoons in bottomland riparian habitat found that fish and other vertebrates made up ~10% of the raccoon diet when averaged across all four seasons, ranging from ~3% in fall to 16% in winter and spring (Llewellyn and Uhler as reported in USEPA 1993). In summer, this category also includes eggs of nesting birds, particularly waterfowl eggs in regions of the northern great plains (Tesky 1995).
Area Use Factor	1	An AUF of 1 is used to be protective of all omnivorous mammals for which the raccoon serves as a surrogate.
Common Yellowthroat		
Body Weight (kg)	0.01	Mean of all adult body weights from Guzy and Ritchison, 1999.
Food Ingestion Rate (kg/d dry wt.)	0.0033	Calculated using allometric equation for passerine birds (Equation 3-4) in Wildlife Exposure Factors Handbook (USEPA, 1993).
Water Ingestion Rate (L/d)	0.0028	Based on water ingestion rate of 0.28 g/g-d as reported in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Sediment Ingestion Rate (k/d dry wt)	0.000066	Calculated as 2% of total ingestion rate
Fraction Invertebrates in Diet (unitless)	1	Diet assumed to be 100% invertebrates to be protective of all insectivorous birds utilizing the Creek
Area Use Factor	1	The AUF of 1 is applied to each individual area within East Fork Armells Creek, assuming that individual common yellowthroats defend territories in the wetland portions of each area.

Table C-2. Food Chain Modeling Exposure Parameters For East Fork Armells Creek Receptors (continued)

Great Blue Heron Exposure Parameters		
Body Weight (kg)	2.336	Mean of all adult body weights reported in Wildlife Exposure Factors Handbook (USEPA, 1993).
Food Ingestion Rate (kg/d dry wt.)	0.105	Total Ingestion of 0.105 kg/d (dry weight) based on ingestion rate of 0.18 kg/kg-d (kilograms per kilograms of body weight per day; wet weight) from Wildlife Exposure Factors Handbook (USEPA, 1993) adjusted for body weight and converted to dry weight by assuming average of 75% moisture in prey items.
Water Ingestion Rate (L/d)	0.105	Based on water ingestion rate of 0.045 g/g-d as reported in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Sediment Ingestion Rate (k/d dry wt)	0.002	Calculated as 2% of total ingestion rate
Fraction Fish in Diet	1	The four studies listed in USEPA (1993) report the diet of the great blue heron as comprised of 94 to 100% fish, with invertebrates, amphibians, birds and mammals comprising the non-fish portion of the diet. For the purposes of evaluating risk to piscivores, the great blue heron will be assumed to have a diet of 100% fish from East Fork Armells Creek.
Area Use Factor	1	The AUF of 1 is applied to each individual area within East Fork Armells Creek. Great Blue Herons have been reported to forage in areas as small as 1.5 acres.

Table C-3. Food Chain Model Exposure Parameters For N1AD, STEP Dam, and CW 932D Soil Area Receptors

Parameter	Value	Source
Ord's Kangaroo Rat (mammalian herbivore)		
Body Weight (kg)	0.052	Mean adult body mass reported in Garrison and Best, 1990.
Food Ingestion Rate (kg/d dry wt.)	0.0058	Calculated using allometric equation for rodents (Equation 3-8) in Wildlife Exposure Factors Handbook (USEPA, 1993)
Water Ingestion Rate (L/d)	0.007	Calculated using allometric equation for mammals (Equation 3-17) in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Soil Ingestion Rate (k/d dry wt)	0.0058	Calculated as 10% of total ingestion
Fraction Plants in Diet	1	Diet assumed to be 100% plant material to be protective of all herbivorous mammals utilizing the upland soil areas
Area Use Factor	1	
Masked Shrew (mammalian insectivore)		
Body Weight (kg)	0.004	Recommended value for masked shrew from Warrington, P.D. 2001.
Food Ingestion Rate (kg/d dry wt.)	0.00084	Based upon a high point recommended value for short-tailed shrew of 0.209 g dw food/g body weight/d (Table 1 of EPA 2007)
Water Ingestion Rate (L/d)	0.0005	Recommended value for masked shrew from Warrington, P.D. 2001.
Incidental Soil Ingestion Rate (k/d dry wt)	0.000325	Calculated as 10% of total ingestion
Fraction Invertebrates in Diet	1	Assumed to be 100% to be protective of all insectivorous mammals
Area Use Factor	1	
Lark Sparrow (avian herbivore)		
Body Weight (kg)	0.0289	Mean adult weight from four studies reported in Martin and Parrish (2000)
Food Ingestion Rate (kg/d dry wt.)	0.00694	Calculated using allometric equation for passerine birds (Equation 3-4) in Wildlife Exposure Factors Handbook (USEPA, 1993).
Water Ingestion Rate (L/d)	0.005	Calculated using allometric equation for birds (Equation 3-15) in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Soil Ingestion Rate (k/d dry wt)	0.00014	Calculated as 2% of total ingestion
Fraction Plants in Diet	0.75	Martin and Parrish, 2000
Fraction Invertebrates in Diet	0.25	Martin and Parrish, 2000
Area Use Factor	1	
Spraque's Pipit (avian insectivore)		
Body Weight (kg)	0.02375	Mean of 343 territorial males and breeding females reported in Davis et al., 2014.
Food Ingestion Rate (kg/d dry wt.)	0.00588	Calculated using allometric equation for passerine birds (Equation 3-4) in Wildlife Exposure Factors Handbook (USEPA, 1993).
Water Ingestion Rate (L/d)	0.005	Calculated using allometric equation for birds (Equation 3-15) in Wildlife Exposure Factors Handbook (USEPA, 1993)
Incidental Soil Ingestion Rate (k/d dry wt)	0.00012	Calculated as 2% of total ingestion
Fraction Invertebrates in Diet	1	According to Davis et al. (2014) diet consists of a wide array of arthropods with a small amount of plant matter. For risk assessment purposes, 100% invertebrate ingestion is assumed
Area Use Factor	1	

Table C-4. Bioaccumulation Factors for Metals in Soil

	Soil to Plant BAF	Soil to Invertebrate BAF	Soil to Flesh BAF
Arsenic[1]	$B_i = 0.03752 * Soil_j$	$\ln(B_i) = 0.706 * \ln(Soil_j) - 1.421$	$\ln(B_i) = 0.8188 * \ln(Soil_j) - 4.8471$
Barium[1]	$B_i = 0.156 * Soil_j$	$B_i = 0.091 * Soil_j$	$B_i = C_{diet} * 0.0075$
Boron[2]	$B_i = 4.0 * Soil_j$	$B_i = 1 * Soil_j$ (Default)	$B_i = 0.000817 * Soil_j$
Cadmium[1]	$\ln(B_i) = 0.546 * \ln(Soil_j) - 0.475$	$\ln(B_i) = 0.795 * \ln(Soil_j) + 2.114$	$\ln(B_i) = 0.4723 * \ln(Soil_j) - 1.2571$
Chromium[1]	$B_i = 0.041 * Soil_j$	$B_i = 0.306 * Soil_j$	$\ln(B_i) = 0.7338 * \ln(Soil_j) - 1.4599$
Lead[1]	$\ln(B_i) = 0.561 * \ln(Soil_j) - 1.328$	$\ln(B_i) = 0.807 * \ln(Soil_j) - 0.218$	$\ln(B_i) = 0.4422 * \ln(Soilj) + 0.0761$
Manganese[1]	$B_i = 0.079 * Soil_j$	$\ln(B_i) = 0.682 * \ln(Soil_j) - 0.809$	$B_i = 0.0205 * Soil_j$
Mercury[2]	$B_i = 0.663 * Soil_j$	$B_i = 3.933 * Soil_j$	$B_i = 0.49 * Soil_j$
Selenium[1]	$\ln(B_i) = 1.104 * \ln(Soilj) - 0.677$	$\ln(B_i) = 0.733 * \ln(Soil_j) - 0.075$	$\ln(B_i) = 0.3764 * \ln(Soil_j) - 0.4158$

[1] Bioaccumulation factors from USEPA EcoSSL guidance documents (USEPA, 2003b)
[2] Bioaccumulation factors from LANL EcoRisk Database v3.3 (LANL, 2014)

Table C-5. Bioaccumulation / Bioconcentation Factors for Metals in Sediment / Surface Water

	Bioaccumulation / Bioconcentration Factor		
	Sediment – Plant [1]	**Sediment – Invert [1]**	**Surface Water – Fish [2]**
Arsenic	$B_i = 0.0375 *$ Sediment	$B_i = 0.236 *$ Sediment	$B_i = 44 *$ Surface Water
Barium	$B_i = 0.156 *$ Sediment	$B_i = 0.091 *$ Sediment	$B_i = 129 *$ Surface Water [3]
Beryllium	$B_i = 0.01 *$ Sediment	$B_i = 0.045 *$ Sediment	$B_i = 19 *$ Surface Water
Boron	$B_i = 4.0 *$ Sediment	$B_i = 1 *$ Sediment (Default)	$B_i = 0.3 *$ Surface Water [4]
Cadmium	$B_i = 0.833 *$ Sediment	$B_i = 14.26 *$ Sediment	$B_i = 64 *$ Surface Water
Chromium	$B_i = 0.041 *$ Sediment	$B_i = 0.1607 *$ Sediment	$B_i = 16 *$ Surface Water
Copper	$B_i = 0.288 *$ Sediment	$B_i = 0.6364 *$ Sediment	$B_i = 36 *$ Surface Water
Lead	$B_i = 0.58 *$ Sediment	$B_i = 0.225 *$ Sediment	$B_i = 49 *$ Surface Water
Manganese	$B_i = 0.15 *$ Sediment	$B_i = 0.0605 *$ Sediment	$B_i = 600 *$ Surface Water [5]
Mercury	$B_i = 0.663 *$ Sediment	$B_i = 3.933 *$ Sediment	$B_i = 5500 *$ Surface Water
Nickel	$B_i = 0.372 *$ Sediment	$B_i = 0.778 *$ Sediment	$B_i = 47 *$ Surface Water
Selenium	$B_i = 0.7 *$ Sediment	$B_i = 0.99 *$ Sediment	$B_i = 4.8 *$ Surface Water
Thallium	$B_i = 0.004 *$ Sediment	$B_i = 0.0541 *$ Sediment	$B_i = 119 *$ Surface Water
Vanadium	$B_i = 0.0055 *$ Sediment	$B_i = 0.042 *$ Sediment	$B_i = 1 *$ Surface Water (default)
Zinc	$B_i = 0.88 *$ Sediment	$B_i = 3.78 *$ Sediment	$B_i = 47 *$ Surface Water

[1] Sediment – Plant and Sediment – Invert bioaccumulation factors obtained from LANL EcoRisk Database (LANL, 2014).
[2] Bioconcentration factor based on ratio of dissolved concentration in water to wet weight concentration in fish tissue. Fish tissue wet weight concentration is converted to dry weight in the food chain models by dividing wet weight concentration by 0.25 (assuming moisture content of 75%). Unless otherwise noted, wet weight values obtained from DEQ-7.
[3] BCF for Barium from ATSDR, 2007
[4] BCF for Boron from CCME, 2009b.
[5] BCF for Manganese from Karlsson et al., 2002

Table C-6. Exposure Units for SOEP/STEP Area Ecological Risk Assessment

Receptor	Ecological Exposure Unit	Exposure Medium	EPC
SLERA			
Aquatic Plants	East Fork Armells Creek	Surface Water	Maximum
Aquatic Plants and Animals	East Fork Armells Creek	Sediment	Maximum
Terrestrial Plants and Animals	Soil Areas N1AD, STEP Dam, and CW-932D (individually)	Soil	Maximum
Livestock	Groundwater Well 901D	Groundwater	Maximum
SLERA Refinement and BERA			
Aquatic Plants and Animals	East Fork Armells Creek	Surface Water	95 UCL (all locations)
		Sediment	95 UCL (all locations)
Terrestrial Plants	Soil Areas N1AD, STEP Dam, and CW-932D (individually)	Soil	95 UCL (N1AD; STEP Dam); Maximum (CW-932D)
Terrestrial Invertebrates	Soil Areas N1AD, STEP Dam, and CW-932D (individually)	Soil	95 UCL (N1AD; STEP Dam); Maximum (CW-932D)
Terrestrial Mammals	East Fork Armells Creek	Surface Water	95 UCL (all locations)
		Sediment	95 UCL (all locations)
		Food Chain	Bioaccumulation based on Sediment/Water 95 UCLs
	Soil Areas N1AD, STEP Dam, and CW-932D (individually)	Soil	95 UCL (N1AD; STEP Dam); Maximum (CW-932D)
		Food Chain	Bioaccumulation based on Soil 95 UCL
Terrestrial Birds	East Fork Armells Creek	Surface Water	95 UCL (all locations)
		Sediment	95 UCL (all locations)
		Food Chain	Bioaccumulation based on Sediment/Water 95%UCLs
	Soil Areas N1AD, STEP Dam, and CW-932D (individually)	Soil	95 UCL (N1AD; STEP Dam); Maximum (CW-932D)
		Food Chain	Bioaccumulation based on Soil 95 UCL
Piscivorous Birds	East Fork Armells Creek	Surface Water	95 UCL (each location)
		Sediment	95 UCL (each location)
		Food Chain	Bioconcentration based on Surface Water 95 UCL
Livestock	Groundwater Well 901D	Groundwater Well 901D	95UCL (across sampling periods)

C-3 ECOLOGICAL TOXICITY ASSESSMENT

The Toxicity Assessment for the COPCs identified for East Fork Armells Creek and the three SOEP/STEP soil areas follows the USEPA recommended approach (USEPA, 1997b, 1998). Surface water screening values were chosen to represent chronic criteria for protection of aquatic life as published in DEQ-7, and sediment screening values were selected from freshwater sediment screening criteria recommended by USEPA Region 3 BTAG. Surface water and sediment screening levels used in the SLERA are shown in Table C-7. Soil screening criteria represent EcoSSLs developed by the USEPA. Alternative sources of screening values, such as the EcoRisk Database developed by Los Alamos National Laboratory (LANL), were used when the primary sources listed above lack screening values for a given COPC. Soil screening levels for plants, invertebrates and wildlife are shown in Table C-8. Where screening levels exist for multiple trophic levels or receptors, the screening level selected for preliminary COPC determination is the lowest value among those provided. Screening levels used in the SLERA and screening refinement represent NOAEL toxicity values, while the BERA considers both NOAEL and lowest-observed adverse effect level (LOAEL) toxicity values. TRVs for evaluation of dose to upper-trophic level birds and mammals likewise represent NOAEL values for screening and NOAEL and LOAEL values for screening refinement and the BERA. TRVs were selected from available sources, including those derived by USEPA as part of the Ecological Soil Screening Level Guidance (EPA, 2003b), and Los Alamos National Laboratory (LANL, 2014). NOAEL TRVs for use in food chain modeling are presented in Table C-9, and LOAEL TRVs are presented in Table C-10.

Table C-7. Ecological Screening Criteria For Protection Of Aquatic Life

	Surface Water Screening Level (µg/L)	Source [1]	Sediment Screening Level (mg/kg)	Source [1]
Trace Metals				
Arsenic	150	DEQ-7	9.8	Region 3
Barium	4	Region 3	150	LANL ER Db
Beryllium	0.66	Region 3	NA	NA
Boron	1.6	Region 3	NA	NA
Cadmium	2.39 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	0.99	Region 3
Chromium (III)	268 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	43.4	Region 3
Copper	30.5 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	31.6	Region 3
Lead	18.6 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	35.8	Region 3
Manganese	120	Region 3	460	Region 3
Mercury	0.91	DEQ-7	0.18	Region 3
Nickel	168 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	22.7	Region 3
Selenium	5	DEQ-7	2	Region 3
Thallium	0.8	Region 3	NA	NA
Vanadium	20	Region 3	NA	NA
Zinc	387 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	DEQ-7	121	Region 3
Common Ions				
Calcium	116,000	Region 3	NA	NA
Chloride	230,000	Region 3	NA	NA
Fluoride	7450 (adjusted for maximum hardness of 400 mg/kg $CaCO_3$)	Region 3	NA	NA
Magnesium	82,000	Region 3	NA	NA
Potassium	53,000	Region 3	NA	NA
Sodium	680,000	Region 3	NA	NA
Sulfate	3,000,000	USDA-ARS	NA	NA

1 DEQ-7 = Montana Numeric Water Quality Standards, Chronic Aquatic Life Standards (DEQ, 2017)
Region 3 = USEPA Region 3 Ecological Screening Benchmarks for Freshwater and Freshwater Sediment, published 2006. Obtained from https://www.epa.gov/risk/biological-technical-assistance-group-btag-screening-values on 4/30/2016
USDA-ARS = USDA-ARS, 2009. Livestock Water Quality. USDA-ARS Fort Keogh Livestock and Range Research Laboratory. Online at http://www.ars.usda.gov/SP2UserFiles/Place/30300000/Research/WATERQUALITYMKP6-09.pdf
LANL ER Db = TRVs obtained from Los Alamos National Laboratory EcoRisk Database v3.3 (LANL, 2014)
NA = Not available

Table C-8. Ecological Soil Screening Levels for Plants, Invertebrates and Wildlife

	Plant Soil Screening Level (mg/kg)	Source [1]	Invert. Soil Screening Level (mg/kg)	Source [1]	Wildlife Soil Screening Level [2] (mg/kg)	Source [1]
Arsenic	18	EPA EcoSSL	6.8	LANL ER Db	43	EPA EcoSSL
Barium	110	LANL ER Db	330	EPA EcoSSL	2000	EPA EcoSSL
Boron	36	LANL ER Db	NA	NA	2	LANL ER Db
Cadmium	32	EPA EcoSSL	140	EPA EcoSSL	0.36	EPA EcoSSL
Chromium (III)	NA	NA	NA	NA	26	EPA EcoSSL
Lead	120	EPA EcoSSL	1700	EPA EcoSSL	11	EPA EcoSSL
Manganese	220	EPA EcoSSL	450	EPA EcoSSL	4000	EPA EcoSSL
Mercury	34	LANL ER Db	0.05	LANL ER Db	0.013	LANL ER Db
Selenium	0.52	EPA EcoSSL	4.1	EPA EcoSSL	0.63	EPA EcoSSL

[1] EPA EcoSSL = TRVs obtained from EPA Ecological Soil Screening Levels documents (USEPA, 2003c, 2005a though 2005e, 2007a, 2007b)
LANL ER Db = TRVs obtained from Los Alamos National Laboratory EcoRisk Database (LANL, 2014)
[2] Wildlife Soil Screening Level represents the minimum soil screening value for birds and mammals

Table C-9. NOAEL Toxicity Reference Values For Wildlife Food Chain Models

	Mammalian NOAEL TRV (mg/kg/d)	Source [1]	Avian NOAEL TRV (mg/kg/d)	Source [1]
Arsenic	1.04	EPA EcoSSL	2.24	EPA EcoSSL
Barium	51.8	EPA EcoSSL	73.5	LANL ER Db
Beryllium	0.532	LANL ER Db	NA	LANL ER Db
Boron	28	LANL ER Db	2.92	LANL ER Db
Cadmium	0.77	EPA EcoSSL	1.47	EPA EcoSSL
Chromium (III)	2.4	EPA EcoSSL	2.66	EPA EcoSSL
Copper	5.6	EPA EcoSSL	4.05	EPA EcoSSL
Lead	4.7	EPA EcoSSL	1.63	EPA EcoSSL
Manganese	51.5	EPA EcoSSL	179	EPA EcoSSL
Mercury	1.41	LANL ER Db	0.019	LANL ER Db
Nickel	1.7	EPA EcoSSL	6.71	EPA EcoSSL
Selenium	0.143	EPA EcoSSL	0.29	EPA EcoSSL
Thallium	0.0071	LANL ER Db	0.35	LANL ER Db
Vanadium	4.16	EPA EcoSSL	0.344	EPA EcoSSL
Zinc	75.4	EPA EcoSSL	66.1	EPA EcoSSL

[1] EPA EcoSSL = TRVs obtained from EPA Ecological Soil Screening Levels documents (EPA, 2003b, 2005, 2007), LANL ER Db = TRVs obtained from Los Alamos National Laboratory EcoRisk Database (LANL, 2014)

Table C-10. LOAEL Toxicity Reference Values for Wildlife Food Chain Modeling

	Mammalian LOAEL TRV (mg/kg/d)	Source [1]	Avian LOAEL TRV (mg/kg/d)	Source [1]
Arsenic	1.66	LANL ER Db	22.4	LANL ER Db
Barium	518	LANL ER Db	131	LANL ER Db
Beryllium	5.32	LANL ER Db	NA	NA
Boron	280	LANL ER Db	14.5	LANL ER Db
Cadmium	7.7	LANL ER Db	14.7	LANL ER Db
Chromium (III)	24	LANL ER Db	26.6	LANL ER Db
Copper	9.34	LANL ER Db	12.1	LANL ER Db
Lead	8.9	LANL ER Db	3.26	LANL ER Db
Manganese	515	LANL ER Db	1790	LANL ER Db
Mercury	14.1	LANL ER Db	0.19	LANL ER Db
Nickel	3.4	LANL ER Db	67.1	LANL ER Db
Selenium	0.215	LANL ER Db	0.579	LANL ER Db
Thallium	0.071	LANL ER Db	3.5	LANL ER Db
Vanadium	8.31	LANL ER Db	0.688	LANL ER Db
Zinc	754	LANL ER Db	661	LANL ER Db

[1] LANL ER Db = TRVs obtained from Los Alamos National Laboratory EcoRisk Database (LANL, 2014)

C-4 ECOLOGICAL RISK CHARACTERIZATION

For complete pathways, risk characterization was performed by combining the exposure and toxicity assessments to produce quantitative estimates of potential ecological risks associated with the COPCs.

Ecological risk assessments generally characterize risk based on direct toxicity of COPCs. Unlike the human health risk characterization, ecological risk characterization does not calculate carcinogenic risk directly. Ecological risk is concerned primarily with risk to populations, and the life-span of most ecological receptors is not long enough for cancer endpoints to pose population level effects.

The potential for direct toxicity of COPCs to ecological receptors will be evaluated through calculation of hazard quotients. For screening of sediment and surface water data for the protection of aquatic life, and screening of soil data for protection of plants, soil invertebrates, and wildlife, hazard quotients will be calculated as follows:

$$\boldsymbol{Hazard\ Quotient = \frac{EPC}{Media\ Specific\ Screening\ Level}}$$

where:

EPC = media-specific exposure concentration

In the BERA potential risk to birds and mammals using the East Fork Armells Creek area will be assessed through calculation of hazard quotients based upon the average daily food chain dose to the organisms identified in Tables 10-2 and 10-3:

$$\boldsymbol{Hazard\ Quotient} = \frac{\boldsymbol{ADD}}{\boldsymbol{TRV}}$$

where:

ADD = average daily dose (mg/kg-d)
TRV = toxicity reference value (mg/kg-d)

The average daily dose is calculated as follows:

$$\boldsymbol{ADD} = \frac{\sum(\boldsymbol{C_i} * \boldsymbol{IR_i}) * \boldsymbol{AUF}}{\boldsymbol{BW}}$$

where:

ADD = average daily dose (mg/kg-d)
C_i = concentration of chemical in media "i" (mg/kg)
IR_i = organism-specific ingestion rate of media "I" (mg/kg-d)
AUF = Area Use Factor (unitless)
BW = organism body weight (kg)

C-4.1 SCREENING-LEVEL ECOLOGICAL RISK CHARACTERIZATION

C-4.1.1 Preliminary Screening of COPCs

Preliminary COPCs for the East Armells Creek exposure area and the three soil exposure areas were determined by comparing maximum detected concentrations in sediment, surface water, and soil to the ecological screening levels presented in Section C-3. Background or reference concentrations of metals were also factored into the determination of preliminary COPCs. A site-specific background data set for soil has not been developed, therefore Background Threshold Values (BTV) for Montana surface soils were used for comparison (DEQ/Hydrometrics, 2013). No background data set was available for Creek sediment or surface water, so a qualitative comparison of downstream sediment and surface water concentrations was made to concentrations at the primary background upstream locations AR-5 and AR-12 as well as Background Screening Levels (BSLs) for surface water calculated by Neptune and Company (2016).

<u>Sediment</u>
In East Fork Armells Creek sediment, one metal, manganese, had maximum detected concentrations exceeding its sediment screening level. Sediment screening levels were not available for beryllium, boron, thallium, and vanadium, and maximum concentrations of beryllium, and thallium in the Units 1&2 SOEP/STEP Area of East Fork Armells Creek exceeded their concentrations at background upstream locations AR-5 and AR-12. Because sediment screening levels were not available for these metals, decisions on their status as preliminary

COPCs in the Creek were based on the results of the surface water screening. Mercury was not detected in any of the 30 East Fork Armells Creek samples, nor was it detected at upstream locations AR-5 and AR-12. Results of the initial sediment screening are shown in Table C-11. Based on the initial screening, manganese is the only constituent in sediment retained as a preliminary sediment COPC and is evaluated further in the screening refinement.

Surface Water

Preliminary ecological screening results for thirteen metals in East Fork Armells Creek surface water are presented in Table C-12. Two metals, manganese and boron, had maximum observed concentrations greater than their respective ecological screening levels. Maximum observed concentrations of boron also exceeded the surface water background value for boron. Maximum observed concentrations of manganese were less than manganese background threshold value (BTV) (see Appendix D). Manganese and boron were retained for further evaluation in the screening refinement for surface water due to their exceedances of ecological screening levels. Beryllium, mercury, thallium, and vanadium were not detected in any of the twenty-eight surface water samples, and were eliminated as potential COPCs in surface water and sediment. Two cations, calcium and magnesium, also exceeded ecological screening levels, but were less than concentrations observed in East Fork Armells Creek upstream of the plant site. In the interest of screening-level conservatism, calcium and magnesium were also retained for further evaluation in the screening refinement for surface water based on exceedances of their respective ecological screening levels.

Soil

Ecological screening of metals concentrations in soil was divided into shallow depth (0 - 6 inches), and mid-depth (12 – 24 inches) surface soils. All ecological receptors included in this evaluation (plants, invertebrates, birds, mammals) were considered to have potential exposure to soils in the shallow depth (0 – 6”) and mid-depth (12 – 24”) horizons. The ecological screening results for soil areas North 1 AD, STEP Dam, and CW 932D are presented in Table C-13, C-14, and C-15, respectively.

In soil area North 1 AD, maximum concentrations of barium, boron, and radium-226 exceeded ecological soil screening levels and Montana Background Threshold Values (BTV) (Hydrometrics, 2013) in the 0-6” shallow soil horizon (Table C-13). Concentrations of boron and radium-226 exceeded ecological soil screening levels and Montana BTVs in the 12-24” depth horizon. Maximum barium concentrations in the 12-24” depth exceeded the ecological soil screening level but were less than the BTV. Therefore barium, boron, and radium-226 were retained as preliminary COPCs in shallow (0-6”) soil in area North 1 AD, and boron and radium-226 were retained as preliminary COPCs in mid-depth (12-24”) soil.

In the STEP Main Dam soil area, maximum concentrations of barium and boron in the 0-6” shallow soil horizon and boron in the 12-124” depth horizon exceeded ecological soil screening levels and Montana BTVs (Table C-14). Maximum barium concentrations in the 12-24” depth exceeded the ecological soil screening level but were less than the BTV. Therefore barium and boron were retained as preliminary COPCs in shallow (0-6”) soil in area STEP Dam area, and boron was retained as a preliminary COPC in mid-depth (12-24”) soil.

In the Capture Well 932D soil area, only boron exceeded both ecological soil screening levels and BTVs, with exceedances in both the 0-6” and 12-24” depth horizons (Table CV-15).

Maximum barium concentrations in both depth horizons exceeded ecological screening levels, but were less than BTVs. Boron was retained as a preliminary COPC in CW 932D soil.

Well 901D Groundwater

Screening results for Well 901D groundwater are presented in Table C-16. Groundwater sampling in Well 901D focused mainly on water quality parameters, with boron and selenium the only two contaminants measured in 2014 and 2015. Concentrations of boron and selenium are below their respective screening levels for water use by livestock. Concentrations of total dissolved solids exceed the TDS screening level, though the Colorado State University Cooperative Extension Service describes TDS concentrations between 1000 and 3000 mg/L as "Very satisfactory for all classes of livestock and poultry. May cause temporary and mild diarrhea in livestock not accustomed to them." Water hardness in Well 901D is approximately 10 times the hardness screening value, suggesting that the groundwater may pose some adverse effects to livestock. Health effects of hard water are due primarily to the salts dissolved in it, primarily calcium and magnesium (Sengupta, 2013). Excess magnesium salts have been shown to have a laxative effect in animals.

Livestock Ingestion of East Fork Armells Creek Surface Water

A focused screening of analytes in surface water was performed for livestock who may utilize the creek as a source of drinking water. The screening was conducted using maximum measured chemical concentrations in surface water and livestock-specific water quality guidelines published by Colorado State University (Soltenpour and Raley, 1999) and the Canadian Council of Ministers of the Environment (CCME, 2009a). Results of this focused screening are shown in Table C-17. Concentrations of all chemicals in East Fork Armells Creek surface water are less than livestock water quality guidelines, with the exception of total sulfates, which exceeded the CCME guideline of 1,000,000 µg/L, The maximum sulfate concentration observed in East Fork Armells creek was 2,670,000 µg/L. USDA-ARS considers sulfate levels between 1,500,000 and 3,000,000 µg/L as "marginal" for ingestion by livestock (USDA-ARS, 2009).

Table C-11. Ecological Screening of East Fork Armells Creek Sediment – SOEP/STEP Area

Analyte	Detects / Samples	Maximum (mg/kg)	Upstream Concentration (AR-5 and AR-12)	Ecological Screening Level (mg/kg)	Hazard Quotient	COPC?	Reason
Arsenic	27/28	3.5	12.6	9.8	0.36	No	HQ < 1
Beryllium	28/28	0.46	0.27	NA	NA	(1)	No ESL, Exceeds Upstream Conc.
Boron	28/28	15.5	19.4	NA	NA	(1)	No ESL, Max < Upstream Conc.
Cadmium	17/28	0.22	0.14	0.99	0.22	No	HQ < 1
Copper	28/28	12.5	7.4	31.6	0.4	No	HQ < 1
Lead	28/28	8.04	4.71	35.8	0.22	No	HQ < 1
Manganese	28/28	5,580	5,910	460	12.1	Yes	HQ > 1,
Mercury	0/28	ND	ND	0.18	NA	No	Not Detected
Nickel	28/28	11.2	6.5	22.7	0.5	No	HQ < 1
Selenium	21/28	0.7	1.1	2	0.35	No	HQ < 1
Thallium	27/28	0.22	0.07	NA	NA	(1)	No ESL, Exceeds Upstream Conc.
Vanadium	28/28	15.2	16.8	NA	NA	(1)	No ESL, Max < Upstream Conc.
Zinc	28/28	42	127	121	0.35	No	HQ < 1

(1) No ecological screening levels are available for these constituents in sediment. Determination of COPC status for these constituents is based on results of surface water screening in Table C-12.

Table C-12. Ecological Screening of East Fork Armells Creek Surface Water – SOEP/STEP Area

Analyte	Detects / Samples	Maximum (µg/L)	Background Conc. (µg/L)[1]	Ecological Screening Level (µg/L)	HQ	COPC?	Reason
Arsenic	19/28	2	17	150	0.01	No	HQ < 1
Beryllium	0/28	ND	ND	0.66	ND	No	Not Detected
Boron	28/28	1,450	880	1.6	906	Yes	HQ > 1, Max > BSL
Cadmium	4/28	0.05	0.6	2.39(2)	0.02	No	HQ < 1
Copper	2/28	3	32	30.5(2)	0.1	No	HQ < 1
Lead	3/28	0.9	23.3	18.6(2)	0.05	No	HQ < 1
Manganese	28/28	2,850	5,080(3)	120	24	Yes	HQ > 1
Mercury	0/28	ND	ND	0.91	ND	No	Not Detected
Nickel	27/28	4	64	168(2)	0.02	No	HQ < 1
Selenium	6/28	1.5	4	5	0.3	No	HQ < 1
Thallium	0/28	ND	ND	0.8	ND	No	Not Detected
Vanadium	0/28	ND	100	20	ND	No	Not Detected
Zinc	2/28	30	290	387(2)	0.08	No	HQ < 1
Calcium	28/28	342,000	397,000	116,000	2.9	No	HQ > 1, Max < upgradient
Chloride	28/28	95,000	239,000	230,000	0.4	No	HQ < 1
Fluoride	28/28	400	300	7450(2)	0.05	No	HQ < 1
Magnesium	28/28	443,000	501,000	82,000	5.4	No	HQ > 1, Max < upgradient
Potassium	28/28	18,000	51,000	53,000	0.3	No	HQ < 1
Sodium	28/28	348,000	214,000	680,000	0.5	No	HQ < 1
Sulfate	28/28	2,670,000	2,260,000	3,000,000(4)	0.9	No	HQ < 1

(1) Unless noted, the Background Concentration represents the lower of the surface water BSL (Neptune and Company, 2016) and the maximum measured upgradient concentration at locations AR-5 and AR-12.
(2) Ecological Screening Level adjusted for the maximum allowable hardness of 400 mg/kg $CaCO_3$, per DEQ-7. Upstream concentration represents the maximum detected concentration at upstream sampling location AR-12 in 2014-2015 surface water samples.
(3) Background concentration for manganese represents background threshold value developed using regional manganese data set. See Appendix D.
(4) No ecological screening level is available for sulfate for protection of aquatic life. Site and upstream surface water concentrations fall within the range of sulfate concentrations considered “marginal” for livestock watering (USDA-ARS, 2009 and CCME, 2009a).
ND = Not detected
NA = Not applicable

Table C-13. Ecological Screening of Soil Area North 1 AD

Analyte	Detects / Samples	Maximum (mg/kg)	Ecological Soil Screening Level (mg/kg)	Background Threshold Value[1] (mg/kg)	HQ	COPC?	Reason
Shallow Soil (0 – 6")							
Arsenic	0/23	ND	6.8	22.5	NA	No	Not Detected
Barium	23/23	1,300	110	429	11.8	Yes	HQ > 1, Max > BTV
Boron	23/23	26	2	NA	13	Yes	HQ > 1, No Background value
Cadmium	0/23	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	23/23	20	26	41.7	0.8	No	HQ < 1, Max < BTV
Lead	0/23	ND	11	29.8	NA	No	Not Detected
Manganese	23/23	490	220	880	2.2	No	Max Less than BTV
Mercury	0/23	ND	0.013	NA	NA	No	Not Detected
Selenium	0/23	ND	0.52	0.7	NA	No	Not Detected
Radium-226	23/23	6.1 pCi/g	1.5 pCi/g	NA	4.1	Yes	HQ > 1, No Background value
Mid-Depth Soil (12 – 24")							
Arsenic	0/23	ND	6.8	22.5	NA	No	Not Detected
Barium	23/23	259	110	429	2.4	No	Max Less than BTV
Boron	23/23	31	2	NA	15.5	Yes	HQ > 1, No Background value
Cadmium	0/23	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	23/23	18	26	41.7	0.7	No	HQ < 1, Max < BTV
Lead	0/23	ND	11	29.8	NA	No	Not Detected
Manganese	23/23	466	220	880	2.2	No	Max Less than BTV
Mercury	0/23	ND	0.013	NA	NA	No	Not Detected
Selenium	0/23	ND	0.52	0.7	NA	No	Not Detected
Radium-226	23/23	3.5 pCi/g	1.5 pCi/g	NA	2.3	Yes	HQ > 1, No Background value

[1] Background values represent Background Threshold Values for Montana Surface Soils from DEQ/Hydrometrics, 2013

Table C-14. Ecological Screening of STEP Dam Soil Area

Analyte	Detects / Samples	Maximum (mg/kg)	Ecological Soil Screening Level (mg/kg)	Background Threshold Value[1] (mg/kg)	HQ	COPC?	Reason
Shallow Soil (0 – 6")							
Arsenic	0/5	ND	6.8	22.5	NA	No	Not Detected
Barium	5/5	731	110	429	6.6	Yes	HQ > 1, Max > BTV
Boron	5/5	33	2	NA	16.5	Yes	HQ > 1, No Background value
Cadmium	0/5	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	5/5	13	26	41.7	0.5	No	HQ < 1, Max < BTV
Lead	0/5	ND	11	29.8	NA	No	Not Detected
Manganese	5/5	330	220	880	1.5	No	Max Less than BTV
Mercury	0/5	ND	0.013	NA	NA	No	Not Detected
Selenium	0/5	ND	0.52	0.7	NA	No	Not Detected
Radium-226	5/5	0.7 pCi/g	1.5 pCi/g	NA	0.5	No	HQ < 1, No BTV
Mid-Depth Soil (12 – 24")							
Arsenic	0/5	ND	6.8	22.5	NA	No	Not Detected
Barium	5/5	250	110	429	2.3	No	Max Less than BTV
Boron	5/5	6	2	NA	3	Yes	HQ > 1, No Background value
Cadmium	0/5	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	5/5	15	26	41.7	0.6	No	HQ < 1, Max < BTV
Lead	0/5	ND	11	29.8	NA	No	Not Detected
Manganese	5/5	575	220	880	2.6	No	Max Less than BTV
Mercury	0/5	ND	0.013	NA	NA	No	Not Detected
Selenium	0/5	ND	0.52	0.7	NA	No	Not Detected
Radium-226	5/5	1.2	1.5 pCi/g	NA	0.8	No	HQ < 1, No BTV

[1] Background values represent Background Threshold Values for Montana Surface Soils from DEQ/Hydrometrics, 2013.

Table C-15. Ecological Screening of Well 932D Soil Area

Analyte	Detects / Samples	Maximum (mg/kg)	Ecological Soil Screening Level (mg/kg)	Background Threshold Value[1] (mg/kg)	HQ	COPC?	Reason
Shallow Soil (0 – 6")							
Arsenic	0/2	ND	6.8	22.5	NA	No	Not Detected
Barium	2/2	140	110	429	1.3	No	Max Less than BTV
Boron	2/2	3	2	NA	1.5	Yes	HQ > 1, No Background value
Cadmium	0/2	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	2/2	16	26	41.7	0.6	No	HQ < 1, Max < BTV
Lead	0/2	ND	11	29.8	NA	No	Not Detected
Manganese	2/2	326	220	880	1.5	No	Max Less than BTV
Mercury	0/2	ND	0.013	NA	NA	No	Not Detected
Selenium	0/2	ND	0.52	0.7	NA	No	Not Detected
Radium-226	2/2	0.8	1.5 pCi/g	NA	0.5	No	HQ < 1, No BTV
Mid-Depth Soil (12 – 24")							
Arsenic	0/2	ND	6.8	22.5	NA	No	Not Detected
Barium	2/2	124	110	429	1.1	No	Max Less than BTV
Boron	2/2	7	2	NA	3.5	Yes	HQ > 1, No Background value
Cadmium	0/2	ND	0.36	0.7	NA	No	Not Detected
Chromium (III)	2/2	15	26	41.7			HQ < 1, Max < BTV
Lead	0/2	ND	11	29.8	NA	No	Not Detected
Manganese	2/2	283	220	880			Max Less than BTV
Mercury	0/2	ND	0.013	NA	NA	No	Not Detected
Selenium	0/2	ND	0.52	0.7	NA	No	Not Detected
Radium-226	2/2	0.7	1.5 pCi/g	NA	0.5	No	HQ < 1, No BTV

[1] Background values represent Background Threshold Values for Montana Surface Soils from DEQ/Hydrometrics, 2013

Table C-16. Screening of Well 901D Water for Livestock Use.

	Livestock Screening Level (µg/L)	Screening Level Source	Max Value Well 901D (µg/L)
Boron	5000	Soltanpour and Raley, 1993	400
Calcium	1,000,000	CCME. 2009a	337,000
Magnesium	250,000	Livestock criteria from NAS, 1972	300,000
Selenium	50	Saltanpour and Raley, 1993	< 5
Other Parameters			
Hardness	180 mg/L	Livestock criteria from NAS, 1972	2080 mg/L
TDS	1200 mg/L	Livestock criteria from NAS, 1972	2890 mg/L

Table C-17. Screening of East Fork Armells Creek Surface Water for Use as a Drinking Water Source by Livestock

	Maximum Measured Concentration (µg/L)	Calculated - All Livestock (µg/L) (See Section C-5)	Soltanpour and Raley (1999) (µg/L)	CCME (2009a) (µg/L)
Arsenic	2	NA	200	500
Beryllium	ND	NA	NA	100
Boron	1,450	39,000	5,000	5,000
Cadmium	0.5	1,500	50	20
Copper	3	NA	500	500
Lead	0.9	NA	100	100
Manganese	2,850	61,000	NA	NA
Mercury	ND	NA	10	3
Nickel	4	NA	NA	1,000
Selenium	1.5	280	50	50
Thallium	ND	NA	NA	NA
Vanadium	ND	NA	100	100
Zinc	0.03	NA	24	50
Calcium	342,000	NA	NA	1,000,000
Chloride	95,000	NA	NA	NA
Fluoride	400	NA	NA	1,000 to 2,000
Magnesium	443,000	NA	NA	NA
Potassium	18,000	NA	NA	NA
Sodium	348,000	NA	NA	NA
Sulfate	2,670,000	NA	NA	1,000,000

ND = Not Detected

NA = Not Available

CCME = Canadian Council of Ministers of the Environment

C-4.1.2 Ecological Screening Refinement Results

The refinement of the initial Units 1&2 SOEP/STEP Area ecological screening results replaces the maximum concentration with the 95% UCL on the mean concentration to represent a more realistic exposure scenario for ecological receptors. The use of the 95% UCL as the estimated EPC is a more realistic exposure scenario for receptors that move across the area, because COPC concentrations are variable spatially across the site, and in the case of surface water, temporally variable as well. Calculation of the 95% UCLs for each media is detailed in Appendix D.

The second step of the refinement process is applied to the soil data only. In the second step, maximum and 95% UCL concentrations of COPCs are compared to an expanded list of screening levels specific for each of the eight receptor groups used in the derivation of EPA EcoSSLs (plants, soil invertebrates, herbivorous mammals, insectivorous mammals, carnivorous mammals, herbivorous birds, insectivorous birds, carnivorous birds). This allows for a more focused evaluation of potential risk to specific receptor groups in the BERA.

Comparison of 95 UCL Exposure Point Concentrations to Ecological Screening Levels

Sediment

Manganese had maximum concentrations in East Fork Armells Creek sediment exceeding its ecological screening benchmark, and was carried forward to screening refinement. The creek-wide 95% UCL concentration of manganese in sediment also exceeded the ecological screening level. Concentrations of manganese exceeded the ecological screening level at four of the seven SOEP/STEP sediment sampling locations. Concentrations of manganese in sediment at upstream locations AR-5 and AR-12 also exceeded the manganese ecological screening level, and manganese concentrations at upstream AR-5 (5,910 mg/kg) exceeded the maximum site concentration of 5,580 mg/kg (Location AR-1). In the interest of conservatism in the risk assessment, manganese was retained as a COPC in sediment for further evaluation in the BERA. Results of the 95 UCL comparisons to sediment screening levels are presented in Table C-18.

Surface water

Boron had maximum concentrations in surface water exceeding its ecological screening benchmark. As shown in Table C-19, the creek-wide 95% UCL concentration of boron also exceeded surface water screening levels. Boron was retained as a COPC for further evaluation in the BERA because 95% UCL concentrations indicate that potential risk exists to aquatic receptors. Though the maximum concentration of manganese in SOEP/STEP surface water also exceeded its ecological screening level, concentrations of manganese in East Fork Armells Creek adjacent to the SOEP/STEP were less than the surface water BTV for manganese of 5,080 µg/L. Because manganese was retained as COPC in sediment and concentrations are elevated in surface water relative to ecological screening levels, in the interest of conservatism manganese was also retained as a COPC in surface water to further evaluate potential risk to aquatic life and wildlife receptors utilizing East Fork East Armells Creek.

Soil

Boron was carried forward as a preliminary COPC in the 0-6” and 12-24” soil depths in all three soil areas. Barium was carried forward as a preliminary COPC in the 0-6” depth interval in North 1 AD and Step Dam Areas, while Radium-226 was retained as a preliminary COPC in the 0-6” and 12-24” depth intervals in North 1 AD only.

The comparison of 95 UCL concentrations of preliminary COPCs in soil to ecological soil screening levels is presented in Table C-20. In North 1 AD, 95 UCL concentrations of barium, boron, and radium-226 exceeded soil screening levels in 0-6” shallow soil and were retained for evaluation in the expanded soil screening. Barium and boron also had 95 UCL concentrations exceeded soil screening levels in the 12-24” soil horizon at North 1 AD and were retained for further evaluation in the expanded screening for that depth interval. 95 UCL concentrations of radium-226 were less than ecological screening levels in the 12-24” soil horizon, and radium-226 is not retained for further evaluation in the 12-24” depth at North 1 AD. Refinement of the preliminary COPCs in the CW 932D soil area using 95 UCLs was not possible due to sample size limitations in the CW 932D soil area. Therefore, boron was retained as a COPC in CW 932D soil for further evaluation in the BERA.

Table C-18. Comparison of 95 UCLs to Sediment Screening Levels

Analyte	Detects / Samples	95 UCL (mg/kg)	Ecological Screening Level (mg/kg)	Hazard Quotient	COPC?
Manganese	28/28	1,476	460	3.2	Yes, HQ > 1

Shaded values indicate HQ values > 1

Table C-19. Comparison of 95 UCLs to Surface Water Screening Levels

Analyte	Detects / Samples	95 UCL (ug/L)	Ecological Screening Level (ug/L)	HQ	COPC?
Boron	28/28	1,340	1.6	840	Yes, HQ > 1
Manganese	28/28	655	120	5.5	Yes, HQ > 1

Shaded values indicate HQ values > 1

Table C-20. Comparison of 95% UCLs to Soil Screening Levels

Analyte	Detects / Samples	95% UCL (mg/kg)	Ecological Screening Level (mg/kg)	HQ	COPC?
North 1 AD - Shallow Soil (0-6")					
Barium	23/23	372	110	3.4	Yes
Boron	23/23	11	2	5.2	Yes
Radium-226	23/23	1.76 pCi/g	1.5 pCi/g	1.2	Yes
North 1 AD - Mid-depth Soil (12-24")					
Boron	23/23	15	2	7.5	Yes
Radium-226	23/23	1.28 pCi/g	1.5 pCi/g	0.9	No
STEP Dam - Shallow Soil (0-6")					
Barium	5/5	635	110	5.7	Yes
Boron	5/5	29	2	14.5	Yes
Step Dam - Mid-depth Soil (12-24")					
Boron	5/5	5	2	2.5	Yes

95 UCLs could not be calculated for CW 932D due to sample size limitations

Expanded Screening of Soil COPCs

In deriving ecological soil screening levels for metals, both USEPA (2003c) and LANL (2014) modeled doses to multiple trophic levels and feeding guilds, and then selected the most sensitive trophic receptor as the basis for the soil screening level. The receptor group/trophic levels evaluated include plants, invertebrates, herbivorous mammals, herbivorous birds, insectivorous mammals, insectivorous birds, carnivorous mammals, and carnivorous birds. To assist in focusing the BERA to those receptors most at potential risk, the ecological screening levels for all eight receptor categories were compared to the 95% UCL for the mean concentrations in soil.

The expanded screening for barium, boron, and radium-226 in North 1 AD soil are presented in Tables C-20 through C-22, respectively. As shown in Table C-20, concentrations of barium in the 0-6" soil horizon pose potential risk to plants and soil invertebrates, but not to wildlife receptors. All measured barium concentrations exceed the ecological screening level for protection of plants (110 mg/kg), but it should also be noted that the Montana BTV for barium (429 mg/k) is nearly four times the soil screening level for plants, and also exceeds the screening level for soil invertebrates (330 mg/kg). The expanded screening for boron (Table C-21) indicates that potential risk from boron concentrations in 0-6" soil and 12-24" soil is to avian receptors, particularly herbivorous and insectivorous birds. Direct exposure of these species to mid-depth soil is not expected to occur only if concentrations in the 12-24" depth interval are transported to the surface.

Table C-20. Expanded Screening of Barium in Soil - North 1 AD

Screening-level Receptor	Ecological Soil Screening Level (mg/kg)	Maximum Concentration in Surface Soil (mg/kg)	Number of Detects in Surface Soil Exceeding Eco-SSL	95 UCL Concentration in Surface Soil (mg/kg)	Does 95%UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	110	1300	23	372	Yes
Soil Invertebrates	330	1300	2	372	Yes
Herbivorous Birds	NA	1300	NA	372	NA
Insectivorous Birds	NA	1300	NA	372	NA
Carnivorous Birds	NA	1300	NA	372	NA
Herbivorous Mammals	3200	1300	0	372	No
Insectivorous Mammal	2000	1300	0	372	No
Carnivorous Mammals	9100	1300	0	372	No

NA = Not Available

Table C-21. Expanded Screening of Boron in Soil – North 1 AD

Screening-level Receptor	Ecological Soil Screening Level (mg/kg)	Maximum Concentration in Surface Soil (mg/kg)	Number of Detects in Surface Soil Exceeding Eco-SSL	95 UCL Concentration in Surface Soil (mg/kg)	Does 95%UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	36	26	0	11	No
Soil Invertebrates	NA	26	NA	11	NA
Herbivorous Birds	2	26	23	11	Yes
Insectivorous Birds	7.5	26	10	11	Yes
Carnivorous Birds	43	26	0	11	No
Herbivorous Mammals	68	26	0	11	No
Insectivorous Mammal	120	26	0	11	No
Carnivorous Mammals	21,000	26	0	11	No
Mid-Depth Soil (12 – 24")					
Plants	36	31	0	15	No
Soil Invertebrates	NA	31	NA	15	NA
Herbivorous Birds	2	31	21	15	Yes
Insectivorous Birds	7.5	31	12	15	Yes
Carnivorous Birds	43	31	0	15	No
Herbivorous Mammals	68	31	0	15	No
Insectivorous Mammal	120	31	0	15	No
Carnivorous Mammals	21,000	31	0	15	No

NA = Not available

Table C-22. Expanded Screening of Radium-226 in Soil - North 1 AD

Screening-level Receptor	Ecological Soil Screening Level (pCi/g)	Maximum Concentration in Surface Soil (pCi/g)	Number of Detects in Surface Soil Exceeding Eco-SSL	95% UCL Concentration in Surface Soil (pCi/g)	Does 95% UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	54	6.1	0	1.76	No
Soil Invertebrates	1.5	6.1	3	1.76	Yes
Herbivorous Birds	37	6.1	0	1.76	No
Insectivorous Birds	8.3	6.1	0	1.76	No
Carnivorous Birds	79	6.1	0	1.76	No
Herbivorous Mammals	310	6.1	0	1.76	No
Insectivorous Mammal	340	6.1	0	1.76	No
Carnivorous Mammals	370	6.1	0	1.76	No

The expanded screening for radium-226 in soil at North 1 AD is presented in Table C-22. As shown in that table, potential risk from radium exists only to soil invertebrates in the 0-6" soil horizon.

Based on the results of the expanded screening for North 1 AD soil, barium is retained for further evaluation in the BERA of potential risk to plants and soil invertebrates; boron was retained for further evaluation of risk to herbivorous and insectivorous birds; and radium-226 was retained for further evaluation of potential risk to soil invertebrates.

The expanded soil screening for barium and boron in the STEP Dam soil area is presented in Table C-23 and C-24, respectively. As in North 1 AD, concentrations of barium in the Step Soil area in the 0-6" soil horizon pose potential risk to plants and soil invertebrates, but not to wildlife receptors. Four of the five measured barium concentrations exceed the ecological screening level for protection of plants (110 mg/kg), while two locations exceed the screening level for soil invertebrates (330 mg/kg). As noted for North 1 AD, the Montana BTV for barium also exceeds the ecological screening levels for protection of plants and soil invertebrates. The expanded screening for boron (Table C-24) indicates that potential risk from boron concentrations in 0-6" soil and 12-24" soil is to avian receptors, particularly herbivorous and insectivorous birds. Direct exposure of these species to mid-depth soil is expected to occur only if concentrations in the 12-24" depth interval are transported to the surface. Based on the results of the expanded screening for STEP Dam soil, barium was retained for further evaluation in the BERA of potential risk to plants and soil invertebrates; and boron was retained for further evaluation of risk to herbivorous and insectivorous birds.

Table C-23. Expanded Screening of Barium in Soil – STEP Dam

Screening-level Receptor	Ecological Soil Screening Level (mg/kg)	Maximum Concentration in Surface Soil (mg/kg)	Number of Detects in Surface Soil Exceeding Eco-SSL	95 UCL Concentration in Surface Soil (mg/kg)	Does 95%UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	110	731	4	635	Yes
Soil Invertebrates	330	731	2	635	Yes
Herbivorous Birds	NA	731	NA	635	NA
Insectivorous Birds	NA	731	NA	635	NA
Carnivorous Birds	NA	731	NA	635	NA
Herbivorous Mammals	3200	731	0	635	No
Insectivorous Mammal	2000	731	0	635	No
Carnivorous Mammals	9100	731	0	635	No

NA = Not available

The expanded soil screening for boron in the CW 932D soil area is presented in Table C-25. As in the other two soil areas, potential risk from boron concentrations in 0-6" soil in 932D soil is to herbivorous and insectivorous birds. Based on the results of the expanded screening for 932D soil, boron was retained for further evaluation of risk to herbivorous and insectivorous birds.

C-4.1.3 Ecological Screening and Refinement Conclusions

Based upon the results of the ecological screening and refinement, boron and manganese were retained for further evaluation in the BERA due to potential risk from exposure to these constituents in East Fork Armells Creek sediment (manganese) and surface water (boron and manganese). Barium, boron, and radium-226 were retained for further evaluation in soil in the North 1 AD soil area. Barium and boron were also retained for further evaluation in soil in the STEP Dam soil area. Boron was the sole COPC retained for further evaluation in the CW 932D soil area. The list of COPCs and the associated endpoints retained for evaluation in the BERA are summarized in Table C-26.

Table C-24. Expanded Screening of Boron in Soil – STEP Dam

Screening-level Receptor	Ecological Soil Screening Level (mg/kg)	Maximum Concentration in Surface Soil (mg/kg)	Number of Detects in Surface Soil Exceeding Eco-SSL	95 UCL Concentration in Surface Soil (mg/kg)	Does 95%UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	36	33	0	29	No
Soil Invertebrates	NA	33	NA	29	NA
Herbivorous Birds	2	33	5	29	Yes
Insectivorous Birds	7.5	33	3	29	Yes
Carnivorous Birds	43	33	0	29	No
Herbivorous Mammals	68	33	0	29	No
Insectivorous Mammal	120	33	0	29	No
Carnivorous Mammals	21,000	33	0	29	No
Mid-Depth Soil (12 – 24")					
Plants	36	6	0	5	No
Soil Invertebrates	NA	6	NA	5	NA
Herbivorous Birds	2	6	3	5	Yes
Insectivorous Birds	7.5	6	0	5	No
Carnivorous Birds	43	6	0	5	No
Herbivorous Mammals	68	6	0	5	No
Insectivorous Mammal	120	6	0	5	No
Carnivorous Mammals	21,000	6	0	5	No

NA = Not available

Table C-25. Expanded Screening of Boron in Soil – CW-932D (0 – 6")

Screening-level Receptor	Ecological Soil Screening Level (mg/kg)	Maximum Concentration in Surface Soil (mg/kg)	Number of Detects in Surface Soil Exceeding Eco-SSL	95 UCL Concentration in Surface Soil (mg/kg)	Does 95%UCL Concentration in Surface Soil Exceed Soil Screening Level?
Shallow Soil (0 – 6")					
Plants	36	3	0	Not Calculated	NA
Soil Invertebrates	NA	3	NA	Not Calculated	NA
Herbivorous Birds	2	3	2	Not Calculated	NA
Insectivorous Birds	7.5	3	0	Not Calculated	NA
Carnivorous Birds	43	3	0	Not Calculated	NA
Herbivorous Mammals	68	3	0	Not Calculated	NA
Insectivorous Mammal	120	3	0	Not Calculated	NA
Carnivorous Mammals	21,000	3	0	Not Calculated	NA
Mid-Depth Soil (12 – 24")					
Plants	36	7	0	5	NA
Soil Invertebrates	NA	7	NA	Not Calculated	NA
Herbivorous Birds	2	7	2	Not Calculated	NA
Insectivorous Birds	7.5	7	0	Not Calculated	NA
Carnivorous Birds	43	7	0	Not Calculated	NA
Herbivorous Mammals	68	7	0	Not Calculated	NA
Insectivorous Mammal	120	7	0	Not Calculated	NA
Carnivorous Mammals	21,000	7	0	Not Calculated	NA

NA = Not available

Table C-26. COPCs and Endpoints for Evaluation in the BERA

	Aquatic Life	Omnivorous Mammals	Piscivorous Birds	Herbivorous Birds	Insectivorous Birds	Carnivorous Birds	Herbivorous Mammals	Insectivorous Mammals	Carnivorous Mammals	Plants	Soil Invertebrates
East Fork Armells Creek Sediment											
Manganese	X	X	X		X						
East Fork Armells Creek Surface Water											
Boron	X	X	X		X						
Manganese	X	X	X		X						
Soil – North 1 AD Soil Area											
Barium										X	X
Boron				X	X						
Radium-226											X
Soil – STEP Dam Area											
Barium										X	X
Boron				X	X						
Soil – Well 932D Area											
Boron				X	X						

C-4.2 BASELINE ECOLOGICAL RISK CHARACTERIZATION

C-4.2.1 East Fork Armells Creek Sediment and Surface Water

Aquatic Life

Based on the results of the SLERA and COPC refinement steps, manganese and boron were carried forward to the BERA for further evaluation in East Fork Armells Creek sediment and surface water. As shown in Table C-26 and discussed in Section C-2.2 Assessment Endpoints, Measures of Effect, and Exposure Pathways, the baseline risk characterization for the Creek involves calculation of estimated average daily doses of COPCs to wildlife potentially exposed to Creek sediment and surface water. The BERA risk characterization also includes consideration of LOAEL toxicity levels in addition to NOAEL levels. LOAEL-based aquatic life criteria for manganese and boron were derived by LANL in the EcoRisk Database (LANL, 2014). BERA risk characterization for aquatic organisms in East Fork Armells Creek was based on the LOAEL thresholds for manganese of 2,300 ug/L for surface water, and 1,100 mg/kg for sediment; and LOAEL thresholds for boron of 1,340 ug/L for surface water. The comparison of surface water and sediment COPC concentrations are presented in Table C-27.

The BTV for manganese in surface water was 5,080 µg/L and the 2015 maximum onsite concentration of manganese in surface water was 2,850 µg/L at location AR-9. The 2015 observed upgradient concentrations of manganese in surface water at locations AR-12 and AR-5 were 5,080 µg/L and 11,900 µg/L, respectively. To further evaluate manganese concentrations in surface water, an upgradient surface water Background Threshold Value (BTV) based on the estimation of the 95/90 Upper Tolerance Level (UTL) for manganese in surface water upgradient of the Plant Site was developed following discussions with the DEQ (2018). The 95/90 UTL is defined as the 95% confidence limit on the 90th percentile (see Appendix D). The surface water BTV of 5,080 µg/L for manganese was based on five surface water sampling locations upgradient of the Plant Site, for which total manganese concentrations were available over a temporal span from 1977 to 2015. The five upgradient surface water sampling locations included in the calculation estimation of the surface water manganese BTV included (AR-5, AR-12, SW-03, SW-55, and SW-75). Surface water sampling locations AR-12, SW-55, and SW-03 are located near the upstream Plant Site AOC boundary. AR-5 is located immediately downstream of the Plant Site AOC boundary, but hydrologically upgradient of the Plant Site itself. SW-75 is located approximately 8 miles upstream of the Plant Site AOC boundary (see Figure 13). The surface water manganese BTV was included as a background/reference data point in Table C-12. This provides strong indication that manganese concentrations in East Fork Armells Creek surface water are not Site related. Manganese concentrations in surface water adjacent to the SOEP/STEP were highest in fall 2015 synoptic run sampling, when concentrations at multiple locations including upstream AR-12 exceeded LOAEL thresholds, with concentrations generally decreasing in a downstream direction. Manganese in surface water did not exceed LOAEL thresholds in any synoptic run sampling period except Fall 2015.

Manganese in sediment did not exceed LOAEL thresholds in any synoptic run sampling period at upgradient location AR-12 or Site locations AR-6, AR-7, AR-8, AR-10, and AR-11; but did exceed LOAEL thresholds for aquatic life at upgradient location AR-5 and Site locations AR-9, and AR-1. Lacking site-specific toxicity information, the LOAEL value of 1,100 mg/kg would serve as the risk-based clean-up goal for manganese in sediment. However, due to partitioning of manganese between surface water and sediment, achievement of the risk-based goal for sediment is unlikely as long as upstream surface water concentrations continue to exceed those found at the Site.

The boron surface water 95% UCL concentration of 1,340 µg/L exceeded the LOAEL threshold of 16 (HQ = 84). The maximum upstream concentration of boron in surface water at AR-5 of 2,060 µg/L also significantly exceeded the LOAEL threshold of 16 µg/L. In addition, more recent reviews of aquatic toxicity information for boron suggest that the NOAEL and LOAEL values used in the SLERA and BERA for protection of aquatic life may be overly conservative. Uncertainties associated with the NOAEL and LOAEL surface water criteria for boron are discussed further in the uncertainty evaluation in Section C-4.3. Because of the elevated upstream surface water concentrations of boron, and the more recent aquatic toxicity information discussed in C-4.3, boron was not retained as a surface water COC at the site.

Manganese and boron do not have DEQ-7 surface water values for protection of aquatic life, which would serve as surface water clean-up levels for those constituents. Implementation of risk-based clean-up goals for sediment and surface water at the site would be ineffective as long

Table C-27. LOAEL Toxicity Evaluation of Sediment and Surface Water COPCs

Analyte	Detects / Samples	95% UCL (ug/L)	LOAEL Aquatic Life Value (ug/L) [1]	LOAEL HQ	COC for Aquatic Life?
Surface Water					
Boron	28/28	1,340	16	84	No [2]
Manganese	28/28	655	2,300	0.3	No
Analyte	**Detects / Samples**	**95% UCL (mg/kg)**	**LOAEL Aquatic Life Value (mg/kg) [1]**	**LOAEL HQ**	**COC for Aquatic Life?**
Sediment					
Manganese	28/28	1,476	1,100	1.3	No [2]

[1] LANL, 2014

[2] See discussion in Section C-4.2.1

as upstream non-site related concentrations in excess of those clean-up goals continue to influence East Fork Armells Creek adjacent to and downstream of the Plant Site and SOEP/STEP area.

Aquatic Dependent Wildlife

Risk characterization to wildlife utilizing the creek was based on the average daily doses of boron and manganese to piscivorous birds, insectivorous birds, and omnivorous mammals, as shown in Tables C-28 to C-30, respectively. For piscivorous birds (Table C-28) the dose modeling indicated manganese risk was between the NOAEL and LOAEL for two locations within the Creek (AR-1 and AR-9), but was less than the NOAEL for the creek as a whole. Boron doses to piscivorous birds were less than NOAEL TRVs for the Creek as a whole and at each location within the Creek. Manganese doses to insectivorous birds did not exceed the NOAEL or LOAEL TRVs for either the whole creek, or any of the individual subareas to which insectivorous birds may be exposed (Table C-29). Boron doses to insectivorous birds foraging in the creek exceeded NOAEL TRVs across the creek and at individual locations within the Creek, but were less than LOAEL TRVs (Table C-29). Manganese and boron doses to omnivorous mammals foraging in the creek were less than LOAEL TRVs (Table C-30). Because manganese and boron doses did not exceed LOAEL TRVs for any food chain receptors, no unacceptable risk is posed to aquatic dependent wildlife from manganese or boron in East Fork Armells Creek surface water or sediment.

Groundwater from Well 901D was not evaluated further in the BERA. Screening results indicate that levels of contaminants are below screening levels, but salinity, particularly in the form of excess magnesium salts, may reduce the palatability of the well water to livestock, and cause mild digestive issues.

C-4.2.2 Soil

Plants and Soil Invertebrates

Based on the SLERA refinement, barium was designated as a COPC in North 1 AD and STEP Dam soils based on potential risk to plants and soil invertebrates in soil, and radium-226 was also retained as a COPC in North 1 AD soil based on potential risk to soil invertebrates.

The barium 95% UCL concentrations in surface soil in North 1 AD and STEP Dam areas (372 mg/kg and 635 mg/kg, respectively) exceeded the LOAEL threshold for plants (260 mg/kg). Barium concentrations in surface soil exceeded the LOAEL threshold in 3 of the 23 surface soil sample locations associated with North 1 AD. However, the Montana background threshold value for barium in soil is 429 mg/kg, and only a single soil sample (DP1AD-4) exceeded the Montana BTV for barium. Given that only one of 23 samples exceeded the barium BTV across the North 1 AD soil area, potential risk to plants from barium is low and very localized, and barium is therefore not retained as a risk driver for plants growing in North 1 AD soil. Barium exceeded the Montana BTV in two of five sampling locations at the STEP Main Dam soil area. Since the boundary of the STEP Main Dam soil area encompasses less than half an acre in total, the area represented by the two exceedances of the barium BTV is likewise small, and any potential impacts to plants are expected to be localized. The area is currently being monitored to visually assess any adverse impacts to vegetation.

Radium-226 95% UCL concentrations in the North 1 AD soil area were less than the ecological LOAEL threshold of 15 pCi/g for protection of plants. Radium-226 was therefore not retained as a COC in soil at North 1AD soil area.

Terrestrial Wildlife

Boron was retained as a COPC after screening and refinement based on potential risk to terrestrial wildlife receptors as summarized in Table C-26. Potential risk to wildlife was limited to herbivorous and insectivorous birds. To further evaluate that risk in the BERA, food-chain models were constructed using lark sparrow and Sprague’s pipit as surrogates for herbivorous and insectivorous birds exposed to boron in site soils. Baseline risk characterization for terrestrial wildlife potentially exposed to boron in soil was based on the calculated average daily doses presented in Tables C-32 and C-3 for herbivorous birds and insectivorous birds, respectively.

Boron doses to herbivorous birds and insectivorous birds were less than NOAEL and LOAEL TRVs (Table C-29 and C-30). Because boron doses did not exceed LOAEL TRVs, no unacceptable risk from boron in surface soil is present in North 1 AD or Step Main Dam soil areas.

C-4.3 EVALUATION OF UNCERTAINTIES

Uncertainties in the risk characterization originate from a cumulative effect of the uncertainties in the Exposure Assessment, the Toxicity Assessment, and the Characterization of Risk, including lack of toxicity information for certain chemicals, uncertainties in exposure parameters, and uncertainties associated with deriving exposure point concentrations for specific chemicals and organisms given the spatial and temporal variability observed in the data.

Available Ecological Toxicity Information. Availability of ecological toxicity information represents a source of uncertainty for a number of chemicals in Site sediment, soil, and surface water. No ecological screening levels were available to evaluate potential risk to aquatic receptors from beryllium, boron, thallium, or vanadium in sediment. Screening levels for each of these constituents were available for surface water, so the risk assessment assumes that surface water levels that are protective of aquatic organisms are also protective of benthic organisms. This may underestimate risk to benthic receptors that get their primary exposure from sediment, not surface water. Uncertainty exists for a number of the constituents for which screening-levels are available due to methodologies used in deriving screening-levels and the scarcity of toxicity information for some chemicals. As an example, the SLERA uses a surface water screening level of 1.6 µg/L and a LOAEL threshold of 16 µg/L for boron. These numbers are based on a Tier II value derived from a limited amount of toxicity information by Suter et. al in 1996. Tier II values were developed so that aquatic benchmarks could be established with less data than are required for the National Ambient Water Quality Criteria, which are the equivalent of DEQ-7 aquatic life criteria. More recent publications from the Canadian Council of Ministers of the Environment calculated protective levels of boron in surface water based on six fish studies, six invertebrate studies, six amphibian studies, and ten plant studies, and derived a Canadian Water Quality Guideline for long-term exposure of 1,500 µg/L (CCME, 2009b). This guideline represents a 5^{th} percentile low-effects species sensitivity distribution, meaning that approximately 95% percent of species have a low-effects threshold for boron greater than 1,500 µg/L. Thus the use of the Tier II derived screening level and LOAEL value for boron is likely overly conservative.

In addition no bioassay testing of site soils and water was conducted. This lack of field information represents uncertainty in interpolating from literature effect levels to actual Site population effects. An aquatic habitat assessment and benthic community survey was conducted in upstream areas of East Fork Armells Creek as part of surface water discharge permitting efforts for the Western Energy Rosebud Mine (Arcadis, 2014). Conditions of East Fork Armells Creek immediately downstream of Rosebud Mine differ from stream conditions through the town of Colstrip in terms of flow rate and ephemerality, but the results of the surveys are suggestive of what is expected throughout East Fork Armells Creek. Surveys were conducted according to MDEQ protocols. Benthic survey results were indicative of a low-gradient stream supportive of a tolerant benthic community dominated by chironomid (midge) larvae and amphipods. The Hilsenhoff Biotic Index scores were representative of “Fairly Poor” to “Poor” benthic community conditions. The habitat assessment characterized the stream as heavily silted, low flow, with prevalent emergent riparian vegetation. Though the section of East Fork Armells Creek through the town of Colstrip tends to contain more permanent water than upstream areas of the Creek, it is also low gradient, with a lack of riffle areas, and contains abundant emergent riparian vegetation. Based on those conditions, a tolerant community would also be expected throughout the stretch of the Creek flowing through Colstrip. A Hilsenhoff Biotic Index score of “Poor”, as assigned to the upstream area of East Fork Armells Creek, is the lowest ranking on the index.

Uncertainties in Exposure Point Calculations. In the screening refinement and BERA, exposure for each ecological receptor group is estimated based on a central tendency estimate of COPC concentrations in the various exposure media. The 95% UCL of the mean concentration is the typical central tendency estimator used as the EPC in ecological risk assessment. Sediment and surface water EPC estimation for East Fork Armells Creek is based on seven locations and four sampling periods. For the smaller location-specific ecological exposure units (i.e., those used for great blue heron and common yellowthroat based on individual sampling locations), the estimated EPC is based on four sampling periods for a single location and only captures variability over time, not space. Therefore, all estimates are based on a small quantity of data informing the mean concentration in time and space, meaning they are highly uncertain in their representativeness of the mean concentration over the defined exposure unit. Calculation of 95% UCLs based on small sample sizes often result in a 95% UCL value greater than the observed maximum value. In the interest of conservatism, the ecological risk assessment used the 95% UCL values even when the UCL was greater than the observed maximum. This conservatism reduces the chance that a COPC will be eliminated from consideration when it should have been retained.

Uncertainties in Exposure Parameters. The SLERA utilized conservative assumptions regarding site use by ecological receptors by assuming that an individual organism gets 100% of its exposure from the site. This is a valid assumption for some of the receptors, such as individual great blue herons and common yellowthroats, which may conduct all of their foraging in a small area. Raccoons, however, range widely and would be expected to only receive a portion of their exposure from the area included within this investigation. The focus of the ERA is protection of populations of ecological receptors, and all of the organisms included in this ERA have populations that extend beyond the sediment, water, and soil boundaries included in this investigation. Ryti et al. (2004) proposed the use of a population area use factor (PAUF) for assessing risk to populations. The PAUF concept assumes that population areas for wildlife are correlated to the median dispersal distance of individuals within the population. In this approach, the population area is defined as a circle where the radius of the circle is the median dispersal distance of the organism. For instance, a masked shrew with a dispersal distance of 150 meters, would have a PAUF of approximately 17.5 acres, or four times the size of the combined soil areas included in the ERA. Therefore, assessing risk to an individual of a population overestimates risk to the population itself.

All COPCs were conservatively assumed to be 100 percent bioavailable for all receptors. Depending on the COPC and receptor, however, bioavailability may be significantly less than 100 percent. This is particularly true for metals in the environment, where bioavailability is often tied to chemical form present, and geochemical parameters such as soil pH, organic carbon, and oxidation-reduction potential. Consideration of bioavailability and bioaccumulation potential of chemicals is important with regard to understanding the risk implications and the potential ecotoxicological effects of total concentrations of chemicals detected in soils. This conservative estimate of 100 percent bioavailability may overestimate risk.

Site-specific tissue residue data were not collected; thus, concentrations in food items for food chain receptors were estimated based on literature bioaccumulation factors and other parameters. This approach is generally associated with more uncertainty than an approach based on collection of site-specific prey/food tissue concentrations. Estimates of food concentration based on literature values do not include accurate predictors of assimilation and depuration of COPCs in the same way as time-averaged tissue concentrations. The estimates of prey concentrations at East Fork Armells Creek and associated soil areas may be either overestimated or underestimated because conditions at the site are likely different from those in the literature.

C-4.4 ECOLOGICAL CLEAN-UP GOALS

Based on the results of the ecological risk characterization, no risk-based clean up levels were derived for chemicals in East Fork Armells Creek surface water and sediment. Concentrations of both boron and manganese in upstream surface water are higher than maximum Site concentrations. Maximum surface water concentrations of boron at the Site were lower than risk-based levels established through a more recent review of boron aquatic toxicity by CCME (2009b). Manganese in Site sediment is higher than the LOAEL level of 1,100 mg/kg, but is lower than upstream concentrations at AR-5 and AR-12. The LOAEL value of 1,100 mg/kg would serve as the basis for a risk-based sediment clean-up goal for manganese, but the ability to achieve this goal throughout the creek is questionable as long as surface water entering the site from upstream contains high levels of manganese.

Table 10-28. Food Chain Model Dose Calculations for Great Blue Heron as Surrogate for Piscivorous Birds

	Analyte	95% UCL Sediment Conc. (mg/kg dw)	95% UCL Water Conc (mg/L), unfiltered	Modeled Fish Conc (mg/kg dry wt)	Fish Ingestion Rate (kg/d)	Sediment Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Body Weight (kg)	AUF	Average Daily Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	NOAEL HQ	LOAEL HQ
Whole Creek	Manganese	1523	0.66	1980	0.105	0.0021	0.105	2.336	1	90.40	179	1790	0.505	0.051
AR-10	Manganese	517	0.4	1200	0.105	0.0021	0.105	2.336	1	54.42	179	1790	0.304	0.030
AR-11	Manganese	251	0.24	720	0.105	0.0021	0.105	2.336	1	32.60	179	1790	0.182	0.018
AR-1	Manganese	5771	2.15	6450	0.105	0.0021	0.105	2.336	1	295.20	179	1790	1.649	0.165
AR-6	Manganese	290	0.14	420	0.105	0.0021	0.105	2.336	1	19.15	179	1790	0.107	0.011
AR-7	Manganese	403	0.1	300	0.105	0.0021	0.105	2.336	1	13.85	179	1790	0.077	0.008
AR-8	Manganese	927	0.21	630	0.105	0.0021	0.105	2.336	1	29.16	179	1790	0.163	0.016
AR-9	Manganese	1671	2.4	7200	0.105	0.0021	0.105	2.336	1	325.24	179	1790	1.817	0.182
Whole Creek	Boron	12.9	1.34	2.01	0.105	0.0021	0.105	2.336	1	0.16	2.92	14.5	0.056	0.011
AR-10	Boron	14.4	1.51	2.265	0.105	0.0021	0.105	2.336	1	0.18	2.92	14.5	0.063	0.013
AR-11	Boron	13.2	1.55	2.325	0.105	0.0021	0.105	2.336	1	0.19	2.92	14.5	0.064	0.013
AR-1	Boron	15.2	1.4	2.1	0.105	0.0021	0.105	2.336	1	0.17	2.92	14.5	0.059	0.012
AR-6	Boron	15.8	1.35	2.025	0.105	0.0021	0.105	2.336	1	0.17	2.92	14.5	0.057	0.011
AR-7	Boron	13.9	1.37	2.055	0.105	0.0021	0.105	2.336	1	0.17	2.92	14.5	0.057	0.011
AR-8	Boron	11.6	1.34	2.01	0.105	0.0021	0.105	2.336	1	0.16	2.92	14.5	0.055	0.011
AR-9	Boron	14.6	1.36	2.04	0.105	0.0021	0.105	2.336	1	0.17	2.92	14.5	0.057	0.011

Table C-29. Food Chain Model Dose Calculations for Common Yellowthroat as Surrogate for Insectivorous Birds

	Analyte	95% UCL Sediment Conc. (mg/kg dw)	95% UCL Water Conc. (mg/L), total	Modeled Invert. Conc (mg/kg dw)	Invert. Ingestion Rate (kg/d)	Sediment Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Body Weight (kg)	AUF	Average Daily Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	NOAEL HQ	LOAEL HQ
Whole Creek	Manganese	1523	0.66	92.1	0.0033	0.000066	0.0028	0.01	1	40.64	179	1790	0.23	0.02
AR-10	Manganese	517	0.4	31.3	0.0033	0.000066	0.0028	0.01	1	13.85	179	1790	0.08	0.01
AR-11	Manganese	251	0.24	15.2	0.0033	0.000066	0.0028	0.01	1	6.74	179	1790	0.04	0.00
AR-1	Manganese	5771	2.15	349.1	0.0033	0.000066	0.0028	0.01	1	153.91	179	1790	0.86	0.09
AR-6	Manganese	290	0.14	17.5	0.0033	0.000066	0.0028	0.01	1	7.74	179	1790	0.04	0.00
AR-7	Manganese	403	0.1	24.4	0.0033	0.000066	0.0028	0.01	1	10.73	179	1790	0.06	0.01
AR-8	Manganese	927	0.21	56.1	0.0033	0.000066	0.0028	0.01	1	24.68	179	1790	0.14	0.01
AR-9	Manganese	1671	2.4	101.1	0.0033	0.000066	0.0028	0.01	1	45.06	179	1790	0.25	0.03
Whole Creek	Boron	12.9	1.34	12.9	0.0033	0.000066	0.0028	0.01	1	4.72	2.92	14.5	1.62	0.33
AR-10	Boron	14.4	1.51	14.4	0.0033	0.000066	0.0028	0.01	1	5.27	2.92	14.5	1.80	0.36
AR-11	Boron	13.2	1.55	13.2	0.0033	0.000066	0.0028	0.01	1	4.88	2.92	14.5	1.67	0.34
AR-1	Boron	15.2	1.4	15.2	0.0033	0.000066	0.0028	0.01	1	5.51	2.92	14.5	1.89	0.38
AR-6	Boron	15.8	1.35	15.8	0.0033	0.000066	0.0028	0.01	1	5.70	2.92	14.5	1.95	0.39
AR-7	Boron	13.9	1.37	13.9	0.0033	0.000066	0.0028	0.01	1	5.06	2.92	14.5	1.73	0.35
AR-8	Boron	11.6	1.34	11.6	0.0033	0.000066	0.0028	0.01	1	4.28	2.92	14.5	1.47	0.30
AR-9	Boron	14.6	1.36	14.6	0.0033	0.000066	0.0028	0.01	1	5.30	2.92	14.5	1.81	0.37

Table 10-30. Food Chain Model Dose Calculations for Raccoon as Surrogate for Riparian Omnivorous Mammals

	Analyte	95%UCL Sediment Conc. (mg/kg dw)	95% UCL Water Conc (mg/L), total	Modeled Plant Conc (mg/kg dry wt)	Modeled Invert. Conc (mg/kg dry wt)	Modeled Fish Conc (mg/kg dry wt)	Plant Ingestion Rate (kg/d)	Invert. Ingestion Rate (kg/d)	Fish Ingestion Rate (kg/d)	Sediment Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Body Weight (kg)	AUF
Whole Creek	Manganese	1523	0.66	228.45	92.14	1980	0.12	0.15	0.03	0.03	0.5	6	1
Whole Creek	Boron	12.9	1.34	51.6	12.9	0.402	0.12	0.15	0.03	0.03	0.5	6	1

Table 30 (continued)

		Average Daily Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	NOAEL HQ	LOAEL HQ
Whole Creek	Manganese	24.44	51.5	515	0.47	0.05
Whole Creek	Boron	1.54	28	280	0.06	0.01

Table C-31. Comparison of 95% UCLs to Plant and Soil Invertebrate LOAEL Thresholds

Analyte	Detects / Samples	95% UCL (mg/kg)	Plant LOAEL Level (ug/L)	Invertebrate LOAEL Threshold (mg/kg)	Plant LOAEL HQ	Invertebrate LOAEL HQ	COPC?
North 1 AD - Shallow Soil (0-6")							
Barium	23/23	372	260	3200	1.43	0.12	Yes
Radium-226	23/23	1.76	NA	15	NA	0.12	No
STEP Dam - Shallow Soil (0-6")							
Barium	5/5	635	260	3200	2.44	0.20	Yes

Table C-32. Food Chain Model Dose Calculations for Lark Sparrow as a Surrogate for Terrestrial Herbivorous Birds

Soil Area	Analyte	95% UCL Soil Conc. (mg/kg-dw)	95% UCL Water Conc. Total (mg/L)	Modeled Plant Conc. (mg/kg)	Modeled Insect Conc. (mg/kg)	Soil Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Food Ingestion Rate (kg/d)	Body Weight (kg)	AUF
North 1AD	Boron	11	1.34	44	11	0.000084	0.0005	0.00084	0.0289	1
Well 932D	Boron	3	1.34	12	3	0.000084	0.0005	0.00084	0.052	1
STEP Dam	Boron	29	1.34	116	29	0.000084	0.0005	0.00084	0.052	1

Table C-32 (continued). Food Chain Model Dose Calculations for Lark Sparrow

Soil Area	Analyte	Average Daily Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	NOAEL HQ	LOAEL HQ
North 1AD	Boron	1.09	2.92	14.5	0.37	0.08
Well 932D	Boron	0.18	2.92	14.5	0.06	0.01
STEP Dam	Boron	1.58	2.92	14.5	0.54	0.11

Table C-33. Food Chain Model Dose Calculations for Sprague's Pipit as a Surrogate for Terrestrial Insectivorous Birds

Region	Analytes	95 UCL Soil Conc. (mg/kg-dw)	95 UCL Water Conc. Total (mg/L)	Modeled Insect Conc. (mg/kg-dw)	Soil Ingestion Rate (kg/d)	Water Ingestion Rate (L/d)	Insect Ingestion Rate (kg/d)	Body Weight (kg)	AUF
North 1AD	Boron	11	1.34	11	0.00012	0.005	0.00588	0.2375	1
Well 932D	Boron	3	1.34	3	0.00012	0.005	0.00588	0.2375	1
STEP Dam	Boron	29	1.34	29	0.00012	0.005	0.00588	0.2375	1

Table C-33 (continued). Food Chain Model Dose Calculations for Sprague's Pipit

Region	Analytes	Average Daily Dose (mg/kg-d)	NOAEL TRV (mg/kg-d)	LOAEL TRV (mg/kg-d)	NOAEL HQ	LOAEL HQ
North 1AD	Boron	0.306	2.92	14.5	0.10	0.02
Well 932D	Boron	0.104	2.92	14.5	0.04	0.01
STEP Dam	Boron	0.761	2.92	14.5	0.26	0.05

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Appendix D

Statistical Analysis

Appendix D:
Statistical Analysis for the Colstrip Power Plant, Units 1 & 2 SOEP and STEP AOC Area Risk Analysis

Prepared for Hydrometrics, Inc.

18 October 2018

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Contents

D-1 Introduction

D-1.1 Executive Summary

Appendix D describes the exploratory data analysis and estimation of Exposure Point Concentrations (EPCs) for the Units 1 & 2 SOEP and STEP AOC Area, Colstrip Stream Electric Station, Colstrip, MT to support the human health risk assessment (HHRA) and ecological risk assessment (ERA). Statistical analysis and results are described for surface water and sediment (Section D-2), as well as for soil (Section D-2). Preliminary chemicals of potential concern (COPCs) identified after first stage screening for the human health and ecological RA are the focus of the graphical and statistical summaries presented in this report.

For the HHRA, manganese was identified as the only preliminary COPC for sediment, and no preliminary COPCs were identified for surface water. For soil, manganese and radium-226 were identified preliminary COPCs, with radium identified in all four depth intervals defined by exposure scenarios (0-6'', 0-24'', 0-7', and 1-7') and manganese in two (0-24'' and 0-7').

For the ERA, boron and manganese were identified as preliminary COPCs in both surface water and sediment. In soil, barium, boron, and radium-226 were identified as preliminary COPCs within the two depth intervals defined by the ecological exposure scenarios (0-6'' and 12-24''). Recommended EPCs for each preliminary COPC and exposure scenario are presented for each medium within each respective section.

General information applicable to estimation of EPCs using 95% upper confidence limits (UCLs) for the mean for all media (surface water, sediment, and soil) is presented in Sections D-1.2, D-1.3, and D-1.4, with additional medium-specific information provided within the subsequent sections. Graphical displays of the data available to support the risk assessment and inform the estimation of EPCs are included in the Figures section, and summary tables of relevant data are included within each section. In summary, Appendix D documents the work performed to explore and evaluate the available data for analytes identified as preliminary COPCs and to calculate 95% UCLs to be used as estimates of EPCs to inform subsequent stages of the assessments. The quality and quantity of data available for the intended use are discussed throughout the report.

D-1.2 Background for Statistical Analysis

The Cleanup Criteria and Risk Assessment Work Plan (Canty, 2017) specifies that upper confidence limits on the mean (UCLs) will be used to represent exposure point concentrations for chemicals identified through the human health and ecological risk assessment screening process. The following subsections provide general background statistical information related to the use of a 95% UCL as an estimate of the mean concentration in an exposure unit.

D-1.2.1 Use of the UCL of the mean as an exposure point concentration (EPC)

In the context of estimating EPCs, the 95% UCL of the mean is often recommended as an estimate of the mean to provide a protective (conservative) estimate of the mean concentration over a spatial area defined by a specified exposure unit (EU) and a specified time interval for inclusion of data. Using an estimate of the mean as an EPC is justified under two scenarios: (1) the concentration of the preliminary COPC is homogeneous over the EU so that receptors are only exposed to concentrations close to the mean, or (2) the concentration is not homogeneous, but the receptors make a random walk around the EU over time so that their average exposure is the mean concentration over the EU.

The use of a single point estimate (e.g., an average or a UCL) as the recommended EPC does not explicitly incorporate uncertainty in the estimate into the risk assessment. A confidence interval is typically developed to express uncertainty in estimation of the mean due to randomness inherent in the specific data obtained through a random sampling procedure. When a UCL is used as the EPC to calculate risk (using a single number), it does build conservatism into the calculation of exposure, but it does not explicitly allow uncertainty to be taken into account in decision-making. For example, the same UCL could be reported for two problems with very different degrees of uncertainty (one with a high estimated mean and little uncertainty in the estimate and another with a low estimated mean and a great deal of uncertainty in the estimate). A probabilistic risk assessment explicitly incorporates uncertainty in a mean concentration based on available data (USEPA, 2001) using distributions rather than point estimates. However, this risk assessment is specified to be deterministic, meaning a single number is used to represent exposure for each scenario; uncertainty is dealt with informally through discussions of data quantity and quality and careful investigation of available data.

The concept of “confidence” is based on the idea of quantifying statistical outcomes over different possible random sets of data (referred to as “random samples” in statistical literature) that could have been taken from the population under the specified sampling procedure. Different random samples from the same exposure unit will lead to different estimates of the mean of the concentration and different 95% UCLs. By definition, the 95% UCL is expected to be smaller than the true mean concentration of the exposure unit in 5% of datasets from random sampling, and larger than the mean in 95% of other possible datasets that could be collected using different randomly selected locations and/or times. Therefore, the 95% UCL is *expected* to overestimate the mean 95% of the time (i.e. be “protective”); however, for a particular set of data, it cannot be known whether the mean is over- or underestimated even when using a 95% UCL as the estimate.

D-1.2.2 Choice of method for calculating an upper confidence limit (UCL)

There are many methods currently used for calculating UCLs to be used as estimated EPCs in risk assessment, and it is common to simply choose the suggested method as provided by the ProUCL software (Singh & Singh, 2015a; Singh & Singh, 2015b; USEPA, 2015). The focus of ProUCL has been finding methods with a minimum specified “coverage” of the mean, which is translated into a desired underestimation rate of 5% or less for 95% UCLs, under strict assumptions about the underlying distributions of concentrations in the population. ProUCL’s data-specific recommendations for methods are based on outcomes of goodness-of-fit hypothesis tests based on particular distributions; the outcomes of these tests are often misinterpreted as evidence *for* a particular distribution and such results are often given too much weight in the process of choosing a UCL estimator of the mean. The applicability and defensibility of statistical results, particularly for small data sets and non-random samples, are context dependent and therefore the methods should not be applied blindly or automatically to any data set. For example, restricting methods to those in ProUCL does not allow for use of fairly basic methods for dealing with clear violations of the assumption of independence in data sets due to repeat measurements on the same locations and/or on the same days (see discussion of this problem in USEPA 2006). The methods available in ProUCL for calculating UCLs assume all observations are independent and random measurements from the population of interest over the specified time period. Often, results for estimating a mean are more sensitive to violations of independence than they are to departures from an assumed distribution for the underlying population of values. The data for this risk assessment have clear violations of independence. Methods used in this report to obtain 95% UCLs may appear non-traditional from a risk assessment perspective, but are very traditional from the perspective of statistical data analysis focused on estimating the mean.

In June 2016, Neptune conducted a large simulation study, using artificial data generated under different scenarios, to compare many UCL estimators in terms of their coverage of the mean (i.e. how often they under- or overestimate the mean over different random samples), as well as their bias (average distance from the mean) and variability over possible random samples (Flagg et al., in preparation). This differs from the focus of ProUCL, which has been almost solely on coverage to summarize how often estimates are expected to be above or below the mean. A method can achieve a specified coverage rate but have estimates that are extremely far from the actual population mean; which is clearly undesirable for risk assessment (such behavior has been documented for methods such as Land's H, Hall's, and Chebyshev's). Therefore, it is important to also consider how close possible estimates obtained from a method are to the true mean (i.e., consider the size of errors). This can be assessed through quantifying bias (average size of estimation errors) and variability of possible estimates based on different random sampling outcomes (or equivalently, variability of estimation errors).

The Neptune simulation study was performed over a wide range of population distributions with varying degrees of skewness and kurtosis and at sample sizes of 5, 10, 20, and 30. The goal of study was to identify methods with relatively low bias and variability over a wide range of population distributions, that still maintained reasonable underestimation rates, to help simplify the decision flow chart and reduce reliance on inappropriate use of goodness-of-fit hypothesis tests. Two estimators were identified as having reasonable properties when considered simultaneously over all scenarios and all sample sizes: (1) the Student's *t* method based on the assumption that the sampling distribution of the average is well-approximated by a *t* distribution, and (2) the bias-corrected and accelerated (BCa) bootstrap method based on resampling from the observed data, along with bias and skew adjustments, to approximate the sampling distribution of the average. These two methods were expected to perform well based on foundational statistical theory. When the distribution of the sample is relatively symmetric and sample sizes are greater than approximately 10, the two methods produce very similar estimates. When the sample is skewed to the right, the BCa typically results in larger estimates, though avoids extreme overestimation common with other methods available in ProUCL intended to account for potential skew in population distributions (e.g., Chebyshev's). For small sample sizes, bootstrap methods are generally not appropriate because they tend to underestimate variance, and therefore the *t*-UCL is recommended because the sample size available for estimating the variance is accounted for in its calculation through the multiplier obtained as a quantile of the associated t-distribution (smaller samples sizes lead to larger *t*-multipliers). Neptune's simulation study indicates that simple rule of choosing the maximum between the *t* and the BCa estimates typically provides a nice balance of underestimation rate, bias, and variance, across a broad range of population distribution shapes, and is thus a reasonable starting place for obtaining a 95% UCL of the mean for use as an estimated EPC.

However, as with any statistical analysis, each study design and data set should be checked individually to assess the reasonableness of the approach. For example, the implications of violations of independence on UCL estimator performance have not been assessed in simulation studies comparing options for UCL estimators of the mean, though they are well studied in general outside the specific context of UCLs used in risk assessment. The presence of clear violations of assumptions may require more sophisticated methods to produce defensible UCLs, such as random effects models, other methods explicitly incorporating dependence among observations from the same site or same date, or models allowing for spatial and/or temporal correlation. For the analysis in this report, the *t*- and BCa-based UCLs represent a starting point, and other methods meant to account for clear violations of the independence assumption are implemented as needed.

D-1.2.3 Use of sample maximum as the EPC

In risk assessments, the maximum observed value is often considered for use as the estimated EPC when the 95% UCL exceeds the maximum observed value. For relatively large sample sizes, it is rare to obtain a sample maximum that is less than the true mean. Therefore, the logic behind the decision to choose the sample maximum as the EPC in such cases is that the sample maximum is expected to be larger than the mean (so it is still "protective"), but it is closer to the mean than the 95% UCL. However, there is a tendency to assume the sample maximum is always greater than the true population mean, which is not true for small sample sizes, particularly if areas with higher concentrations are not captured in the sampling locations just by chance. Likewise, it is tempting to assume that the sample maximum should be greater than the 95% UCL. However, with very small sample sizes, it is not rare for the sample maximum to be less than the true 95% UCL (theoretically defined as the 95th percentile of the distribution of possible sample averages). Therefore, in practice, a choice must be made between using a 95% UCL or the maximum observed sample value as the EPC, and the decision should be problem dependent, depending on both the conceptual model for the site and the observed data.

Generally, when confronted with a 95% UCL estimate of the mean that is greater than the sample maximum, the high uncertainty surrounding the value used for the EPC should be acknowledged. The USEPA (2004) states in Section 5.2.2 that "when data are insufficient to estimate the 95% UCL, any value used [as an EPC estimate] (such as the maximum value or arithmetic mean) is likely to contribute significantly to the uncertainty in estimates" of risk. USEPA (2002) allows use of the sample maximum as the EPC when the UCL exceeds the max, but only if the sample size is large because the maximum may not be protective if the sample size is small.

For this risk assessment, uncertainty in the EPCs should be considered large given the small number of locations informing each EPC. Further information regarding expectations of the maximum and the 95% UCL, relative to the mean, are provided in individual sections in the context of estimating the EPC for the smaller location-specific ecological EUs with only four observations each.

D-1.2.4 Software used for UCL calculations

Analyses are performed using R statistical software (R Core Team, 2016). This software allows for flexibility in exploratory data analysis and in methods for calculating UCLs. By not restricting methods to only those available in packages such as ProUCL, methods addressing violations of assumptions can be investigated and more defensible EPCs can be produced. Methods for addressing violations of independence assumptions are described in further detail in Sections D-2, D-3, and D-4. For exploratory data analysis, the ggplot2 R package (Wickham, 2009) is used to create all figures in this report. Several other packages are used behind the scenes: the dplyr R package was used to manipulate and subset the data (Wickham et al., 2015), the lubridate package to manipulate dates within the data (Grolemund et al., 2011), the knitr package to make tables (Xie, 2016), the openxlsx package to make tables in Excel from R (Walker, 2015), and the sp package to make plots referenced to spatial locations or distances (Pebesma & Bivand, 2005; Bivand et al., 2013).

D-1.3 **Information available for censored observations**

Laboratory data are often reported with multiple "detection limits" (e.g. method detection limit, quantitation limit, reporting limit, etc.), and censored using one of them (i.e. instrument measurements are only reported if above the chosen limit). For UCLs meant to describe an entire population, it is desirable to retain as much information from the lab data as possible, which corresponds to using the smallest detection limit deemed appropriate for censoring (resulting in fewer observations labeled as "non-detect"). Method detection limits (MDLs), if available, often fill that need. The lowest detection limits are suggested because they provide the most information available to estimate mean concentrations using all data from an exposure unit, rather than make datum-based decisions from individual concentrations**.** For the data used in this report, the laboratory measurements were censored using the contract required quantitation limits (CRQLS), meaning that any laboratory measurements below the CRQL were labeled as "non-detects" and assigned a label "< CRQL". The CRQLs are also referred to as "contract required reporting limits" and simply "reporting limits" (RLs). CRQLs are targets the lab is required to meet and may not be appropriate for use as reporting limits. Lower detection limits are available (MDLs), but the data were censored using the CRQLs and there are no concentrations available for those original instrument readings falling between the MDL and CRQL (used as the RL); therefore, it is impossible to re-censor the data using the lower MDL. Additionally, MT DEQ recommends use of the RL over the MDL. Using larger detection limits in UCL calculations does not necessarily lead to larger UCLs because the detection limits used also affect the estimated standard deviation, which can be smaller with use of larger detection limits. Fortunately, this has very little impact on this risk assessment because of the identified preliminary COPCs for the ecological and human health RA, there are no censored observations. Any discussion in the following sections using the term "detection limits" is referring to CRQLs (referred to as RLs in the dataset). Information about associated MDLs for observations summarized in this report is provided as footnotes with tables when appropriate.

D-1.4 **Data quantity and scope of inference**

The data used to inform this risk assessment were collected as part of the monitoring and investigation of the area around the Colstrip Power Plant. The scope of inference for the risk assessment refers to how broadly the results from statistical analysis should be applied over time and space (i.e. over what spatial area and temporal span can the results be justifiably applied?), and depends on the sampling design or availability of data over time and space. A particular scope of inference can be justified based on the study design and expert considerations regarding the context of the risk problem.

Data to inform this risk assessment are restricted to 2014 and 2015 for sediment and surface water, 2017 for soil, and 2016 and 2017 for radium in groundwater under the assumption that recent data best reflect the current conditions. Assuming the results apply into the future assumes conditions will remain approximately constant. For surface water and sediment, there are typically four sampling dates within 2014 and 2015, with one sampling event in the spring and one in the fall of each year. All soil sampling was performed in August of 2017.

The spatial extent of this risk assessment is defined as Units 1 & 2 SOEP and STEP AOC Area. Surface water and sediment calculations are based on only seven sampling locations along East Fork Armells Creek within the region of interest. Therefore, use of the data to make statements about the entire creek in the Units 1 & 2 SOEP and STEP AOC Area should be done with caution. For soil, sampling areas are spatially restricted to areas that may have been affected by process wastewater (as per the AOC) and do not necessarily support generalization to all soil in the Area.

It is important to not only consider the total number of samples available, but the larger context in which they were collected over space and time. The total number of available concentrations might not seem limited when ignoring the number of unique locations and/or number of unique sampling events, but may be limited when considering the degree of dependence among the observations. The common methods available for UCL calculations (e.g. available in ProUCL) assume independence among samples and have been tested under the assumption of independent samples. Section D-2 discusses this in more detail within the context of surface water and sediment.

D-1.5 **Organization of the report**

This report is organized into two additional sections, one for surface water and sediment (D-2) and one for soil (D-3). Within each section, exposure scenarios, preliminary chemicals of potential concern (preliminary COPCs), and available data are described. Data summary tables are provided for identified preliminary COPCs, EPCs estimated with 95% UCLs for the mean are reported for each EU and preliminary COPC at the end of each section, and graphical summaries are presented in the Figures section.

D-2 Surface Water and Sediment

The relevant surface water and sediment within the Units 1 & 2 SOEP and STEP AOC Area is the segment of East Fork Armells Creek running through the Area (see Figures 2, 8, and 9 in the main CCRA document). Exposure point concentrations (EPCs) are estimated for each identified preliminary COPC for each associated exposure unit defined by an exposure scenario identified for the human health or ecological RA.

D-2.1 Exposure Units and Chemicals of Potential Concern

The human health risk assessment (HHRA) identifies manganese as a preliminary COPC for sediment, with no preliminary COPCs identified for surface water. The ecological risk assessment (ERA) identifies manganese and boron as the only preliminary COPCs for both surface water and sediment.

D-2.1.1 Human Health

For the HHRA, a single EU is defined to cover all surface water and sediment of the section of East Fork Armells Creek within the Units 1 & 2 SOEP and STEP AOC Area (EU5 in Figures 8 of the main CCRA document). All available stream sampling locations (AR-1, AR-9, AR-8, AR-7, AR-6, AR-11, and AR-10) were used to screen for preliminary COPCs. AR-12 is a sampling location upstream of the Units 1 & 2 SOEP and STEP AOC area and is used as the primary background location. First stage screening, using maximum concentrations, identified manganese (Mn) as the only preliminary COPC.

D-2.1.2 Ecological

For the EcoRA, there are two different exposure scenarios for East Fork Armells Creek surface water and sediment: (1) animals using the entire creek area on and adjacent to the Units 1 & 2 SOEP and STEP AOC Area, and (2) plants or animals restricted to smaller areas within the creek on and adjacent to the Units 1 & 2 SOEP and STEP AOC Area. The first exposure scenario uses a single EU defined as all East Fork Armells Creek surface water within and adjacent to the Units 1 & 2 SOEP and STEP AOC Area (same as the HH EU5). The second exposure scenario results in smaller exposure units defined as areas around each of the seven creek sampling locations, with data from one location informing only a single exposure unit. Therefore, EPCs are estimated for the entire area (using data from all locations simultaneously), as well as estimated separately for all seven locations, based on the four observations at each location over the two years. First stage screening, using maximum concentrations, identified manganese (Mn) and boron (B) as the preliminary COPCs.

D-2.2 Available data

D-2.2.1 Sampling Locations

There are seven sampling locations (AR-1, AR-9, AR-7, AR-6, AR-11, AR-10, AR-8) along East Fork Armells Creek used to inform EPCs. AR-12 is upstream of the Units 1 & 2 SOEP and STEP AOC boundary and is used as a primary background point location; it is included in exploratory plots of available concentrations in Appendix D Figures for comparison.

D-2.2.2 Sampling Dates

Data from 2014 and 2015 are used to inform EPCs, with the goal of representing recent conditions at the site given available data. For most locations and preliminary COPCs, there were two samples taken per year, one in the fall and one in the spring on the following dates: April 8, 2014; October 16, 2014; March 19, 2015; and October 15, 2015. AR-10 and AR-1 had field duplicates taken in March 19, 2015 and October 15, 2015, respectively.

D-2.3 **Exploratory Data Analysis**

D-2.3.1 Graphical displays and general observations

Surface water and sediment data available for boron and manganese are plotted over all years with available data by location in Figures D-2.1 (surface water) and D-2.5 (sediment), as well as only the 2014 and 2015 data used for estimation of EPCs in Figures D-2.2 (surface water) and D-2.6 (sediment). Both measurements from the field duplicate pairs at AR-10 and AR-1 are included as separate points, and the primary background location AR-12 is included for comparison. Summaries of the individual sample concentrations in tabular form can be found in Appendix C. Summary tables of the data are provided for the preliminary COPCs within this report in following sections.

D-2.3.2 Field duplicates

Two pairs of field duplicates were collected from AR-10 (on March 19, 2015) and AR-1 (on October 15, 2015) for both surface water (Table D-2.1) and sediment (Table D-2.2). An additional pair of field duplicates was collected for sediment at the upstream primary background location AR-12 on October 16, 2014 (Table D-2.2). Concentrations are very close within the field duplicate pair relative to the variability among concentrations from different locations and/or dates (see Figures). MT DEQ requires that only the maximum concentration within a field duplicate pair be used for estimation of EPCs, and therefore this approach is used for this report.

Table D-2.1 Surface water field duplicate measurements for manganese and boron recorded from location AR-10 and AR-1 on March 19, 2015 and October 15, 2015. The concentration labeled as the field duplicate is the one on the right.

Date sampled	Location	Chemical	FD Pair Concentrations (mg/L)	
3/19/15	AR-10	manganese	**0.071**	0.066
		boron	0.88	**0.91**
10/15/15	AR-1	manganese	**2.46**	2.3
		boron	1.1	**1.23**

Table D-2.2 Sediment field duplicate measurements for manganese and boron from AR-10 and AR-1 on March 19, 2015 and October 15, 2015, along with upstream primary background point location AR-12 on March 19, 2015. The concentration labeled as the field duplicate is the one on the right.

Date sampled	Location	Chemical	FD Pair Concentrations (mg/kg)	
10/15/15	AR-1	manganese	334	**382**
		boron	**9.8**	**9.8**
3/19/15	AR-10	manganese	**536**	430
		boron	8.3	**9.6**
10/16/14	AR-12	manganese	534	**564**
		boron	15.8	**18.8**

D-2.3.3 Summary statistics

Summary statistics for data used to estimate EPCs for surface water and sediment are provided in Table D-2.3 for all ecological and human health preliminary COPCs (manganese and boron). Location-specific data used to support the smaller ecological EUs are displayed in Figures D-2.3 (surface water) and D-2.7 (sediment).

Table D-2.3 Surface water summary statistics (mg/L) for all ecological and human health preliminary COPCs using data from 2014 and 2015 from HH EU5. Summaries are calculated using the maximum of the field duplicate pairs from AR-1 and AR-10 per MDEQ guidance and do not include data from the primary background point AR-12.

	Locations	Total	Detects (mg/L)					Non-detects
	#	samples	#	Min	Median	Average	Max	#
Boron	7	28	28	0.78	1.21	1.159	1.45	0
Manganese	7	28	28	0.012	0.104	0.314	2.85	0

Table D-2.4 Sediment summary statistics (mg/kg) for preliminary COPCs in the ecological and human health risk assessments using 2014 and 2015 data. Summaries are calculated using the maximum of two field duplicates from AR-1 and AR-10 per MDEQ guidance and do not include data from the primary background location AR-12.

	Locations	Total	Detects (mg/kg)					Non-detects
	#	samples	#	Min	Median	Average	Max	#
Boron	7	28	28	3.2	10.9	10.7	15.5	0
Manganese	7	28	28	175	383	882	5580	0

D-2.4 **Assessing assumptions and available data for EPC calculations**

D-2.4.1 Quantity of data

Surface water and sediment EPCs are based on data from seven locations and four sampling occasions. For the smaller location-specific ecological EUs, each estimated EPC is based on the four measurements from a single location. Therefore, all estimates of EPCs are based on a very small quantity of data informing the mean concentration in time and space, and as such are highly uncertain in their representativeness of the mean concentration over the defined EUs. EPCs are estimated using 95% upper confidence limits for the mean to provide estimates that are protective of human and ecological health based on expected sampling variability. However, use of point estimates, even conservative ones, does not explicitly incorporate uncertainty into decision-making and UCLs do not account for all sources of uncertainty.

D-2.4.2 Implications of independence violations on calculating UCLs

The statistical properties of the common UCL estimators of the mean are assessed under the assumption that independent samples from the population are available. Violations of the independence assumption can be identified by describing reasons why some samples are expected to have more similar concentrations to each other than other samples (e.g., samples coming from the same location and/or same sampling period). For surface water and sediment, the assumption is violated due to repeat measurements taken at the same locations and repeat measurements taken on the same dates. That is, samples are naturally clustered into groups by location and sampling date, and observations within a cluster are expected to be more similar than those from different clusters, as seen in general in Figures D-2.2 (surface water) and D-2.6 (sediment), where some locations tend to be greater than average for all dates, and some dates tend to be greater than average for all locations.

The 28 total measurements should not be automatically assumed to constitute 28 independent pieces of information about the mean concentration over the EU during 2014 and 2015 because of the sampling design; measurements from the same location and/or time are expected to be more similar than those from different locations and/or times. The extent of this similarity (i.e. dependence) depends on the data set and the severity can be assessed to make a decision about how important it is to account for one or both sources of dependence (location and/or sampling event). If judged as severe enough, UCL methods should account for the dependence in the data in order to obtain defensible EPCs.

In the context of producing protective estimates of the mean, the potential negative implication of not accounting for sources of dependence in the data is that the standard deviation of the population of interest may be underestimated (smaller variability is expected among dependent measurements than among the same number of independent measurements). Additionally, the degrees of freedom (meant to reflect the number of independent pieces of information being used to estimate the mean) may be inflated because the reported sample size is larger than the number of independent pieces of information contained in the data. These two implications can lead to a UCL that is smaller than would be obtained under independence. In practice, the effects of dependence in the data on the UCL depend on the severity of the violation of independence. Violations of independence is a very common problem in data analysis and there are many statistical strategies and tools available to help account for it; ranging from calculating cluster-specific averages before subsequent analysis to more complicated models with built-in correlation structures, such as random effects models. Such methods are implemented for UCL calculations and are described in more detail here for surface water (Section D-2.4.1) and sediment (Section D-2.4.2).

For the UCLs presented for sediment and surface water for HH EU5, the clustering of observations by locations and sampling occasions is accounted for in the analysis by using a random effects model allowing for correlation among observations from the same location and/or same sampling occasion, where sampling occasion is defined by the combination of year and season. When the violation of dependence is severe, this method will typically result in a larger 95% UCL than methods assuming independence; thus, when this is the case, this *corrected* UCL is typically recommended for use as the estimated EPC as it is thought to more honestly account for the amount of information in the sample. Note that ProUCL treats all observations as independent and does not have the capability to account for dependence in obtaining a UCL as done in this report.

Dependence also arises on a more continuous manner in time and space, rather than just by clearly defined groups. Temporal autocorrelation generally captures that measurements taken closer in time tend to be more similar and spatial autocorrelation captures that measurements taken closer in space tend to be more similar. The general idea is that if samples are taken very close together in time and/or space, they do not contain the same amount of information as two samples taken farther apart in time and space. If the samples are treated as if they are two independent measurements then they are given more weight in the analysis than they should be. For the data described in this report, there are too few measurements over time and space to adequately estimate the degree of dependence due to these sources. Instead, it is assumed that the locations and sampling occasions (different years and seasons) are spaced far enough apart that the spatial and temporal autocorrelation does not need to be dealt with beyond that already accounted for by incorporating the clusters of observations from the same location and/or sampling occasion into the analysis.

D-2.5 **95% UCLs**

This section describes the methods used to obtain 95% UCLs and provides the estimated EPCs for exposure units described in Section D-2.1.1. Subsection are organized by human health or ecological and by the EU.

D-2.5.1 Surface Water: Ecological Single EU

As described in Section D-1.2, the recommended EPC is generally the maximum of the 95% *t*-UCL, the BCa-UCL, and the t-UCL *corrected* for lack of independence. The 95% UCLs from all three methods are shown in Table D-2.5, along with the average and maximum concentrations from available data and the recommended estimated EPC based on the 95% UCL results.

In this case, the most severe dependence was due to sampling occasion. The 95% UCL *corrected* is obtained using the profile-likelihood approach after fitting a linear mixed model with random effects for sampling occasion and location to be consistent with the model also used for surface water. The model was fit using the lmer() function within the lme4 package in R (Bates et al., 2015). This method assumes approximate normality, but is typically more robust to departures from normality than common UCL procedures are to departures from independence. The estimated mean concentration of boron in surface water is 1.16 mg/L with an associated 90% confidence interval from 0.98 to 1.34 mg/L. The estimated mean concentration of manganese in surface water is 0.31 mg/L, with an associated confidence interval from approximately 0 to 0.66 mg/L. The recommended 95% UCL for use as the surface water EPC for boron is 1.34 mg/L and the recommended 95% UCL for manganese is 0.66 mg/L.

Table D-2.5. Surface water 95% UCLs (mg/L) and estimated EPCs for the identified human health and ecological preliminary COPCs (boron and manganese) using 2014 and 2015 data. Data from primary background location AR-12 are not included and the maximums of field duplicate pairs from AR-1 and AR-10 are used in the calculations, as per MDEQ guidance.

	Boron (B)	Manganese (Mn)
Average	1.16	0.31
Maximum	1.45	2.85
95% t-UCL	1.22	0.53
95% BCa-UCL	1.21	0.64
95% UCL corrected	1.34	0.66
Estimated EPC	**1.34**	**0.66**

D-2.5.2 Surface Water: Ecological Location-Specific EUs

There are seven locations used to define smaller exposure units along East Fork Armells Creek in the Units 1 & 2 SOEP and STEP AOC Area. EPCs are estimated separately for the seven EUs using only the data from the location associated with the EU (four concentrations from the four different sampling occasions). All variability in the data is attributed to temporal variability for that location, and does not include variability over space within the small EUs. In this case adjustments for lack of independence are not made, though if more observations were available accounting for dependence among observations within the same season could be explored.

The t-UCL is recommended because it more appropriately adjusts for the small sample size than bootstrap techniques. In locations with little or no right skew apparent in the data, the t-UCL is about equal to, or larger than, the sample maximum. The skew associated with large concentrations from AR-1 and AR-9 comes from a single large observation in October 2015. The bias corrected and accelerated bootstrap (BCa) results are also reported for comparison. However, the bootstrap method should be used with extreme caution when there are less than 10 observations because it relies completely on the data available to capture important characteristics of the sampling distribution of the average, a nearly impossible task with 4 observations. Both UCL methods are of questionable use with four observations, but there is more of a theoretical basis for the use of the t-UCL in this case than the BCa. Therefore, we recommend the t-UCLs for these calculations.

For many locations and chemicals, the reported 95% UCL exceeds the maximum observed concentration over the individual samples used to calculate the UCL (see Section D-1.1.3 for more discussion). This is not unexpected for a sample size of 4 where the sample maximum and 95% t-UCL are expected to be close together for most samples (assuming normality, independence, and random sampling). The underestimation rate for the 95% t-UCL is 0.05 (by definition) and the underestimation rate for the sample maximum is about 0.06. If the minimum of the sample maximum and the 95% t-UCL is chosen, then the underestimation rate increases to about 0.07. The sample maximum is actually expected to be less than the 95% t-UCL in 57% of random datasets, meaning a 95% UCL greater than the sample maximum should not be interpreted as evidence of an unreasonably conservative UCL. Therefore, for a sample size of 4, it is recommended that the t-UCL be used over the sample maximum (even if the maximum is smaller) if 5% underestimation rate is desired. Both are similarly conservative estimates of the mean and any estimate of the mean should be used with caution when the sample size is 4.

Table D-2.6. Surface water estimated EPCs (mg/L) for boron using 95% t-UCLs for the small location-specific ecological EUs. The 95% UCLs should be used with caution given the small number of samples informing them. AR-12 is included in the table for comparison only as the primary background point location.

Boron (B)	AR-12	AR-10	AR-11	AR-1	AR-6	AR-7	AR-8	AR-9
Sample Avg	0.66	1.25	1.25	1.13	1.14	1.15	1.10	1.10
Sample Max	0.89	1.39	1.45	1.30	1.28	1.26	1.25	1.29
Estimated EPC (95% t-UCL)	0.90	**1.51**	**1.55**	**1.40**	**1.35**	**1.37**	**1.34**	**1.36**

Table D-2.7. Surface water estimated EPCs (mg/L) for manganese using 95% t-UCLs for the small location-specific ecological EUs. The 95% UCLs should be used with caution given the small number of samples informing them. AR-12 is included in the table for comparison only as the primary background point location.

Manganese (Mn)	AR-12	AR-10	AR-11	AR-1	AR-6	AR-7	AR-8	AR-9
Sample Avg	1.38	0.22	0.15	0.80	0.09	0.07	0.11	0.76
Sample Max	5.08	0.39	0.23	2.46	0.14	0.10	0.21	2.85
Estimated EPC (95% t-UCL)	4.28	**0.40**	**0.24**	**2.15**	**0.14**	**0.10**	**0.21**	**2.40**

D-2.5.3 Sediment: Ecological Single EU and Human Health EU5

For sediment, concentrations are fairly constant over sampling occasions within a location, with the exception of AR-1 that has much higher concentrations in October 2014 and April 2015 (Figures D-2.7 and D-2.8). That is, observations from one location tend to have similar concentrations across sampling occasions. For consistency across surface water and sediment, as well as boron and manganese, the model includes random effects for both location and sampling occasion to account for dependence in the analysis. The estimates are obtained from a linear mixed effects model explicitly accounting for dependence within locations and dates using the lmer() function in the *lme4* package in R (Bates et al., 2015).

The estimated mean concentration of boron in sediment is 10.7 mg/kg with an associated 90% confidence interval from 8.47 mg/kg to 12.9 mg/kg. The estimated mean concentration of manganese in sediment is 882 mg/kg, with an associated confidence interval from 241 to 1523 mg/kg. The 95% UCL recommended for use as the sediment EPC for boron is 12.9 mg/kg and for manganese is 1523 mg/kg.

Table D-2.8. Sediment estimated EPCs (mg/kg) using 95% UCLs for human health and ecological preliminary COPCs. The estimates are based on data collected during 2014 and 2015 for locations AR-1, AR-9, AR-7, AR-6, AR-11, and AR-10. The maximum of field duplicate pairs is used for AR-10 and AR-1.

	Boron (B)	Manganese (Mn)
Average	10.7	882
Maximum	15.5	5580
95% t-UCL	11.6	1278
95% BCa-UCL	11.5	1440
95% UCL corrected	12.9	1523
Estimated EPC	**12.9**	**1523**

D-2.5.4 Sediment: Ecological Location-Specific EUs

As for surface water, there are seven sediment locations informing the smaller exposure units along the East Fork Armells Creek and UCL calculations are performed separately for each. The t-UCLs are recommended for use in estimating EPCs for the same reasons described for surface water in Section D-2.4.1. For many locations for both boron and manganese, the reported 95% UCL exceeds the maximum observed concentration over the individual samples used to calculate the UCL. This is expected and more discussion can be found in Section D-2.4.2 for surface water, as well as Section D-1.1.3 for more discussion.

Table D-29. Boron sediment estimated EPCs (mg/kg) using 95% UCLs for the small ecological EUs. The estimates are based on four concentrations collected over 2014 and 2015 for each location. The maximums of field duplicate pairs are used.

Boron (B)	AR-12	AR-10	AR-11	AR-1	AR-6	AR-7	AR-8	AR-9
Sample Avg	14.6	12.1	10.2	11.4	10.6	9.2	9.9	11.6
Sample Max	18.8	13.9	12.2	14.6	15.5	12	11.1	14.2
Estimated EPC (95% t-UCL)	20.3	**14.4**	**13.2**	**15.2**	**15.8**	**13.9**	**11.6**	**14.6**

Table D-2.10. Manganese sediment 95% UCLs (mg/kg) for the small ecological EUs based on four concentrations collected over 2014 and 2015 for each location. The 95% UCL should be used as the EPC with caution given the small number of samples informing it.

Manganese (Mn)	AR-12	AR-10	AR-11	AR-1	AR-6	AR-7	AR-8	AR-9
Sample Avg	542	430	218	2908	231	346	750	1292
Sample Max	700	536	243	5580	289	377	881	1710
Estimated EPC (95% t-UCL)	767	**517**	**251**	**5771**	**290**	**403**	**927**	**1671**

D-3 Soil

Soil sampling was performed by Hydrometrics following an Interim Response Action Work Plan (Hydrometrics, 2017d). The soil samples were taken from three areas where former spills are known to have occurred: (1) near the North 1 AD Pipeline Drain Pond, (2) at the STEP Main Dam, and (3) near Capture Well 932D (see Figures 1, 2 and 3 in Hydrometrics, 2017d or Figures 10 and 11 in the main CCRA document). The sampling is therefore limited in spatial scale relative to the entire Units 1 & 2 SOEP and STEP AOC Area, but covers areas with a history of spills assumed to be most impacted.

D-3.1 **Exposure Units and Preliminary Chemicals of Potential Concern**

Exposure units (EUs) and preliminary COPCs are defined and identified separately for the HHRA and ERA.

D-3.1.1 Human Health

For human health, three EUs are defined by the former spill sites, consistent with where soil samples were taken, as described above. The area near North 1 AD Pipeline Drain Pond (N1AD) is EU6, the area near STEP Main Dam (STEP) is EU7, and the area near Capture Well 932D (932D) is defined as EU8 (see Tables 6-1 and 6-2 in the main CCRA report). The three EUs are defined in general over all depths, but 95% UCLs are calculated using data from different depth intervals to correspond to different exposure scenarios or definitions of surface soil and subsurface soil.

Manganese and radium 226 were identified as preliminary COPCs in EU6 and EU7 in the first stage screening process based on maximum concentrations. For manganese, data from the following depth intervals and EUs are used to obtain 95% UCLs to be used in subsequent steps in HHRA: (1) surface soil (0-24’’) for EU6, (2) surface soil (0-24’’) for EU7, and (3) the entire soil column (0-7’) for EU6. General descriptions of the available data are provided in the next section and summaries of data available to inform each 95% UCL are presented in Tables 3-2 and 3-3 and Figures 3-1 through 3-8.

For radium-226 there are an additional two depth intervals of interest due to correspond to EPA definitions of surface vs. subsurface soil: (1) shallow surface only (0-6’’) in EU6, (2) shallow surface only (0-6’’) in EU7, and (3) subsurface only (1-7’) in EU6. Therefore, a total of six different 95% UCLs are estimated for radium 226. Descriptions of the available data are provided in the next section and summaries of the data to inform estimation of UCL are presented in Tables 3-2, 3-3, 3-4, and 3-5 and Figures 3-1 through 3-8.

Radium 226 is also identified as a preliminary COPC for EU8. The data are summarized in Tables D-3.2, D-3.5, and D-3.6 and presented in Figures D-3.7 and D-3-8. However, 95% UCLs are not calculated due to the limited number of three sampling locations.

D-3.1.2 Ecological

Six ecological EUs are considered by combining each soil sampling area with two different depth intervals, one for non-burrowing animals (soil depth interval of 0-6”) and one for burrowing animals (soil depth interval of 12-24”). For area N1AD, barium, boron, and radium 226 are identified as the preliminary COPCs through the first stage screening process using maximum concentrations, for both depths. For STEP and 932D areas, barium and boron are identified as preliminary COPCs.

To support the ERA, 95% UCLs are calculated for the associated preliminary COPCs for (1) a depth interval of 0-6'' for N1AD, (2) depth interval of 0-6'' for STEP, (3) depth interval of 12-24'' for N1AD, and (4) depth interval of 12-24'' for STEP. As for the HHRA, 95% UCLs are not calculated for soil sampling area 932D because there are only three sampling locations. The data used for each UCL are summarized in Tables 3-4 and 3-5 in Section D-3.3.2 and presented in Figures 3-1 through 3-8.

D-3.2 **Available Data**

D-3.2.1 Soil sampling areas and sampling depths

The three distinct sampling areas are shown in a series of figures in the Interim Response Action Work Plan Outline (see Figures 10 and 11 in the main CCRA document) to correspond to areas with known former spills. Two spills in N1AD in 2002 resulted in the removal of soil for remediation. In 2008, water was released from a broken pipe near Well 932D, and a release of flyash slurry occurred in 2016 near the Units 1&2 STEP Main Dam.

The area nearest to the creek is the North 1AD Pipeline Drain Pond (N1AD) and contains 26 of the 33 sampling locations. Of the 26 sampling locations in the original sampling plan, samples were analyzed from 23. Five sampling locations in the N1AD area are on the railroad, while all remaining locations are on the Talen property. Shallow sample (depth intervals of 0-6" or 12-24") locations were chosen using a 100' by 100' grid over the portion of the N1AD area where spills were known to have occurred, as well as around the perimeter of the pond. Eight additional locations were chosen for deep soil collection (5-7' depth): the seven nearest surface sample locations northwest and west of the drain pond, in the area of the clearwater spill, and one near SPS (southwest of the drain pond), in the area of the slurry spill (Hydrometrics, 2017d). Sample locations DP1AD-1 thru DP1AD-26 are used for the analysis of the former spill site near the North 1AD Pipeline Drain Pond (EU6).

Northwest of the N1AD area is Capture Well 932D (932D) and it contains 2 sampling locations. The two locations in the 932D area were chosen where a release of captured groundwater pooled in 2009. Soil samples were taken in the depth intervals 0-6" and 12-24" (Hydrometrics, 2017d). Sample locations 932D-S-27 and 932D-S-28 are located in EU8, the former spill site near capture well 932D.

Further northwest of area 932D, near the base of the Units 1&2 Main Dam, is the STEP area containing 5 sampling locations. The locations in the STEP area were chosen based on area where the release of flyash slurry flowed and pooled. Soil samples were taken in the depth intervals 0-6" and 12-24" (Hydrometrics, 2017d). Sample locations MDE-29 thru MDE-33 are used for the analysis of the spill site at the STEP Main Dam (EU7).

D-3.2.3 Sieved samples

Concentrations from sieved samples are used for all analysis.

D-3.2.4 Field duplicates

There are four pairs of field duplicates taken at three different locations (MDE-30 in the STEP area, and DP1AD-6 and DP1AD-26 in the N1AD area). A duplicate at the shallowest depth interval (0-6'') was taken from each location, and an additional one was taken at MDE-30 for the 12-24'' depth interval. The pairs of field duplicates generally have similar concentrations relative to variability among observations that are not duplicates and pairs of concentrations for the preliminary COPCs are provided in Table 3-1. MT DEQ requires that the maximum of the field duplicate pair be used in estimation of the EPC, and therefore this approach is used for the analysis**.**

Table D-3.1 Soil field duplicate measurements for barium, boron, manganese, and radium 226 from the N1AD and STEP areas. All samples were taken on August 16, 2017. The second concentration in the pair is labeled as the field duplicate in the database.

Depth	Location	Analyte	Units	FD Pair Concentrations	
0-6''	DP1AD-26	Barium	mg/kg	141	**143**
		Boron		12	12
		Manganese		264	**271**
		Radium 226	pCi/g	**0.9**	0.7
	DP1AD-6	Barium	mg/kg	**278**	221
		Boron		**11**	10
		Manganese		**353**	334
		Radium 226	pCi/g	**2.2**	1.2
	MDE-30	Barium	mg/kg	**608**	540
		Boron		26	**29**
		Manganese		**330**	297
		Radium 226	pCi/g	0.6	**0.7**
12-24''	MDE-30	Barium	mg/kg	237	**250**
		Boron		4	**5**
		Manganese		**575**	497
		Radium 226	pCi/g	0.5	**0.6**

D-3.3 **Exploratory Data Analysis and Data Summaries**

Tabular summaries of available data are presented in this section, along with graphical displays of the raw data in the Figures section. General observations from the figures and tables are presented in Section 3.3.1.

D-3.3.1 Graphical displays and general observations

All three analytes identified as preliminary COPCs for the HHRA (barium, manganese, and radium 226) have observed maximum concentrations in the N1AD area. Manganese has a maximum concentration of 1830 mg/kg in the 5-7' depth interval at location DP1AD-17, while typical concentrations from other locations are under 500 mg/kg (Figures D-3.5 and D-3.6). A relatively high concentration at one depth is not necessarily associated with a relatively high concentration at another depth interval from the same location (see Figure D-3.6); for example, at location DP1AD-3, there is a relatively high concentration in the depth interval 0-6" but a relatively low concentration in the depth interval 12-24". There is one field duplicate pair in the STEP area (location MDE-30) with high concentrations for both samples relative to concentrations of manganese at other locations.

Barium has a maximum concentration of 1300 mg/kg in the 0-6" depth interval at location DP1AD-22. Concentrations of barium were found to be less than 250 mg/kg for most samples. There is also a group of 3 observations (including one field duplicate pair) from two near-by locations (MDE-30 and MDE-33) within 0-6'' in the STEP area with barium concentrations greater than 500 mg/kg (Figures D-3.1 and D-3.2). There is one field duplicate pair in the STEP area with high concentrations for both the 0-6" depth interval and 12-24" depth interval relative to concentrations of barium at other locations, location MDE-30. There are also two near-by locations (DPIAD-4 and DP1AD-5) in the N1AD with high concentrations of barium in the 0-6'' depth interval relative to concentrations at other locations; one is the maximum observed concentration.

Radium 226 has a maximum concentration of 25.3 pCi/g-dry in the depth interval 5-7' at location DP1AD-13. Samples typically have radium 226 concentrations under 3.0 pCi/g-dry (Figures D-3.7 and D-3.8). One N1AD location (DP1AD-10) has a relatively high concentration in both the 0-6'' depth interval and the 12-24'' depth interval in the N1AD area, and no near-by locations have high concentrations.

Boron, a preliminary COPC only for the ERA, has a maximum concentration of 33 mg/kg at location MDE-33 in the STEP area in the 0-6'' depth interval. Samples typically have boron concentrations under 10 mg/kg (Figures D-3.3 and D-3.4), and it is not uncommon for a location to have a relatively high concentration of boron in multiple depth intervals. For example, location MDE-33 in the STEP area has a relatively high concentration of boron at both the 0-6" depth interval and the 12-24" depth interval. In area N1AD, DP1AD-13 has a relatively high concentration of boron at both the 12-24" depth interval and 5-7' depth interval, and DP1AD-4 has a relatively high concentration of boron at both the 0-6" depth interval and 12-24" depth interval. It is not uncommon for locations near one another to have relatively high concentrations of boron; see for example MDE-30 and MDE-33 in the STEP area in the 0-6" depth interval or locations near to DP1AD-13 in the N1AD area in the 12-24" depth interval (Figure 3-4).

Of the analytes identified as preliminary COPCs for the HHRA (barium, manganese, and radium 226) or the ERA (barium, boron, and radium 226), there were no censored observations (non-detects).

D-3.3.2 Summary tables

Summary statistics tables are presented for data used for each 95% UCL calculation performed to estimate EPCs for soil (see section D-3.1 for more detail). The maximums from field duplicate pairs are used in estimating EPCs as required by MT DEQ, and thus are used in these tables. The data summarized in each table correspond to the descriptions of EUs and exposure scenarios provided in Section D-3.1, with data from EU8 included in all tables. The tables provide summaries of data from:

- all three soil sampling areas for depths 0-6'' and 0-24'' combined (Table 3-2),
- N1AD soil sampling locations for depths 0-6'', 12-24'', and 5-7' combined (Table 3-3),
- N1AD soil sampling locations for depths 12-24'' and 5-7' combined to represent the depth interval of 1-7'' (Table 3-4),
- all three soil sampling areas for depth interval 0-6'' for the ERA (Table 3-5), and
- all three soil sampling areas for depth interval 12-24'' for the ERA (Table 3-6).

Table D-3.2. Summary of analytes from all samples within the 0-6" and 12-24" depth intervals from all three soil sampling areas. Barium, manganese, and radium 226 are of interest for the HHRA; barium, boron, and radium 226 are of interest for the ERA.

			#	#	Detects					Non-detects
Area	Analyte	Units	Loc.	Samp.	#	Min	Med	Avg	Max	#
N1AD	Barium	mg/kg	23	48	48	111	160	191.6	1300	0
	Boron	mg/kg	23	48	48	2	7	10.4	31	0
	Manganese	mg/kg	23	48	48	180	334	331.1	490	0
	Radium 226	pCi/g	23	48	48	0.4	0.7	1.01	6.1	0
STEP	Barium	mg/kg	5	12	12	86	222	284.9	731	0
	Boron	mg/kg	5	12	12	1	5	10.1	33	0
	Manganese	mg/kg	5	12	12	247	325	376.8	691	0
	Radium 226	pCi/g	5	12	12	0.50	0.60	0.69	1.20	0
932D	Barium	mg/kg	2	4	4	81	123	116.8	140	0
	Boron	mg/kg	2	4	4	3	3	4	7	0
	Manganese	mg/kg	2	4	4	261	282	287.8	326	0
	Radium 226	pCi/g	2	4	4	0.50	0.60	0.63	0.80	0

Table D-3.3. Summary of analytes from all samples from all depths in the N1AD area (HH EU6). Barium, manganese, and radium 226 are of interest for the HHRA; barium, boron, and radium 226 are of interest for the ERA.

		#	#	Detects					Non-detects
Analyte	Units	Loc.	Samp.	#	Min	Med	Avg	Max	#
Barium	mg/kg	23	56	56	91	158	183.6	1300	0
Boron	mg/kg	23	56	56	2	7	9.8	31	0
Manganese	mg/kg	23	56	56	180	334	356.0	1830	0
Radium 226	pCi/g	23	56	56	0.4	0.7	1.4	25.3	0

Table D-3.4. Summary of analytes from all samples within the 12-24" and 5-7' depth intervals in the N1AD area (HH EU6). Barium, manganese, and radium 226 are of interest for the HHRA; barium, boron, and radium 226 are of interest for the ERA.

		#	#	Detects					Non-detects
Analyte	Units	Loc.	Samp.	#	Min	Med	Avg	Max	#
Barium	mg/kg	23	31	16	91	167	161.9	259	0
Boron	mg/kg	23	31	16	2	7	10.4	31	0
Manganese	mg/kg	23	31	16	180	315	364.3	1830	0
Radium 226	pCi/g	23	31	16	0.4	0.7	1.7	25.3	0

Table D-3.5. Summaries of all samples within the 0-6" depth interval from all three soil sampling areas. Barium, manganese, and radium 226 are of interest for the HHRA; barium, boron, and radium 226 are of interest for the ERA.

			#	#	Detects					Non-detects
Area	Analyte	Units	Loc.	Samp.	#	Min	Med	Avg	Max	#
N1AD	Barium	mg/kg	23	25	25	111	146	210.4	1300	0
	Boron	mg/kg	23	25	25	3	7	9	26	0
	Manganese	mg/kg	23	25	25	213	346	345.6	490	0
	Radium 226	pCi/g	23	25	25	0.4	0.6	1.1	6.1	0
STEP	Barium	mg/kg	5	6	6	108	373.5	390.5	731	0
	Boron	mg/kg	5	6	6	3	16	16.7	33	0
	Manganese	mg/kg	5	6	6	270	321.5	312.5	335	0
	Radium 226	pCi/g	5	6	6	0.6	0.6	0.7	0.8	0
932D	Barium	mg/kg	2	2	2	122	131	131	140	0
	Boron	mg/kg	2	2	2	3	3	3	3	0
	Manganese	mg/kg	2	2	2	281	303.5	303.5	326	0
	Radium 226	pCi/g	2	2	2	0.5	0.6	0.6	0.8	0

Table D-3.6 Summary of concentration data from all samples within the 12-24" depth interval from all three soil sampling areas. Barium, manganese, and radium 226 are of interest for the HHRA; barium, boron, and radium 226 are of interest for the ERA.

			#	#	Detects	Non-detects

Area	Analyte	Units	Loc.	Samp.	#	Min	Med	Avg	Max	#
N1AD	Barium	mg/kg	23	23	23	112	172	171.1	259	0
	Boron	mg/kg	23	23	23	2	8	11.9	31	0
	Manganese	mg/kg	23	23	23	180	315	315.3	466	0
	Radium 226	pCi/g	23	23	23	0.4	0.7	0.9	3.5	0
STEP	Barium	mg/kg	5	6	6	86	194	179.3	250	0
	Boron	mg/kg	5	6	6	1	4	3.5	6	0
	Manganese	mg/kg	5	6	6	247	411	441.2	691	0
	Radium 226	pCi/g	5	6	6	0.5	0.6	0.7	1.2	0
932D	Barium	mg/kg	2	2	2	81	103	102.5	124	0
	Boron	mg/kg	2	2	2	3	5	5	7	0
	Manganese	mg/kg	2	2	2	261	272	272	283	0
	Radium 226	pCi/g	2	2	2	0.5	0.6	0.6	0.7	0

D-3.4 **Assessing Assumptions**

D-3.4.1 Quantity of data

As discussed in Section D-3.1, the soil samples are limited in spatial scale relative to the Units 1 & 2 SOEP and STEP AOC Area near East Fork Armells Creek and represent three small areas with known history of spills (see Figures 10 and 11 in the main CCRA document or Figures 2 and 3 in Hydrometrics, 2017d); the estimated EPCs in this report apply only to their associated sampling areas.

D-3.4.2 Implications of independence violations

Common methods for calculating 95% UCLs assume all observations are independent. However, samples taken closer together in space tend to be more similar than those taken far apart, known as spatial autocorrelation. The general idea is that if samples are taken close enough together in space, the samples actually overlap in their information about the mean concentration and therefore contain less information than independent samples would. See Section D-1.1 for more discussion about the potential implications of violations of independence on UCLs. Dependence due to samples coming from different depths from the same locations is accounted for within the UCL calculations by using the number of locations as the sample size and the location averages as the observations in the usual t- and BCa- confidence interval calculations. This is a simple method to correct for dependence while still using common methods for obtaining UCLs.

D-3.4.3 Choice of UCL estimator for the mean

The general approach to estimating 95% UCLs is described in Section D-1.1. For the N1AD area the approach involves choosing the maximum of the t-UCL or the BCa-UCL. For the STEP area, with only 5 samples, only the t-UCL is used. For the 932D, with only 2 samples, no UCLs are calculated.

D-3.5 **95% UCLs**

95% UCLs are calculated for the exposure units for human health using (1) soil samples in the depth interval 0-24'' for both the N1AD area and the STEP area (Table 3-7), (2) soil samples in the depth interval 0-7' for the N1AD area (Table 3-8), (3) soil samples in the depth interval 1-7' from the N1AD area (Table 3-9), and (4) soil samples in the depth interval 0-6'' for both the N1AD area and STEP area (Table 3-10).

95% UCLs are calculated for the ecological exposure units using (1) soil samples in the depth interval 0-6'' for both the N1AD area and STEP area (Table 3-11) and (2) soil samples in the depth interval 12-24'' for both the N1AD and STEP areas (Table 3-12).

Details of the 95% UCLs calculated for the HHRA are described in sections D-3.4.1, D-3.4.2, D-3.4.3, and D-3.4.4, the results of which are presented in Tables D-3.7, D-3.8, D-3.9, and D-3.10. Details of the 95% UCLS calculated for the ERA are described in sections D-3.4.5 and D-3.4.6, and the results of which are presented in Tables D-3.11 and D-3.12.

D-3.5.1 95% UCLs for HHRA EU6 and EU7, 0-24”

The estimated mean concentration of manganese in soil for the N1AD area within a depth of 0-24” is 331 mg/kg with an associated 90% confidence interval from 311 mg/kg to 351 mg/kg; the recommended estimated EPC is 351 mg/kg. The estimated mean concentration of radium 226 is 1.01 pCi/g, with an associated 90% confidence interval from 0.50 to 1.52 pCi/g; the recommended EPC is 1.52 pCi/g (Table D-3.7).

The estimated mean concentration of manganese in soil for the STEP area within a depth of 0-24” is 377 mg/kg with an associated 90% confidence interval from 280 mg/kg to 474 mg/kg; the recommended estimated EPC is 474 mg/kg. The estimated mean concentration of radium 226 is 0.69 pCi/g, with an associated 90% confidence interval from 0.52 to 0.86 pCi/g; the recommended EPC is 0.86 pCi/g (Table D-3.7).

Table D-3.7 Estimated EPCs for the preliminary COPCs identified for the HHRA for N1AD (EU6) and STEP (EU7) within the depth intervals 0-6” and 12-24''. The N1AD area had 23 locations. The STEP area had 5 locations.

Area	Depth interval: 0-24’’	Manganese (Mn) (mg/kg)	Radium 226 (pCi/g-dry)
N1AD	Average	331	1.01
	Max	490	6.10
	95% t-UCL	351	1.34
	95% BCa-UCL	348	1.52
	Estimated EPC	**351**	**1.52**
STEP	Average	377	0.69
	Max	691	1.20
	Estimated EPC (95% t-UCL)	**474**	**0.86**

D-3.5.2 HHRA 95% UCLs for EU6, 0-7’

The mean concentrations of manganese and radium 226 for the entire soil column within the N1AD area are based on all samples from depth intervals 0-6’’, 12-24’’, and 5-7’. These UCLs are estimated from all samples and because there are more samples from the 0-6’’ and 12-24’’, they are weighted more heavily by information from the top two feet of soil than the deeper samples. There are 23 samples from 0-6’’, 23 from 12-24’’, and only 8 from 5-7’. It is possible to weight the samples differently so that the deep samples are given more weight, but this was not done for these calculations. The estimated mean concentration of manganese in soil for the N1AD area for the entire soil column is 351 mg/kg with an associated 90% confidence interval from 281 mg/kg to 421 mg/kg; the recommended estimates EPC is 421 mg/kg (Table D-3.8). The estimated mean concentration of radium 226 is 1.37 pCi/g, with an associated 90% confidence interval from 0.34 to 2.40 pCi/g; the recommended estimated EPC is 2.40 pCi/g (Table D-3.8).

Table D-3.8 Estimated EPCs for the preliminary COPCs identified for the HHRA for the N1AD (EU6) for the entire soil column (0-7'). The N1AD area had 23 sampling locations for 0-6'', 23 for 12-24'', and only 8 sampling locations with samples from 5-7'. Therefore, the shallower depth intervals are more represented in the UCLs.

Depth interval: 0-7'	Manganese (Mn) (mg/kg)	Radium 226 (pCi/g-dry)
Average	351	1.37
Max	1830	25.30
95% t-UCL	395	2.03
95% BCa-UCL	421	2.40
Estimated EPC	**421**	**2.40**

D-3.5.3 HHRA 95% UCLs for EU6 and EU7, Depth 0-6"

The estimated mean concentration of radium 226 in soil for the N1AD area within a depth of 0-6" is 1.06 pCi/g, with an associated 90% confidence interval from 0.36 to 1.76 pCi/g; the recommended estimated EPC is 1.76 pCi/g (Table D-3.9).

The estimated mean concentration of radium 226 in soil for the STEP area within a depth of 0-6" is 0.67 pCi/g, with an associated 90% confidence interval from 0.58 to 0.76 pCi/g; the recommended estimated EPC is 0.76 pCi/g (Table D-3.9).

Table D-3.9 Estimated EPCs for the preliminary COPCs identified for the HHRA for N1AD (EU6) and STEP (EU7) within only shallow surface soil (depth interval 0-6''). There are 23 sampling locations in the N1AD area and 5 sampling locations in the STEP area.

Area	**Depth interval: 0-6''**	**Radium 226 (pCi/g-dry)**
N1AD	Average	1.06
	Max	6.10
	95% t-UCL	1.50
	95% BCa-UCL	1.76
	Estimated EPC	**1.76**
STEP	Average	0.67
	Max	0.80
	Estimated EPC (95% t-UCL)	**0.76**

D-3.5.4 HHRA 95% UCLs for EU6, Depth Interval 1-7'

The mean concentration of radium 226 in soil for the N1AD area within for the depth interval specified as subsurface by EPA (greater than 6'') is estimated using the samples from depths of 12-24" and 5-7'.

The estimated mean concentration is 1.49 pCi/g, with an associated 90% confidence interval from 0 to 3.17 pCi/g; the 95% UCL recommended for the estimated EPC is 3.17 pCi/g (Table D-3.10). As described for UCLs constructed for the entire soil column (Section D-3.4.2), this UCL is estimated from all available samples from the desired interval, meaning the UCL is more informed by the samples from 12-24'' (23 of the 31 samples) than the samples from 5-7' (8 of the 31 samples). It would be possible to weight the samples differently to give the deeper samples more weight, but this was not done for these calculations.

Table D-3.10. Estimated EPC for the HHRA for the N1AD (EU6) sampling area for depth interval 1–7' (including sampling depths of 12-24'' and 5-7') for EPA's definition of subsurface. There were 23 sampling locations in the N1AD area, but only 8 locations with samples from the 5-7'.

Depth interval: 1-7'	Radium 226 (pCi/g-dry)
Average	1.49
Max	25.30
95% t-UCL	2.42
95% BCa-UCL	3.17
Estimated EPC	**3.17**

D-3.5.5 ERA 95% UCLs, N1AD and STEP, Depth 0-6"

The estimated mean concentration of barium in soil for the N1AD area within a depth of 0-6" is 210 mg/kg with an associated 90% confidence interval from 48 mg/kg to 372 mg/kg; the 95% UCL recommended as the estimated EPC is 372 mg/kg. The estimated mean concentration of boron is 9 mg/kg with an associated 90% confidence interval from 7 mg/kg to 11 mg/kg; the 95% UCL for boron recommended for the EPC is 11 mg/kg. For radium 226, the estimated mean concentration is 1.06 pCi/g, with an associated 90% confidence interval from 0.36 to 1.76 pCi/g; the recommended estimated EPC is 1.76 pCi/g (Table D-3.11).

The estimated mean concentration of barium in soil for the STEP area within a depth of 0-6" is 391 mg/kg with an associated 90% confidence interval from 147 mg/kg to 635 mg/kg; the 95% UCL recommended for use as the estimated EPC is 635 mg/kg. The estimated mean concentration of boron is 17 mg/kg with an associated 90% confidence interval from 5 mg/kg to 29 mg/kg; the recommended estimated EPC is 29 mg/kg. Finally, the estimated mean concentration of radium 226 in soil for the STEP area within a depth of 0-6" is 0.67 pCi/g, with an associated 90% confidence interval from 0.58 to 0.76 pCi/g; the recommended estimated EPC is 0.76 pCi/g (Table D-3.11).

Table D-3.11. ERA estimated EPCs for the preliminary COPCs for the N1AD and STEP sampling areas within the depth interval 0-6''. There were 23 sampling locations in the N1AD area and 5 in the STEP area. The maximum of the one field duplicate pair was used.

Area	Depth interval: 0-6"	Barium (Ba) (mg/kg)	Boron (B) (mg/kg)	Radium 226 (pCi/g-dry)
N1AD	Average	210	9	1.06
	Max	1300	26	6.100
	95% t-UCL	301	11	1.50
	95% BCa-UCL	372	11	1.76
	Estimated EPC	**372**	**11**	**1.76**
STEP	Average	391	17	0.67
	Max	731	33	0.80
	Estimated EPC (95% t-UCL)	**635**	**29**	**0.76**

D-3.5.6 ERA 95% UCLs for N1AD, Depth 12-24"

The estimated mean concentration of barium in soil for the N1AD area within a depth of 12-24" is 171 mg/kg with an associated 90% confidence interval from 168 mg/kg to 184 mg/kg; the recommended estimated EPC is 184 mg/kg. The estimated mean concentration of boron is 12 mg/kg with an associated 90% confidence interval from 9 mg/kg to 15 mg/kg; the recommended estimated EPC for boron is 15 mg/kg. The estimated mean concentration of radium 226 is 0.95 pCi/g, with an associated 90% confidence interval from 0.62 to 1.28 pCi/g; the recommended EPC is 1.28 pCi/g (Table 3-12).

The estimated mean concentration of barium in soil for the STEP area within a depth of 12-24" is 179 mg/kg with an associated 90% confidence interval from 117 mg/kg to 241 mg/kg; the recommended estimated EPC is 241 mg/kg. The estimated mean concentration of boron is 4 mg/kg with an associated 90% confidence interval from 3 mg/kg to 5 mg/kg; the recommended EPC is 5 mg/kg. Finally, the estimated mean concentration of radium is 0.72 pCi/g, with an associated 90% confidence interval from 0.40 to 1.04 pCi/g; the recommended EPC is 1.04 pCi/g (Table 3-12).

Table D-3.12 ERA estimated EPCs for the preliminary COPCs for the N1AD and STEP sampling areas within the depth interval 12-24''. There were 23 sampling locations in N1AD and 5 in the STEP area.

Area	Depth interval: 12-24"	Barium (Ba) (mg/kg)	Boron (B) (mg/kg)	Radium 226 (pCi/g-dry)
N1AD	Average	171	12	0.95
	Max	259	31	3.50
	95% t-UCL	184	15	1.19
	95% BCa-UCL	184	15	1.28
	Estimated EPC	**184**	**15**	**1.28**
STEP	Average	179	4	0.72
	Max	250	6	1.20
	Estimated EPC (95% t-UCL)	**241**	**5**	**1.04**

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Figures

Figures D-2: Surface Water and Sediment

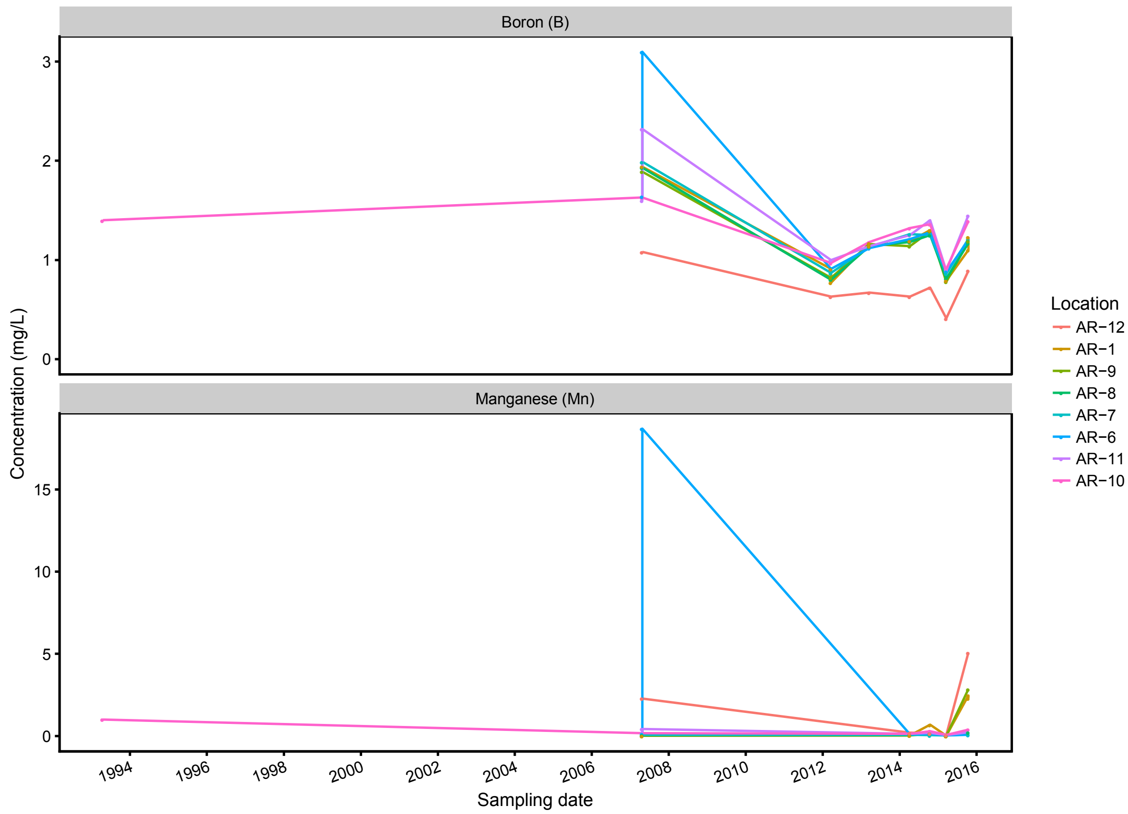


Figure D-2.1. Surface water dissolved concentrations (mg/L) over time for all data available for the preliminary ecological COPCs of boron (B) and manganese (Mn) from locations AR-1, AR-9, AR-8, AR-7, AR-6, AR-11, and AR-10, as well as the primary background point location AR-12. Only 2014 and 2015 data are used in estimation of EPCs. Boron and manganese are only COPCs for ecological health, and manganese is only COPC for human health.

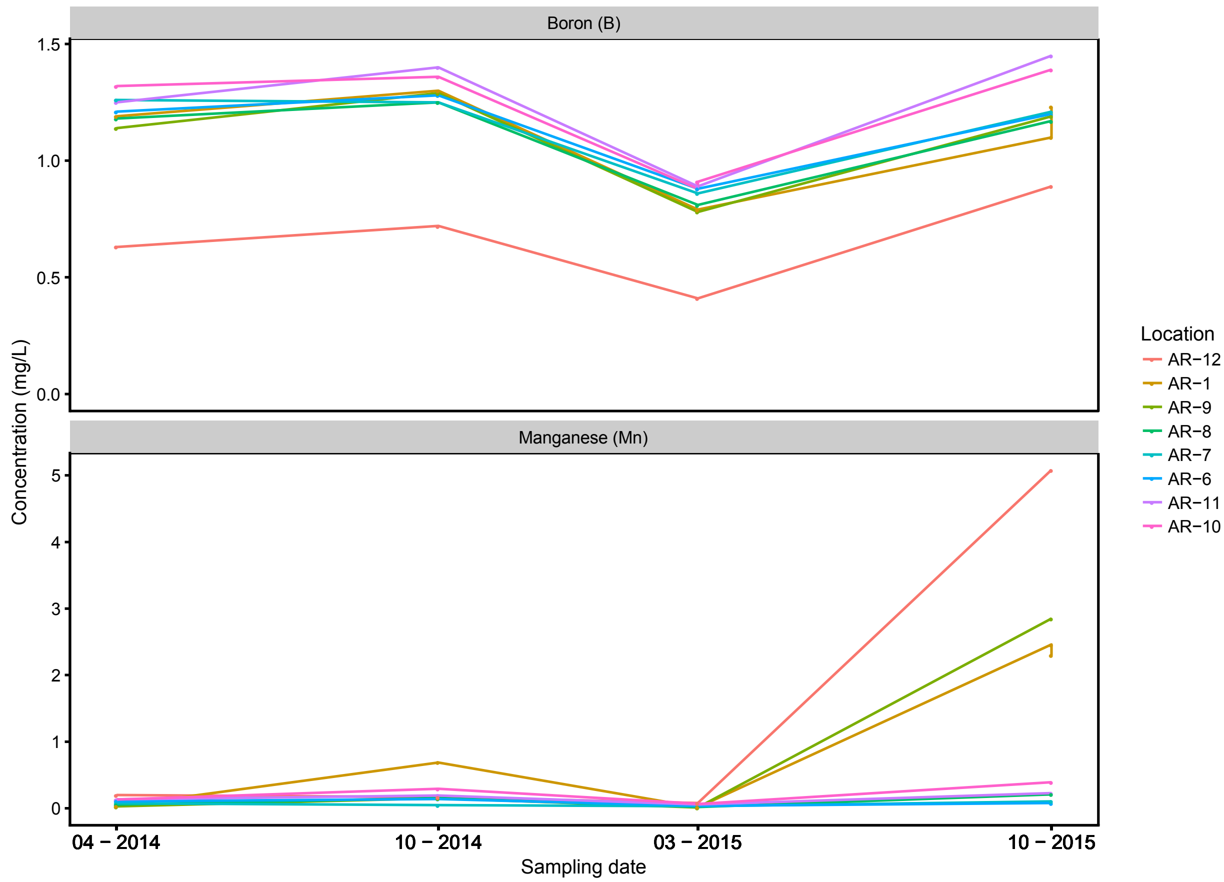


Figure D-2.2. Surface water (mg/L) dissolved concentrations (2014-2015) over time for all data available for boron and manganese sampled from seven locations along East Fork Armells Creek (AR-12 included as the primary background location).

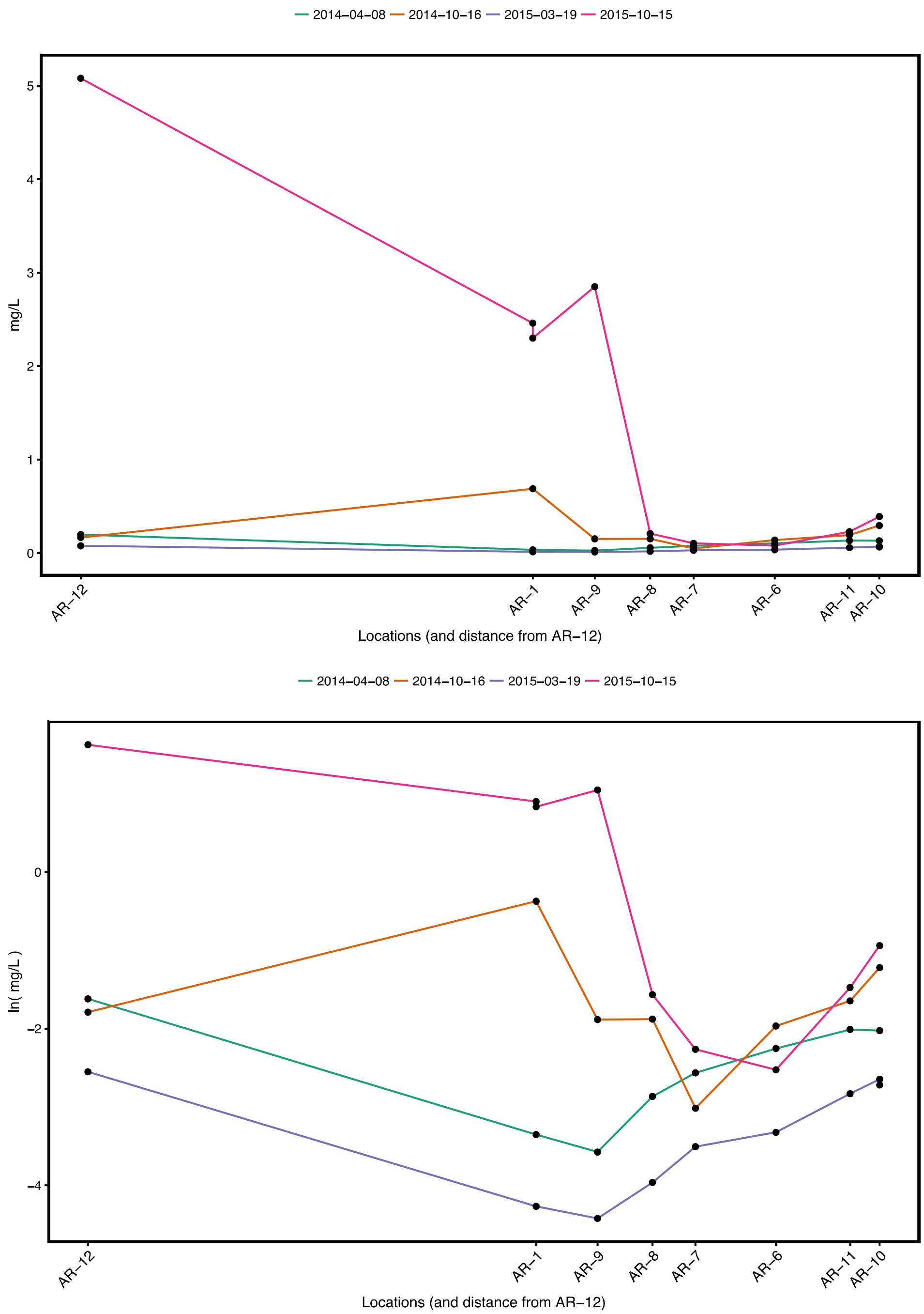
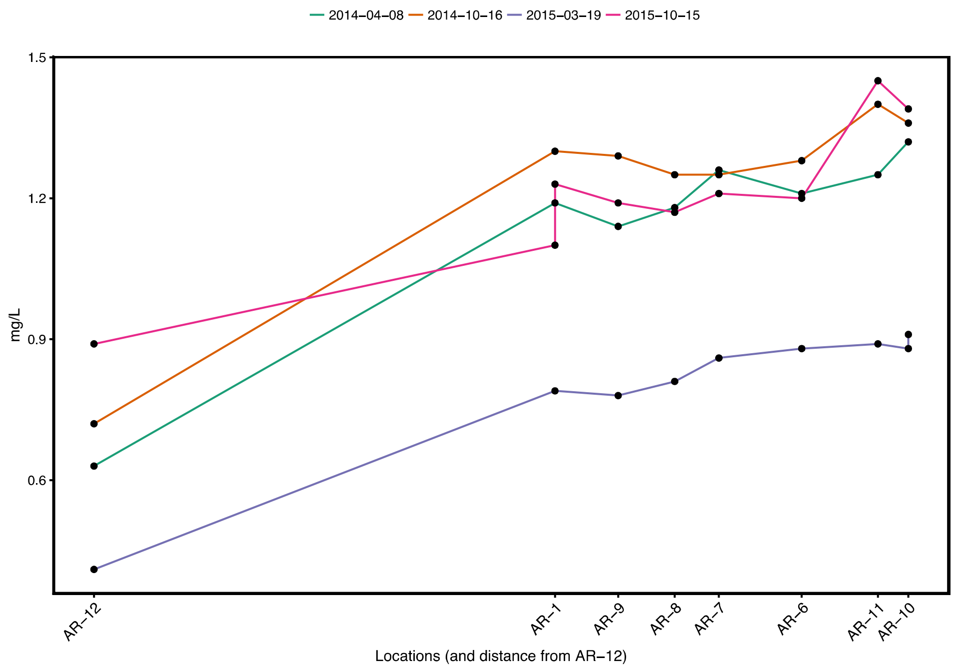


Figure D-2.3. Surface water manganese concentrations from 2014 and 2015 on the original scale (top) and natural log scale (bottom) plotted by location; distances between labels are proportional to the Euclidean distance between the actual locations. AR-12 is the most upstream location.



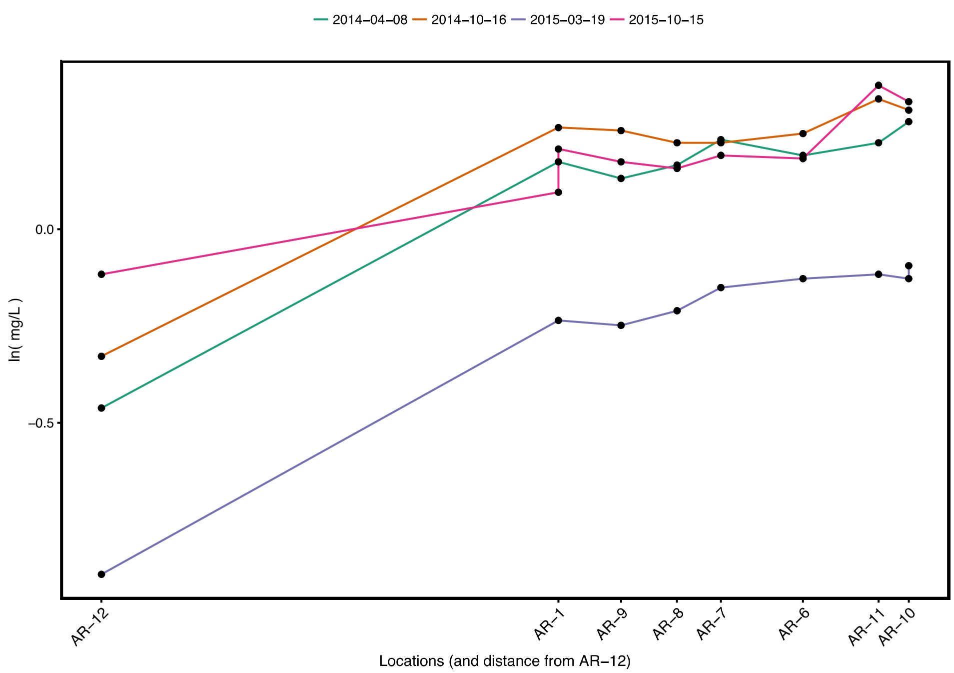


Figure D-2.4. Surface water boron concentrations from 2014 and 2015 on the original scale (top) and natural log scale (bottom) plotted by location; distances between labels are proportional to the Euclidean distance between the actual locations. AR-12 is the most upstream location.

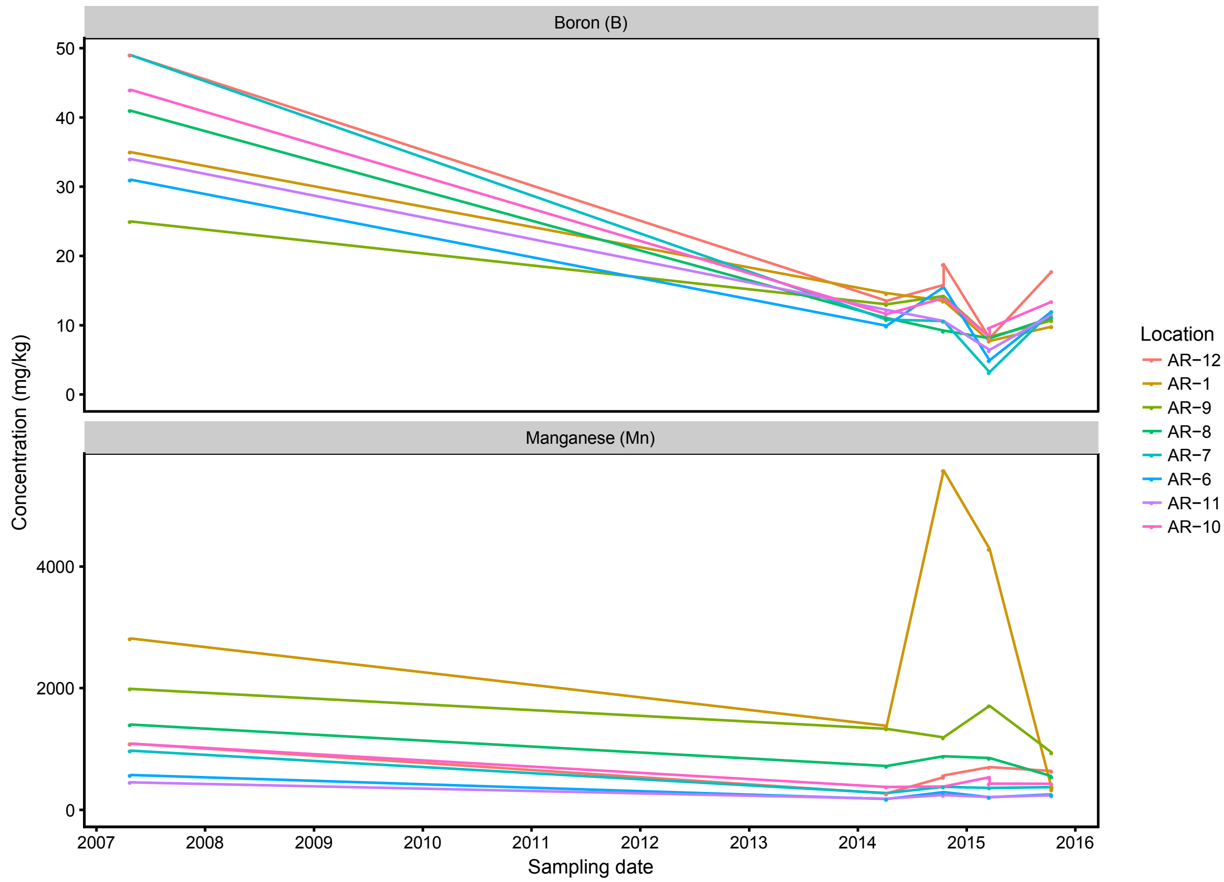


Figure D-2.5. Sediment concentrations (all available years) for the preliminary COPCs boron and manganese sampled from seven locations along East Fork Armells Creek (AR-12 included as the primary background location). Only 2014 and 2015 data are used in estimation of EPCs. Boron and manganese are only COPCs for ecological health, and manganese is only COPC for human health.

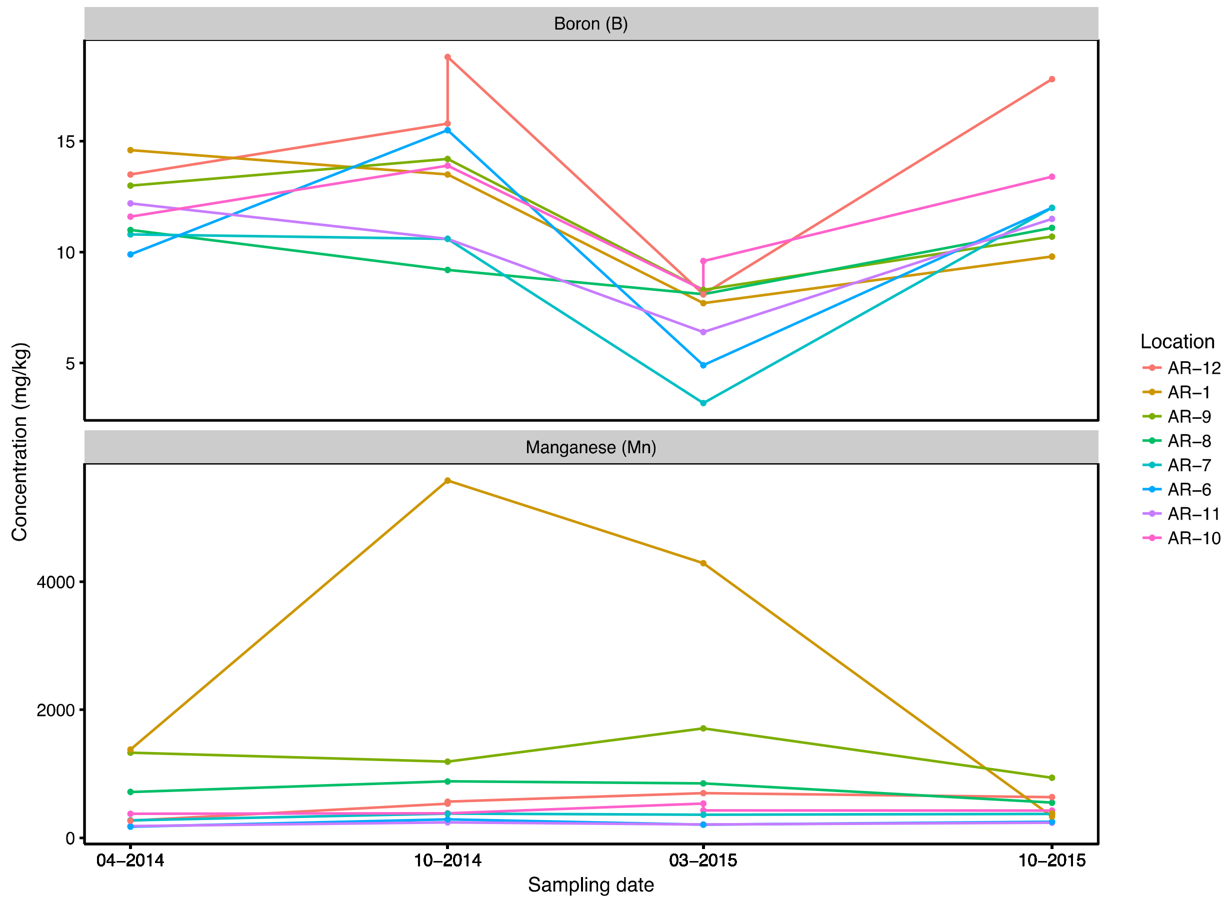


Figure D-2.6. Sediment concentrations (2014-2015) for preliminary COPCs boron and manganese sampled from seven locations along East Fork Armells Creek (AR-12 included for comparison as the primary background location).

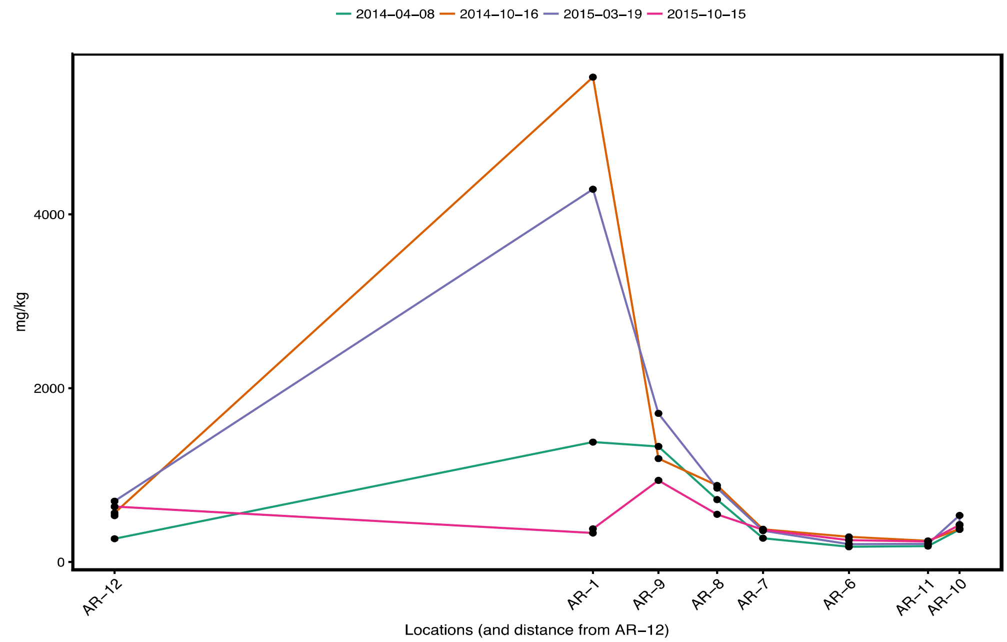


Figure D-2.7. Sediment manganese concentrations from 2014 and 2015 plotted by location. Distances between labels are proportional to the Euclidean distance between the actual locations. AR-12 is the most upstream and the primary background point location.

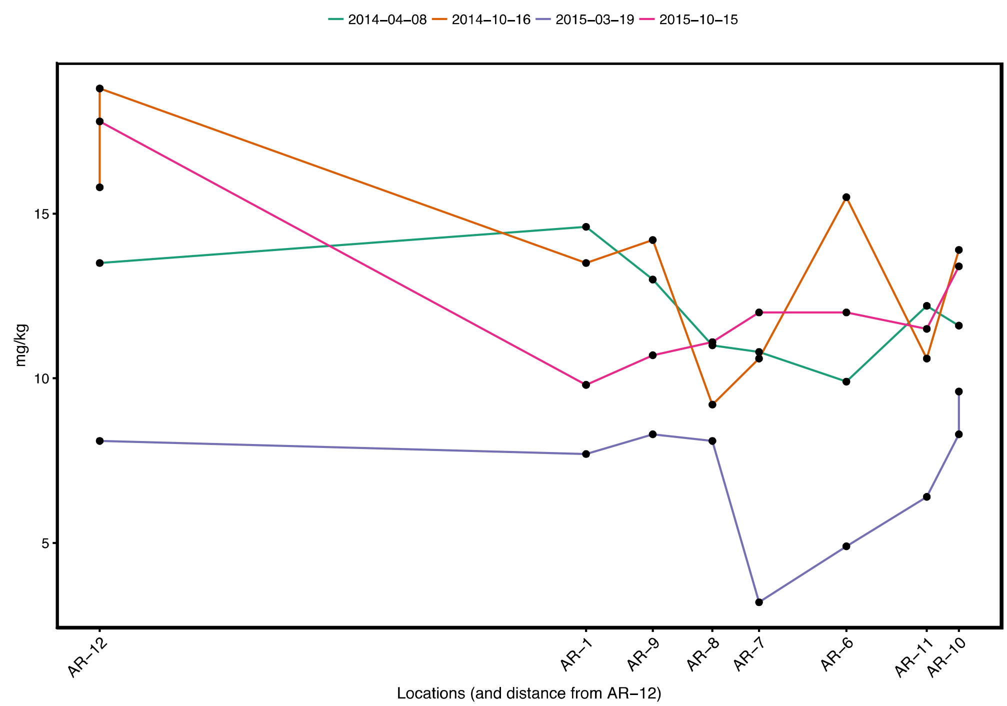
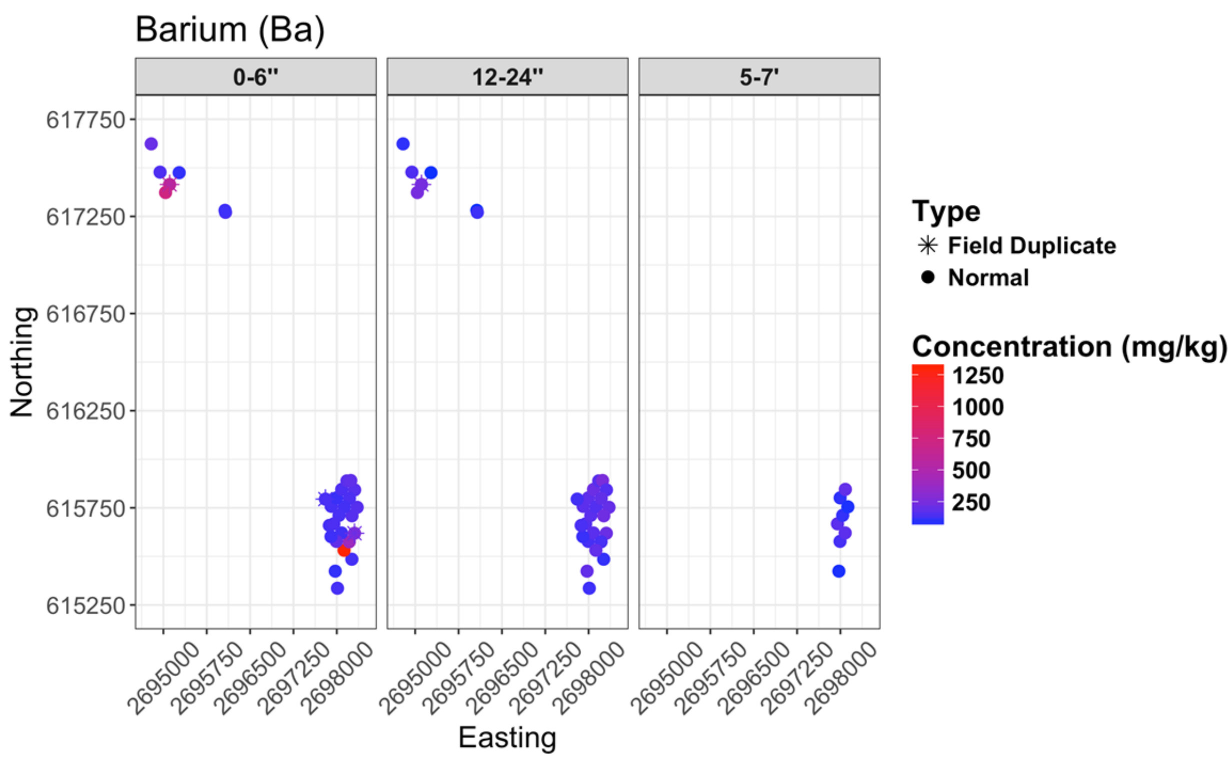


Figure D-2.8. Sediment boron concentrations from 2014 and 2015 plotted by location. Distances between labels are proportional to the Euclidean distance between the actual locations. AR-12 is the most upstream location.

Figures D-3: Soil



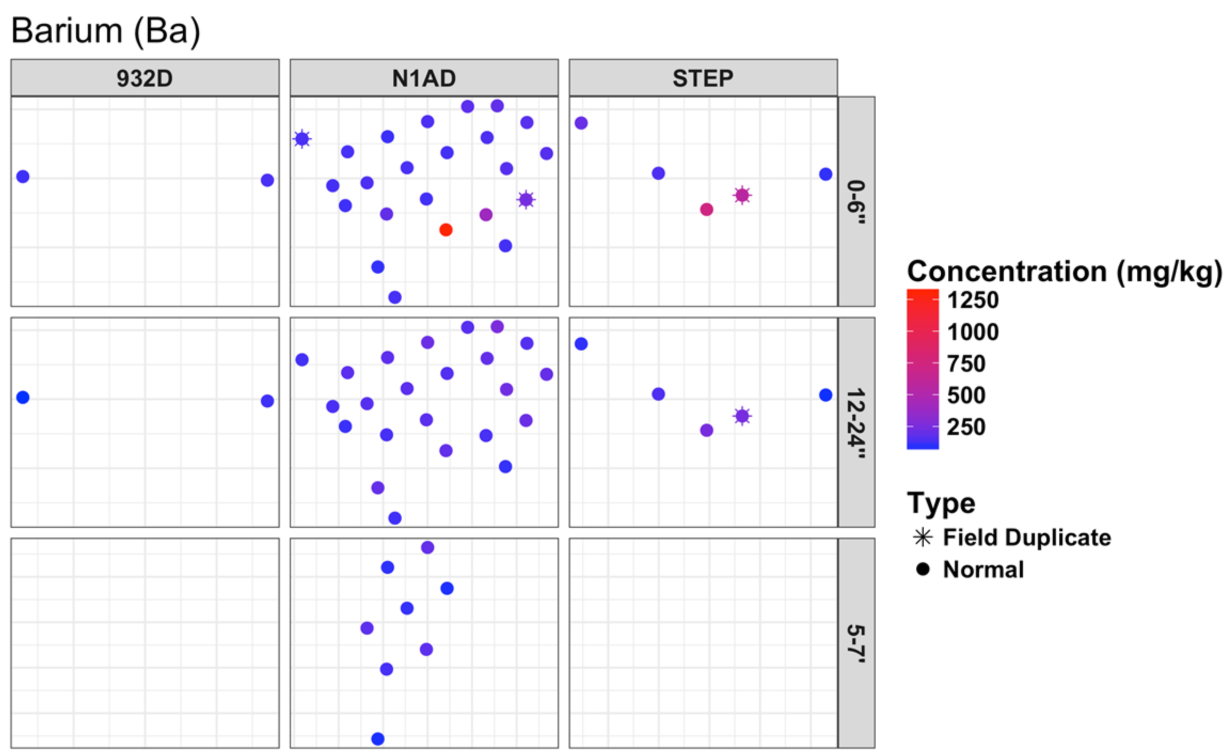


Figure D-3.1 Concentrations of barium (mg/kg) at each soil sampling location, displayed by the northing and easting relative to an origin for the NAD 1983 State Plane system for Montana.

The top plot is paneled by depth only, and the bottom plot is paneled by depth and area to zoom in on each sampling area.

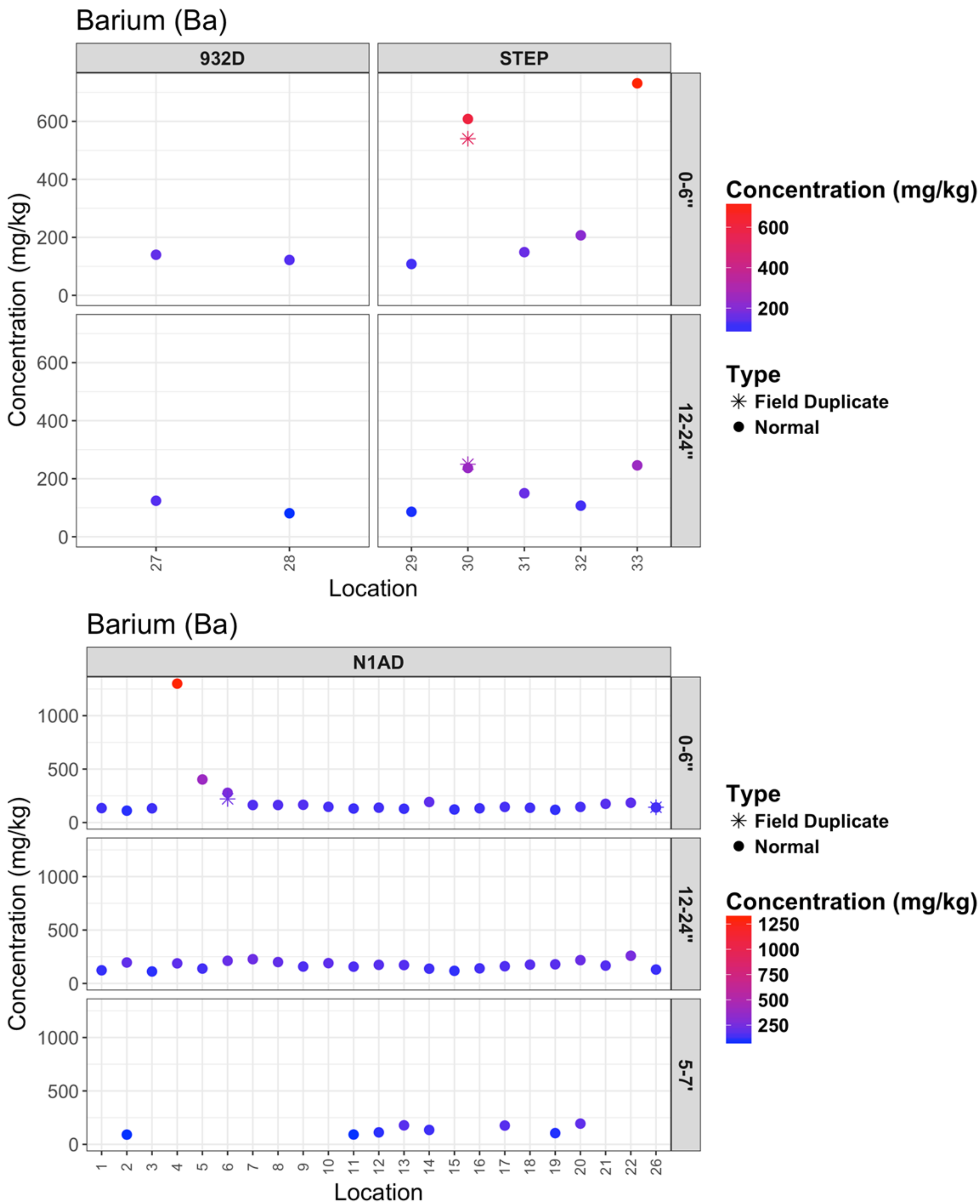
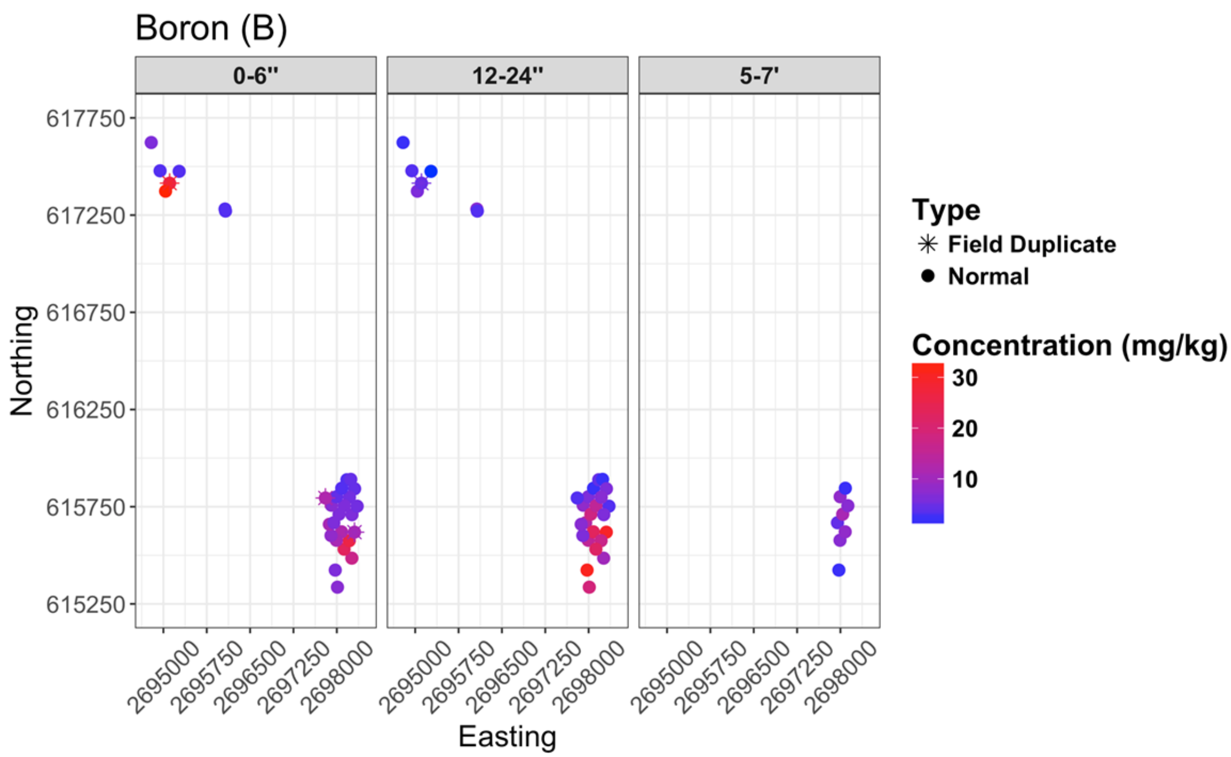


Figure D-3.2 Concentrations of barium (mg/kg) by depth category and location in soil sampling area 932D (top plot, left column), STEP (top plot, right column), and N1AD (bottom plot).



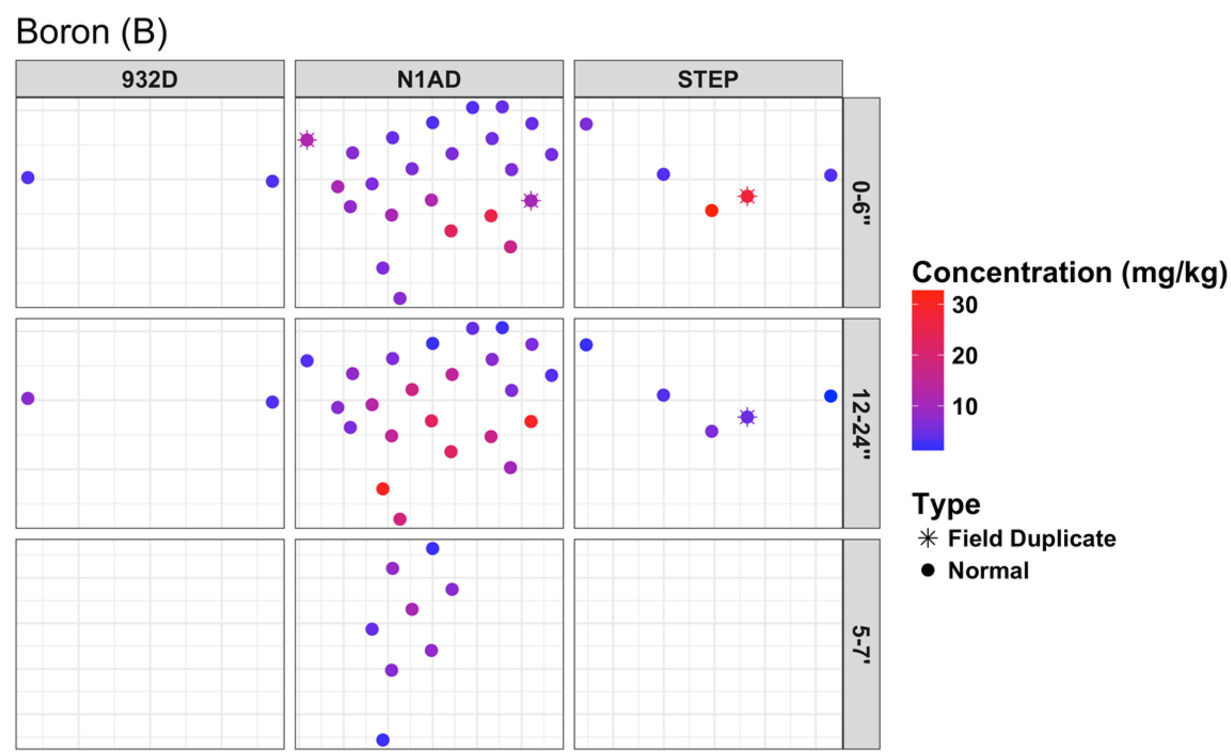
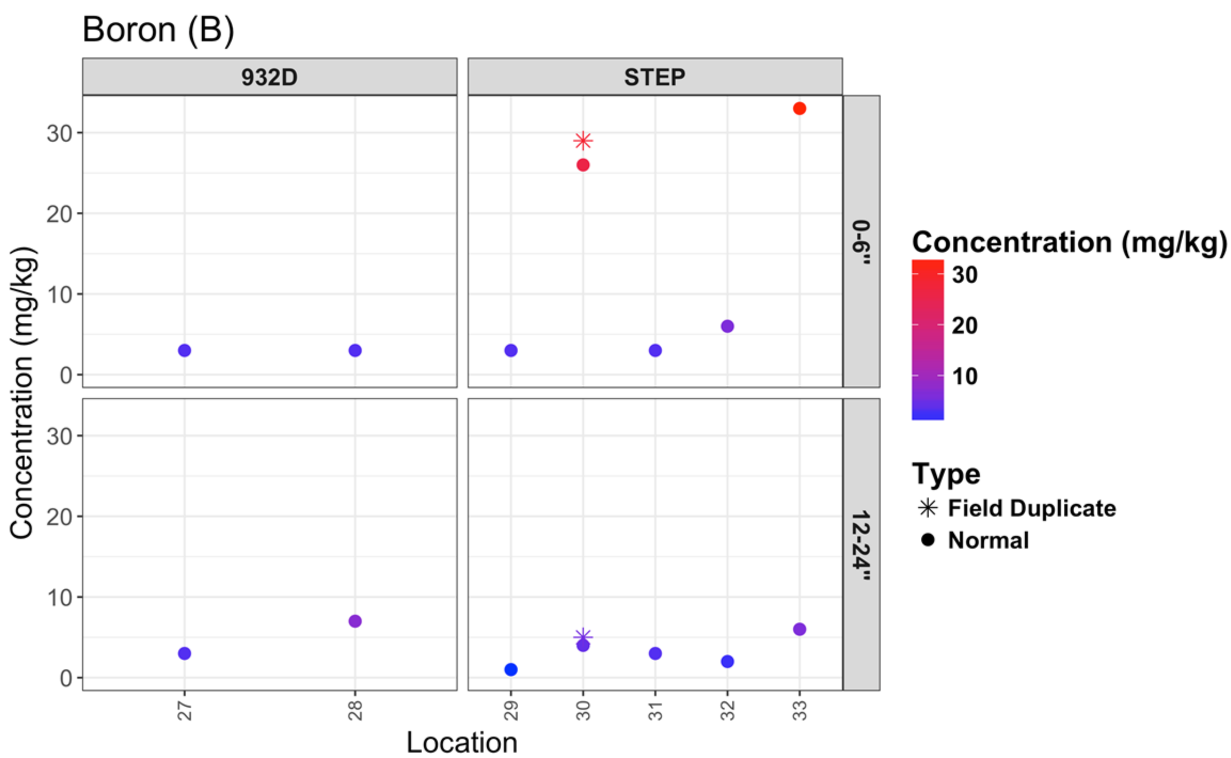


Figure D-3.3 Concentrations of boron (mg/kg) at each soil sampling location, displayed by the northing and easting relative to an origin for the NAD 1983 State Plane system for Montana. The top plot is paneled by depth only, and the bottom plot is paneled by depth and area to zoom in on each sampling area.



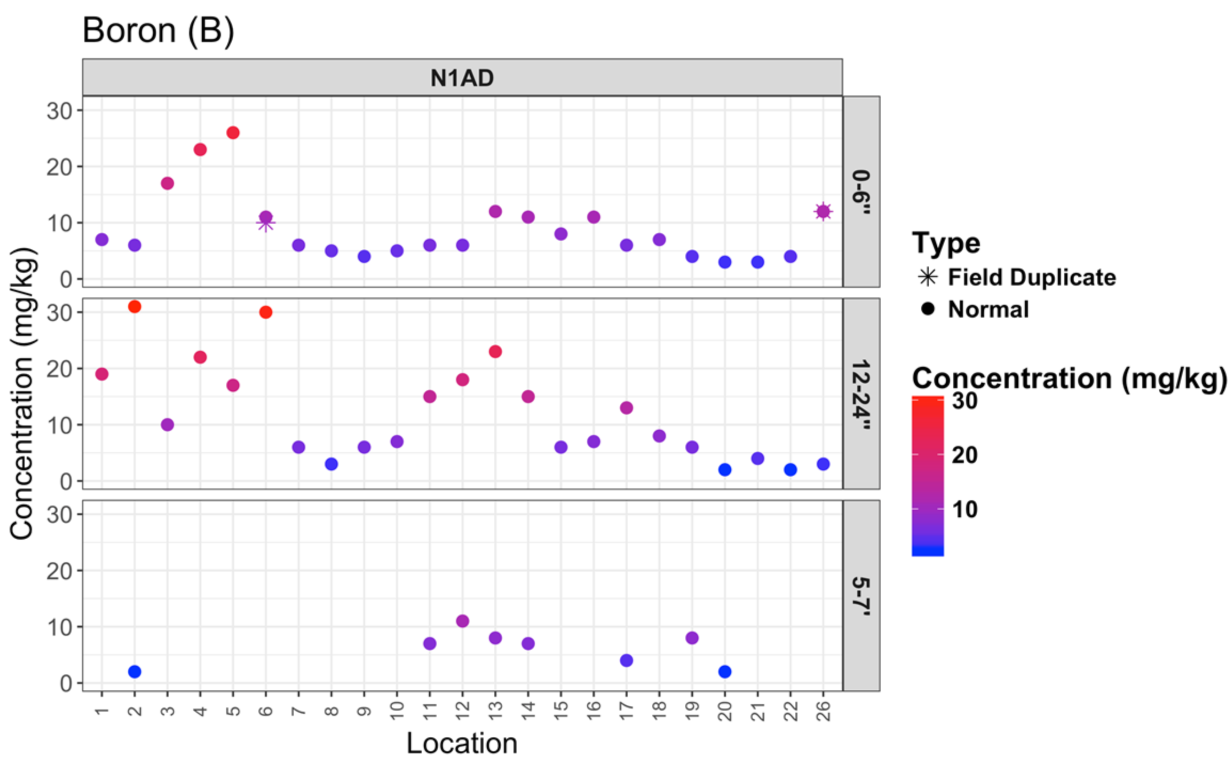


Figure D-3.4. Concentrations of boron (mg/kg) by depth category and location in soil sampling area 932D (top plot, left column), STEP (top plot, right column), and N1AD (bottom plot).

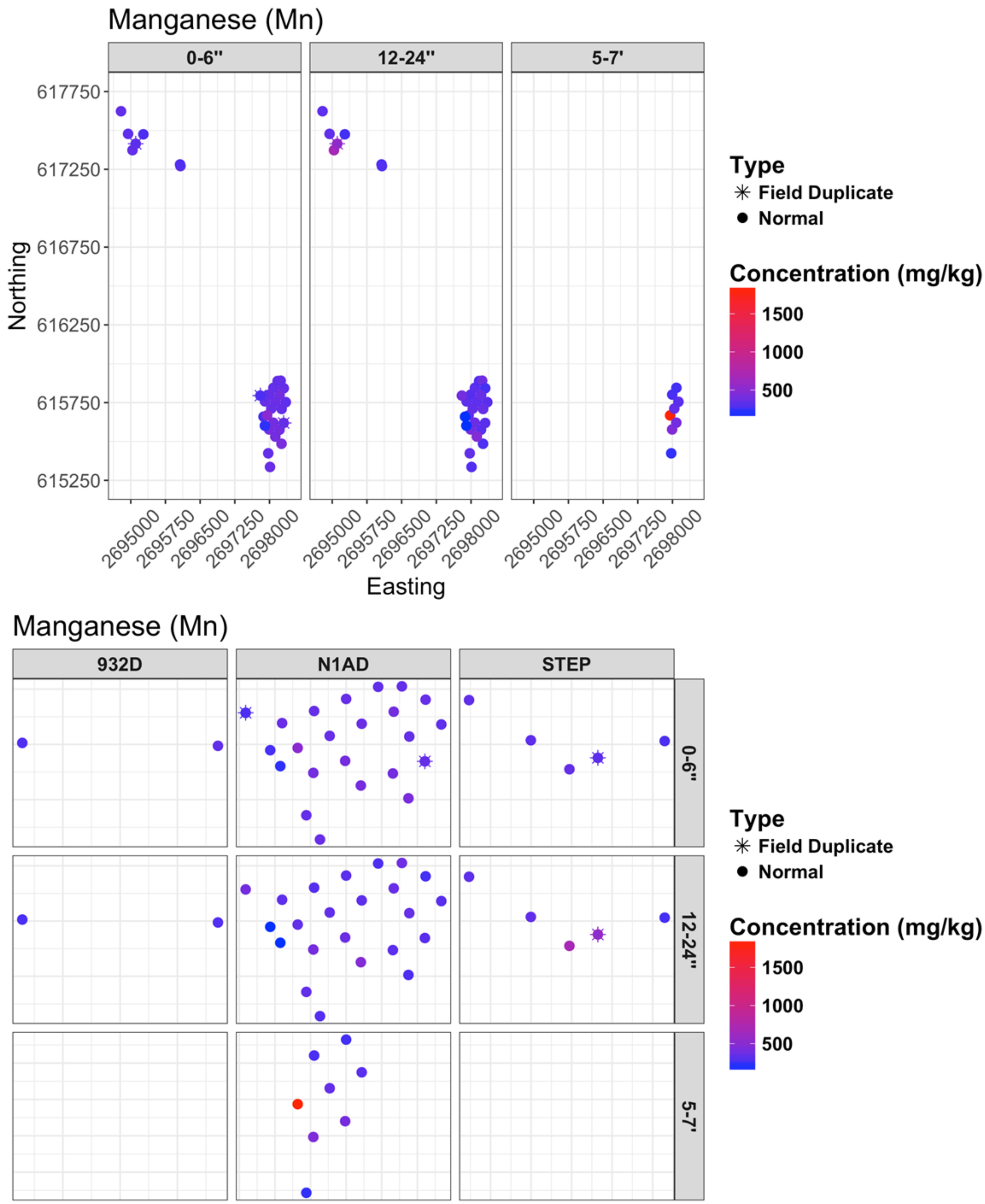


Figure D-3.5. Concentrations of manganese (mg/kg) at each soil sampling location, displayed by the northing and easting relative to an origin for the NAD 1983 State Plane system for Montana. The top plot is paneled by depth only, and the bottom plot is paneled by depth and area to zoom in on each sampling area.

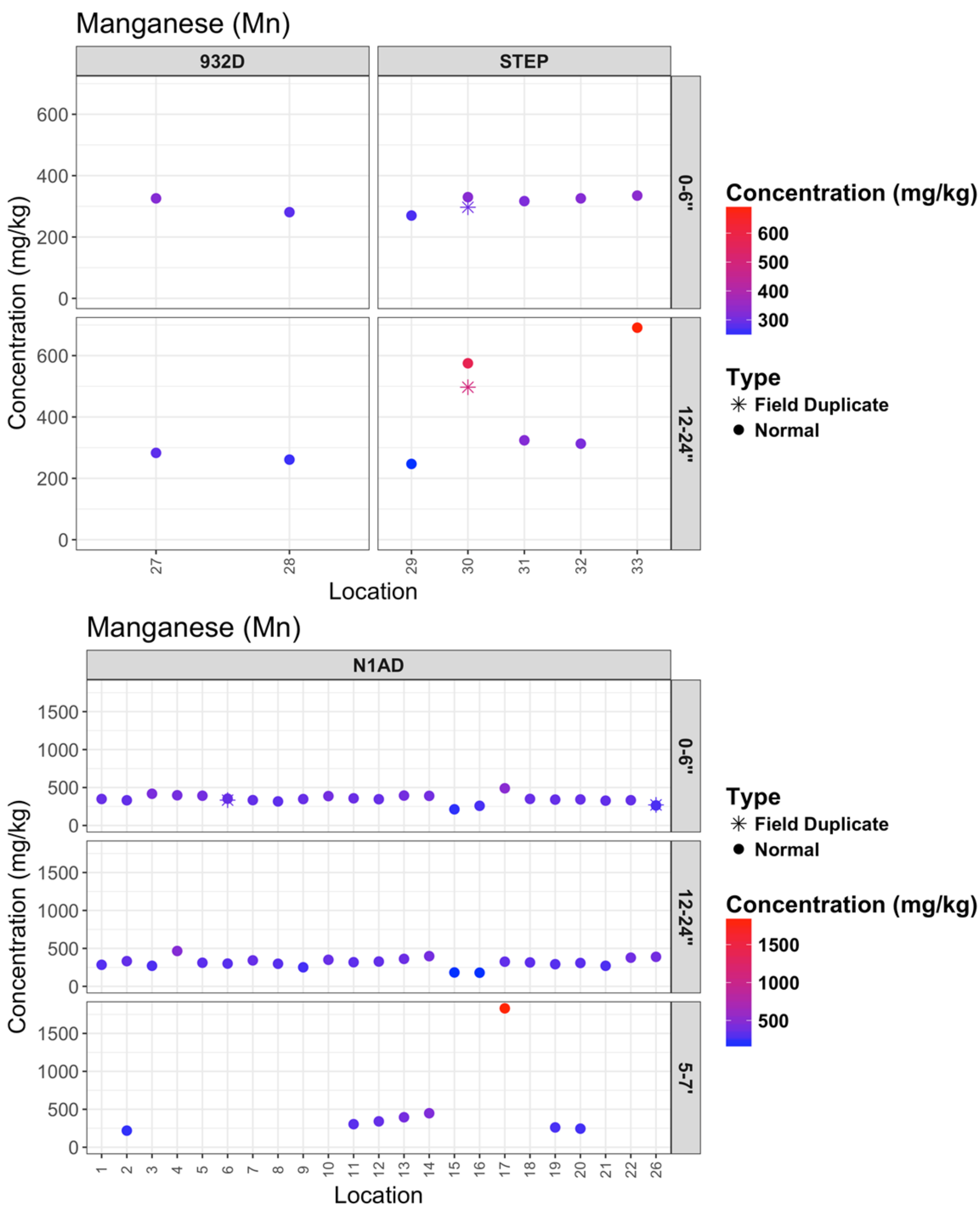


Figure D-3.6. Concentrations of manganese (mg/kg) by depth category and location in soil sampling area 932D (top plot, left column), STEP (top plot, right column), and N1AD (bottom plot).

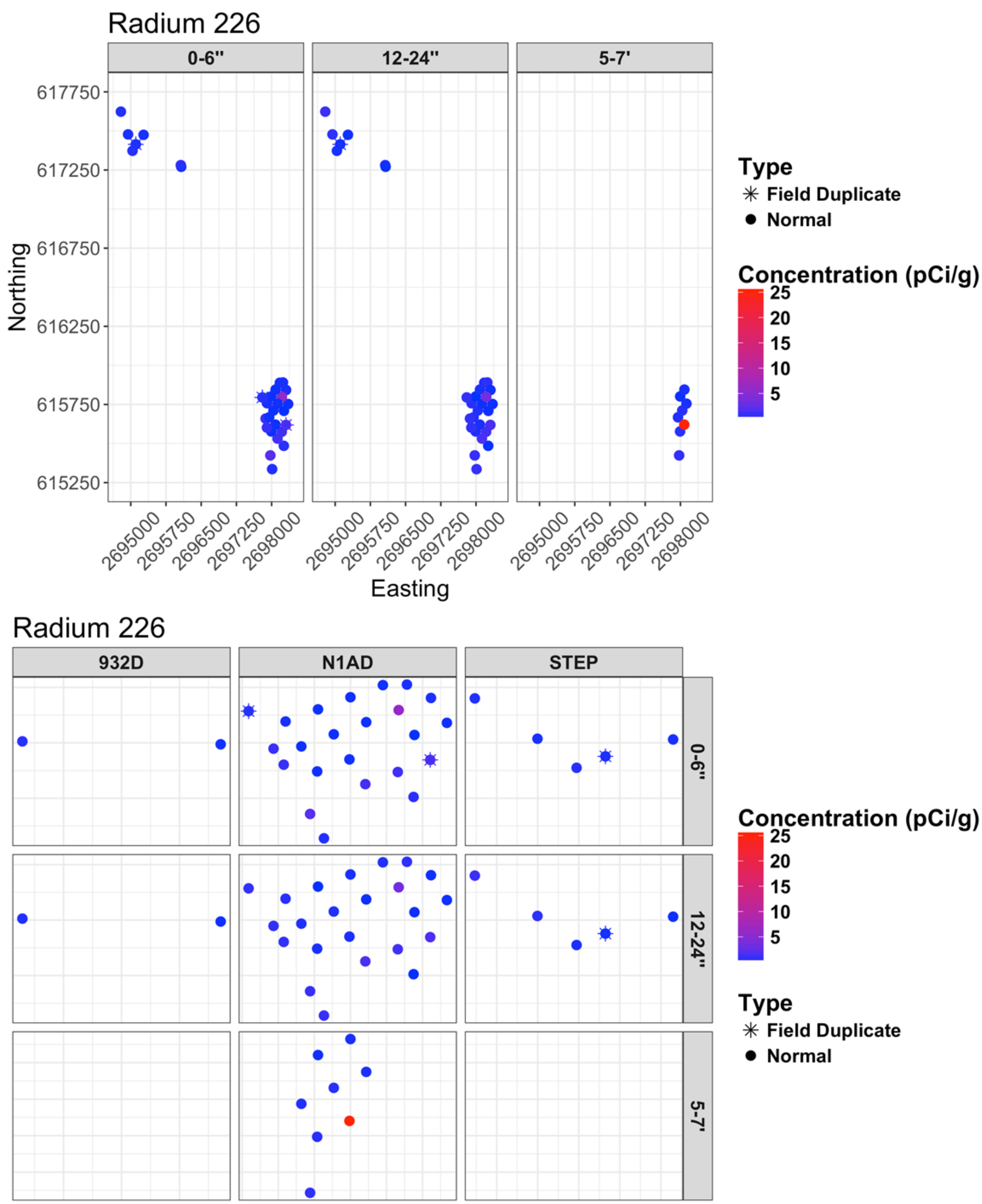


Figure D-3.7. Concentrations of radium 226 (pCi/g) at each soil sampling location, displayed by the northing and easting relative to an origin for the NAD 1983 State Plane system for Montana. The top plot is paneled by depth only, and the bottom plot is paneled by depth and area to zoom in on each sampling area.

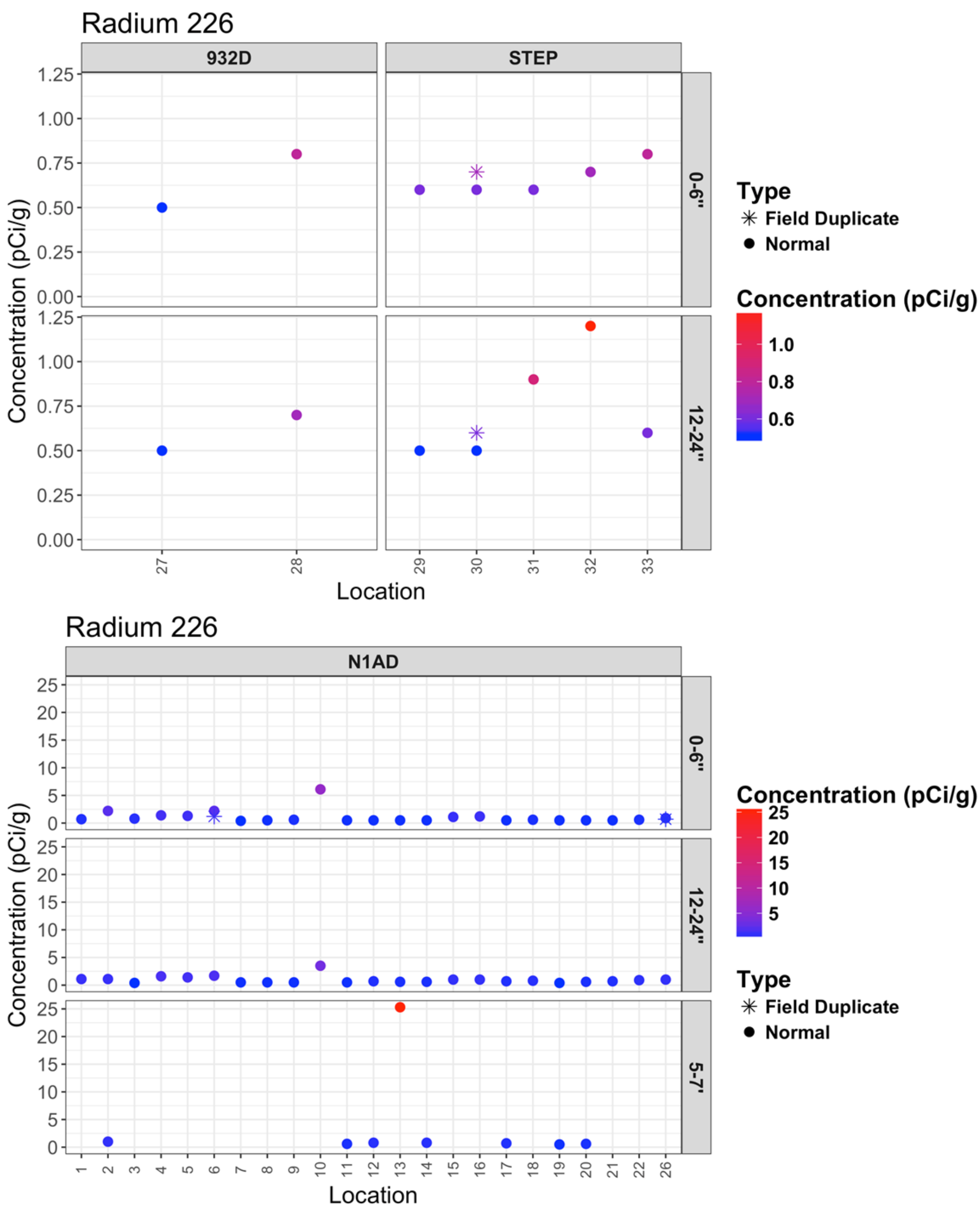


Figure D-3.8. Concentrations of radium 226 (pCi/g) by depth category and location in soil sampling area 932D (top plot, left column), STEP (top plot, right column), and N1AD (bottom plot).

Appendix E

Data Used in the Risk Assessment Work Plan

Table E-1
Colstrip Units 1&2 SOEP and STEP Area, EU 5
Surface Water Data Used in the HHRA (Total Metals)
2014 and 2015

Sample Location	Date	Al mg/L	As mg/L	Be mg/L	B mg/L	Cd mg/L	Cu mg/L	Pb mg/L	Mn mg/L	Hg mg/L	Ni mg/L	Se mg/L	Sr mg/L	Tl mg/L	V mg/L	Zn mg/L	Ca (DIS) mg/L	Mg (DIS) mg/L	Cl mg/L	F mg/L	Sulfate mg/L	pH (Field) std units	TDS mg/L
AR-12	4/8/2014	< 0.05 0.10	0.001	< 0.001	0.63	< 0.0005	< 0.002	< 0.0003	0.198	< 0.00005	0.002	< 0.001	6.23	< 0.0003	< 0.01	< 0.008	271	327	132	0.2	1,950	7.78	3,350
AR-5	4/8/2014	< 0.05 <0.05	< 0.001	< 0.001	0.75	< 0.0005	< 0.002	< 0.0003	0.278	< 0.00005	< 0.002	< 0.001	6.28	< 0.0003	< 0.01	< 0.008	283	330	126	0.2	1,900	7.49	3,210
AR-1	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.19	<0.0005	<0.002	<0.0003	0.035	<0.00005	0.004	<0.001	6.38	<0.0003	<0.01	<0.008	282	329	88	0.2	1,950	7.73	3,270
AR-9	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.14	<0.0005	<0.002	<0.0003	0.028	<0.00005	0.004	<0.001	6.27	<0.0003	<0.01	<0.008	271	311	82	0.2	1,890	7.82	3,180
AR-8	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.18	<0.0005	<0.002	<0.0003	0.057	<0.00005	<0.002	<0.001	6.27	<0.0003	<0.01	0.009	266	304	81	0.2	1,910	7.83	3,240
AR-7	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.26	<0.0005	<0.002	<0.0003	0.077	<0.00005	0.002	<0.001	6.33	<0.0003	<0.01	<0.008	261	321	77	0.2	1,920	7.84	3,200
AR-6	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.21	<0.0005	<0.002	<0.0003	0.105	<0.00005	0.003	<0.001	6.23	<0.0003	<0.01	<0.008	269	310	78	0.3	1,950	7.9	3,290
AR-11	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.25	<0.0005	<0.002	<0.0003	0.134	<0.00005	0.003	<0.001	6.37	<0.0003	<0.01	<0.008	268	331	78	0.3	1,990	7.91	3,290
AR-10PBR	4/8/2014	<0.05 <0.05	<0.001	<0.001	1.32	<0.0005	<0.002	<0.0003	0.132	<0.00005	0.003	0.002	6.64	<0.0003	<0.01	<0.008	278	337	78	0.3	2,050	7.91	3,350
AR-1	9/3/2014																342	383	69		2,080		3,450
AR-10	9/3/2014																332	442	83		2,330		3,940
AR-12	10/16/2014	0.015 0.038	0.002	< 0.002	0.72	<0.00003	< 0.002	< 0.0003	0.167	< 0.00005	< 0.002	< 0.001	7.95	< 0.0003	< 0.01	< 0.008	306	402	132	0.3	1,940	7.51	3,770
AR-5	10/16/2014	0.01 0.014	0.001	< 0.002	0.96	--	< 0.002	< 0.0003	0.146	< 0.00005	0.003	< 0.001	8.32	< 0.0003	< 0.01	< 0.008	315	423	170	0.2	2,180	7.38	3,950
AR-1	10/16/2014	<0.009 <0.009	0.001	<0.002	1.30	<0.00003	<0.002	<0.0003	0.689	<0.00005	0.008	<0.001	7.00	<0.0003	<0.01	<0.008	299	339	86	0.3	1,940	7.68	3,370
AR-9	10/16/2014	<0.009 0.019	0.001	<0.002	1.29	<0.00003	<0.002	<0.0003	0.152	<0.00005	0.004	<0.001	6.83	<0.0003	<0.01	<0.008	296	337	74	0.3	1,730	7.67	3,340
AR-8	10/16/2014	<0.009 <0.009	0.001	<0.002	1.25	<0.00003	<0.002	<0.0003	0.153	<0.00005	0.004	<0.001	6.61	<0.0003	<0.01	<0.008	292	342	84	0.3	2,010	7.69	3,420
AR-7	10/16/2014	<0.009 0.05	0.001	<0.002	1.25	<0.00003	<0.002	<0.0003	0.049	<0.00005	0.004	<0.001	6.44	<0.0003	<0.01	<0.008	295	346	82	0.3	2,010	7.64	3,370
AR-6	10/16/2014	<0.009 0.991	0.002	<0.002	1.28	<0.00003	0.003	0.0008	0.140	<0.00005	0.005	<0.001	6.56	<0.0003	<0.01	<0.008	296	353	95	0.3	2,030	7.73	3,330
AR-11	10/16/2014	0.195 0.36	0.002	<0.002	1.40	0.00003	<0.002	<0.0003	0.193	<0.00005	0.005	<0.001	7.28	<0.0003	<0.01	<0.008	309	381	87	0.3	2,110	7.61	3,600
AR-10PBR	10/16/2014	<0.009 0.968	0.002	<0.002	1.36	<0.00003	0.002	0.0009	0.295	<0.00005	0.005	0.001	7.42	<0.0003	<0.01	<0.008	317	402	79	0.3	2,340	7.53	3,800
AR-12	3/19/2015	--- 0.019	0.001	< 0.002	0.41	< 0.00003	< 0.002	< 0.0003	0.078	< 0.00005	< 0.002	< 0.001	6.33	< 0.0003	< 0.01	< 0.008	212	264	37	0.2	1,410	7.94	2,470
AR-5	3/19/2015	--- < 0.009	0.002	< 0.002	0.51	< 0.00003	< 0.002	< 0.0003	0.059	< 0.00005	< 0.002	< 0.001	6.29	< 0.0003	< 0.01	< 0.008	216	265	38	0.2	1,400	7.71	2,460
AR-1	3/19/2015	--- 0.011	0.001	<0.002	0.79	<0.00003	<0.002	<0.0003	0.014	<0.00005	0.003	0.002	5.89	<0.0003	<0.01	<0.008	232	269	50	0.2	1,490	8.02	2,630
AR-9	3/19/2015	--- <0.009	0.001	<0.002	0.78	<0.00003	<0.002	<0.0003	0.012	<0.00005	0.002	<0.001	5.64	<0.0003	<0.01	<0.008	235	272	50	0.2	1,460	8.12	2,630
AR-8	3/19/2015	--- <0.009	0.001	<0.002	0.81	<0.00003	<0.002	<0.0003	0.019	<0.00005	0.002	<0.001	5.67	<0.0003	<0.01	<0.008	236	274	50	0.2	1,440	8.24	2,630
AR-7	3/19/2015	--- 0.023	0.001	<0.002	0.86	<0.00003	<0.002	<0.0003	0.030	<0.00005	0.002	<0.001	5.71	<0.0003	<0.01	<0.008	243	283	49	0.2	1,510	8.16	2,660
AR-6	3/19/2015	--- 0.053	0.001	<0.002	0.88	<0.00003	<0.002	<0.0003	0.036	<0.00005	0.002	<0.001	5.90	<0.0003	<0.01	<0.008	244	288	50	0.2	1,530	10.1	2,670
AR-11	3/19/2015	--- 0.048	0.002	<0.002	0.89	<0.00003	<0.002	<0.0003	0.059	<0.00005	0.003	<0.001	5.84	<0.0003	<0.01	<0.008	251	299	52	0.2	1,580	7.97	2,670
AR-10PBR	3/19/2015	--- 0.019	<0.001	<0.002	0.88	0.00005	<0.002	<0.0003	0.071	<0.00005	0.003	0.001	5.72	<0.0003	<0.01	<0.008	259	311	47	0.2	1,640	8.99	2,760
AR-10PBR (dup)	3/19/2015	--- 0.021	0.001	<0.002	0.91	0.00004	<0.002	<0.0003	0.066	<0.00005	0.003	0.002	5.95	<0.0003	<0.01	0.030	253	306	54	0.2	1,620		2,790

Table E-1
Colstrip Units 1&2 SOEP and STEP Area, EU 5
Surface Water Data Used in the HHRA (Total Metals)
2014 and 2015

Sample Location	Date	Al mg/L	As mg/L	Be mg/L	B mg/L	Cd mg/L	Cu mg/L	Pb mg/L	Mn mg/L	Hg mg/L	Ni mg/L	Se mg/L	Sr mg/L	Tl mg/L	V mg/L	Zn mg/L	Ca (DIS) mg/L	Mg (DIS) mg/L	Cl mg/L	F mg/L	Sulfate mg/L	pH (Field) std units	TDS mg/L
AR-1	3/24/2015																239	291	56		1,530		2,800
AR-10	3/24/2015																269	305	60		1,680		2,970
AR-1	8/28/2015																307	344	60		2,040		3,400
AR-10	8/28/2015																286	437	87		2,670		4,190
AR-12	10/14/2015	-- 24	0.056	<0.002	0.89	0.0006	0.032	0.0233	5.08	<0.0002	0.064	<0.002	11.8	0.0006	0.18	0.706	334	458	239	0.2	1,360	7.97	6,590
AR-5	10/15/2015	--- 11.2	0.058	< 0.002	2.06	0.00042	0.026	0.0192	11.6	< 0.0001	0.030	0.004	8.61	0.0004	0.05	0.202	397	501	87	0.2	2,800	7.85	4,540
AR-1	10/14/2015	--- 0.032	<0.001	<0.002	1.10	<0.00004	<0.002	<0.0003	2.46	<0.00005	0.004	<0.001	6.85	<0.0003	<0.01	<0.008	302	350	55	0.3	1,970	8.27	3,360
AR-1 (dup)	10/14/2015	-- 0.027	<0.001	<0.002	1.23	<0.00004	<0.002	<0.0003	2.30	<0.00005	0.004	<0.001	7.31	<0.0003	<0.01	<0.008	317	364	57	0.3	2,070		3,310
AR-9	10/14/2015	--- 0.009	0.001	<0.002	1.19	<0.00004	<0.002	<0.0003	2.85	<0.00005	0.003	<0.001	7.31	<0.0003	<0.01	<0.008	288	344	53	0.3	1,860	8.39	3,290
AR-8	10/14/2015	--- 0.028	0.001	<0.002	1.17	<0.00004	<0.002	<0.0003	0.209	<0.00005	0.003	<0.001	7.38	<0.0003	<0.01	<0.008	299	366	64	0.3	2,240	8.44	3,250
AR-7	10/14/2015	--- 0.02	<0.001	<0.002	1.21	<0.00004	<0.002	<0.0003	0.104	<0.00005	0.002	<0.001	6.79	<0.0003	<0.01	<0.008	258	315	57	0.3	1,960	8.39	3,380
AR-6	10/14/2015	--- 0.053	0.001	<0.002	1.20	<0.00004	<0.002	<0.0003	0.080	<0.00005	0.003	<0.001	7.25	<0.0003	<0.01	<0.008	295	366	60	0.3	2,050	8.44	3,380
AR-11	10/14/2015	-- 0.033	<0.001	<0.002	1.45	<0.00004	<0.002	<0.0003	0.229	<0.00005	0.004	<0.001	7.56	<0.0005	<0.01	<0.008	303	418	72	0.3	2,260	8.14	3,690
AR-10PBR	10/14/2015	--- 0.54	<0.001	<0.002	1.39	0.00005	<0.002	0.0006	0.391	<0.00005	0.004	0.001	7.93	<0.0003	<0.01	<0.008	317	443	77	0.4	2,480	7.82	4,050

Notes:

--	Standard Not Available, Use MCL if available, or Tapwater Screening Level if MCL not available (DEQ, 2017). Or, data not available/not analyzed.
Al	First number is the dissolved concentration; the second number is the total concentration
DEQ-7	Montana Department of Enviromental Quality, 2017
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
RSL	Regional Screening Level
USEPA	United States Environmental Protection Agency

Table E-2
Colstrip Units 1 & 2 SOEP and STEP AOC Area, EU5
Synoptic Run Sediment Sampling Results Data Used in the HHRA
2014 and 2015

Sample Location	Date	Al mg/kg	As mg/kg	Be mg/kg	B mg/kg	Cd mg/kg	Cu mg/kg	Pb mg/kg	Mn mg/kg	Hg mg/kg	Ni mg/kg	Se mg/kg	Sr mg/kg	Tl mg/kg	V mg/kg	Zn mg/kg	Ca mg/kg	Ca meq/L sat paste	Mg mg/kg	Mg meq/L sat paste	Cl mg/L sat paste	F mg/L sat paste	Sulfate mg/L sat paste	pH std units
AR-12	4/8/2014	2,930	1.4	0.13	13.5	0.08	5.1	3.50	268	< 0.02	5.0	< 0.2	166	< 0.05	6.6	37.8	16,500	28.4	4,100	56.0	149	< 10	4,080	7.4
AR-5	4/8/2014	1020	2.9	0.05	12.3	< 0.05	2	2.3	1,040	< 0.02	2.3	0.7	180	< 0.05	4.1	14.9	12,900	28.0	1,900	85.1	203	<10	6,050	7.5
AR-1	4/8/2014	2,940	2.5	0.16	14.6	<0.05	6.7	4.27	1,380	<0.02	5.5	0.3	234	0.22	7	28.7	24,500	27.1	3,720	65.2	147	12	5,070	7.4
AR-9	4/8/2014	2,810	1.4	0.16	13.0	<0.05	4.7	3.74	1,330	<0.02	5.2	<0.2	113	0.06	6.6	20.7	11,500	27.9	3,630	50.9	128	10	4,080	7.5
AR-8	4/8/2014	2,310	0.5	0.12	11.0	<0.05	5.2	3.15	718	<0.02	3.9	<0.2	376	0.06	4.6	24.1	30,500	27.4	4,010	55.5	120	21	4,110	7.5
AR-7	4/8/2014	3,050	0.8	0.17	10.8	<0.05	5.6	3.78	274	<0.02	4.4	0.2	221	0.06	5.1	24.8	24,500	28.1	4,910	41.7	110	11	3,480	7.4
AR-6	4/8/2014	2,910	1.5	0.17	9.9	<0.05	5.5	4.06	175	<0.02	5.4	0.3	85.9	0.06	6.3	25.3	15,900	26.0	5,640	49.2	138	< 10	3,840	7.7
AR-11	4/8/2014	2,770	1.1	0.16	12.2	<0.05	5.5	3.81	183	<0.02	5.4	0.3	186	0.1	5.6	21.5	20,200	28.4	5,730	63.1	94	17	4,340	7.4
AR-10PBR	4/8/2014	3,410	1.6	0.24	11.6	0.1	7.2	4.92	375	<0.02	6.5	0.4	239	0.1	6.7	24	22,200	26.4	5,720	69.3	106	13	5,350	7.4
AR-12	10/16/2014	4,980	2.8	0.2	15.8	< 0.05	7.4	4.71	534	< 0.1	6.2	0.3	313	0.07	12	127	26,600	27.9	5,710	70.8	230	< 20	4,850	7.5
AR-12 (dup)	10/16/2014	5,700	2.7	0.25	18.8	<0.05	8.1	5.09	564	<0.1	6.7	0.2	266	0.08	11.9	79.6	24,900	28.1	6,010	62.4	160	< 20	4,230	7.6
AR-5	10/16/2014	1,150	12.6	0.06	19.4	< 0.05	6.1	2.89	5,910	< 0.1	2.4	0.5	568	< 0.05	16.8	112	39,500	32.0	2,820	61.6	250	<20	4,170	7.7
AR-1	10/16/2014	2,250	1.7	0.11	13.5	0.09	5.5	3.84	5,580	<0.1	5.7	0.3	309	0.09	14.6	33.4	26,100	29.2	3,750	81.9	165	< 50	5,780	7.6
AR-9	10/16/2014	2,840	1.7	0.21	14.2	<0.05	7.4	5.04	1,190	<0.1	6.9	0.3	166	0.08	9.4	26.3	13,200	25.4	3,510	53.8	139	< 20	4,300	7.7
AR-8	10/16/2014	1,840	0.5	0.10	9.2	<0.05	4.5	2.60	881	<0.1	2.9	0.2	458	0.06	4.8	16.5	35,500	30.4	3,360	82.4	192	< 50	5,770	7.4
AR-7	10/16/2014	2,700	1.0	0.14	10.6	<0.05	5	3.7	377	<0.1	4.3	0.3	212	0.07	5.5	21.5	20,400	30.2	4,230	74.0	202	< 20	5,480	7.4
AR-6	10/16/2014	3,890	1.6	0.23	15.5	<0.05	7.2	4.82	289	<0.1	5.6	0.2	133	0.12	7.8	30.8	16,100	30.5	5,490	67.6	197	< 20	4,680	7.4
AR-11	10/16/2014	3,430	1.4	0.18	10.6	<0.05	6.2	4.28	243	<0.1	5.4	0.3	193	0.13	7.3	25.3	23,500	28.8	6,280	71.3	156	< 20	4,750	7.3
AR-10PBR	10/16/2014	4,040	2.1	0.22	13.9	<0.05	8.2	5.17	383	<0.1	6.4	0.7	231	0.12	8.6	27.3	23,100	30.9	6,130	59.2	149	< 20	5,220	7.3
AR-12	3/19/2015	4,030	2.9	0.27	8.1	0.11	6.3	4.17	700	< 0.1	4.7	0.2	227	0.06	8.4	78	21,400	28.5	4,770	59.7	124	< 5	4,140	7.5
AR-5	3/19/2015	2110	2.8	0.15	18	0.08	5	4.36	1,370	< 0.1	3.9	1.1	353	< 0.05	6.1	27	30,500	29.3	3,390	62.8	105	<5	4,460	7.6
AR-1	3/19/2015	1,550	1.0	0.11	7.7	0.07	3.9	2.52	4,290	<0.1	4.6	0.2	207	0.08	3.9	28	20,600	29.7	3,000	73.0	148	< 10	4,950	7.5
AR-9	3/19/2015	1,930	1.6	0.15	8.3	<0.05	5	3.4	1,710	<0.1	4.4	0.2	120	0.06	4.5	19	10,500	29.3	3,140	56.6	126	< 5	4,030	7.4
AR-8	3/19/2015	4,030	0.9	0.29	8.1	0.15	10.1	6.03	850	<0.1	6.6	0.3	279	0.12	8.2	42	31,700	28.1	7,420	61.5	98	< 5	4,100	7.4
AR-7	3/19/2015	5,910	3.0	0.46	3.2	0.16	12.5	8.04	361	<0.1	10.6	0.3	101	0.12	12.3	38	23,100	28.7	9,300	54.0	80	< 5	3,780	7.4
AR-6	3/19/2015	3,680	2.2	0.28	4.9	0.14	8.3	5.64	206	<0.1	6.7	0.3	74.6	0.09	8.6	37	19,300	25.6	7,850	37.4	95	< 5	3,220	7.4
AR-11	3/19/2015	3,220	1.3	0.26	6.4	0.13	7.3	5.62	209	<0.1	6.9	0.3	173	0.13	8.1	28	23,500	27.2	7,040	59.0	79	< 5	4,470	7.4
AR-10PBR	3/19/2015	4,210	2.5	0.34	8.3	0.15	8.5	6.51	536	<0.1	7.8	0.4	326	0.12	9.7	33.0	31,400	27.8	7,600	71.1	95	< 10	5,020	7.6
AR-10PBR (dup)	3/19/2015	3,840	1.3	0.31	9.6	0.15	10.2	6.6	430	<0.1	7.2	0.4	266	0.11	9.6	30	31,400	25.0	7,600	76.8	112	< 10	5,210	7.6
AR-12	10/15/2015	4,120	2.2	0.22	17.8	0.14	6.4	4.68	637	< 0.1	6.5	< 0.2	354	< 0.05	9.9	44.9		28.2		78.4	324	< 10	5,330	7.6
AR-5	10/15/2015	1,650	3	0.11	16.4	0.08	3.8	3.47	1,860	< 0.1	3.9	0.5	349	< 0.05	7	17.7		28.4		63.4	166	<10	4,880	7.7
AR-1	10/15/2015	5,270	1.2	0.33	9.8	0.21	8.5	7.91	334	<0.1	10.6	<0.2	221	0.08	15.2	19.3		26.8		39.2	53	< 5	3,370	7.6
AR-1 (dup)	10/15/2015	4,900	3.5	0.31	9.8	0.22	9.5	7.49	382	<0.1	11.2	<0.2	293	0.08	15.1	18.7		27.0		40.3	52	< 5	3,340	7.7
AR-9	10/15/2015	4,110	2.3	0.25	10.7	0.14	9.1	5.97	939	<0.1	9.0	<0.2	111	0.06	11.4	16.5		26.8		60.2	98	< 10	4,870	7.5
AR-8	10/15/2015	1,700	<0.2	0.10	11.1	0.08	4.9	3.16	549	<0.1	3.5	<0.2	637	<0.05	3.9	16.8		29.4		60.4	118	< 10	4,820	7.6
AR-7	10/15/2015	2,660	1.2	0.18	12.0	0.11	6.7	4.26	372	<0.1	5.6	<0.2	236	<0.05	7.2	15.5		28.0		71.0	131	< 10	5,400	7.4
AR-6	10/15/2015	2,300	0.6	0.15	12.0	0.09	5	4.05	252	<0.1	4.8	<0.2	153	<0.05	5.1	15.8		27.5		70.7	139	< 10	5,490	7.6
AR-11	10/15/2015	2,300	0.6	0.16	11.5	0.12	6	3.98	237	<0.1	5.2	<0.2	231	0.14	5.5	14.8		29.0		73.5	144	< 10	5,580	7.4
AR-10PBR	10/15/2015	3,940	0.8	0.22	13.4	0.16	7.5	5.79	426	<0.1	7.6	0.3	202	0.10	10.0	19.6		24.8		84.1	141	< 10	6,200	7.5

Notes:

mg/kg	milligram per kilogram
meq/L	milliequivalent per liter
sat paste	saturated paste
RSL	Regional Screening Level
USEPA	United States Environmental Protection Agency
NA	Not Applicable/Not Available

Table E-3
Colstrip Units 1 & 2 SOEP and STEP AOC Area, EU6
Former Spill Site near North 1AD - Soil Sampling Results Data Used in the HHRA
2017

Sample Location	Sample Depth	Date	Sb mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Co mg/kg	Pb mg/kg	Li mg/kg	Mn mg/kg	Hg mg/kg	Mo mg/kg	Se mg/kg	Tl mg/kg	Ra 226 pCi/g	Ra 228 pCi/g	pH std units	Ca meq/L sat paste	Mg meq/L sat paste	Cl mg/L sat paste	Sulfate mg/L sat paste	F mg/L sat paste
DP1AD-1	0-6 in	8/16/2017	<1	<40	135	<1	7	<1	18	7	<40	17	349	<1	1	<1	<1	0.7	0.1	7.5	26.4	22	21	2,750	<5
DP1AD-1	12-24 in	8/16/2017	<1	<40	123	<1	19	<1	16	6	<40	16	284	<1	<1	<1	<1	1.1	0.1	8.1	20.7	69.8	48	6,490	<10
DP1AD-2	0-6 in	8/16/2017	<1	<40	111	<1	6	<1	16	7	<40	17	332	<1	1	<1	<1	2.2	0.7	7.6	30.7	10.3	13	1,990	<5
DP1AD-2	12-24 in	8/16/2017	<1	<40	196	<1	31	<1	13	<6	<40	12	332	<1	1	<1	<1	1.1	0.1	7.3	26.8	30.0	11	2,860	<5
DP1AD-2	5-6 ft	8/16/2017	<1	<40	91	<1	2	<1	13	<6	<40	11	219	<1	<1	<1	<1	1	-0.2	8.1	12.0	18.2	19	1,980	<5
DP1AD-3	0-6 in	8/16/2017	<1	<20	133	<1	17	<1	18	7	<20	14	418	<1	<1	<1	<1	0.8	0.6	7.2	21.6	63.4	68	5,800	<10
DP1AD-3	12-24 in	8/16/2017	<1	<20	112	<1	10	<1	15	4	<20	12	271	<1	<1	<1	<1	0.4	0.1	8.4	21.4	147	103	13,300	<10
DP1AD-4	0-6 in	8/16/2017	<1	<40	1,300	<1	23	<1	20	6	<40	14	398	<1	<8	<1	<1	1.4	0.4	7.5	4.33	6.08	53	66	<1
DP1AD-4	12-24 in	8/16/2017	<1	<40	188	<1	22	<1	18	7	<40	13	466	<1	<1	<1	<1	1.6	0.8	8.1	21.4	42.7	24	4,370	<10
DP1AD-5	0-6 in	8/16/2017	<1	<40	403	<1	26	<1	15	<6	<40	13	392	<1	1	<1	<1	1.3	0.5	7.2	8.38	7.54	40	56	<2
DP1AD-5	12-24 in	8/16/2017	<1	<40	139	<1	17	<1	15	<6	<40	12	311	<1	<1	<1	<1	1.4	0.3	7.9	22.7	45.8	65	4,320	<10
DP1AD-6	0-6 in	8/16/2017	<1	<40	278	<1	11	<1	16	6	<40	12	353	<1	<1	<1	<1	2.2	0.5	8.0	22.7	60.3	19	5,040	<10
DP1AD-6 (dup)	0-6 in	8/16/2017	<1	<40	221	<1	10	<1	19	6	<40	12	334	<1	<1	<1	<1	1.2	0.6	7.4	8.16	7.35	37	66	<1
DP1AD-6	12-24 in	8/16/2017	<1	<40	212	<1	30	<1	15	<6	<40	14	300	<1	<1	<1	<1	1.7	0.3	7.6	26.7	37.9	18	3,430	<5
DP1AD-7	0-6 in	8/16/2017	<1	<40	164	<1	6	<1	14	<6	<40	9	334	<1	<1	<1	<1	0.4	0.07	7.8	20.6	26.1	22	2,590	<5
DP1AD-7	12-24 in	8/16/2017	<1	<40	227	<1	6	<1	15	7	<40	11	342	<1	<1	<1	<1	0.5	0.2	7.5	8.83	8.10	14	541	<2
DP1AD-8	0-6 in	8/16/2017	<1	<20	164	<1	5	<1	13	5	<20	9	317	<1	<1	<1	<1	0.5	0.5	7.1	17.8	9.56	23	1,120	<2
DP1AD-8	12-24 in	8/16/2017	<1	<20	200	<1	3	<1	12	5	<20	8	298	<1	<1	<1	<1	0.5	0.4	7.4	19.7	17.3	14	1,950	<5
DP1AD-9	0-6 in	8/16/2017	<1	<20	166	<1	4	<1	14	6	<20	10	348	<1	<1	<1	<1	0.6	0.5	7.5	28.5	16.7	32	2,110	<5
DP1AD-9	12-24 in	8/16/2017	<1	<20	158	<1	6	<1	11	5	<20	8	251	<1	<1	<1	<1	0.5	0.5	8.5	22.2	141	66	10,400	<10
DP1AD-10	0-6 in	8/16/2017	<1	<40	147	<1	5	<1	17	7	<40	11	387	<1	<1	<1	<1	6.1	0.2	7.5	4.71	3.26	16	80	<1
DP1AD-10	12-24 in	8/16/2017	<1	<40	190	<1	7	<1	18	7	<40	14	350	<1	<1	<1	<1	3.5	0.3	7.7	24.4	36.1	25	3,360	<5
DP1AD-11	0-6 in	8/16/2017	<1	<40	131	<1	6	<1	15	6	<40	10	358	<1	<1	<1	<1	0.5	1	7.1	14.3	9.99	48	714	<2
DP1AD-11	12-24 in	8/16/2017	<1	<40	157	<1	15	<1	13	6	<40	11	318	<1	<1	<1	<1	0.5	0.2	8.1	21.6	120	58	10,600	<10
DP1AD-11	5-6 ft	8/16/2017	<1	<40	92	<1	7	<1	12	<6	<40	11	304	<1	<1	<1	<1	0.6	0.3	8	23.6	35.4	23	3,640	<5
DP1AD-12	0-6 in	8/16/2017	<1	<40	139	<1	6	<1	14	6	<40	11	346	<1	<1	<1	<1	0.5	0.2	7.2	7.43	7.89	16	81	<1
DP1AD-12	12-24 in	8/16/2017	<1	<40	174	<1	18	<1	12	<6	<40	11	327	<1	<1	<1	<1	0.7	0.6	8.0	22.7	138	38	10,500	<10
DP1AD-12	5-6 ft	8/16/2017	<1	<40	112	<1	11	<1	16	<6	<40	14	341	<1	<1	<1	<1	0.8	0.6	7.8	24.7	31.9	18	3,380	<5
DP1AD-13	0-6 in	8/16/2017	<1	<40	129	<1	12	<1	15	6	<40	11	394	<1	<1	<1	<1	0.5	0.09	7.0	18.5	19.9	80	1,420	<5
DP1AD-13	12-24 in	8/16/2017	<1	<40	172	<1	23	<1	15	<6	<40	13	362	<1	<1	<1	<1	0.6	0.3	8.5	21.6	155	108	13,100	<10
DP1AD-13	5-6 ft	8/16/2017	<1	<40	178	<1	8	<1	11	<6	<40	11	395	<1	<1	<1	<1	25.3	0.3	8.0	22.5	32.9	24	3,420	<5
DP1AD-14	0-6 in	8/16/2017	<1	<20	192	<1	11	<1	17	6	<20	10	390	<1	<1	<1	<1	0.5	0.8	7.6	27.7	38.2	70	3,800	<5
DP1AD-14	12-24 in	8/16/2017	<1	<20	138	<1	15	<1	16	6	<20	12	398	<1	<1	<1	<1	0.6	1.6	8.4	21.2	94.0	76	8,210	<10
DP1AD-14	5-6 ft	8/16/2017	<1	<20	135	<1	7	<1	14	6	<20	11	448	<1	1	<1	<1	0.8	0.5	8.0	23.9	36.0	21	3,730	<5
DP1AD-15	0-6 in	8/16/2017	<1	<40	122	<1	8	<1	16	<6	<40	13	213	<1	<1	<1	<1	1.1	-0.08	7.9	21.5	40.1	91	3,820	<5
DP1AD-15	12-24 in	8/16/2017	<1	<40	118	<1	6	<1	16	<5	<40	13	183	<1	1	<1	<1	1.0	-0.3	8.1	9.80	17.3	26	1,780	<5
DP1AD-16	0-6 in	8/16/2017	<1	<40	133	<1	11	<1	17	<6	<40	14	259	<1	1	<1	<1	1.2	-0.6	8.0	19.5	36.9	37	4,340	<10
DP1AD-16	12-24 in	8/16/2017	<1	<40	141	<1	7	<1	17	<6	<40	14	180	<1	<1	<1	<1	1	0.1	8.0	11.3	19.8	23	2,010	<5
DP1AD-17	0-6 in	8/16/2017	<1	<20	146	<1	6	<1	16	4	<20	11	490	<1	1	<1	<1	0.5	1	7.6	26.9	35.0	25	3,350	<5
DP1AD-17	12-24 in	8/16/2017	<1	<20	161	<1	13	<1	14	6	<20	11	325	<1	1	<1	<1	0.7	0.5	8.4	21.8	120	50	8,560	<10
DP1AD-17	6-7 ft	8/16/2017	<1	<20	176	<1	4	<1	11	13	<20	8	1,830	<1	<4	<1	<1	0.7	0.4	8.2	13.2	23.3	28	2,440	<5
DP1AD-18	0-6 in	8/16/2017	<1	<20	138	<1	7	<1	15	6	<20	10	350	<1	<1	<1	<1	0.6	1.3	7.7	20.3	18.2	19	1,730	<2
DP1AD-18	12-24 in	8/16/2017	<1	<20	176	<1	8	<1	14	5	<20	10	315	<1	<1	<1	<1	0.8	0.7	8.3	22.3	88.8	28	7,060	<10
DP1AD-19	0-6 in	8/16/2017	<1	<20	119	<1	4	<1	15	6	<20	10	341	<1	<1	<1	<1	0.5	0.5	7.4	8.12	5.12	22	151	<1
DP1AD-19	12-24 in	8/16/2017	<1	<20	179	<1	6	<1	13	5	<20	10	292	<1	<1	<1	<1	0.4	0.3	8.5	22.2	154	92	10,900	<10
DP1AD-19	5-6 ft	8/16/2017	<1	<20	105	<1	8	<1	13	5	<20	11	261	<1	<1	<1	<1	0.5	-0.03	8.3	23.0	69.6	24	5,750	<10
DP1AD-20	0-6 in	8/16/2017	<1	<20	146	<1	3	<1	14	6	<20	9	343	<1	<1	<1	<1	0.5	1.2	7.4	7.03	3.78	20	29	<1
DP1AD-20	12-24 in	8/16/2017	<1	<20	218	<1	2	<1	10	5	<20	8	308	<1	1	<1	<1	0.6	0.6	7.8	24.0	38.2	40	3,350	<5
DP1AD-20	5-6 ft	8/16/2017	<1	<20	194	<1	2	<1	12	5	<20	7	245	<1	<1	<1	<1	0.6	0.7	8.0	14.9	21.5	39	2,250	<5
DP1AD-21	0-6 in	8/16/2017	<1	<20	175	<1	3	<1	12	5	<20	8	327	<1	<1	<1	<1	0.5	0.8	7.4	5.56	3.42	38	38	<1
DP1AD-21	12-24 in	8/16/2017	<1	<20	167	<1	4	<1	11	5	<20	8	271	<1	1	<1	<1	0.7	1.6	8.5	22.8	111	66	8,680	<10
DP1AD-22	0-6 in	8/16/2017	<1	<20	185	<1	4	<1	14	6	<20	10	333	<1	<1	<1	<1	0.6	3.0	7.6	6.67	3.63	42	80	<1
DP1AD-22	12-24 in	8/16/2017	<1	<20	259	<1	2	<1	12	7	<20	7	378	<1	1	<1	<1	0.9	2.4	8.1	25.4	66.4	98	5,510	<10
DP1AD-26	0-6 in	8/16/2017	<1	<40	141	<1	12	<1	16	6	<40	14	264	<1	<1	<1	<1	0.9	-0.02	7.7	24.7	44.8	44	3,900	<5
DP1AD-26 dup	0-6 in	8/16/2017	<1	<40	143	<1	12	<1	17	6	<40	15	271	<1	<1	<1	<1	0.7	0.08	7.8	24.8	45.5	45	4,020	<5
DP1AD-26	12-24 in	8/16/2017	<1	<40	130	<1	3	<1	16	<6	<40	15	389	<1	<1	<1	<1	1	0.8	8.1	25.2	38.5	30	3,740	<2

Notes:

mg/kg	milligram per kilogram
meq/L	milliequivalent per liter
pCi/g	picoCurie/gram
sat paste	saturated paste
RSL	Regional Screening Level
USEPA	United States Environmental Protection Agency
NA	Not Applicable/Not Available

Table E-4
Colstrip Units 1 & 2 SOEP and STEP AOC Area, EU7
Former Spill Site near STEP Main Dam - Soil Sampling Results Data Used in the HHRA
2017

Sample Location	Sample Depth	Date	Sb mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Co mg/kg	Pb mg/kg	Li mg/kg	Mn mg/kg	Hg mg/kg	Mo mg/kg	Se mg/kg	Tl mg/kg	Ra 226 pCi/g	Ra 228 pCi/g	pH std units	Ca meq/L sat paste	Mg meq/L sat paste	Cl mg/L sat paste	Sulfate mg/L sat paste	F mg/L sat paste
MDE-29	0-6 in	8/16/2017	<1	<20	108	<1	3	<1	12	5	<20	9	270	<1	<1	<1	<1	0.6	0.6	7.4	8.00	2.21	14	77	<1
MDE-29	12-24 in	8/16/2017	<1	<20	86	<1	1	<1	11	4	<20	8	247	<1	<1	<1	<1	0.5	0.9	7.8	2.57	1.24	4	34	<0.5
MDE-30	0-6 in	8/16/2017	<1	<20	608	<1	26	<1	12	5	<20	15	330	<1	1	<1	<1	0.6	0.7	7.4	20.6	16.6	29	1,780	<2
MDE-30 dup	0-6 in	8/16/2017	<1	<20	540	<1	29	<1	12	5	<20	16	297	<1	<4	<1	<1	0.7	0.6	7.7	22.7	18.9	30	2,050	<5
MDE-30	12-24 in	8/16/2017	<20	<20	237	<1	4	<1	12	6	<20	9	575	<1	1	<1	<1	0.5	0.5	7.9	25.1	33.7	14	3,210	<5
MDE-30 dup	12-24 in	8/16/2017	<1	<20	250	<1	5	<1	13	6	<20	9	497	<1	<4	<1	<1	0.6	0.5	7.8	25.1	33.7	14	3,210	<5
MDE-31	0-6 in	8/16/2017	<1	<20	149	<1	3	<1	12	6	<20	9	317	<1	<1	<1	<1	0.6	1.1	7.4	16.9	14.4	36	1,450	<2
MDE-31	12-24 in	8/16/2017	<1	<20	150	<1	3	<1	13	6	<20	9	324	<1	<1	<1	<1	0.9	0.5	7.6	16.2	26	10	2,270	<5
MDE-32	0-6 in	8/16/2017	<1	<20	207	<1	6	<1	13	5	<20	10	326	<1	<1	<1	<1	0.7	0.5	7.5	28.6	32.0	49	3,080	<5
MDE-32	12-24 in	8/16/2017	<1	<20	107	<1	2	<1	15	8	12	8	313	<1	1	<1	<1	1.2	0.7	7.5	8.83	7.02	29	710	<2
MDE-33	0-6 in	8/16/2017	<1	<20	731	<1	33	<1	11	5	<20	15	335	<1	<4	<1	<1	0.8	0.9	7.4	19.2	15.2	49	1,450	<2
MDE-33	12-24 in	8/16/2017	<1	<20	246	<1	6	<1	11	5	<20	8	691	<1	1	<1	<1	0.6	0.6	7.6	5.00	5.58	14	403	<1

Notes:

mg/kg	milligram per kilogram
meq/L	milliequivalent per liter
pCi/g	picoCurie per gram
sat paste	saturated paste
RSL	Regional Screening Level
USEPA	United States Environmental Protection Agency
NA	Not Applicable/Not Available

Table E-5
Colstrip Units 1 & 2 SOEP and STEP AOC Area, EU8
Former Spill Site near Capture Well 932D - Soil Sampling Results Data Used in the HHRA
2017

Sample Location	Sample Depth	Date	Sb mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	B mg/kg	Cd mg/kg	Cr mg/kg	Co mg/kg	Pb mg/kg	Li mg/kg	Mn mg/kg	Hg mg/kg	Mo mg/kg	Se mg/kg	Tl mg/kg	Ra 226 pCi/g	Ra 228 pCi/g	pH std units	Ca meq/L sat paste	Mg meq/L sat paste	Cl mg/L sat paste	Sulfate mg/L sat paste	F mg/L sat paste
932D-S-27	0-6 in	8/16/2017	<1	<20	140	<1	3	<1	15	6	<20	9	326	<1	<1	<1	<1	0.5	0.4	7.5	5.50	3.15	16	13	<1
932D-S-27	12-24 in	8/16/2017	<1	<20	124	<1	3	<1	15	6	<20	9	283	<1	<1	<1	<1	0.5	0.7	7.6	4.02	4.55	8	13	<1
932D-S-28	0-6 in	8/16/2017	<1	<20	122	<1	3	<1	16	6	<20	10	281	<1	<1	<1	<1	0.8	1.1	7.5	4.17	4.29	17	57	<1
932D-S-28	12-24 in	8/16/2017	<1	<20	81	<1	7	<1	15	7	<20	12	261	<1	<4	<1	<1	0.7	0.8	7.7	23.3	43.2	42	3,890	<5

Notes:

mg/kg	milligram per kilogram
meq/L	milliequivalent per liter
pCi/g	picoCurie per gram
sat paste	saturated paste
RSL	Regional Screening Level
USEPA	United States Environmental Protection Agency
NA	Not Applicable/Not Available

Appendix F

Federal CCR Rule Baseline Monitoring Data

Appendix F

Colstrip SES Federal CCR Rule Groundwater Draft Baseline Monitoring Data - 2016 Through November 2017

Comparison For Montana DEQ Human Health GW MCLs (If No MCL Listed Then EPA RSL For Tapwater - Ingestion For Child, RSL Limit Was Used)

***Metals analyzed as Total Recoverable (TRC) unless turbidity >10, then metals ran both as Total Recoverable (TRC) and Dissolved (DIS).**

Highlighted Values Exceed MCL or EPA Tapwater RSL

Highlighted Values Are Detection Limits Higher than the MCL or EPA Tapwater RSL

Site Code	Sample Code	Date	ANTIMONY 7440-36-0 mg/L	ARSENIC 7440-38-2 mg/L	BARIUM 7440-39-3 mg/L	BERYLLIUM 7440-41-7 mg/L	BORON 7440-42-8 mg/L	CADMIUM 7440-43-9 mg/L	CALCIUM 7440-70-2 mg/L	CHROMIUM 7440-47-3 mg/L	COBALT 7440-48-4 mg/L	FLUORIDE 16984-48-8 mg/L	IRON 7439-89-6 mg/L	LEAD 7439-92-1 mg/L	LITHIUM 7439-93-2 mg/L	MANGANESE 7439-96-5 mg/L	MERCURY 7439-97-6 mg/L	MOLYBDENUM 7439-98-7 mg/L	pH NA standard units	RADIUM 226/228 7440-14-4 pCi/L	SELENIUM 7782-49-2 mg/L	SULFATE 14808-79-8 mg/L	THALLIUM 7440-28-0 mg/L	TDS NA mg/L
			MCL - 0.006	MCL - 0.01	MCL - 2.0	MCL - 0.004	RSL - 4.0	MCL - 0.005	No MCL/ RSL	MCL - 0.1	RSL - 0.006	MCL - 4.0	RSL - 14.0	MCL - 0.015	RSL - 0.04	RSL - 0.43	MCL - 0.002	RSL - 0.1	No MCL/ RSL	MCL - 5.0	MCL - 0.05	No MCL/ RSL	MCL - 0.002	No MCL/ RSL
Units 1&2 Fly Ash Evap Pond (STEP AREA)																								
2018D	TLN-1602-106-CCR	2/3/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.53	< 0.001	145	< 0.005	< 0.005	0.6	1.51	< 0.001	< 0.1	0.038	< 0.0001	< 0.001	7.3	3.8	< 0.001	1630	< 0.0005	2660
2018D	CTLN-1604-136	4/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.6	< 0.001	163	< 0.005	< 0.005	0.6	2.34	< 0.001	0.1	0.033	< 0.0001	< 0.001	7.4	3.1	< 0.001	1650	< 0.0005	2780
2018D	CTLN-1606-333	6/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.56	< 0.001	162	< 0.005	< 0.005	0.6	2.6	< 0.001	0.1	0.039	< 0.0001	< 0.001	7.4	1.9	< 0.001	1660	< 0.0005	2770
2018D	CTLN-1607-328	7/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.57	< 0.001	197	< 0.005	< 0.005	0.6	2.43	< 0.001	< 0.1	0.042	< 0.0001	< 0.001	7.3	3.2	< 0.001	1640	< 0.0005	2680
2018D	CTLN-1608-315	8/29/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.57	< 0.001	163	< 0.005	< 0.005	0.5	2.25	< 0.001	< 0.1	0.04	< 0.0001	< 0.001	7.3	5.1	< 0.001	1770	< 0.0005	2720
2018D	CTLN-1611-310	11/14/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.54	< 0.001	155	< 0.005	< 0.005	0.5	2.25	< 0.001	0.1	0.04	< 0.0001	0.001	7.3	4	< 0.002	1660	< 0.0005	2730
2018D	CTLN-1701-300	1/9/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.55	< 0.001	156	< 0.005	< 0.005	0.5	2.48	< 0.001	< 0.1	0.043	< 0.0001	< 0.001	7.4	3.3	< 0.002	1740	< 0.0005	2730
2018D	CTLN-1702-307	2/21/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.57	< 0.001	160	< 0.005	< 0.005	0.6	2.2	< 0.001	< 0.1	0.043	< 0.0001	< 0.001	7.4	3.8	< 0.002	1680	< 0.0005	2780
2018D	CTLN-1704-311	4/13/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.47	< 0.001	147	< 0.005	< 0.005	0.6	2.1	< 0.001	< 0.1	0.044	< 0.0001	< 0.001	7.4	3.1	< 0.002	1680	< 0.0005	2620
2018D	CTLN-1708-333	8/3/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.53	< 0.001	169	< 0.005	< 0.005	0.6	2.42	< 0.001	< 0.1	0.045	< 0.0001	< 0.001	7.3	2.6	< 0.001	1730	< 0.0005	2760
2019D	CTLN-1604-112	4/7/2016	< 0.001	< 0.001	< 0.05	< 0.001	9.55	< 0.001	313	< 0.005	< 0.005	0.2	0.03	< 0.001	0.1	0.203	< 0.0001	0.003	7.3	1.2	0.006	3100	< 0.0005	5020
2019D	CTLN-1605-215	5/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	8.1	< 0.001	463	< 0.005	< 0.005	0.2	0.03	< 0.001	0.1	0.137	< 0.0001	0.005	7.3	1	0.006	3060	< 0.0005	4970
2019D	CTLN-1607-311	7/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	7.92	< 0.001	453	< 0.005	< 0.005	0.2	< 0.02	< 0.001	0.1	0.175	< 0.0001	0.004	7.3	0.7	0.005	3430	< 0.0005	5620
2019D	CTLN-1609-331	9/1/2016	< 0.001	< 0.001	< 0.05	< 0.001	7.38	< 0.001	433	< 0.005	< 0.005	0.2	0.06	< 0.001	0.1	0.21	< 0.0001	0.003	7.3	2.9	0.005	3350	< 0.0005	5100
2019D	CTLN-1611-311	11/14/2016	< 0.001	< 0.001	< 0.05	< 0.001	9.01	< 0.001	411	< 0.005	< 0.005	0.2	0.04	< 0.001	0.2	0.327	< 0.0001	0.003	7.3	1.2	< 0.004	3460	0.0011	5400
2019D	CTLN-1701-308	1/11/2017	< 0.001	< 0.002	< 0.05	< 0.001	7.5	< 0.001	417	< 0.005	< 0.005	0.2	< 0.04	< 0.001	< 0.1	0.191	< 0.0001	0.003	7.2	1.3	0.004	3650	< 0.0005	5600
2019D	CTLN-1702-305	2/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	8.22	< 0.001	417	< 0.005	< 0.005	0.2	< 0.02	< 0.001	0.1	0.178	< 0.0001	0.003	7.3	2	0.004	3240	< 0.0005	5200
2019D	CTLN-1704-326	4/19/2017	< 0.001	0.001	< 0.05	< 0.001	9.39	< 0.001	425	< 0.005	< 0.005	0.2	< 0.02	< 0.001	0.1	0.208	< 0.0001	0.004	7.3	0.1	0.004	3510	< 0.0005	5160
2019D	CTLN-1708-450	8/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	7.09	< 0.001	380	< 0.005	< 0.005	0.2	< 0.02	< 0.001	< 0.1	0.164	< 0.0001	0.003	7.2	0.5	0.004	3110	< 0.0005	4780
2022D	TLN-1602-104-CCR	2/3/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.3	< 0.001	463	< 0.005	< 0.005	0.2	< 0.03	< 0.001	0.1	0.347	< 0.0001	< 0.001	6.9	2.3	< 0.002	3370	< 0.0005	5080
2022D	CTLN-1604-132	4/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.28	< 0.001	476	< 0.005	< 0.005	0.2	0.1	< 0.001	0.2	0.707	< 0.0001	< 0.001	7.0	1.8	< 0.002	3340	< 0.0005	5300
2022D	CTLN-1605-307	5/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.28	< 0.001	498	< 0.005	< 0.005	0.2	0.14	< 0.001	0.2	0.622	< 0.0001	< 0.001	7.0	3.9	< 0.002	3320	< 0.0005	5260
2022D	CTLN-1607-305	7/12/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.27	< 0.001	496	< 0.005	< 0.005	0.2	0.29	< 0.001	0.2	0.882	< 0.0001	< 0.001	7.0	2.5	< 0.002	3300	< 0.0005	5200
2022D	CTLN-1608-306	8/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.24	< 0.001	485	< 0.005	0.006	0.2	0.24	< 0.001	0.1	0.802	< 0.0001	< 0.001	7.2	3.9	< 0.002	3050	< 0.0005	5330
2022D	CTLN-1611-314	11/15/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.24	< 0.001	471	< 0.005	0.01	0.2	0.26	0.001	0.2	0.923	< 0.0001	< 0.001	7.0	1.1	< 0.004	3430	0.0013	5340
2022D	CTLN-1701-320	1/31/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.23	< 0.001	477	< 0.005	0.011	0.2	0.29	< 0.001	< 0.1	0.94	< 0.0001	< 0.001	7.0	4.4	< 0.002	3750	< 0.0005	5260
2022D	CTLN-1702-310	2/22/2017	< 0.001	< 0.002	< 0.05	< 0.001	0.27	< 0.001	465	< 0.005	0.011	0.2	0.22	< 0.001	0.2	0.85	< 0.0001	0.001	7.0	3.3	< 0.004	3420	< 0.0005	5320
2022D	CTLN-1704-308	4/12/2017	< 0.001	< 0.002	< 0.05	< 0.001	0.21	< 0.001	475	< 0.005	0.01	0.2	0.29	< 0.001	< 0.1	0.803	< 0.0001	< 0.001	7.1	2.7	< 0.004	3420	< 0.0005	5030
2022D	CTLN-1708-421	8/3/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.13	< 0.001	443	< 0.005	0.008	0.2	0.39	< 0.001	< 0.1	0.719	< 0.0001	< 0.001	7	1.6	< 0.001	3460	< 0.0005	5330
2023D	TLN-1602-105-CCR	2/3/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.4	< 0.001	360	< 0.005	< 0.005	< 0.1	< 0.03	< 0.001	< 0.1	0.016	< 0.0001	< 0.001	6.9	2.8	< 0.002	2910	< 0.0005	4790
2023D	CTLN-1604-133	4/20/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.4	< 0.001	380	< 0.005	< 0.005	< 0.1	< 0.05	0.005	0.1	0.024	< 0.0001	< 0.001	7.0	3.1	< 0.002	3000	< 0.0005	5190
2023D	CTLN-1605-308	5/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.42	< 0.001	403	< 0.005	< 0.005	< 0.1	< 0.05	< 0.001	0.2	0.027	< 0.0001	< 0.001	7.0	4.1	< 0.01	2880	< 0.0005	5080
2023D	CTLN-1607-303	7/12/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.38	< 0.001	381	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	0.1	0.026	< 0.0001	< 0.001	7.0	3.5	0.001	2690	< 0.0005	5030
2023D	CTLN-1608-303	8/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.35	< 0.001	391	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	0.1	0.033	< 0.0001	0.001	7.0	4.5	< 0.002	2810	< 0.0005	5080
2023D	CTLN-1611-312	11/15/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.34	< 0.001	349	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	0.2	0.026	< 0.0001	< 0.001	7.0	-2	< 0.002	2950	0.0006	4830
2023D	CTLN-1701-310	1/12/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.35	< 0.001	351	< 0.005	< 0.005	< 0.1	0.02	< 0.001	< 0.1	0.037	< 0.0001	< 0.001	7.0	3.4	< 0.004	2790	< 0.0005	4640
2023D	CTLN-1702-322	2/28/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.33	< 0.001	338	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.034	< 0.0001	< 0.001	7.0	2.3	< 0.002	2800	< 0.0005	4640
2023D	CTLN-1704-317	4/18/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.38	< 0.001	344	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.046	< 0.0001	< 0.001	7	3.3	< 0.002	2720	< 0.0005	4390
2023D	CTLN-1708-424A	8/7/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.27	< 0.001	314	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.052	< 0.0001	< 0.001	7	2.8	< 0.001	2700	< 0.0005	4720
2043D-CCR	CTLN-1604-221	4/28/2016	0.002	0.001	< 0.05	< 0.001	1.28	< 0.001	342	< 0.005	< 0.005	0.2	0.94	< 0.001	0.1	0.215	< 0.0001	0.004	7.2	2.1	< 0.002	2050	< 0.0005	3680
2043D-CCR (Dup)	CTLN-1604-222	4/28/2016	0.002	< 0.001	< 0.05	< 0.001	1.25	< 0.001	321	< 0.005	< 0.005	0.3	0.93	< 0.001	0.1	0.214	< 0.0001	0.005	7.1	2.3	< 0.001	2050	< 0.0005	3620
2043D-CCR	CTLN-1607-306	7/12/2016	< 0.001	0.001	< 0.05	< 0.001	1.43	< 0.001	326	< 0.005	< 0.005	0.2	3.26	< 0.001	< 0.1	0.09	< 0.0001	< 0.001	7.0	9.6	< 0.001	1840	< 0.0005	3260
2043D-CCR	CTLN-1608-359	8/11/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.41	< 0.001	308	< 0.005	< 0.005	0.2	3.71	< 0.001	< 0.1	0.073	< 0.0001	< 0.001	7.0	2.9	< 0.001	2110	< 0.0005	3280
2043D-CCR	CTLN-1608-318	8/30/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.43	< 0.001	322	< 0.005	< 0.005	0.2	3.46	< 0.001	0.1	0.066	< 0.0001	< 0.001	7.0	5.5	< 0.001	1920	< 0.0005	3330
2043D-CCR	CTLN-1611-321	11/17/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.35	< 0.001	305	< 0.005	< 0.005	0.2	3.54	< 0.001	0.1	0.059	< 0.0001	< 0.001	7.0	2.2	< 0.002	1960	< 0.0005	3260
2043D-CCR	CTLN-1701-307	1/11/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.42	< 0.001	312	< 0.005	< 0.005	0.2	3.92	< 0.001	< 0.1	0.059	< 0.0001	< 0.001	7.0	3.8	< 0.002	2010	< 0.0005	3200
2043D-CCR	CTLN-1702-304	2/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.41	< 0.001	319	< 0.005	< 0.005	0.2	3.94	< 0.001	0.1	0.051	< 0.0001	< 0.001	7.0	3.3	< 0.001	2000	< 0.0005	3340
2043D-CCR	CTLN-1704-318	4/18/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.43	< 0.001	317	< 0.005	< 0.005	0.2	3.9	< 0.001	< 0.1	0.054	< 0.0001	< 0.001	7	3.4	< 0.002	1990	< 0.0005	3120
2043D-CCR	CTLN-1708-425	8/7/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.32	< 0.001	296	< 0.005	< 0.005	0.2	3.53	< 0.001	< 0.1	0.046	< 0.0001	< 0.001	7	5.1	< 0.001	2090	< 0.0005	3360
2044D-CCR	CTLN-1604-223	4/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.15	< 0.001	323	< 0.005	< 0.005	0.2	1.47	< 0.001	0.1	0.162	< 0.0001	0.002	7.1	4.8	< 0.001	2040	< 0.0005	3520
2044D-CCR	CTLN-1606-322	6/20/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.15	< 0.001	319	< 0.005	< 0.005	0.2	2.69	< 0.001	0.1	0.07	< 0.0001	< 0.001	6.9	4	< 0.001	2050	< 0.0005	3370
2044D-CCR	CTLN-1607-322	7/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.24	< 0.001	335	< 0.005	< 0.005	0.2	3.34	< 0.001	0.1	0.049	< 0.0001	< 0.001	6.9	3.5	< 0.001	2020	< 0.0005	3380
2044D-CCR	CTLN-1608-319	8/30/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.16	< 0.001	307	< 0.005	< 0.005	0.2	3.23	< 0.001	< 0.1	0.044	< 0.0001	< 0.001	7.0	4	< 0.001	2140	< 0.0005	3350
2044D-CCR	CTLN-1611-322	11/17/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.18	< 0.001	309	< 0.005	< 0.005	0.2	3.53	< 0.001	0.1	0.034	< 0.0001	< 0.001	7.0	1.5	< 0.002	2040	< 0.0005	3360
2044D-CCR	CTLN-1701-309	1/12/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.21	< 0.001	313	< 0.005	< 0.005	0.2	3.69	< 0.001	< 0.1	0.036	< 0.0001	< 0.001	7.0	8.7	< 0.002	2100	< 0.0005	3270
2044D-CCR	CTLN-1702-314	2/23/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.19	< 0.001	303	< 0.005	< 0.005	0.2	3.51	< 0.001	0.1	0.039	< 0.0001	< 0.001	7.0	1.1	< 0.002	1990	< 0.0005	3390
2044D-CCR	CTLN-1704-319	4/18/2017	< 0.001	0.001	< 0.05	< 0.001	1.23	< 0.001	315	< 0.005	< 0.005	0.2	3.59	< 0.001	< 0.1	0.037	< 0.0001	< 0.001	7	7	< 0.002	2100	< 0.0005	3220
2044D-CCR	CTLN-1708-426	8/7/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.2	< 0.001	303	< 0.005	< 0.005	0.2	3.3	< 0.001	< 0.1	0.029	< 0.0001	< 0.001	7	3.7	< 0.001	2260	< 0.0005	3350
2045D-CCR	CTLN-1604-225	4/28/2016	< 0.001 DIS 0.001 TRC	0.002 DIS 0.004 TRC	< 0.05 DIS 0.09 TRC	< 0.001 DIS 0.001 TRC	0.26 DIS 0.26 TRC	< 0.001 DIS < 0.001 TRC	26 DIS 32 TRC	< 0.005 DIS 0.005 TRC	< 0.005 DIS < 0.005 TRC	2.3	0.13 DIS 4.25 TRC	< 0.001 DIS 0.006 TRC	< 0.1 DIS < 0.1 TRC	0.028 DIS 0.086 TRC	< 0.0001 DIS < 0.0001 TRC	0.006 DIS 0.007 TRC	8.1	4	< 0.001 DIS < 0.001 TRC	1770	< 0.0005 < 0.0005	3120
2045D-CCR	CTLN-1606-312	6/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.25	< 0.001	28	< 0.005	< 0.005	2.1	0.36	< 0.001	< 0.1	0.037	< 0.0001	0.005	8.0	2.7	< 0.001	1810	0.0009	2920
2045D-CCR	CTLN-1607-310	7/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.3	< 0.001	28	< 0.005	< 0.005	2.1	0.13	< 0.001	< 0.1	0.033	< 0.0001	0.009	8.0	0.6	< 0.001	1760	< 0.0005	3130
2045D-CCR	CTLN-1608-309	8/24/2016	< 0.001	0.001	< 0.05	< 0.001	0.26	< 0.001	27	< 0.005	< 0.005	2.1	0.13	< 0.001	< 0.1	0.048	< 0.0001	0.014	8.1	0.5	< 0.001	1670	< 0.0005	3020
2045D-CCR	CTLN-1611-304	11/10/2016	< 0.001	0.002	< 0.05	< 0.001	0.31	< 0.001	24	< 0.005	< 0.005	2.9	0.11	< 0.001	< 0.1	0.069	< 0.0001	0.015	8.0	1.3	< 0.002	1710	< 0.0005	2800
2045D-CCR	CTLN-1701-302	1/10/2017	< 0.001	0.003	< 0.05	< 0.001	0.26	< 0.001	24	< 0.005	< 0.005	2.4	0.96	0.001	< 0.1	0.085	< 0.0001	0.014	8.0	0.8	< 0.002	1720	< 0.0005	2680
2045D-CCR	CTLN-1702-308	2/21/2017	< 0.001	0.002	< 0.05	< 0.001	0.27	< 0.001	21	< 0.005	< 0.005	2.4	0.24	< 0.001	< 0.1	0.059	< 0.0001	0.013	8.1	1.8	< 0.002	1660	< 0.0005	2720
2045D-CCR	CTLN-1704-314	4/17/2017	< 0.001	0.002	< 0.05	< 0.001	0.28	< 0.001	23	< 0.005	< 0.005	2.6	0.16	< 0.001	< 0.1	0.054	< 0.0001	0.012	8	1.1	< 0.002	1660	< 0.0005	2620

Appendix F

Colstrip SES Federal CCR Rule Groundwater Draft Baseline Monitoring Data - 2016 Through November 2017

Comparison For Montana DEQ Human Health GW MCLs (If No MCL Listed Then EPA RSL For Tapwater - Ingestion For Child, RSL Limit Was Used)

***Metals analyzed as Total Recoverable (TRC) unless turbidity >10, then metals ran both as Total Recoverable (TRC) and Dissolved (DIS).**

Highlighted Values Exceed MCL or EPA Tapwater RSL

Highlighted Values Are Detection Limits Higher than the MCL or EPA Tapwater RSL

Site Code	Sample Code	Date	ANTIMONY 7440-36-0 mg/L	ARSENIC 7440-38-2 mg/L	BARIUM 7440-39-3 mg/L	BERYLLIUM 7440-41-7 mg/L	BORON 7440-42-8 mg/L	CADMIUM 7440-43-9 mg/L	CALCIUM 7440-70-2 mg/L	CHROMIUM 7440-47-3 mg/L	COBALT 7440-48-4 mg/L	FLUORIDE 16984-48-8 mg/L	IRON 7439-89-6 mg/L	LEAD 7439-92-1 mg/L	LITHIUM 7439-93-2 mg/L	MANGANESE 7439-96-5 mg/L	MERCURY 7439-97-6 mg/L	MOLYBDENUM 7439-98-7 mg/L	pH NA standard units	RADIUM 226/228 7440-14-4 pCi/L	SELENIUM 7782-49-2 mg/L	SULFATE 14808-79-8 mg/L	THALLIUM 7440-28-0 mg/L	TDS NA mg/L
			MCL - 0.006	MCL - 0.01	MCL - 2.0	MCL - 0.004	RSL - 4.0	MCL - 0.005	No MCL/ RSL	MCL - 0.1	RSL - 0.006	MCL - 4.0	RSL - 14.0	MCL - 0.015	RSL - 0.04	RSL - 0.43	MCL - 0.002	RSL - 0.1	No MCL/ RSL	MCL - 5.0	MCL - 0.05	No MCL/ RSL	MCL - 0.002	No MCL/ RSL
Units 1&2 Fly Ash Evap Pond (STEP AREA) (continued)																								
2045D-CCR	CTLN-1708-338	8/2/2017	< 0.001	0.002	< 0.05	< 0.001	0.23	< 0.001	24	< 0.005	< 0.005	2.6	0.14	< 0.001	< 0.1	0.04	< 0.0001	0.009	8.1	0.6	< 0.001	1810	< 0.0005	2530
2046D-CCR	CTLN-1605-240	5/2/2016	< 0.001 DIS < 0.001 TRC	< 0.001 DIS 0.002 TRC	< 0.05 DIS 0.07 TRC	< 0.001 DIS < 0.001 TRC	0.32 DIS 0.32 TRC	< 0.001 DIS < 0.001 TRC	39 DIS 35 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	1	0.14 DIS 4.10 TRC	< 0.001 DIS 0.005 TRC	< 0.1 DIS < 0.1 TRC	0.062 DIS 0.129 TRC	< 0.0001 DIS < 0.0001 TRC	0.004 DIS 0.003 TRC	8.0	3.6	< 0.001 DIS < 0.004 TRC	1870	< 0.0005 DIS < 0.0005 TRC	3190
2046D-CCR	CTLN-1606-310	6/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.31	< 0.001	34	< 0.005	< 0.005	1	0.14	< 0.001	< 0.1	0.095	< 0.0001	0.004	8.0	1.7	< 0.001	1860	0.0013	3130
2046D-CCR	CTLN-1607-309	7/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.31	< 0.001	33	< 0.005	< 0.005	1.1	0.11	< 0.001	< 0.1	0.086	< 0.0001	0.003	8.0	1.3	< 0.001	1880	< 0.0005	3290
2046D-CCR	CTLN-1608-308	8/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.3	< 0.001	35	< 0.005	< 0.005	1.1	0.11	< 0.001	< 0.1	0.102	< 0.0001	0.002	7.9	1.6	< 0.001	1770	< 0.0005	3250
2046D-CCR	CTLN-1611-303	11/10/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.32	< 0.001	32	< 0.005	< 0.005	1.1	0.04	< 0.001	0.1	0.099	< 0.0001	0.001	8.0	1.6	< 0.002	1920	< 0.0005	3160
2046D-CCR	CTLN-1701-303	1/10/2017	< 0.001	0.002	< 0.05	< 0.001	0.25	< 0.001	32	< 0.005	< 0.005	1.3	0.64	< 0.001	< 0.1	0.104	< 0.0001	< 0.001	7.9	0.9	< 0.004	1940	< 0.0005	3130
2046D-CCR	CTLN-1702-301	2/15/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.27	< 0.001	31	< 0.005	< 0.005	1.3	0.16	< 0.001	< 0.1	0.088	< 0.0001	< 0.001	7.9	1.4	< 0.002	1930	< 0.0005	3110
2046D-CCR	CTLN-1704-304	4/11/2017	< 0.001	0.001	< 0.05	< 0.001	0.25	< 0.001	32	< 0.005	< 0.005	1.2	0.08	< 0.001	< 0.1	0.084	< 0.0001	< 0.001	8	1.2	< 0.002	1960	< 0.0005	2960
2046D-CCR	CTLN-1708-339	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.23	< 0.001	34	< 0.005	< 0.005	1.3	0.1	< 0.001	< 0.1	0.068	< 0.0001	< 0.001	8	0.05	< 0.001	1880	< 0.0005	3130
2047D-CCR	CTLN-1605-214	5/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.28	< 0.001	27	< 0.005	< 0.005	2.3	0.25	< 0.001	< 0.1	0.033	< 0.0001	< 0.001	8.1	2	< 0.001	1440	< 0.0005	2560
2047D-CCR	CTLN-1606-334	6/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.25	< 0.001	27	< 0.005	< 0.005	2.1	0.09	< 0.001	< 0.1	0.043	< 0.0001	< 0.001	8.1	1.6	< 0.001	1400	< 0.0005	2480
2047D-CCR	CTLN-1607-329	7/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.25	< 0.001	32	< 0.005	< 0.005	2.2	0.05	< 0.001	< 0.1	0.044	< 0.0001	< 0.001	8.1	0.9	< 0.001	1420	< 0.0005	2420
2047D-CCR	CTLN-1608-316	8/29/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.24	< 0.001	25	< 0.005	< 0.005	2.2	0.05	< 0.001	< 0.1	0.037	< 0.0001	< 0.001	8.1	1.3	< 0.001	1580	< 0.0005	2480
2047D-CCR	CTLN-1611-325	11/17/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.24	< 0.001	25	< 0.005	< 0.005	2.2	0.04	< 0.001	< 0.1	0.023	< 0.0001	< 0.001	8.1	0.4	< 0.002	1440	< 0.0005	2460
2047D-CCR	CTLN-1701-301	1/10/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.24	< 0.001	26	< 0.005	< 0.005	2.2	0.19	< 0.001	< 0.1	0.027	< 0.0001	< 0.001	8.1	-0.5	< 0.002	1470	< 0.0005	2460
2047D-CCR	CTLN-1702-306	2/21/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.25	< 0.001	25	< 0.005	< 0.005	2.6	0.16	< 0.001	< 0.1	0.024	< 0.0001	< 0.001	8.1	1.1	< 0.002	1470	< 0.0005	2520
2047D-CCR	CTLN-1704-312	4/13/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.22	< 0.001	25	< 0.005	< 0.005	2.3	0.05	< 0.001	< 0.1	0.025	< 0.0001	< 0.001	8.2	1.2	< 0.002	1470	< 0.0005	2420
2047D-CCR	CTLN-1708-340	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.2	< 0.001	28	< 0.005	< 0.005	2.3	0.05	< 0.001	< 0.1	0.022	< 0.0001	< 0.001	8.2	0.6	< 0.001	1500	< 0.0005	2430
2048D-CCR	CTLN-1605-207	5/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.27	< 0.001	273	< 0.005	< 0.005	0.2	1.79	< 0.001	0.1	0.145	< 0.0001	0.005	7.0	6.4	< 0.001	2090	< 0.0005	3570
2048D-CCR	CTLN-1606-328	6/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.38	< 0.001	295	< 0.005	< 0.005	0.2	2.66	< 0.001	0.1	0.079	< 0.0001	0.002	7.0	4.3	< 0.001	1810	< 0.0005	3460
2048D-CCR	CTLN-1607-330	7/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.37	< 0.001	323	< 0.005	< 0.005	0.2	2.94	< 0.001	0.1	0.055	< 0.0001	0.002	7.0	3.2	< 0.001	2140	< 0.0005	3460
2048D-CCR	CTLN-1608-323	8/31/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.33	< 0.001	290	< 0.005	< 0.005	0.2	2.82	< 0.001	0.1	0.039	< 0.0001	< 0.001	7.1	4.3	< 0.001	2260	< 0.0005	3570
2048D-CCR	CTLN-1611-327	11/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.29	< 0.001	281	< 0.005	< 0.005	0.2	2.97	< 0.001	0.1	0.033	< 0.0001	0.001	7.1	5.2	< 0.002	2080	< 0.0005	3430
2048D-CCR	CTLN-1702-321A	2/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.31	< 0.001	277	< 0.005	< 0.005	0.2	3.98	0.001	< 0.1	0.046	< 0.0001	< 0.001	7.0	3.4	< 0.001	2170	< 0.0005	3420
2048D-CCR	CTLN-1702-321	2/27/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.27	< 0.001	285	< 0.005	< 0.005	0.2	2.88	< 0.001	< 0.1	0.024	< 0.0001	< 0.001	7.1	4.5	< 0.002	2170	< 0.0005	3450
2048D-CCR	CTLN-1704-310	4/12/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.18	< 0.001	267	< 0.005	< 0.005	0.1	2.97	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	7.2	3.7	< 0.002	2110	< 0.0005	3160
2048D-CCR	CTLN-1708-348	8/9/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.31	< 0.001	276	< 0.005	< 0.005	0.1	2.9	< 0.001	< 0.1	0.021	< 0.0001	< 0.001	7.1	11.3	< 0.001	2300	< 0.0005	3410
2049D-CCR	CTLN-1605-206	5/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.17	< 0.001	285	< 0.005	< 0.005	0.2	0.48	< 0.001	0.1	0.232	< 0.0001	< 0.001	7.0	6.9	< 0.001	2020	< 0.0005	3480
2049D-CCR	CTLN-1606-326	6/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.14	< 0.001	292	< 0.005	< 0.005	0.2	1.49	< 0.001	0.1	0.183	< 0.0001	< 0.001	7.0	5.5	< 0.001	2100	< 0.0005	3410
2049D-CCR (Dup)	CTLN-1606-327	6/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.19	< 0.001	301	< 0.005	< 0.005	0.2	1.48	< 0.001	0.1	0.187	< 0.0001	< 0.001	7.0	4.4	< 0.001	2000	< 0.0005	3440
2049D-CCR	CTLN-1607-326	7/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.19	< 0.001	326	< 0.005	< 0.005	0.2	2.8	< 0.001	< 0.1	0.134	< 0.0001	< 0.001	7.0	3.1	< 0.001	2060	< 0.0005	3410
2049D-CCR	CTLN-1608-307	8/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.17	< 0.001	305	< 0.005	< 0.005	0.2	3.69	< 0.001	< 0.1	0.106	< 0.0001	< 0.001	7.1	7.2	< 0.001	1920	< 0.0005	3370
2049D-CCR	CTLN-1611-315	11/15/2016	0.001	< 0.001	< 0.05	< 0.001	1.18	< 0.001	292	< 0.005	< 0.005	0.2	3.48	0.002	0.1	0.084	< 0.0001	0.001	7.0	6.9	< 0.002	2110	0.0009	3380
2049D-CCR	CTLN-1701-318	1/31/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.25	< 0.001	291	< 0.005	< 0.005	0.2	3.75	< 0.001	< 0.1	0.057	< 0.0001	< 0.001	7.0	2.6	< 0.001	2160	< 0.0005	3400
2049D-CCR	CTLN-1702-311	2/22/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.18	< 0.001	279	< 0.005	< 0.005	0.2	3.72	< 0.001	< 0.1	0.052	< 0.0001	< 0.001	7.1	5.8	< 0.002	2070	< 0.0005	3370
2049D-CCR	CTLN-1704-309	4/12/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.04	< 0.001	277	< 0.005	< 0.005	0.2	3.53	< 0.001	< 0.1	0.041	< 0.0001	< 0.001	7.2	7.1	< 0.002	2050	< 0.0005	3210
2050D-CCR	CTLN-1605-209	5/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.7	< 0.001	532	< 0.005	< 0.005	0.2	0.11	< 0.001	0.1	0.422	< 0.0001	< 0.001	6.9	4.1	< 0.004	6720	< 0.0005	10400
2050D-CCR	CTLN-1605-210	5/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.5	< 0.001	519	< 0.005	< 0.005	0.2	0.10	< 0.001	0.2	0.417	< 0.0001	< 0.001	6.9	1.8	< 0.004	6570	< 0.0005	10300
2050D-CCR	CTLN-1606-330	6/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.8	< 0.001	528	< 0.005	< 0.005	0.2	< 0.05	< 0.001	0.1	0.424	< 0.0001	< 0.001	7.0	1.6	0.004	7050	< 0.0005	10100
2050D-CCR	CTLN-1607-332	7/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.9	< 0.001	613	< 0.005	< 0.005	0.2	0.04	< 0.001	0.1	0.488	< 0.0001	0.001	6.9	1.6	< 0.004	7120	< 0.0005	9950
2050D-CCR	CTLN-1608-325	8/31/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.7	< 0.001	515	< 0.005	< 0.005	0.2	< 0.02	< 0.001	0.1	0.448	< 0.0001	0.001	6.9	0.9	< 0.002	6930	< 0.0005	10400
2050D-CCR	CTLN-1611-329	11/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	11.3	< 0.001	499	< 0.005	< 0.005	0.2	0.03	0.001	0.3	0.466	< 0.0001	0.001	6.9	0.2	< 0.004	5980	0.0006	10000
2050D-CCR	CTLN-1702-323A	2/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	11.6	< 0.001	515	< 0.005	< 0.005	0.2	0.07	< 0.001	< 0.1	0.482	< 0.0001	< 0.001	6.9	0.8	0.003	6790	< 0.0005	10100
2050D-CCR	CTLN-1702-324	2/28/2017	< 0.001	< 0.002	< 0.05	< 0.001	11	< 0.001	489	< 0.005	< 0.005	0.2	< 0.04	< 0.001	< 0.1	0.45	< 0.0001	< 0.001	6.9	1.1	< 0.004	6880	< 0.0005	10200
2050D-CCR	CTLN-1702-325	2/28/2017	< 0.001	< 0.002	< 0.05	< 0.001	11.6	< 0.001	512	< 0.005	< 0.005	0.2	< 0.04	< 0.001	< 0.1	0.48	< 0.0001	< 0.001	6.9	2.7	< 0.004	6970	< 0.0005	10200
2050D-CCR	CTLN-1704-329	4/20/2017	< 0.001	0.011	< 0.05	< 0.001	12	< 0.001	533	< 0.005	< 0.005	0.2	0.04	< 0.001	< 0.1	0.5	< 0.0001	< 0.001	7	1	< 0.004	6980	< 0.0005	8440
2050D-CCR	CTLN-1708-349	8/9/2017	< 0.001	< 0.001	< 0.05	< 0.001	11.7	< 0.001	498	< 0.005	< 0.005	0.2	0.03	< 0.001	< 0.1	0.523	< 0.0001	< 0.001	7	2.5	0.003	6740	< 0.0005	10000
2051D-CCR	CTLN-1605-212	5/20/2016	< 0.001	0.004	< 0.05	< 0.001	9.59	< 0.001	585	< 0.005	< 0.005	0.4	1.04	< 0.001	0.2	0.953	< 0.0001	0.028	7.4	3.4	< 0.004	6150	< 0.0005	8980
2051D-CCR	CTLN-1606-331	6/22/2016	0.001	0.004	< 0.05	< 0.001	9.15	< 0.001	574	< 0.005	0.023	0.4	0.16	< 0.001	0.2	1.11	< 0.0001	0.02	7.3	4.1	< 0.001	6070	< 0.0005	8170
2051D-CCR	CTLN-1607-335	7/29/2016	< 0.001	0.004	< 0.05	< 0.001	6.82	< 0.001	573	< 0.005	0.008	0.4	2.46	< 0.001	0.1	1.33	< 0.0001	0.004	7.1	3.4	< 0.002	5410	< 0.0005	7370
2051D-CCR	CTLN-1608-326	8/31/2016	< 0.001	0.003	< 0.05	< 0.001	6.31	< 0.001	481	< 0.005	< 0.005	0.4	1.49	< 0.001	0.2	1.01	< 0.0001	< 0.001	7.2	4.4	< 0.002	4990	< 0.0005	7200
2051D-CCR	CTLN-1611-326	11/21/2016	< 0.001	0.002	< 0.05	< 0.001	5.04	< 0.001	448	< 0.005	< 0.005	0.4	2.66	0.001	0.2	0.887	< 0.0001	0.005	7.2	4.6	< 0.004	4600	< 0.0005	6520
2051D-CCR	CTLN-1702-325A	2/1/2017	< 0.001	0.004	< 0.05	< 0.001	4.43	< 0.001	456	< 0.005	< 0.005	0.4	3.11	< 0.001	< 0.1	0.779	< 0.0001	< 0.001	7.2	3.3	< 0.002	4410	< 0.0005	6230
2051D-CCR	CTLN-1703-328	3/1/2017	< 0.001	0.002	< 0.05	< 0.001	3.72	< 0.001	440	< 0.005	< 0.005	0.4	2.85	< 0.001	< 0.1	0.645	< 0.0001	< 0.001	7.2	5.5	< 0.004	4050	< 0.0005	5960
2051D-CCR	CTLN-1704-323	4/19/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.78	< 0.001	364	< 0.005	< 0.005	0.4	3.11	< 0.001	< 0.1	0.508	< 0.0001	0.002	7.2	2.6	< 0.002	3290	< 0.0005	4810
2051D-CCR	CTLN-1708-345	8/8/2017	< 0.001	0.004	< 0.05	< 0.001	1.82	< 0.001	288	< 0.005	< 0.005	0.4	1.32	< 0.001	< 0.1	0.518	< 0.0001	0.002	7.3	4.5	< 0.001	2900	< 0.0005	4140
2053D-CCR	CTLN-1605-211	5/20/2016	< 0.001	< 0.002	< 0.05	< 0.001	1.8	< 0.001	332	0.005	< 0.005	0.5	0.21	< 0.001	0.1	0.164	< 0.0001	< 0.001	7.1	2.9	< 0.004	2660	< 0.0005	4440
2053D-CCR	CTLN-1606-332	6/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.06	< 0.001	357	< 0.005	< 0.005	0.4	3.43	< 0.001	0.1	0.184	< 0.0001	< 0.001	7.2	2.3	< 0.001	2840	< 0.0005	4480
2053D-CCR	CTLN-1607-333	7/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.31	< 0.001	432	< 0.005	< 0.005	0.5	4.78	< 0.001	0.1	0.214	< 0.0001	< 0.001	7.1	7.5	< 0.002	2860	< 0.0005	4580
2053D-CCR	CTLN-1608-327	8/31/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.26	< 0.001	366	< 0.005	< 0.005	0.4	4.93	< 0.001	0.1	0.203	< 0.0001	< 0.001	7.2	5.9	< 0.001	2680	< 0.0005	4770
2053D-CCR	CTLN-1611-330	11/22/2016	0.004	0.005	< 0.05	0.002	2.59	0.002	384	< 0.005	0.006	0.4	9.36	0.005	0.2	0.294	< 0.0001	0.005	7.1	3.1	0.045	3000	0.0037	4840
2053D-CCR	CTLN-1702-345	2/15/2017	< 0.001	< 0.002	< 0.05	< 0.001	2.68	< 0.001	391	< 0.005	< 0.005	0.4	26	< 0.001	0.1	0.247	< 0.0001	< 0.001	7.1	4.2	< 0.004	3170	< 0.0005	4970
2053D-CCR	CTLN-1703-329	3/1/2017	< 0.001	< 0.002	< 0.05	< 0.001	2.62	< 0.001	380	< 0.005	< 0.005	0.1	15.4	0.002	< 0.1	0.249	< 0.0001	< 0.001	7.1	1.7	< 0.004	3060	< 0.0005	5030
2053D-CCR	CTLN-1704-322	4/18/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.8	< 0.001	389	< 0.005	< 0.005	0.5	8.78	< 0.001	< 0.1	0.265	< 0.0001	< 0.001	7.1	5.7	< 0.002	3230	< 0.0005	4750

Appendix F

Colstrip SES Federal CCR Rule Groundwater Draft Baseline Monitoring Data - 2016 Through November 2017

Comparison For Montana DEQ Human Health GW MCLs (If No MCL Listed Then EPA RSL For Tapwater - Ingestion For Child, RSL Limit Was Used)

***Metals analyzed as Total Recoverable (TRC) unless turbidity >10, then metals ran both as Total Recoverable (TRC) and Dissolved (DIS).**

Highlighted Values Exceed MCL or EPA Tapwater RSL

Highlighted Values Are Detection Limits Higher than the MCL or EPA Tapwater RSL

Site Code	Sample Code	Date	ANTIMONY 7440-36-0 mg/L	ARSENIC 7440-38-2 mg/L	BARIUM 7440-39-3 mg/L	BERYLLIUM 7440-41-7 mg/L	BORON 7440-42-8 mg/L	CADMIUM 7440-43-9 mg/L	CALCIUM 7440-70-2 mg/L	CHROMIUM 7440-47-3 mg/L	COBALT 7440-48-4 mg/L	FLUORIDE 16984-48-8 mg/L	IRON 7439-89-6 mg/L	LEAD 7439-92-1 mg/L	LITHIUM 7439-93-2 mg/L	MANGANESE 7439-96-5 mg/L	MERCURY 7439-97-6 mg/L	MOLYBDENUM 7439-98-7 mg/L	pH NA standard units	RADIUM 226/228 7440-14-4 pCi/L	SELENIUM 7782-49-2 mg/L	SULFATE 14808-79-8 mg/L	THALLIUM 7440-28-0 mg/L	TDS NA mg/L
			MCL - 0.006	MCL - 0.01	MCL - 2.0	MCL - 0.004	RSL - 4.0	MCL - 0.005	No MCL/ RSL	MCL - 0.1	RSL - 0.006	MCL - 4.0	RSL - 14.0	MCL - 0.015	RSL - 0.04	RSL - 0.43	MCL - 0.002	RSL - 0.1	No MCL/ RSL	MCL - 5.0	MCL - 0.05	No MCL/ RSL	MCL - 0.002	No MCL/ RSL
Units 1&2 Fly Ash Evap Pond (STEP AREA) (continued)																								
2053D-CCR	CTLN-1708-351	8/9/2017	< 0.001 DIS < 0.001 TRC	< 0.001 DIS 0.02 TRC	< 0.05 DIS < 0.05 TRC	< 0.001 DIS 0.003 TRC	3.05 DIS 3.37 TRC	< 0.001 DIS < 0.001 TRC	378 DIS 415 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	0.4 TRC	4.26 DIS 553 TRC	< 0.001 DIS < 0.001 TRC	< 0.1 DIS < 0.1 TRC	0.285 DIS 0.363 TRC	< 0.0001 DIS < 0.0001 TRC	< 0.001 DIS 0.001 TRC	7	77 TRC	< 0.001 DIS < 0.001 TRC	3190 TRC	< 0.0005 DIS < 0.0005 TRC	4830 TRC
2053D-CCR	CTLN-1711-300	11/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	3.28	< 0.001	392	< 0.005	< 0.005	0.4	6.43	< 0.001	< 0.1	0.302	< 0.0001	< 0.001	7	1.7	< 0.001	3230	< 0.0005	5050
2054D-CCR	CTLN-1605-208	5/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.84	< 0.001	290	< 0.005	< 0.005	0.1	2.55	< 0.001	0.1	0.078	< 0.0001	< 0.001	7.0	7.3	< 0.001	1960	< 0.0005	3460
2054D-CCR	CTLN-1606-329	6/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	304	< 0.005	< 0.005	0.1	3.21	< 0.001	0.1	0.042	< 0.0001	< 0.001	7.0	4.1	< 0.001	1510	< 0.0005	3410
2054D-CCR	CTLN-1607-331	7/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.94	< 0.001	351	< 0.005	< 0.005	0.1	3.54	< 0.001	0.1	0.033	< 0.0001	< 0.001	7.0	3.4	< 0.001	1900	< 0.0005	3340
2054D-CCR	CTLN-1608-324	8/31/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.91	< 0.001	301	< 0.005	< 0.005	0.1	3.22	< 0.001	0.1	0.028	< 0.0001	< 0.001	7.1	5.6	< 0.001	2120	< 0.0005	3460
2054D-CCR	CTLN-1611-328	11/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.88	< 0.001	286	< 0.005	< 0.005	0.1	3.75	< 0.001	0.1	0.029	< 0.0001	< 0.001	7.0	4.4	< 0.002	2030	< 0.0005	3430
2054D-CCR	CTLN-1702-322A	2/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.94	< 0.001	310	< 0.005	< 0.005	0.1	3.07	< 0.001	0.1	0.026	< 0.0001	< 0.001	7.0	2.4	< 0.001	2070	< 0.0005	3420
2054D-CCR	CTLN-1702-323	2/28/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	294	< 0.005	< 0.005	0.1	3.53	< 0.001	0.1	0.022	< 0.0001	< 0.001	7.0	3.7	< 0.002	2100	< 0.0005	3520
2054D-CCR	CTLN-1704-328	4/20/2017	< 0.001	0.002	< 0.05	< 0.001	0.96	< 0.001	311	< 0.005	< 0.005	0.1	3.9	< 0.001	0.1	0.036	< 0.0001	< 0.001	7	3.7	< 0.002	2110	< 0.0005	3310
2054D-CCR	CTLN-1708-350	8/9/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	296	< 0.005	< 0.005	0.1	3.33	< 0.001	< 0.1	0.025	< 0.0001	< 0.001	7.1	12	< 0.001	1900	< 0.0005	3440
2055D-CCR	CTLN-1606-336	6/27/2016	0.003	0.003	< 0.05	< 0.001	1.01	< 0.001	142	< 0.005	< 0.005	0.7	0.95	< 0.001	0.1	0.324	< 0.0001	0.028	7.6	2.4	< 0.002	2180	< 0.0005	3550
2055D-CCR	CTLN-1608-338	8/2/2016	0.002 DIS 0.002 TRC	0.004 DIS 0.005 TRC	< 0.05 DIS < 0.05 TRC	< 0.001 DIS < 0.001 TRC	0.98 DIS 0.95 TRC	< 0.001 DIS < 0.001 TRC	126 DIS 123 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	0.8 TRC	0.52 DIS 2.58 TRC	< 0.001 DIS < 0.001 TRC	< 0.1 DIS < 0.1 TRC	0.309 DIS 0.329 TRC	< 0.0001 TRC	0.024 DIS 0.026 TRC	7.7	7 TRC	< 0.001 DIS < 0.001 TRC	2210 TRC	< 0.0005 DIS 0.0008 TRC	3520 TRC
2055D-CCR	CTLN-1609-328	9/1/2016	< 0.001 DIS 0.001 TRC	0.004 DIS 0.004 TRC	< 0.05 DIS < 0.05 TRC	< 0.001 DIS < 0.001 TRC	0.82 DIS 0.84 TRC	< 0.001 DIS < 0.001 TRC	113 DIS 123 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	0.9 TRC	0.33 DIS 1.09 TRC	< 0.001 DIS < 0.001 TRC	0.1 DIS 0.1 TRC	0.318 DIS 0.314 TRC	< 0.0001 DIS < 0.0001 TRC	0.004 DIS 0.010 TRC	7.7	4.9 TRC	0.010 DIS < 0.001 TRC	2390 TRC	< 0.0005 DIS < 0.0005 TRC	3590 TRC
2055D-CCR	CTLN-1611-336	11/29/2016	0.002	0.005	< 0.05	< 0.001	0.71	< 0.001	103	< 0.005	< 0.005	1.2	0.22	< 0.001	0.1	0.242	< 0.0001	0.004	7.7	5	< 0.002	2190	< 0.0005	3570
2055D-CCR	CTLN-1702-342	2/14/2017	< 0.001 DIS < 0.001 TRC	0.002 DIS 0.006 TRC	< 0.05 DIS < 0.05 TRC	< 0.001 DIS < 0.001 TRC	0.33 DIS 0.42 TRC	< 0.001 DIS < 0.001 TRC	56 DIS 71 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	1 TRC	0.40 DIS 5.65 TRC	< 0.001 DIS 0.004 TRC	< 0.1 DIS < 0.1 TRC	0.095 DIS 0.216 TRC	< 0.0001 DIS < 0.0001 TRC	< 0.001 DIS 0.002 TRC	7.8	1.7 TRC	0.003 DIS < 0.002 TRC	2250 TRC	< 0.0005 DIS < 0.0005 TRC	3540 TRC
2055D-CCR	CTLN-1703-330	3/1/2017	< 0.001	0.002	< 0.05	< 0.001	0.3	< 0.001	53	< 0.005	< 0.005	1.1	0.6	< 0.001	< 0.1	0.087	< 0.0001	< 0.001	7.8	3.1	< 0.002	2230	< 0.0005	3530
2055D-CCR	CTLN-1704-324	4/19/2017	< 0.001	0.002	< 0.05	< 0.001	0.42	< 0.001	59	< 0.005	< 0.005	1	0.72	< 0.001	< 0.1	0.095	< 0.0001	< 0.001	7.9	2.2	< 0.002	2250	< 0.0005	3380
2055D-CCR	CTLN-1708-341	8/7/2017	< 0.001 DIS < 0.001 TRC	< 0.001 DIS 0.002 TRC	< 0.05 DIS < 0.05 TRC	< 0.001 DIS < 0.001 TRC	0.28 DIS 0.31 TRC	< 0.001 DIS < 0.001 TRC	50 DIS 54 TRC	< 0.005 DIS < 0.005 TRC	< 0.005 DIS < 0.005 TRC	1 TRC	0.23 DIS 1.87 TRC	<0.001 DIS 0.002 TRC	< 0.1 DIS < 0.1 TRC	0.05 DIS 0.102 TRC	< 0.0001 DIS < 0.0001 TRC	0.001 DIS 0.002 TRC	7.9	3.8 TRC	< 0.001 DIS 0.001 TRC	2520 TRC	< 0.0005 DIS < 0.0005 TRC	3500 TRC
2056A-CCR	CTLN-1606-341	6/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	30.3	< 0.001		< 0.005	< 0.005	0.4	0.09	< 0.001	0.3	0.006	< 0.0001	< 0.001		0.6	< 0.004		< 0.0005	
2056A-CCR	CTLN-1607-334	7/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	29.6	< 0.001	545	< 0.005	< 0.005	0.4	0.03	< 0.001	0.3	0.003	< 0.0001	0.001	7.1	0.8	< 0.004	7960	< 0.0005	11600
2056A-CCR	CTLN-1608-313	8/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	29	< 0.001	499	< 0.005	< 0.005	0.3	0.16	< 0.001	0.3	0.005	< 0.0001	< 0.001	7.1	0.9	< 0.002	8010	< 0.0005	12200
2056A-CCR	CTLN-1610-384	10/13/2016	< 0.001	0.001	< 0.05	< 0.001	30.4	< 0.001	461	< 0.005	< 0.005	0.4	< 0.2	0.001	0.4	0.026	< 0.0001	< 0.001	7.2	2.4	< 0.002	6980	< 0.0005	12200
2056A-CCR	CTLN-1611-332	11/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	31.5	< 0.001	489	< 0.005	< 0.005	0.4	0.05	< 0.001	0.3	0.014	< 0.0001	0.002	7.1	0.7	< 0.004	7780	< 0.0005	11900
2056A-CCR	CTLN-1702-324A	2/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	31.7	< 0.001	488	< 0.005	< 0.005	0.4	0.11	< 0.001	0.2	0.004	< 0.0001	< 0.001	7.1	0.9	< 0.002	8130	< 0.0005	11800
2056A-CCR	CTLN-1702-326	2/28/2017	< 0.001	< 0.002	< 0.05	< 0.001	30.4	< 0.001	470	< 0.005	< 0.005	0.3	< 0.04	< 0.001	0.2	0.006	< 0.0001	0.001	7.0	1.9	< 0.004	8100	< 0.0005	11900
2056A-CCR	CTLN-1704-330	4/20/2017	< 0.001	< 0.002	< 0.05	< 0.001	30.8	< 0.001	471	< 0.005	< 0.005	0.4	0.07	< 0.001	0.2	0.006	< 0.0001	0.001	7.1	1	< 0.004	8110	< 0.0005	10700
2056A-CCR	CTLN-1708-352	8/9/2017	< 0.001	< 0.001	< 0.05	< 0.001	30.9	< 0.001	453	< 0.005	< 0.005	0.4	0.22	< 0.001	0.1	< 0.001	< 0.0001	< 0.001	7.1	3.7	< 0.001	7770	< 0.0005	11500
392D	TLN-1602-107-CCR	2/4/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.92	< 0.001	173	< 0.005	< 0.005	0.4	2.6	< 0.001	< 0.1	0.052	< 0.0001	< 0.001	7.1	4.1	< 0.001	1670	< 0.0005	2660
392D	CTLN-1604-134	4/20/2016	< 0.001	< 0.001	< 0.05	< 0.001	1	< 0.001	189	< 0.005	< 0.005	0.5	2.42	< 0.001	0.1	0.048	< 0.0001	< 0.001	7.2	4.8	< 0.001	1580	< 0.0005	2780
392D	CTLN-1606-335	6/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.99	< 0.001	197	< 0.005	< 0.005	0.4	2.24	< 0.001	0.1	0.05	< 0.0001	< 0.001	7.1	4.5	< 0.001	1560	< 0.0005	2730
392D	CTLN-1608-336	8/1/2016	< 0.001	< 0.001	< 0.05	< 0.001	1	< 0.001	197	< 0.005	< 0.005	0.4	2.35	< 0.001	< 0.1	0.055	< 0.0001	< 0.001	7.2	6.3	< 0.001	1790	< 0.0005	2750
392D	CTLN-1608-322	8/30/2016	< 0.001	0.001	< 0.05	< 0.001	0.99	< 0.001	186	< 0.005	< 0.005	0.4	5.71	< 0.001	0.1	0.05	< 0.0001	< 0.001	7.1	5.1	< 0.001	1560	< 0.0005	2770
392D	CTLN-1611-320	11/16/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.93	< 0.001	185	< 0.005	< 0.005	0.4	3.11	< 0.001	0.1	0.045	< 0.0001	< 0.001	7.2	6.4	< 0.002	1590	< 0.0005	2750
392D	CTLN-1702-328A	2/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.98	< 0.001	185	< 0.005	< 0.005	0.5	4.45	< 0.001	< 0.1	0.052	< 0.0001	< 0.001	7.3	2.8	< 0.001	1580	< 0.0005	2770
392D	CTLN-1702-313	2/23/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.98	< 0.001	194	< 0.005	< 0.005	0.5	2.4	< 0.001	< 0.1	0.051	< 0.0001	< 0.001	7.2	3.6	< 0.002	1610	< 0.0005	2670
392D	CTLN-1704-306	4/11/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.94	< 0.001	193	< 0.005	< 0.005	0.4	3.05	< 0.001	< 0.1	0.054	< 0.0001	< 0.001	7.3	4	< 0.002	1600	< 0.0005	2540
392D	CTLN-1708-343	8/8/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.94	< 0.001	188	< 0.005	< 0.005	0.5	2.48	< 0.001	< 0.1	0.047	< 0.0001	< 0.001	7.2	9.9	< 0.001	1740	< 0.0005	2740
902D	TLN-1602-103-CCR	2/3/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.64	< 0.001	287	< 0.005	< 0.005	0.2	3.33	< 0.001	< 0.1	0.142	< 0.0001	< 0.001	6.9	3.6	< 0.001	1880	< 0.0005	3140
902D	CTLN-1604-131	4/19/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.68	< 0.001	306	< 0.005	< 0.005	0.2	3.51	< 0.001	0.1	0.17	< 0.0001	< 0.001	7.0	3.4	< 0.001	1910	< 0.0005	3270
902D	CTLN-1605-306	5/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.72	< 0.001	326	< 0.005	< 0.005	0.3	3.93	< 0.001	0.1	0.17	< 0.0001	< 0.001	7.0	3.4	< 0.002	1920	< 0.0005	3230
902D	CTLN-1607-304	7/12/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.7	< 0.001	314	< 0.005	< 0.005	0.2	3.56	< 0.001	0.1	0.181	< 0.0001	< 0.001	7.0	6.8	< 0.001	1870	< 0.0005	3260
902D	CTLN-1608-304	8/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.65	< 0.001	311	< 0.005	< 0.005	0.2	3.76	< 0.001	< 0.1	0.184	< 0.0001	< 0.001	7.0	6.1	< 0.001	1810	< 0.0005	3380
902D	CTLN-1608-305	8/23/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.69	< 0.001	321	< 0.005	< 0.005	0.2	3.86	< 0.001	0.1	0.185	< 0.0001	< 0.001	7.1	6.8	< 0.001	1810	< 0.0005	3280
902D	CTLN-1611-313	11/15/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.67	< 0.001	306	< 0.005	< 0.005	0.2	4.07	< 0.001	0.1	0.175	< 0.0001	< 0.001	7.1	4.2	< 0.002	1990	0.0006	3200
902D	CTLN-1701-319	1/31/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.68	< 0.001	315	< 0.005	< 0.005	0.2	3.5	< 0.001	< 0.1	0.187	< 0.0001	< 0.001	7.0	2.8	< 0.001	1930	< 0.0005	3100
902D	CTLN-1702-309	2/22/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.67	< 0.001	298	< 0.005	< 0.005	0.2	3.64	< 0.001	0.1	0.185	< 0.0001	< 0.001	7.1	4.6	< 0.002	1950	< 0.0005	3210
902D	CTLN-1704-307	4/12/2017	< 0.001	0.001	< 0.05	< 0.001	0.65	< 0.001	311	< 0.005	< 0.005	0.2	3.53	< 0.001	< 0.1	0.176	< 0.0001	< 0.001	7.1	4.4	< 0.002	1950	< 0.0005	2980
902D	CTLN-1708-420	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.61	< 0.001	288	< 0.005	< 0.005	0.2	3.75	< 0.001	< 0.1	0.188	< 0.0001	< 0.001	7.1	7.6	< 0.001	2150	< 0.0005	3140
921A	CTLN-1604-108	4/6/2016	< 0.001	< 0.001	< 0.05	< 0.001	27.4	< 0.001	333	< 0.005	< 0.005	0.4	0.08	< 0.001	0.2	0.077	< 0.0001	< 0.001	7.3	1	< 0.001	7350	< 0.0005	10900
921A	CTLN-1606-323	6/21/2016	< 0.001	0.002	0.05	< 0.001	27	< 0.001	474	< 0.005	< 0.005	0.3	2.18	< 0.001	0.3	0.67	< 0.0001	0.003	7.3	3.1	< 0.001	7070	< 0.0005	10400
921A	CTLN-1607-323	7/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	29.4	< 0.001	498	< 0.005	< 0.005	0.4	0.8	< 0.001	0.2	0.188	< 0.0001	0.002	7.2	-0.7	< 0.004	7640	< 0.0005	10700
921A	CTLN-1608-320	8/30/2016	< 0.001	< 0.001	< 0.05	< 0.002	29	< 0.001	441	< 0.005	< 0.005	0.4	0.56	< 0.001	0.3	0.14	< 0.0001	0.001	7.3	0.7	< 0.002	7390	< 0.0005	10600
921A	CTLN-1611-323	11/17/2016	< 0.001	< 0.001	< 0.05	< 0.001	28	< 0.001	431	< 0.005	< 0.005	0.4	0.36	< 0.001	0.4	0.124	< 0.0001	< 0.001	7.3	0.3	< 0.004	7330	0.0008	10900
921A	CTLN-1701-314	1/30/2017	< 0.001	< 0.001	< 0.05	< 0.001	28.4	< 0.001	430	< 0.005	< 0.005	0.4	0.2	< 0.001	0.2	0.102	< 0.0001	0.001	7.3	0.7	< 0.002	7690	0.0007	10800
921A (Dup)	CTLN-1701-315	1/30/2017	< 0.001	< 0.001	< 0.05	< 0.001	27.7	< 0.001	498	< 0.005	< 0.005	0.4	0.22	< 0.001	0.2	0.105	< 0.0001	0.001	7.2	0.8	< 0.002	7700	0.0005	10400
921A	CTLN-1702-315	2/23/2017	< 0.001	< 0.002	< 0.05	< 0.001	28.2	< 0.001	423	< 0.005	< 0.005	0.4	0.26	< 0.001	0.3	0.103	< 0.0001	0.002	7.3	-2	< 0.004	7180	< 0.0005	10700
921A	CTLN-1704-320	4/18/2017	< 0.001	< 0.002	< 0.05	< 0.001	28.7	< 0.001	446	< 0.005	< 0.005	0.5	0.2	< 0.001	0.2	0.12	< 0.0001	0.002	7.3	2.6	< 0.004	7510	< 0.0005	10100
921A	CTLN-1708-299	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	26.1	< 0.001	492	< 0.005	< 0.005	0.4	0.15	< 0.001	0.1	0.093	< 0.0001	< 0.001	7.2	0.4	< 0.001	7330	< 0.0005	10500
952D	CTLN-1604-137	4/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.25	< 0.001	198	< 0.005	< 0.005	0.4	2.66	< 0.001	0.1	0.08	< 0.0001	< 0.001	7.3	3.5	< 0.001	1670	< 0.0005	2980
952D	CTLN-1606-337	6/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.17	< 0.001	208	< 0.005	< 0.005	0.4	2.85	< 0.001	0.1	0.076	< 0.0001	< 0.001	7.2	5.3	< 0.002	1630	< 0.0005	2930

Appendix F

Colstrip SES Federal CCR Rule Groundwater Draft Baseline Monitoring Data - 2016 Through November 2017

Comparison For Montana DEQ Human Health GW MCLs (If No MCL Listed Then EPA RSL For Tapwater - Ingestion For Child, RSL Limit Was Used)

***Metals analyzed as Total Recoverable (TRC) unless turbidity >10, then metals ran both as Total Recoverable (TRC) and Dissolved (DIS).**

Highlighted Values Exceed MCL or EPA Tapwater RSL

Highlighted Values Are Detection Limits Higher than the MCL or EPA Tapwater RSL

Site Code	Sample Code	Date	ANTIMONY 7440-36-0 mg/L	ARSENIC 7440-38-2 mg/L	BARIUM 7440-39-3 mg/L	BERYLLIUM 7440-41-7 mg/L	BORON 7440-42-8 mg/L	CADMIUM 7440-43-9 mg/L	CALCIUM 7440-70-2 mg/L	CHROMIUM 7440-47-3 mg/L	COBALT 7440-48-4 mg/L	FLUORIDE 16984-48-8 mg/L	IRON 7439-89-6 mg/L	LEAD 7439-92-1 mg/L	LITHIUM 7439-93-2 mg/L	MANGANESE 7439-96-5 mg/L	MERCURY 7439-97-6 mg/L	MOLYBDENUM 7439-98-7 mg/L	pH NA standard units	RADIUM 226/228 7440-14-4 pCi/L	SELENIUM 7782-49-2 mg/L	SULFATE 14808-79-8 mg/L	THALLIUM 7440-28-0 mg/L	TDS NA mg/L
			MCL - 0.006	MCL - 0.01	MCL - 2.0	MCL - 0.004	RSL - 4.0	MCL - 0.005	No MCL/ RSL	MCL - 0.1	RSL - 0.006	MCL - 4.0	RSL - 14.0	MCL - 0.015	RSL - 0.04	RSL - 0.43	MCL - 0.002	RSL - 0.1	No MCL/ RSL	MCL - 5.0	MCL - 0.05	No MCL/ RSL	MCL - 0.002	No MCL/ RSL
Units 1&2 Fly Ash Evap Pond (STEP AREA) (continued)																								
952D	CTLN-1608-339	8/2/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.17	< 0.001	192	< 0.005	< 0.005	0.4	2.63	< 0.001	< 0.1	0.079	< 0.0001	< 0.001	7.2	8.7	< 0.001	1650	< 0.0005	2890
952D	CTLN-1609-329	9/1/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.12	< 0.001	204	< 0.005	< 0.005	0.4	2.52	< 0.001	0.1	0.072	< 0.0001	< 0.001	7.2	4	< 0.001	1780	< 0.0005	2860
952D	CTLN-1611-333	11/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.22	< 0.001	215	0.031	< 0.005	0.4	3.23	< 0.001	0.1	0.084	< 0.0001	< 0.001	7.2	3.4	< 0.002	1690	< 0.0005	2860
952D	CTLN-1702-343	2/14/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.19	< 0.001	207	< 0.005	< 0.005	0.4	2.85	0.002	< 0.1	0.077	< 0.0001	< 0.001	7.2	4.1	< 0.002	1710	< 0.0005	2870
952D	TLN-1602-108-CCR	2/4/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.12	0.002	196	< 0.005	< 0.005	0.5	2.03	< 0.001	< 0.1	0.082	< 0.0001	< 0.001	7.2	4.1	< 0.001	1730	< 0.0005	2840
952D	CTLN-1703-331	3/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.12	< 0.001	188	< 0.005	< 0.005	0.4	2.78	< 0.001	< 0.1	0.074	< 0.0001	< 0.001	7.1	3.1	< 0.002	1770	< 0.0005	2820
952D	CTLN-1704-325	4/19/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.2	< 0.001	205	< 0.005	< 0.005	0.5	2.91	< 0.001	< 0.1	0.08	< 0.0001	< 0.001	7.2	3.8	< 0.002	1730	< 0.0005	2720
952D	CTLN-1708-342	8/7/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.12	< 0.001	194	< 0.005	< 0.005	0.5	2.61	< 0.001	< 0.1	0.08	< 0.0001	< 0.001	7.4	3.8	< 0.001	1940	< 0.0005	2910
953D	CTLN-1604-109	4/7/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.3	< 0.001	31	< 0.005	< 0.005	2.6	0.27	< 0.001	< 0.1	0.023	< 0.0001	< 0.001	8.1	1.9	< 0.001	1810	< 0.0005	2900
953D	CTLN-1606-324	6/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.27	< 0.001	30	< 0.005	< 0.005	2.3	0.23	< 0.001	< 0.1	0.022	< 0.0001	< 0.001	8.1	5.4	< 0.001	1560	< 0.0005	2890
953D	CTLN-1608-337	8/1/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.26	< 0.001	28	< 0.005	< 0.005	2.3	0.21	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	8.1	4.7	< 0.001	1780	< 0.0005	2950
953D	CTLN-1609-330	9/1/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.22	< 0.001	29	< 0.005	< 0.005	2.4	0.05	< 0.001	0.1	0.022	< 0.0001	< 0.001	8.1	2.4	< 0.001	1960	< 0.0005	2920
953D	CTLN-1611-334	11/28/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.29	< 0.001	31	< 0.005	< 0.005	2.4	0.25	< 0.001	0.1	0.025	< 0.0001	< 0.001	8.1	0.2	< 0.002	1820	< 0.0005	2900
953D	CTLN-1702-344	2/14/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.26	< 0.001	30	< 0.005	< 0.005	2.7	0.23	< 0.001	< 0.1	0.027	< 0.0001	< 0.001	8.1	1.4	< 0.002	1920	< 0.0005	2900
953D	CTLN-1703-332	3/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.23	< 0.001	28	< 0.005	< 0.005	2.4	0.12	< 0.001	< 0.1	0.023	< 0.0001	< 0.001	8.1	1.2	< 0.002	1890	< 0.0005	2910
953D	CTLN-1704-327	4/20/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.29	< 0.001	33	< 0.005	< 0.005	2.4	0.09	< 0.001	< 0.1	0.037	< 0.0001	< 0.001	8.1	3.1	< 0.002	1910	< 0.0005	2720
953D	CTLN-1708-353	8/10/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.17	< 0.001	25	< 0.005	< 0.005	2.4	0.33	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	8.1	2.1	< 0.001	1900	< 0.0005	2900
958D -also capture	CTLN-1604-139	4/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.95	< 0.001	305	< 0.005	< 0.005	0.2	3.24	< 0.001	0.1	0.028	< 0.0001	< 0.001	7.1	4.8	< 0.001	2070	< 0.0005	3510
958D	CTLN-1605-305	5/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.03	< 0.001	317	< 0.005	< 0.005	0.2	3.19	< 0.001	0.1	0.025	< 0.0001	< 0.001	7.0	4.5	< 0.002	2050	< 0.0005	3430
958D	CTLN-1607-312	7/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.99	< 0.001	301	< 0.005	< 0.005	0.2	3.22	< 0.001	0.1	0.025	< 0.0001	< 0.001	7.0	7.4	< 0.001	1960	< 0.0005	3480
958D	CTLN-1608-321	8/30/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.01	< 0.001	299	< 0.005	< 0.005	0.2	3.29	< 0.001	0.1	0.025	< 0.0001	< 0.001	7.0	4.7	< 0.001	2220	< 0.0005	3360
958D	CTLN-1611-324	11/17/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.96	< 0.001	290	< 0.005	< 0.005	0.2	3.38	< 0.001	0.1	0.025	< 0.0001	< 0.001	7.0	3	< 0.002	2040	< 0.0005	3410
958D	CTLN-1701-316	1/30/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.05	< 0.001	294	< 0.005	< 0.005	0.2	6.14	< 0.001	< 0.1	0.034	< 0.0001	< 0.001	7.0	4.7	< 0.001	2200	< 0.0005	3430
958D	CTLN-1702-316	2/23/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.3	< 0.001	296	< 0.005	< 0.005	0.2	4	< 0.001	0.1	0.033	< 0.0001	< 0.001	7.0	2.7	< 0.002	2110	< 0.0005	3500
958D	CTLN-1702-317	2/23/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.28	< 0.001	294	< 0.005	< 0.005	0.2	4.05	< 0.001	0.1	0.032	< 0.0001	< 0.001	7.0	2.4	< 0.002	2120	< 0.0005	3560
958D	TLN-1602-109-CCR	2/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.08	< 0.001	309	< 0.005	< 0.005	0.2	1.99	< 0.001	< 0.1	0.027	< 0.0001	< 0.001	6.9	4.3	< 0.001	2050	< 0.0005	3450
958D	CTLN-1704-321	4/18/2017	< 0.001	0.003	< 0.05	< 0.001	1.03	< 0.001	304	< 0.005	< 0.005	0.2	3.32	< 0.001	< 0.1	0.032	< 0.0001	< 0.001	7	5.9	< 0.002	2170	< 0.0005	3200
958D	CTLN-1708-302	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.93	< 0.001	332	< 0.005	< 0.005	0.2	3.64	< 0.001	< 0.1	0.027	< 0.0001	< 0.001	7	2.4	< 0.001	2170	< 0.0005	3350
964D	CTLN-1604-135	4/20/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.45	< 0.001	270	< 0.005	< 0.005	0.4	0.11	< 0.001	0.2	0.026	< 0.0001	< 0.001	7.2	2.7	0.003	3230	< 0.0005	5510
964D	CTLN-1605-309	5/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.47	< 0.001	296	< 0.005	< 0.005	0.4	0.07	< 0.001	0.2	0.002	< 0.0001	< 0.001	7.2	1.3	< 0.01	3270	< 0.0005	5330
964D	CTLN-1607-308	7/13/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.55	< 0.001	293	< 0.005	< 0.005	0.4	0.13	< 0.001	0.1	0.02	< 0.0001	< 0.001	7.2	1.3	0.004	3250	< 0.0005	5540
964D	CTLN-1608-312	8/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.14	< 0.001	298	< 0.005	< 0.005	0.4	0.28	< 0.001	0.1	0.008	< 0.0001	< 0.001	7.2	3	< 0.002	2960	< 0.0005	5420
964D	CTLN-1611-319	11/16/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.46	< 0.001	274	< 0.005	< 0.005	0.4	1.95	< 0.001	0.2	0.142	< 0.0001	< 0.001	7.2	2.1	< 0.004	3400	< 0.0005	5590
964D	CTLN-1702-327A	2/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	3.37	< 0.001	272	< 0.005	< 0.005	0.4	3.31	< 0.001	< 0.1	0.262	< 0.0001	< 0.001	7.2	2.2	0.003	3190	< 0.0005	5310
964D	CTLN-1702-312	2/22/2017	< 0.001	< 0.002	< 0.05	< 0.001	3.35	< 0.001	281	< 0.005	< 0.005	0.4	1.49	< 0.001	0.1	0.14	< 0.0001	< 0.001	7.2	0.2	< 0.004	3470	< 0.0005	5260
964D	TLN-1602-100-CCR	2/2/2016	0.001	0.002	< 0.05	< 0.001	3.37	< 0.001	270	< 0.005	< 0.005	0.4	0.29	0.002	0.1	0.005	< 0.0001	0.001	7.1	3.2	0.006	3330	0.0016	5260
964D	CTLN-1704-302	4/10/2017	< 0.001	< 0.002	< 0.05	< 0.001	3.22	< 0.001	262	< 0.005	< 0.005	0.4	2.32	< 0.001	< 0.1	0.205	< 0.0001	< 0.001	7.3	2.2	< 0.004	3330	< 0.0005	5090
964D	CTLN-1708-344	8/8/2017	< 0.001	< 0.001	< 0.05	< 0.001	3.56	< 0.001	276	< 0.005	< 0.005	0.4	4.17	< 0.001	< 0.1	0.074	< 0.0001	< 0.001	7.2	3.3	0.003	3480	< 0.0005	5310
974D	CTLN-1604-104	4/5/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.35	< 0.001	177	< 0.005	< 0.005	0.3	0.3	< 0.001	< 0.1	0.627	< 0.0001	< 0.001	7.1	3.9	< 0.001	1190	< 0.0005	2180
974D	CTLN-1605-303	5/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.38	< 0.001	235	< 0.005	< 0.005	0.3	0.04	< 0.001	< 0.1	0.147	< 0.0001	< 0.001	7.2	2.7	< 0.002	1190	< 0.0005	2170
974D	CTLN-1607-307	7/12/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.36	< 0.001	228	< 0.005	< 0.005	0.2	0.02	< 0.001	< 0.1	0.006	< 0.0001	< 0.001	7.3	1.1	< 0.001	1170	< 0.0005	2180
974D	CTLN-1608-310	8/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.35	< 0.001	235	< 0.005	< 0.005	0.3	0.55	< 0.001	< 0.1	0.019	< 0.0001	< 0.001	7.3	1.8	< 0.001	1090	< 0.0005	2230
974D	CTLN-1611-318	11/16/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.35	0.001	220	< 0.005	< 0.005	0.2	0.04	< 0.001	< 0.1	0.145	< 0.0001	< 0.001	7.1	2.3	< 0.002	1200	< 0.0005	2190
974D	CTLN-1701-317	1/30/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.36	< 0.001	233	< 0.005	< 0.005	0.3	0.69	< 0.001	< 0.1	0.439	< 0.0001	< 0.001	7.1	3.7	< 0.001	1230	< 0.0005	2210
974D	CTLN-1702-319	2/27/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.32	< 0.001	214	< 0.005	< 0.005	0.3	1.21	< 0.001	< 0.1	0.344	< 0.0001	< 0.001	7.0	3.6	< 0.002	1210	< 0.0005	2170
974D	CTLN-1704-305	4/11/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.35	< 0.001	225	< 0.005	< 0.005	0.2	2.12	< 0.001	< 0.1	0.39	< 0.0001	< 0.001	7.2	2.6	< 0.002	1210	< 0.0005	2050
974D	CTLN-1708-419	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.26	< 0.001	219	< 0.005	< 0.005	0.3	0.03	< 0.001	< 0.1	0.002	< 0.0001	< 0.001	7.3	2.6	< 0.001	1230	< 0.0005	2170
975D	CTLN-1604-138	4/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.65	< 0.001	325	< 0.005	< 0.005	0.2	4.34	< 0.001	0.1	0.028	< 0.0001	< 0.001	7.0	4.2	< 0.001	2020	< 0.0005	3430
975D	CTLN-1606-325	6/21/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.58	< 0.001	316	< 0.005	< 0.005	0.2	4.08	< 0.001	0.1	0.025	< 0.0001	< 0.001	6.9	4.6	< 0.001	1920	< 0.0005	3330
975D	CTLN-1607-327	7/27/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.62	< 0.001	342	< 0.005	< 0.005	0.2	4.05	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	6.9	3.7	< 0.001	1950	< 0.0005	3330
975D	CTLN-1608-311	8/24/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.51	< 0.001	319	< 0.005	< 0.005	0.2	3.97	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	7.0	7.6	< 0.001	1880	< 0.0005	3520
975D	CTLN-1611-316	11/16/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.54	< 0.001	302	< 0.005	< 0.005	0.2	4.31	< 0.001	0.1	0.027	< 0.0001	< 0.001	7.0	4.3	< 0.002	2010	0.0006	3430
975D	CTLN-1611-317	11/16/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.5	< 0.001	294	< 0.005	< 0.005	0.2	4.19	< 0.001	0.1	0.024	< 0.0001	< 0.001	7.0	3.9	< 0.002	2080	0.0005	3420
975D	CTLN-1701-311	1/12/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.59	< 0.001	310	< 0.005	< 0.005	0.2	3.96	< 0.001	< 0.1	0.027	< 0.0001	< 0.001	7.0	8.9	0.009	2130	< 0.0005	3320
975D	CTLN-1702-320	2/27/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.53	< 0.001	299	< 0.005	< 0.005	0.2	3.85	< 0.001	< 0.1	0.03	< 0.0001	< 0.001	7.0	3.7	< 0.002	2070	< 0.0005	3380
975D	TLN-1602-102-CCR	2/2/2016	< 0.001	< 0.001	< 0.05	< 0.001	1.58	< 0.001	301	< 0.005	< 0.005	0.2	3.62	< 0.001	< 0.1	0.022	< 0.0001	< 0.001	6.9	5	< 0.001	2070	< 0.0005	3250
975D	CTLN-1704-313	4/17/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.58	< 0.001	296	< 0.005	< 0.005	0.2	3.8	< 0.001	< 0.1	0.028	< 0.0001	< 0.001	7	4.3	< 0.002	2050	< 0.0005	3210
975D	CTLN-1708-418	8/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	1.44	< 0.001	275	< 0.005	< 0.005	0.2	3.79	< 0.001	< 0.1	0.026	< 0.0001	< 0.001	7	6.6	< 0.001	2150	< 0.0005	3300

Appendix F

Colstrip SES Federal CCR Rule Groundwater Draft Baseline Monitoring Data - 2016 Through November 2017

Comparison For Montana DEQ Human Health GW MCLs (If No MCL Listed Then EPA RSL For Tapwater - Ingestion For Child, RSL Limit Was Used)

***Metals analyzed as Total Recoverable (TRC) unless turbidity >10, then metals ran both as Total Recoverable (TRC) and Dissolved (DIS).**

Highlighted Values Exceed MCL or EPA Tapwater RSL

Highlighted Values Are Detection Limits Higher than the MCL or EPA Tapwater RSL

Site Code	Sample Code	Date	ANTIMONY 7440-36-0 mg/L	ARSENIC 7440-38-2 mg/L	BARIUM 7440-39-3 mg/L	BERYLLIUM 7440-41-7 mg/L	BORON 7440-42-8 mg/L	CADMIUM 7440-43-9 mg/L	CALCIUM 7440-70-2 mg/L	CHROMIUM 7440-47-3 mg/L	COBALT 7440-48-4 mg/L	FLUORIDE 16984-48-8 mg/L	IRON 7439-89-6 mg/L	LEAD 7439-92-1 mg/L	LITHIUM 7439-93-2 mg/L	MANGANESE 7439-96-5 mg/L	MERCURY 7439-97-6 mg/L	MOLYBDENUM 7439-98-7 mg/L	pH NA standard units	RADIUM 226/228 7440-14-4 pCi/L	SELENIUM 7782-49-2 mg/L	SULFATE 14808-79-8 mg/L	THALLIUM 7440-28-0 mg/L	TDS NA mg/L
			MCL - 0.006	MCL - 0.01	MCL - 2.0	MCL - 0.004	RSL - 4.0	MCL - 0.005	No MCL/ RSL	MCL - 0.1	RSL - 0.006	MCL - 4.0	RSL - 14.0	MCL - 0.015	RSL - 0.04	RSL - 0.43	MCL - 0.002	RSL - 0.1	No MCL/ RSL	MCL - 5.0	MCL - 0.05	No MCL/ RSL	MCL - 0.002	No MCL/ RSL
Background Well at SOEP/STEP Area																								
357A	CTLN-1604-110	4/7/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.39	< 0.001	132	< 0.005	< 0.005	0.3	0.14	< 0.001	< 0.1	0.067	< 0.0001	< 0.001	7.5	1	0.001	1180	< 0.0005	2050
357A	CTLN-1606-321	6/20/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.41	< 0.001	183	< 0.005	< 0.005	0.2	0.35	< 0.001	< 0.1	0.106	< 0.0001	0.001	7.3	3.6	< 0.001	1250	< 0.0005	2150
357A	CTLN-1607-324	7/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.48	< 0.001	194	< 0.005	< 0.005	0.3	0.1	< 0.001	< 0.1	0.105	< 0.0001	0.001	7.4	1.7	< 0.001	1200	< 0.0005	2140
357A (Dup)	CTLN-1607-325	7/26/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.45	< 0.001	194	< 0.005	< 0.005	0.3	0.06	< 0.001	< 0.1	0.096	< 0.0001	0.001	7.3	0.6	< 0.001	1260	< 0.0005	2130
357A	CTLN-1608-314	8/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.46	< 0.001	180	< 0.005	< 0.005	0.3	0.1	< 0.001	< 0.1	0.102	< 0.0001	0.001	7.4	1.8	< 0.001	1110	< 0.0005	2150
357A	CTLN-1611-331	11/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.52	< 0.001	187	< 0.005	< 0.005	0.3	0.08	< 0.001	< 0.1	0.093	< 0.0001	0.001	7.4	-0.5	< 0.002	1230	< 0.0005	2090
357A	CTLN-1702-329A	2/2/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.41	< 0.001	178	< 0.005	< 0.005	0.3	0.27	< 0.001	< 0.1	0.388	< 0.0001	0.001	7.4	0.2	< 0.001	1310	< 0.0005	2190
357A	CTLN-1702-327	2/28/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.4	< 0.001	182	< 0.005	< 0.005	0.2	0.18	< 0.001	< 0.1	0.072	< 0.0001	0.001	7.4	1.3	< 0.002	1290	< 0.0005	2120
357A	CTLN-1704-315	4/17/2017	< 0.001	0.002	< 0.05	< 0.001	0.39	< 0.001	189	< 0.005	< 0.005	0.3	0.12	< 0.001	< 0.1	0.097	< 0.0001	0.001	7.4	1.3	< 0.002	1490	< 0.0005	2350
357A (Dup)	CTLN-1704-316	4/17/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.4	< 0.001	201	< 0.005	< 0.005	0.3	0.14	< 0.001	< 0.1	0.098	< 0.0001	0.001	7.4	1	< 0.002	1480	< 0.0005	2330
357A	CTLN-1708-346	8/8/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.43	< 0.001	178	< 0.005	< 0.005	0.3	0.23	< 0.001	< 0.1	0.123	< 0.0001	0.001	7.4	2.3	< 0.001	1420	< 0.0005	2300
357A (Dup)	CTLN-1708-347	8/8/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.39	< 0.001	182	< 0.005	< 0.005	0.3	0.22	< 0.001	< 0.1	0.111	< 0.0001	0.001	7.4	3.6	< 0.001	1430	< 0.0005	2310
Upgradients Wells at SOEP/STEP Area																								
371D	CTLN-1604-103	4/6/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.14	< 0.001	267	< 0.005	< 0.005	< 0.1	0.03	< 0.001	< 0.1	0.001	< 0.0001	< 0.001	7.3	2.5	0.004	2990	< 0.0005	4670
371D	CTLN-1605-300	5/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.26	< 0.001	380	< 0.005	< 0.005	< 0.1	0.03	< 0.001	0.1	0.002	< 0.0001	< 0.001	7.2	5.1	0.006	2930	< 0.0005	4660
371D	CTLN-1607-301	7/11/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.11	< 0.001	361	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.003	< 0.0001	< 0.001	7.3	4.6	0.004	2920	< 0.0005	4550
371D	CTLN-1608-301	8/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.96	< 0.001	368	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.002	< 0.0001	< 0.001	7.3	3.1	0.003	2660	< 0.0005	4610
371D	CTLN-1611-301	11/10/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.2	< 0.001	368	< 0.005	< 0.005	< 0.1	0.02	< 0.001	0.2	0.004	< 0.0001	< 0.001	7.2	1.1	0.002	2880	< 0.0005	4530
371D	CTLN-1701-305	1/11/2017	< 0.001	< 0.001	< 0.05	0.002	2.93	< 0.001	368	< 0.005	< 0.005	< 0.1	0.1	< 0.001	< 0.1	0.003	< 0.0001	< 0.001	7.3	2.8	< 0.004	2900	< 0.0005	4380
371D (Dup)	CTLN-1701-306	1/11/2017	< 0.001	< 0.002	< 0.05	< 0.001	2.88	< 0.001	360	< 0.005	< 0.005	< 0.1	0.05	< 0.001	< 0.1	0.003	< 0.0001	< 0.001	7.3	0.6	< 0.004	2850	< 0.0005	4350
371D	CTLN-1702-302	2/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.97	< 0.001	359	< 0.005	< 0.005	< 0.1	0.02	< 0.001	< 0.1	0.002	< 0.0001	< 0.001	7.3	1.4	0.002	2940	< 0.0005	4500
371D	CTLN-1704-300	4/10/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.78	< 0.001	353	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.003	< 0.0001	< 0.001	7.4	1.5	0.002	2920	< 0.0005	4270
371D	CTLN-1708-417	8/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.82	< 0.001	362	< 0.005	< 0.005	< 0.1	< 0.02	< 0.001	< 0.1	0.002	< 0.0001	< 0.001	7.3	5.1	0.002	3050	< 0.0005	4500
373D	CTLN-1604-106	4/6/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.69	< 0.001	122	< 0.005	< 0.005	0.2	0.03	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.5	1.5	0.006	901	< 0.0005	1600
373D	CTLN-1605-301	5/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.04	0.001	167	< 0.005	0.006	0.2	< 0.02	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.4	2.9	0.007	897	< 0.0005	1600
373D	CTLN-1607-302	7/11/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.03	< 0.001	156	< 0.005	< 0.005	0.3	< 0.02	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.4	1.9	0.006	837	< 0.0005	1570
373D	CTLN-1608-302	8/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	2.74	< 0.001	152	< 0.005	< 0.005	0.2	< 0.02	< 0.001	< 0.1	0.001	< 0.0001	0.002	7.4	1.3	0.006	790	< 0.0005	1520
373D	CTLN-1611-302	11/10/2016	< 0.001	< 0.001	< 0.05	< 0.001	3.07	< 0.001	139	< 0.005	0.007	0.2	< 0.02	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.4	-0.3	0.004	779	< 0.0005	1410
373D	CTLN-1701-313	1/30/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.86	< 0.001	124	< 0.005	< 0.005	0.3	0.1	< 0.001	< 0.1	0.003	< 0.0001	0.002	7.4	1.1	0.005	694	< 0.0005	1300
373D	CTLN-1702-303	2/16/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.78	< 0.001	117	< 0.005	< 0.005	0.3	< 0.02	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.5	1.4	0.005	686	< 0.0005	1250
373D	CTLN-1704-301	4/10/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.65	< 0.001	108	< 0.005	< 0.005	0.3	0.08	< 0.001	< 0.1	0.003	< 0.0001	0.002	7.6	0.6	0.005	634	< 0.0005	1150
373D	CTLN-1708-416	8/1/2017	< 0.001	< 0.001	< 0.05	< 0.001	2.66	< 0.001	88	< 0.005	< 0.005	0.3	< 0.02	< 0.001	< 0.1	< 0.001	< 0.0001	0.002	7.5	2	0.005	539	< 0.0005	1090
388D	CTLN-1604-107	4/6/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.72	< 0.001	214	< 0.005	< 0.005	0.2	0.38	< 0.001	0.1	0.15	< 0.0001	< 0.001	7.1	3.3	< 0.001	1500	< 0.0005	2660
388D	CTLN-1605-302	5/25/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.85	< 0.001	267	< 0.005	< 0.005	0.2	0.38	< 0.001	0.2	0.108	< 0.0001	< 0.001	7.1	2.7	< 0.002	1480	< 0.0005	2640
388D	CTLN-1607-300	7/11/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	256	< 0.005	< 0.005	0.2	0.2	< 0.001	0.1	0.157	< 0.0001	< 0.001	7.1	5.6	< 0.001	1450	< 0.0005	2650
388D	CTLN-1608-300	8/22/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.88	< 0.001	271	< 0.005	< 0.005	0.1	0.46	< 0.001	0.1	0.208	< 0.0001	< 0.001	7.1	2.8	< 0.001	1440	< 0.0005	2650
388D	CTLN-1611-300	11/9/2016	< 0.001	< 0.001	< 0.05	< 0.001	0.96	< 0.001	251	< 0.005	< 0.005	0.1	0.69	< 0.001	0.2	0.21	< 0.0001	< 0.001	7.1	3.2	< 0.002	1500	< 0.0005	2640
388D	CTLN-1701-304	1/11/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	247	< 0.005	< 0.005	0.2	1.46	< 0.001	0.1	0.195	< 0.0001	< 0.001	7.1	3	< 0.002	1530	< 0.0005	2620
388D	CTLN-1702-300	2/15/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.89	< 0.001	249	< 0.005	< 0.005	0.2	1.26	< 0.001	0.1	0.188	< 0.0001	< 0.001	7.0	2.5	< 0.002	1540	< 0.0005	2610
388D	CTLN-1704-303	4/11/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.82	< 0.001	235	< 0.005	< 0.005	0.2	1.31	< 0.001	0.1	0.192	< 0.0001	< 0.001	7.2	2.7	< 0.002	1520	< 0.0005	2,510
388D	CTLN-1708-427	8/8/2017	< 0.001	< 0.001	< 0.05	< 0.001	0.82	< 0.001	227	< 0.005	< 0.005	0.2	1.2	< 0.001	< 0.1	0.175	< 0.0001	< 0.001	7.1	1.5	< 0.001	1650	< 0.0005	2,700

Appendix G

USDOE RAIS Radium PRG Calculator Outputs

Site-Specific
Resident Equation Inputs for Soil

Variable	Value
TR (target cancer risk) unitless	0.000001
t_{res} (time - resident) yr	26
ED_{res} (exposure duration - resident) yr	26
ET_{res} (exposure time - resident) hr/day	24
ET_{res-c} (exposure time - resident child) hr/day	24
ET_{res-a} (exposure time - resident adult) hr/day	24
ET_{res-i} (exposure time - indoor resident) hr/day	16.416
ET_{res-o} (exposure time - outdoor resident) hr/day	1.752
ED_{res-c} (exposure duration - resident child) yr	6
ED_{res-a} (exposure duration - resident adult) yr	20
EF_{res} (exposure frequency - resident) day/yr	270
EF_{res-c} (exposure frequency - resident child) day/yr	270
EF_{res-a} (exposure frequency - resident adult) day/yr	270
IRS_{res-a} (soil intake rate - resident adult) mg/day	100
IRS_{res-c} (soil intake rate - resident child) mg/day	200
IRA_{res-a} (inhalation rate - resident adult) m^3/day	20
IRA_{res-c} (inhalation rate - resident child) m^3/day	10
$IFS_{res-adj}$ (age-adjusted soil ingestion factor - resident) mg	864000
$IFA_{res-adj}$ (age-adjusted soil inhalation factor - resident) m^3	124200
GSF_i (gamma shielding factor - indoor) unitless	0.4
$MLF_{produce}$ (produce mass loading factor) unitless	0.0135
Site area for ACF (area correction factor) m^2	1000
Cover thickness for GSF_o (gamma shielding factor) cm	0
IRV_{res-a} (vegetable consumption rate - resident adult) g/day	128.9
IRV_{res-c} (vegetable consumption rate - resident child) g/day	41.7
$IFV_{res-adj}$ (age-adjusted vegetable consumption factor - resident) g	763614
$IFF_{res-adj}$ (age-adjusted fruit consumption factor - resident) g	1128222
IRF_{res-a} (fruit consumption rate - resident adult) g/day	188.5
IRF_{res-c} (fruit consumption rate - resident child) g/day	68.1
$CF_{res-produce}$ (contaminated plant fraction) unitless	0.25
TR (target cancer risk) unitless	0.000001
ED_{res-c} (exposure duration - resident child) yr	6
ED_{res-a} (exposure duration - resident adult) yr	20
EF_{res-c} (exposure frequency - resident child) day/yr	270
EF_{res-a} (exposure frequency - resident adult) day/yr	270
City (Climate Zone)	29
A_s (acres)	0.5

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Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
PEF (particulate emission factor) m^3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U_m (mean annual wind speed) m/s	4.69
U_t (equivalent threshold value)	11.32
F(x) (function dependent on U_m/U_t) unitless	0.194

Output generated 22MAY2018:10:25:37

Site-Specific
Resident PRG for Soil

Isotope	ICRP Lung Absorption Type	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Particulate Emission Factor (m^3/kg)	Lambda (1/yr)	Halflife (yr)	1000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Wet Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-wet soil)	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Consumption PRG (pCi/g)	Total PRG (pCi/g)
Ra-226	S	S	2.82E-08	2.50E-08	5.14E-10	6.77E-10	1.36E+09	4.33E-04	1.60E+03	6.85E-01	1.00E+00	1.70E-02	1.72E+00	3.91E+02	8.81E+00	1.36E-01	1.24E-01
Ra-228	S	S	4.37E-08	3.43E-11	1.42E-09	1.98E-09	1.36E+09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	1.70E-02	1.92E+00	8.21E+02	1.43E+04	1.59E-01	1.47E-01

Output generated 22MAY2018:10:25:37

Site-Specific
Outdoor Worker Equation Inputs for Soil

Variable	Value
Slab size for ACF (area correction factor) m^2	1000
Cover layer thickness for GSF (gamma shielding factor) cm	0
TR (target cancer risk) unitless	0.000001
t_{ow} (time - outdoor worker) yr	25
EF_{ow} (exposure frequency - outdoor worker) day/yr	187
ED_{ow} (exposure duration - outdoor worker) yr	25
IRS_{ow} (soil intake rate - outdoor worker) mg/day	100
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60
ET_{ow} (exposure time - outdoor worker) hr/day	8
City (Climate Zone)	29
A_s (acres)	0.5
Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
PEF (particulate emission factor) m^3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U_m (mean annual wind speed) m/s	4.69
U_t (equivalent threshold value)	11.32
F(x) (function dependent on U_m/U_t) unitless	0.194

Output generated 22MAY2018:10:44:43

Site-Specific
Outdoor Worker PRG for Soil

Isotope	ICRP Lung Absorption Type	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Particulate Emission Factor (m^3/kg)	Lambda (1/yr)	Halflife (yr)	1000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)
Ra-226	S	S	2.82E-08	2.50E-08	2.95E-10	1.36E+09	4.33E-04	1.60E+03	6.85E-01	1.00E+00	7.30E+00	5.19E+02	1.38E+01	4.73E+00
Ra-228	S	S	4.37E-08	3.43E-11	6.70E-10	1.36E+09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	1.01E+01	1.06E+03	2.16E+04	1.00E+01

Output generated 22MAY2018:10:44:43

Site-Specific
Excavation Worker Equation Inputs for Soil

Variable	Value
Cover layer thickness for GSF (gamma shielding factor) cm	0
TR (target cancer risk) unitless	0.000001
t_{ew} (time - excavation worker) yr	1
EF_{ew} (exposure frequency - excavation worker) day/yr	124
ED_{ew} (exposure duration - excavation worker) yr	1
ET_{ew} (outdoor exposure time - excavation worker) hr/day	8
IRA_{ew} (inhalation rate - excavation worker) m^3/day	60
IR_{ew} (soil intake rate - excavation worker) mg/day	330
City (Climate Zone)	29
A_s (acres)	0.5
Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
PEF (particulate emission factor) m^3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U_m (mean annual wind speed) m/s	4.69
U_t (equivalent threshold value)	11.32
F(x) (function dependent on U_m/U_t) unitless	0.194

Output generated 22MAY2018:10:52:40

Site-Specific
Excavation Worker PRG for Soil

Isotope	ICRP Lung Absorption Type	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Particulate Emission Factor (m^3/kg)	Lambda (1/yr)	Halflife (yr)	1000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)
Ra-226	S	S	2.82E-08	2.50E-08	2.95E-10	1.36E+09	4.33E-04	1.60E+03	6.85E-01	1.00E+00	8.30E+01	1.95E+04	5.16E+02	7.12E+01
Ra-228	S	S	4.37E-08	3.43E-11	6.70E-10	1.36E+09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	3.87E+01	1.33E+04	2.73E+05	3.86E+01

Output generated 22MAY2018:10:52:40

Appendix H

SPLP Calculations

NJDEP SPLP Spreadsheet, V3.1, November 2013

Case name/area of concern:	Colstrip SOEP/STEP Area
Case number:	Revised 5/17/2018
Sampling date:	8/16/2017

Contaminant:	Barium (total)
CAS No:	7440-39-3
Water solubility (mg/L)	NA
Aqueous reporting limit (µg/L):	2.00E+02
Soil reporting limit (mg/kg):	2.00E+01
Health-based GWQC (µg/L)	6.00E+03
DAF (20, or site-specific if approved):	10
Leachate Criterion (µg/L):	6.00E+04
Henry's law constant (dimensionless):	0.00E+00

NOTE:
USE ONE PAGE PER CONTAMINANT, do not leave empty rows between samples
Do not enter samples with soil concentrations at or below the reporting limit
When leachate concentration is non-detect, enter the aqueous reporting limit
Enter site-specific dilution-attenuation factor (DAF) if desired

Data entry cells (do not skip rows)
Optional data entry
Calculated or locked cells
Indicates that Alternative Remediation Standard needs to be recalculated

Sample ID	Soil sample weight (kg)	Leachate Volume (L)	Total Soil Concentration (mg/kg)	SPLP Leachate Concentration (µg/L)	Final pH of Leachate (except VOCs)	Optional data				Kd (L/kg)	% Contaminant in Leachate	Field leachate concentration (µg/L)	Pass or fail?
						Sampling Depth (ft)	Soil Type	Organic Carbon (mg/kg)	Organic Carbon (%)				
MDE-30 (0-6 in)	0.1	2	608	50	9.7					12140.0	0.16	50.00	PASS
MDE-33 (0-6 in)	0.1	2	731	50	9.8					14600.0	0.14	50.00	PASS
MDE-30 (Dup) (0-6 in)	0.1	2	540	80	9.5					6730.0	0.30	80.00	PASS
DP1AD-4 (0-6 in)	0.1	2	1300	850	9.9					1509.4	1.31	861.18	PASS

SPLP RESULTS for

OPTION 1a: All adjusted leachate concentrations are below the leachate criterion

REMEDIATION STANDARD = 1300 mg/kg

OPTION 1b: Simple inspection of tabulated results to find highest acceptable standard
EVERYTHING PASSED, OPTION 1b NOT VALID

OPTION 2: Remediation standard using site-specific Kd value
Kd ratio = 9.67, AVERAGING Kds OK
Kd USED FOR CALCULATING STANDARD = 8744.85 L/kg
result before rounding = 524700.3765 mg/kg
REMEDIATION STANDARD = 1300 mg/kg (controlled by maximum soil concentration)

OPTION 3: Remediation standard using linear regression
Number of points = 1
(points were eliminated because leachate concentrations were not above the aqueous reporting limit)
Less than three points with leachate concentrations above the aqueous reporting limit
LINEAR REGRESSION CANNOT BE CONDUCTED

NJDEP SPLP Spreadsheet, V3.1, November 2013

Case name/area of concern:	Colstrip SOEP/STEP Area
Case number:	Revised 5/17/2018
Sampling date:	8/16/2017
Contaminant:	Cobalt (total)
CAS No:	7440-48-4
Water solubility (mg/L)	NA
Aqueous reporting limit (µg/L):	5.00E-01
Soil reporting limit (mg/kg):	5.00E+00
Health-based GWQC (µg/L)	1.00E+02
DAF (20, or site-specific if approved):	**10**
Leachate Criterion (µg/L):	1.00E+03
Henry's law constant (dimensionless):	0.00E+00

NOTE:
USE ONE PAGE PER CONTAMINANT, do not leave empty rows between samples
Do not enter samples with soil concentrations at or below the reporting limit
When leachate concentration is non-detect, enter the aqueous reporting limit
Enter site-specific dilution-attenuation factor (DAF) if desired

Data entry cells (do not skip rows)
Optional data entry
Calculated or locked cells
Indicates that Alternative Remediation Standard needs to be recalculated

Sample ID	Soil sample weight (kg)	Leachate Volume (L)	Total Soil Concentration (mg/kg)	SPLP Leachate Concentration (µg/L)	Final pH of Leachate (except VOCs)	Optional data: Sampling Depth (ft)	Optional data: Soil Type	Optional data: Organic Carbon (mg/kg)	Optional data: Organic Carbon (%)	Kd (L/kg)	% Contaminant in Leachate	Field leachate concentration (µg/L)	Pass or fail?
DP1AD-17 (6-7 ft)	0.1	2	13	5	9.6					2580.0	0.77	5.04	PASS
MDE-30 (0-6 in)	0.1	2	5	5	9.7					980.0	2.00	5.10	PASS
MDE-33 (0-6 in)	0.1	2	5	5	9.8					980.0	2.00	5.10	PASS

SPLP RESULTS for

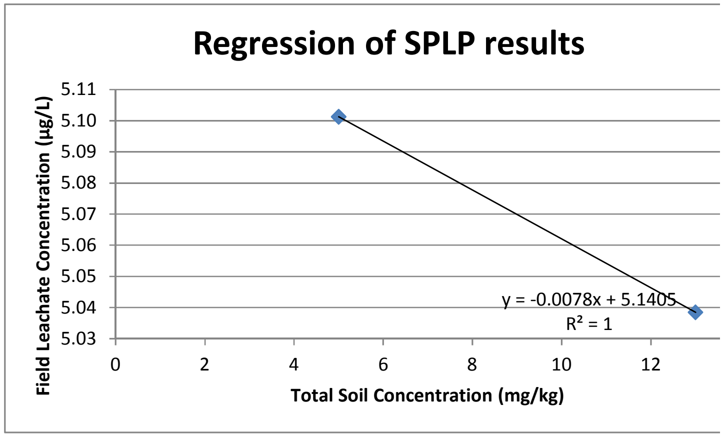
OPTION 1a: All adjusted leachate concentrations are below the leachate criterion

REMEDIATION STANDARD = 13 mg/kg

OPTION 1b: Simple inspection of tabulated results to find highest acceptable standard
EVERYTHING PASSED, OPTION 1b NOT VALID

OPTION 2: Remediation standard using site-specific Kd value
Kd ratio = 2.63, AVERAGING Kds OK
Kd USED FOR CALCULATING STANDARD = 1513.33 L/kg
result before rounding = 1513.4867 mg/kg
REMEDIATION STANDARD = 13 mg/kg (controlled by maximum soil concentration)

OPTION 3: Remediation standard using linear regression
Number of points = 3
Soil concentration midrange = 9.
Number of points above midrange = 1
Enough points above midrange? NO
R-Square high enough? YES
Leachate criterion within range of leachate concentrations? NO
OPTION 3 NOT VALID



NJDEP SPLP Spreadsheet, V3.1, November 2013

Case name/area of concern:	Colstrip SOEP/STEP
Case number:	Revised 5-17-2018
Sampling date:	8/16/2017

Contaminant:	Manganese (total)
CAS No:	7439-96-5
Water solubility (mg/L)	NA
Aqueous reporting limit (µg/L):	4.00E-01
Soil reporting limit (mg/kg):	2.00E+00
Health-based GWQC (µg/L)	5.00E+01
DAF (20, or site-specific if approved):	**10**
Leachate Criterion (µg/L):	5.00E+02
Henry's law constant (dimensionless):	0.00E+00

NOTE:
USE ONE PAGE PER CONTAMINANT, do not leave empty rows between samples
Do not enter samples with soil concentrations at or below the reporting limit
When leachate concentration is non-detect, enter the aqueous reporting limit
Enter site-specific dilution-attenuation factor (DAF) if desired

Data entry cells (do not skip rows)
Optional data entry
Calculated or locked cells
Indicates that Alternative Remediation Standard needs to be recalculated

Sample ID	Soil sample weight (kg)	Leachate Volume (L)	Total Soil Concentration (mg/kg)	SPLP Leachate Concentration (µg/L)	Final pH of Leachate (except VOCs)	Optional data: Sampling Depth (ft)	Optional data: Soil Type	Optional data: Organic Carbon (mg/kg)	Optional data: Organic Carbon (%)	Kd (L/kg)	% Contaminant in Leachate	Field leachate concentration (µg/L)	Pass or fail?
DP1AD-17 (6-7 ft)	0.1	2	1830	2	9.6					914980.0	0.00	2.00	PASS
MDE-30 (0-6 in)	0.1	2	608	2	10					303980.0	0.01	2.00	PASS
MDE-30 (Dup)(0-6 in)	0.1	2	540	4	9.9					134980.0	0.01	4.00	PASS
MDE-33 (0-6 in)	0.1	2	731	90	98					8102.2	0.25	90.22	PASS

SPLP RESULTS for

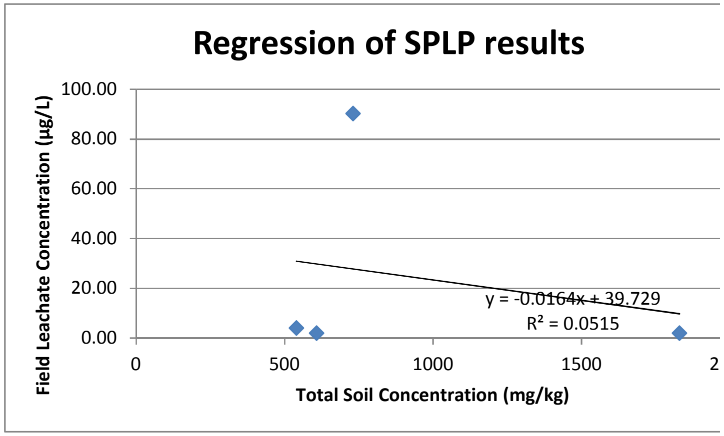
OPTION 1a: All adjusted leachate concentrations are below the leachate criterion

REMEDIATION STANDARD = 1830 mg/kg

OPTION 1b: Simple inspection of tabulated results to find highest acceptable standard
EVERYTHING PASSED, OPTION 1b NOT VALID

OPTION 2: Remediation standard using site-specific Kd value
Kd ratio = 112.93, USE MINIMUM Kd
Kd USED FOR CALCULATING STANDARD = 8102.22 L/kg
result before rounding = 4051.1878 mg/kg
REMEDIATION STANDARD = 1800 mg/kg (controlled by maximum soil concentration)

OPTION 3: Remediation standard using linear regression
Number of points = 4
Soil concentration midrange = 1185.
Number of points above midrange = 1
Enough points above midrange? NO
R-Square high enough? NO
Leachate criterion within range of leachate concentrations? NO
OPTION 3 NOT VALID



NJDEP SPLP Spreadsheet, V3.1, November 2013

Case name/area of concern:	Colstrip SOEP/STEP Area
Case number:	Revised 5/17/2018
Sampling date:	8/16/2017

Contaminant:	Radium 226	
CAS No:	7440-14-4	enter NA if inorganic
Water solubility (mg/L)	7.00E+05	
Aqueous reporting limit (µg/L):	1.00E-05	if unavailable, enter a value below lowest concentration measured
Soil reporting limit (mg/kg):	1.20E-08	
Health-based GWQC (µg/L)	5.00E-06	
DAF (20, or site-specific if approved):	**10**	
Leachate Criterion (µg/L):	5.00E-05	
Henry's law constant (dimensionless):	0.00E+00	enter 0 if inorganic

NOTE:
USE ONE PAGE PER CONTAMINANT, do not leave empty rows between samples
Do not enter samples with soil concentrations at or below the reporting limit.
When leachate concentration is non-detect, enter the aqueous reporting limit
Enter site-specific dilution-attenuation factor (DAF) if desired

Data entry cells (do not skip rows)
Optional data entry
Calculated or locked cells
Indicates that Alternative Remediation Standard needs to be recalculated

Sample ID	Soil sample weight (kg)	Leachate Volume (L)	Total Soil Concentration (mg/kg)	SPLP Leachate Concentration (µg/L)	Final pH of Leachate (except VOCs)	Optional data				Kd (L/kg)	% Contaminant in Leachate	Field leachate concentration (µg/L)	Pass or fail?
						Sampling Depth (ft)	Soil Type	Organic Carbon (mg/kg)	Organic Carbon (%)				
DP1AD-10 (12-24 in)	0.1	2	3.50E-06	1.00E-07	9.9					34980.0	0.06	0.00	PASS
DP1AD-13 (5-6 ft)	0.1	2	2.53E-05	2.00E-07	9.3					126480.0	0.02	0.00	PASS
DP1AD-10 (0-6 in)	0.1	2	6.10E-06	3.00E-07	10.1					20313.3	0.10	0.00	PASS

SPLP RESULTS for

OPTION 1a: All adjusted leachate concentrations are below the leachate criterion

REMEDIATION STANDARD = 0.0000253 mg/kg

OPTION 1b: Simple inspection of tabulated results to find highest acceptable standard
EVERYTHING PASSED, OPTION 1b NOT VALID

OPTION 2: Remediation standard using site-specific Kd value
Kd ratio = 6.23, AVERAGING Kds OK
Kd USED FOR CALCULATING STANDARD = 60591.11 L/kg
result before rounding = 0.003 mg/kg
REMEDIATION STANDARD = 0.00003 mg/kg (controlled by maximum soil concentration)

OPTION 3: Remediation standard using linear regression
Number of points = 1
(points were eliminated because leachate concentrations were not above the aqueous reporting limit)
Less than three points with leachate concentrations above the aqueous reporting limit
LINEAR REGRESSION CANNOT BE CONDUCTED

Radium-226 Properties/Constants

Property	Value Used	Reference
Water solubility (mg/L)	7×10^5 mg/L	The Radiochemistry of Radium, National Academy of Sciences, National Research Council. https://library.lanl.gov/cgi-bin/getfile?rc000041.pdf
Aqueous reporting limit (µg/L)	1×10^{-6} µg/L	Maximum Contaminant Level Recommendations for Radium in Drinking Water, New Jersey Drinking Water Quality Institute, 2002. http://www.nj.gov/dep/watersupply/pdf/radium_bb_5_20_02.pdf
Soil reporting limit (mg/kg)	1.2×10^{-8} mg/kg	Minimum detection limit for a study was 12 pCi/kg = 1.2×10^{-8} mg/kg (1Ci = 1 g)
Health-based GWQC (µg/L)	5×10^{-6} µg /L	DEQ-7 for Radium 226/228 is 5.0 pCi/L. This is equal to 5×10^{-12} g/L or 5×10^{-6} µg /L
Dilution Attenuation Factor (DAF)	10	MDEQ Default is 10
Leachate criterion (µg /L)	1×10^{-4} µg /L.	NJDEP SPLP guidance document

Appendix I

SPLP Laboratory Results

ANALYTICAL SUMMARY REPORT

December 06, 2017

Hydrometrics Inc
5602 Hesper Rd
Billings, MT 59106

Work Order: B17081923 Quote ID: B4274

Project Name: Talen Job # 12072 Soil Sampling

Energy Laboratories Inc Billings MT received the following 72 samples for Hydrometrics Inc on 8/17/2017 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
B17081923-001	TLN-1708-032	08/16/17 9:25	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio
B17081923-002	TLN-1708-040	08/16/17 9:30	08/17/17	Soil	Same As Above
B17081923-003	TLN-1708-031	08/16/17 9:35	08/17/17	Soil	Same As Above
B17081923-004	TLN-1708-041	08/16/17 9:40	08/17/17	Soil	Same As Above
B17081923-005	TLN-1708-033	08/16/17 9:45	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals

ANALYTICAL SUMMARY REPORT

B17081923-006	TLN-1708-042	08/16/17 9:50	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals
B17081923-007	TLN-1708-030	08/16/17 9:55	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals
B17081923-008	TLN-1708-044	08/16/17 9:55	08/17/17	Splp Extract	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals

ANALYTICAL SUMMARY REPORT

B17081923-009	TLN-1708-043	08/16/17 10:00	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals
B17081923-010	TLN-1708-045	08/16/17 10:00	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals
B17081923-011	TLN-1708-029	08/16/17 10:10	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio
B17081923-012	TLN-1708-046	08/16/17 10:15	08/17/17	Soil	Same As Above
B17081923-013	TLN-1708-028	08/16/17 10:25	08/17/17	Soil	Same As Above
B17081923-014	TLN-1708-047	08/16/17 10:30	08/17/17	Soil	Same As Above
B17081923-015	TLN-1708-027	08/16/17 10:35	08/17/17	Soil	Same As Above
B17081923-016	TLN-1708-048	08/16/17 10:40	08/17/17	Soil	Same As Above
B17081923-017	TLN-1708-014	08/16/17 11:10	08/17/17	Soil	Same As Above
B17081923-018	TLN-1708-050	08/16/17 11:15	08/17/17	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

B17081923-019	TLN-1708-051	08/16/17 11:25	08/17/17	Soil	Same As Above
B17081923-020	TLN-1708-017	08/16/17 11:30	08/17/17	Soil	Same As Above
B17081923-021	TLN-1708-052	08/16/17 11:35	08/17/17	Soil	Same As Above
B17081923-022	TLN-1708-053	08/16/17 11:40	08/17/17	Splp Extract	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals
B17081923-023	TLN-1708-018	08/16/17 11:45	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio
B17081923-024	TLN-1708-054	08/16/17 11:50	08/17/17	Soil	Same As Above
B17081923-025	TLN-1708-019	08/16/17 12:07	08/17/17	Soil	Same As Above
B17081923-026	TLN-1708-058	08/16/17 12:10	08/17/17	Soil	Same As Above
B17081923-027	TLN-1708-059	08/16/17 12:13	08/17/17	Soil	Same As Above
B17081923-028	TLN-1708-020	08/16/17 12:19	08/17/17	Soil	Same As Above
B17081923-029	TLN-1708-060	08/16/17 12:21	08/17/17	Soil	Same As Above
B17081923-030	TLN-1708-061	08/16/17 12:24	08/17/17	Soil	Same As Above
B17081923-031	TLN-1708-021	08/16/17 12:30	08/17/17	Soil	Same As Above
B17081923-032	TLN-1708-062	08/16/17 12:33	08/17/17	Soil	Same As Above
B17081923-033	TLN-1708-022	08/16/17 12:36	08/17/17	Soil	Same As Above
B17081923-034	TLN-1708-063	08/16/17 12:38	08/17/17	Soil	Same As Above
B17081923-035	TLN-1708-009	08/16/17 12:41	08/17/17	Soil	Same As Above
B17081923-036	TLN-1708-064	08/16/17 12:44	08/17/17	Soil	Same As Above
B17081923-037	TLN-1708-008	08/16/17 12:46	08/17/17	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

B17081923-038	TLN-1708-065	08/16/17 12:49 08/17/17	Soil	Same As Above
B17081923-039	TLN-1708-003	08/16/17 12:52 08/17/17	Soil	Same As Above
B17081923-040	TLN-1708-066	08/16/17 12:55 08/17/17	Soil	Same As Above
B17081923-041	TLN-1708-012	08/16/17 13:48 08/17/17	Soil	Same As Above
B17081923-042	TLN-1708-067	08/16/17 13:50 08/17/17	Soil	Same As Above
B17081923-043	TLN-1708-068	08/16/17 13:54 08/17/17	Soil	Same As Above
B17081923-044	TLN-1708-011	08/16/17 13:57 08/17/17	Soil	Same As Above
B17081923-045	TLN-1708-069	08/16/17 13:59 08/17/17	Soil	Same As Above
B17081923-046	TLN-1708-070	08/16/17 14:02 08/17/17	Soil	Same As Above
B17081923-047	TLN-1708-013	08/16/17 14:05 08/17/17	Soil	Same As Above
B17081923-048	TLN-1708-071	08/16/17 14:07 08/17/17	Soil	Same As Above
B17081923-049	TLN-1708-072	08/16/17 14:10 08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 226, Total Radium 228 Radium 228, Total Sodium Adsorption Ratio SPLP Extraction, Regular
B17081923-050	TLN-1708-010	08/16/17 14:15 08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 226, Total Radium 228 Radium 228, Total Sodium Adsorption Ratio SPLP Extraction, Regular

ANALYTICAL SUMMARY REPORT

B17081923-051	TLN-1708-073	08/16/17 14:18	08/17/17	Splp Extract	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 226, Total Radium 228 Radium 228, Total Sodium Adsorption Ratio SPLP Extraction, Regular
B17081923-052	TLN-1708-007	08/16/17 14:20	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio
B17081923-053	TLN-1708-074	08/16/17 14:23	08/17/17	Soil	Same As Above
B17081923-054	TLN-1708-006	08/16/17 14:25	08/17/17	Soil	Same As Above
B17081923-055	TLN-1708-075	08/16/17 4:30	08/17/17	Soil	Same As Above
B17081923-056	TLN-1708-076	08/16/17 14:27	08/17/17	Soil	Same As Above
B17081923-057	TLN-1708-005	08/16/17 14:32	08/17/17	Soil	Same As Above
B17081923-058	TLN-1708-077	08/16/17 14:35	08/17/17	Soil	Same As Above
B17081923-059	TLN-1708-004	08/16/17 14:37	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Metals by ICP/ICPMS, SPLP Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio SPLP Extraction, Regular Digestion, Total Metals

ANALYTICAL SUMMARY REPORT

B17081923-060	TLN-1708-078	08/16/17 14:40	08/17/17	Soil	Metals by ICP/ICPMS, Total or Soluble Metals, Saturated Paste Alkalinity, Saturated Paste Extract Conductivity, Saturated Paste Extract Mercury in Solid By CVAA Anions, Saturated Paste Extract pH, Saturated Paste Digestion, Total Metals Digestion, Mercury by CVAA Digestion For RadioChemistry Saturated Paste Extraction Radium 226 Radium 228 Sodium Adsorption Ratio
B17081923-061	TLN-1708-002	08/16/17 14:43	08/17/17	Soil	Same As Above
B17081923-062	TLN-1708-079	08/16/17 14:45	08/17/17	Soil	Same As Above
B17081923-063	TLN-1708-080	08/16/17 14:48	08/17/17	Soil	Same As Above
B17081923-064	TLN-1708-001	08/16/17 14:53	08/17/17	Soil	Same As Above
B17081923-065	TLN-1708-081	08/16/17 14:56	08/17/17	Soil	Same As Above
B17081923-066	TLN-1708-015	08/16/17 15:12	08/17/17	Soil	Same As Above
B17081923-067	TLN-1708-083	08/16/17 15:15	08/17/17	Soil	Same As Above
B17081923-068	TLN-1708-016	08/16/17 15:17	08/17/17	Soil	Same As Above
B17081923-069	TLN-1708-084	08/16/17 15:20	08/17/17	Soil	Same As Above
B17081923-070	TLN-1708-026	08/16/17 15:22	08/17/17	Soil	Same As Above
B17081923-071	TLN-1708-085	08/16/17 15:23	08/17/17	Soil	Same As Above
B17081923-072	TLN-1708-086	08/16/17 15:25	08/17/17	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 1120 S 27th St., Billings, MT 59101, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

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

Report Approved By:

CLIENT: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Work Order: B17081923

Revised Date: 12/06/17
Report Date: 10/18/17

CASE NARRATIVE

Tests associated with analyst identified as ELI-CA were subcontracted to Energy Laboratories, PO Box 247, Casper, WY, EPA Number WY00002 and WY00937.

Revised Report:
SPLP extraction and Barium analysis was added to samples TLN-1708-004, TLN-1708-030, TLN-1708-044, and TLN-1708-033.
SPLP extraction and Manganese analysis was added to samples TLN-1708-053, TLN-1708-043, TLN-1708-045, and TLN-1708-042.
SPLP extraction and Radium 226 and 228 analysis was added to samples TLN-1708-010, TLN-1708-073, and TLN-1708-072.

This revised report replaces any previous report in its entirety.

Revised 11/30/2017:

Per Gary Hoffman on 11/28/2017, include the weight of sample used, leachate volume used and the final pH for SPLP extraction.

	pH	sample wt	leachate vol
TLN-1708-033	10.4 s.u.	100 g	2000 mL
TLN-1708-042	9.8 s.u.	100 g	2000 mL
TLN-1708-030	9.7 s.u.	100 g	2000 mL
TLN-1708-044	9.5 s.u.	100 g	2000 mL
TLN-1708-043	10.0 s.u.	100 g	2000 mL
TLN-1708-045	9.9 s.u.	100 g	2000 mL
TLN-1708-053	9.6 s.u.	100 g	2000 mL
TLN-1708-072	9.3 s.u.	100 g	2000 mL
TLN-1708-010	10.1 s.u.	100 g	2000 mL
TLN-1708-073	9.9 s.u.	100 g	2000 mL
TLN-1708-004	9.9 s.u.	100 g	2000 mL

Revised 12/5/2017:

Per request from Jenny Vanek on 12/5/2017, SPLP Cobalt has been added to sample TLN-1708-053 (B17081923-022).

The report has been revised and replaces any previously issued report in its entirety.

Revised 12/6/2017:

Per request from Jenny Vanek on 12/6/2017, SPLP Cobalt has been added to samples TLN-1708-033 (B17081923-005) and TLN-1708-030 (B17081923-007).

The report has been revised and replaces any previously issued report in its entirety.

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-001	**Collection Date:**	08/16/17 09:25
Client Sample ID:	TLN-1708-032	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	28.6	meq/L		0.05		SW6010B	08/30/17 13:34 / slf
Magnesium, sat. paste	32.0	meq/L		0.08		SW6010B	08/30/17 13:34 / slf
Potassium, sat. paste	0.75	meq/L		0.03		SW6010B	08/30/17 13:34 / slf
Sodium, sat. paste	8.79	meq/L		0.04		SW6010B	08/30/17 13:34 / slf
Sodium Adsorption Ratio (SAR)	1.60	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	108	mg/L		4		ASA10-3	08/31/17 14:15 / bas
Bicarbonate as HCO3	132	mg/L		4		ASA10-3	08/31/17 14:15 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:15 / bas
Bromide	16	mg/L	D	2		E300.0	08/30/17 20:55 / cjm
Chloride	49	mg/L		1		E300.0	08/30/17 20:55 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/30/17 20:55 / cjm
Sulfate	3080	mg/L	D	5		E300.0	08/30/17 20:55 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:15 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 03:45 / slf
Barium	207	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Boron	6	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 03:45 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 03:45 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 03:45 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Manganese	326	mg/kg		1		SW6010B	08/25/17 03:45 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:42 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:15 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:15 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:15 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 228	0.5	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.9	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-002	**Collection Date:**	08/16/17 09:30
Client Sample ID:	TLN-1708-040	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	1.5	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	8.83	meq/L		0.05		SW6010B	08/30/17 13:42 / slf
Magnesium, sat. paste	7.02	meq/L		0.08		SW6010B	08/30/17 13:42 / slf
Potassium, sat. paste	0.48	meq/L		0.03		SW6010B	08/30/17 13:42 / slf
Sodium, sat. paste	1.72	meq/L		0.04		SW6010B	08/30/17 13:42 / slf
Sodium Adsorption Ratio (SAR)	0.61	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	89	mg/L		4		ASA10-3	08/31/17 14:27 / bas
Bicarbonate as HCO3	109	mg/L		4		ASA10-3	08/31/17 14:27 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:27 / bas
Bromide	12	mg/L	D	1		E300.0	08/30/17 21:54 / cjm
Chloride	29	mg/L		1		E300.0	08/30/17 21:54 / cjm
Fluoride	ND	mg/L	D	2		E300.0	08/30/17 21:54 / cjm
Sulfate	710	mg/L	D	2		E300.0	08/30/17 21:54 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 03:49 / slf
Barium	107	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Boron	2	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Chromium	15	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Cobalt	8	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Lead	12	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Lithium	8	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Manganese	313	mg/kg		1		SW6010B	08/25/17 03:49 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:43 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:17 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:17 / rlh
RADIONUCLIDES							
Radium 226	1.2	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 226 precision (±)	0.4	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 226 MDC	0.4	pCi/g-dry				E903.0	10/02/17 12:35 / eli-g
Radium 228	0.7	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.8	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	1.8	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 09:35
Lab ID:	B17081923-003	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-031	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	2.5	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	16.9	meq/L		0.05		SW6010B	08/30/17 13:50 / slf
Magnesium, sat. paste	14.4	meq/L		0.08		SW6010B	08/30/17 13:50 / slf
Potassium, sat. paste	0.49	meq/L		0.03		SW6010B	08/30/17 13:50 / slf
Sodium, sat. paste	4.07	meq/L		0.04		SW6010B	08/30/17 13:50 / slf
Sodium Adsorption Ratio (SAR)	1.03	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	126	mg/L		4		ASA10-3	08/31/17 14:34 / bas
Bicarbonate as HCO3	153	mg/L		4		ASA10-3	08/31/17 14:34 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:34 / bas
Bromide	3	mg/L	D	1		E300.0	08/30/17 22:13 / cjm
Chloride	36	mg/L		1		E300.0	08/30/17 22:13 / cjm
Fluoride	ND	mg/L	D	2		E300.0	08/30/17 22:13 / cjm
Sulfate	1450	mg/L	D	2		E300.0	08/30/17 22:13 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:20 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 03:53 / slf
Barium	149	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 03:53 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 03:53 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 03:53 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Manganese	317	mg/kg		1		SW6010B	08/25/17 03:53 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:45 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:20 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:20 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:20 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.4	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	1.1	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.7	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	1.5	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-004
Client Sample ID: TLN-1708-041

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 09:40
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	16.2	meq/L		0.05		SW6010B	08/30/17 13:54 / slf
Magnesium, sat. paste	25.5	meq/L		0.08		SW6010B	08/30/17 13:54 / slf
Potassium, sat. paste	0.43	meq/L		0.03		SW6010B	08/30/17 13:54 / slf
Sodium, sat. paste	5.93	meq/L		0.04		SW6010B	08/30/17 13:54 / slf
Sodium Adsorption Ratio (SAR)	1.30	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	81	mg/L		4		ASA10-3	08/31/17 14:39 / bas
Bicarbonate as HCO3	99	mg/L		4		ASA10-3	08/31/17 14:39 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:39 / bas
Bromide	ND	mg/L	D	2		E300.0	08/30/17 22:33 / cjm
Chloride	10	mg/L		1		E300.0	08/30/17 22:33 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/30/17 22:33 / cjm
Sulfate	2270	mg/L	D	5		E300.0	08/30/17 22:33 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:23 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 03:57 / slf
Barium	150	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 03:57 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 03:57 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 03:57 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Manganese	324	mg/kg		1		SW6010B	08/25/17 03:57 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:47 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:23 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:23 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:23 / rlh
RADIONUCLIDES							
Radium 226	0.9	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.4	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.3	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.5	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	1.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-005	**Collection Date:**	08/16/17 09:45
Client Sample ID:	TLN-1708-033	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	2.6	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	19.2	meq/L		0.05		SW6010B	08/30/17 13:58 / slf
Magnesium, sat. paste	15.2	meq/L		0.08		SW6010B	08/30/17 13:58 / slf
Potassium, sat. paste	1.22	meq/L		0.03		SW6010B	08/30/17 13:58 / slf
Sodium, sat. paste	2.49	meq/L		0.04		SW6010B	08/30/17 13:58 / slf
Sodium Adsorption Ratio (SAR)	0.60	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	182	mg/L		4		ASA10-3	08/31/17 14:42 / bas
Bicarbonate as HCO3	222	mg/L		4		ASA10-3	08/31/17 14:42 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:42 / bas
Bromide	2	mg/L	D	1		E300.0	08/30/17 22:52 / cjm
Chloride	49	mg/L		1		E300.0	08/30/17 22:52 / cjm
Fluoride	ND	mg/L	D	2		E300.0	08/30/17 22:52 / cjm
Sulfate	1450	mg/L	D	2		E300.0	08/30/17 22:52 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:25 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:01 / slf
Barium	731	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Boron	33	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 04:01 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 04:01 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:01 / slf
Lithium	15	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Manganese	335	mg/kg		1		SW6010B	08/25/17 04:01 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:49 / jh
Molybdenum	ND	mg/kg		4		SW6010B	08/25/17 04:01 / slf
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:25 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:25 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.9	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-005	**Collection Date:**	08/16/17 09:45
Client Sample ID:	TLN-1708-033	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Barium	0.08	mg/L		0.05		SW6010B	11/03/17 17:40 / slf
Cobalt	ND	mg/L		0.005		SW6010B	11/03/17 17:40 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-006
Client Sample ID: TLN-1708-042

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 09:50
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	1.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	5.00	meq/L		0.05		SW6010B	08/30/17 14:02 / slf
Magnesium, sat. paste	5.58	meq/L		0.08		SW6010B	08/30/17 14:02 / slf
Potassium, sat. paste	0.31	meq/L		0.03		SW6010B	08/30/17 14:02 / slf
Sodium, sat. paste	1.00	meq/L		0.04		SW6010B	08/30/17 14:02 / slf
Sodium Adsorption Ratio (SAR)	0.43	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	119	mg/L		4		ASA10-3	08/31/17 14:49 / bas
Bicarbonate as HCO3	145	mg/L		4		ASA10-3	08/31/17 14:49 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:49 / bas
Bromide	1.3	mg/L		0.5		E300.0	08/30/17 23:12 / cjm
Chloride	14	mg/L		1		E300.0	08/30/17 23:12 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/30/17 23:12 / cjm
Sulfate	403	mg/L		1		E300.0	08/30/17 23:12 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:28 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:05 / slf
Barium	246	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Boron	6	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 04:05 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 04:05 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:05 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Manganese	691	mg/kg		1		SW6010B	08/25/17 04:05 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:50 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:28 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:28 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:28 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.3	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.6	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	1.2	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 09:50
Lab ID:	B17081923-006	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-042	**Matrix:**	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Manganese	0.090	mg/L		0.001		SW6010B	11/03/17 17:47 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-007	**Collection Date:**	08/16/17 09:55
Client Sample ID:	TLN-1708-030	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	2.7	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	20.6	meq/L		0.05		SW6010B	08/30/17 14:06 / slf
Magnesium, sat. paste	16.6	meq/L		0.08		SW6010B	08/30/17 14:06 / slf
Potassium, sat. paste	0.61	meq/L		0.03		SW6010B	08/30/17 14:06 / slf
Sodium, sat. paste	3.02	meq/L		0.04		SW6010B	08/30/17 14:06 / slf
Sodium Adsorption Ratio (SAR)	0.70	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	138	mg/L		4		ASA10-3	08/31/17 14:53 / bas
Bicarbonate as HCO3	168	mg/L		4		ASA10-3	08/31/17 14:53 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:53 / bas
Bromide	7	mg/L	D	1		E300.0	08/30/17 23:31 / cjm
Chloride	29	mg/L		1		E300.0	08/30/17 23:31 / cjm
Fluoride	ND	mg/L	D	2		E300.0	08/30/17 23:31 / cjm
Sulfate	1780	mg/L	D	2		E300.0	08/30/17 23:31 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:38 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:16 / slf
Barium	608	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Boron	26	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 04:16 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 04:16 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:16 / slf
Lithium	15	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Manganese	330	mg/kg		1		SW6010B	08/25/17 04:16 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:52 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 21:38 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:38 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:38 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.7	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-007	**Collection Date:**	08/16/17 09:55
Client Sample ID:	TLN-1708-030	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Barium	ND	mg/L		0.05		SW6010B	11/03/17 18:04 / slf
Cobalt	ND	mg/L		0.005		SW6010B	11/03/17 18:04 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-008	**Collection Date:**	08/16/17 09:55
Client Sample ID:	TLN-1708-044	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.7	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	2.9	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	22.7	meq/L		0.05		SW6010B	08/30/17 14:10 / slf
Magnesium, sat. paste	18.9	meq/L		0.08		SW6010B	08/30/17 14:10 / slf
Potassium, sat. paste	0.62	meq/L		0.03		SW6010B	08/30/17 14:10 / slf
Sodium, sat. paste	3.29	meq/L		0.04		SW6010B	08/30/17 14:10 / slf
Sodium Adsorption Ratio (SAR)	0.72	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	132	mg/L		4		ASA10-3	08/31/17 14:57 / bas
Bicarbonate as HCO3	160	mg/L		4		ASA10-3	08/31/17 14:57 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 14:57 / bas
Bromide	7	mg/L	D	2		E300.0	08/30/17 23:51 / cjm
Chloride	30	mg/L		1		E300.0	08/30/17 23:51 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/30/17 23:51 / cjm
Sulfate	2050	mg/L	D	5		E300.0	08/30/17 23:51 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:41 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:20 / slf
Barium	540	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Boron	29	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 04:20 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 04:20 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:20 / slf
Lithium	16	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Manganese	297	mg/kg		1		SW6010B	08/25/17 04:20 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:54 / jh
Molybdenum	ND	mg/kg		4		SW6010B	08/25/17 04:20 / slf
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:41 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:41 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.6	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-008	**Collection Date:**	08/16/17 09:55
Client Sample ID:	TLN-1708-044	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Barium	ND	mg/L		0.05		SW6010B	11/03/17 18:11 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:00
Lab ID:	B17081923-009	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-043	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.9	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.8	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	25.1	meq/L		0.05		SW6010B	08/30/17 14:22 / slf
Magnesium, sat. paste	33.7	meq/L		0.08		SW6010B	08/30/17 14:22 / slf
Potassium, sat. paste	0.57	meq/L		0.03		SW6010B	08/30/17 14:22 / slf
Sodium, sat. paste	7.59	meq/L		0.04		SW6010B	08/30/17 14:22 / slf
Sodium Adsorption Ratio (SAR)	1.40	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	77	mg/L		4		ASA10-3	08/31/17 15:03 / bas
Bicarbonate as HCO3	94	mg/L		4		ASA10-3	08/31/17 15:03 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:03 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 00:11 / cjm
Chloride	14	mg/L		1		E300.0	08/31/17 00:11 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 00:11 / cjm
Sulfate	3210	mg/L	D	5		E300.0	08/31/17 00:11 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		20		SW6010B	08/25/17 04:24 / slf
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:24 / slf
Barium	237	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 04:24 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 04:24 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:24 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Manganese	575	mg/kg		1		SW6010B	08/25/17 04:24 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:56 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 21:44 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:44 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:44 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.5	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:00
Lab ID:	B17081923-009	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-043	**Matrix:**	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Manganese	ND	mg/L		0.002		SW6010B	11/03/17 18:18 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:00
Lab ID:	B17081923-010	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-045	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.8	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	25.1	meq/L		0.05		SW6010B	08/30/17 14:25 / slf
Magnesium, sat. paste	33.7	meq/L		0.08		SW6010B	08/30/17 14:25 / slf
Potassium, sat. paste	0.57	meq/L		0.03		SW6010B	08/30/17 14:25 / slf
Sodium, sat. paste	7.59	meq/L		0.04		SW6010B	08/30/17 14:25 / slf
Sodium Adsorption Ratio (SAR)	1.40	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	74	mg/L		4		ASA10-3	08/31/17 15:07 / bas
Bicarbonate as HCO3	90	mg/L		4		ASA10-3	08/31/17 15:07 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:07 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 00:30 / cjm
Chloride	14	mg/L		1		E300.0	08/31/17 00:30 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 00:30 / cjm
Sulfate	3210	mg/L	D	5		E300.0	08/31/17 00:30 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:46 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:28 / slf
Barium	250	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Boron	5	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 04:28 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 04:28 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:28 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Manganese	497	mg/kg		1		SW6010B	08/25/17 04:28 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 09:57 / jh
Molybdenum	ND	mg/kg		4		SW6010B	08/25/17 04:28 / slf
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:46 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:46 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.5	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-010	**Collection Date:**	08/16/17 10:00
Client Sample ID:	TLN-1708-045	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Manganese	ND	mg/L		0.004		SW6010B	11/03/17 18:25 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:10
Lab ID:	B17081923-011	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-029	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.9	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	8.00	meq/L		0.05		SW6010B	08/30/17 14:29 / slf
Magnesium, sat. paste	2.21	meq/L		0.08		SW6010B	08/30/17 14:29 / slf
Potassium, sat. paste	0.61	meq/L		0.03		SW6010B	08/30/17 14:29 / slf
Sodium, sat. paste	0.29	meq/L		0.04		SW6010B	08/30/17 14:29 / slf
Sodium Adsorption Ratio (SAR)	0.13	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	297	mg/L		4		ASA10-3	08/31/17 15:11 / bas
Bicarbonate as HCO3	362	mg/L		4		ASA10-3	08/31/17 15:11 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:11 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 01:28 / cjm
Chloride	14	mg/L		1		E300.0	08/31/17 01:28 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 01:28 / cjm
Sulfate	77	mg/L		1		E300.0	08/31/17 01:28 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:49 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:32 / slf
Barium	108	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 04:32 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 04:32 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:32 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Manganese	270	mg/kg		1		SW6010B	08/25/17 04:32 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:02 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:49 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:49 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:49 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.6	pCi/g-dry	U			RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-012
Client Sample ID: TLN-1708-046

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 10:15
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.4	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	2.57	meq/L		0.05		SW6010B	08/30/17 14:37 / slf
Magnesium, sat. paste	1.24	meq/L		0.08		SW6010B	08/30/17 14:37 / slf
Potassium, sat. paste	0.26	meq/L		0.03		SW6010B	08/30/17 14:37 / slf
Sodium, sat. paste	0.12	meq/L		0.04		SW6010B	08/30/17 14:37 / slf
Sodium Adsorption Ratio (SAR)	0.08	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	142	mg/L		4		ASA10-3	08/31/17 15:30 / bas
Bicarbonate as HCO3	173	mg/L		4		ASA10-3	08/31/17 15:30 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:30 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 02:27 / cjm
Chloride	4	mg/L		1		E300.0	08/31/17 02:27 / cjm
Fluoride	ND	mg/L	D	0.5		E300.0	08/31/17 02:27 / cjm
Sulfate	34	mg/L		1		E300.0	08/31/17 02:27 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:51 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:36 / slf
Barium	86	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Boron	1	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 04:36 / slf
Cobalt	4	mg/kg	D	3		SW6010B	08/25/17 04:36 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:36 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Manganese	247	mg/kg		1		SW6010B	08/25/17 04:36 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:04 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:51 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:51 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:51 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.9	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/27/17 17:34 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-013	**Collection Date:**	08/16/17 10:25
Client Sample ID:	TLN-1708-028	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.8	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	4.17	meq/L		0.05		SW6010B	08/30/17 14:45 / slf
Magnesium, sat. paste	4.29	meq/L		0.08		SW6010B	08/30/17 14:45 / slf
Potassium, sat. paste	0.34	meq/L		0.03		SW6010B	08/30/17 14:45 / slf
Sodium, sat. paste	0.65	meq/L		0.04		SW6010B	08/30/17 14:45 / slf
Sodium Adsorption Ratio (SAR)	0.32	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	264	mg/L		4		ASA10-3	08/31/17 15:34 / bas
Bicarbonate as HCO3	322	mg/L		4		ASA10-3	08/31/17 15:34 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:34 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 02:47 / cjm
Chloride	17	mg/L		1		E300.0	08/31/17 02:47 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 02:47 / cjm
Sulfate	57	mg/L		1		E300.0	08/31/17 02:47 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:54 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:40 / slf
Barium	122	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Chromium	16	mg/kg	D	4		SW6010B	08/25/17 04:40 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 04:40 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:40 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Manganese	281	mg/kg		1		SW6010B	08/25/17 04:40 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:06 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:54 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:54 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:54 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	1.1	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca
Radium 228 MDC	0.8	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:30
Lab ID:	B17081923-014	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-047	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.7	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.6	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	23.3	meq/L		0.05		SW6010B	08/30/17 14:49 / slf
Magnesium, sat. paste	43.2	meq/L		0.08		SW6010B	08/30/17 14:49 / slf
Potassium, sat. paste	0.53	meq/L		0.03		SW6010B	08/30/17 14:49 / slf
Sodium, sat. paste	13.9	meq/L		0.04		SW6010B	08/30/17 14:49 / slf
Sodium Adsorption Ratio (SAR)	2.42	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	73	mg/L		4		ASA10-3	08/31/17 15:42 / bas
Bicarbonate as HCO3	89	mg/L		4		ASA10-3	08/31/17 15:42 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:42 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 03:06 / cjm
Chloride	42	mg/L		1		E300.0	08/31/17 03:06 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 03:06 / cjm
Sulfate	3890	mg/L	D	5		E300.0	08/31/17 03:06 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:57 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:44 / slf
Barium	81	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Boron	7	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 04:44 / slf
Cobalt	7	mg/kg	D	3		SW6010B	08/25/17 04:44 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:44 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Manganese	261	mg/kg		1		SW6010B	08/25/17 04:44 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:08 / jh
Molybdenum	ND	mg/kg		4		SW6010B	08/25/17 04:44 / slf
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:57 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:57 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/02/17 14:21 / eli-g
Radium 228	0.8	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca
Radium 228 MDC	0.8	pCi/g-dry				RA-05	09/27/17 19:16 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc		**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling		**Report Date:**	10/18/17
Lab ID:	B17081923-015		**Collection Date:**	08/16/17 10:35
Client Sample ID:	TLN-1708-027		**DateReceived:**	08/17/17
			Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.8	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	5.50	meq/L		0.05		SW6010B	08/30/17 14:53 / slf
Magnesium, sat. paste	3.15	meq/L		0.08		SW6010B	08/30/17 14:53 / slf
Potassium, sat. paste	0.63	meq/L		0.03		SW6010B	08/30/17 14:53 / slf
Sodium, sat. paste	0.12	meq/L		0.04		SW6010B	08/30/17 14:53 / slf
Sodium Adsorption Ratio (SAR)	0.06	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	285	mg/L		4		ASA10-3	08/31/17 15:45 / bas
Bicarbonate as HCO3	347	mg/L		4		ASA10-3	08/31/17 15:45 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:45 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 03:26 / cjm
Chloride	16	mg/L		1		E300.0	08/31/17 03:26 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 03:26 / cjm
Sulfate	13	mg/L		1		E300.0	08/31/17 03:26 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 21:59 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:47 / slf
Barium	140	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 04:47 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 04:47 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:47 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Manganese	326	mg/kg		1		SW6010B	08/25/17 04:47 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:09 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 21:59 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 21:59 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 21:59 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.4	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.8	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 10:40
Lab ID:	B17081923-016	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-048	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.7	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	4.02	meq/L		0.05		SW6010B	08/30/17 14:57 / slf
Magnesium, sat. paste	4.55	meq/L		0.08		SW6010B	08/30/17 14:57 / slf
Potassium, sat. paste	0.24	meq/L		0.03		SW6010B	08/30/17 14:57 / slf
Sodium, sat. paste	0.15	meq/L		0.04		SW6010B	08/30/17 14:57 / slf
Sodium Adsorption Ratio (SAR)	0.07	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	240	mg/L		4		ASA10-3	08/31/17 15:52 / bas
Bicarbonate as HCO3	293	mg/L		4		ASA10-3	08/31/17 15:52 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:52 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 03:45 / cjm
Chloride	8	mg/L		1		E300.0	08/31/17 03:45 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 03:45 / cjm
Sulfate	13	mg/L		1		E300.0	08/31/17 03:45 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:02 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 04:51 / slf
Barium	124	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 04:51 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 04:51 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 04:51 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Manganese	283	mg/kg		1		SW6010B	08/25/17 04:51 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:11 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 22:02 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:02 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:02 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 13:13 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:13 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:13 / eli-ca
Radium 228	0.7	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-017	**Collection Date:**	08/16/17 11:10
Client Sample ID:	TLN-1708-014	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.7	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	27.7	meq/L		0.05		SW6010B	08/30/17 15:08 / slf
Magnesium, sat. paste	38.2	meq/L		0.08		SW6010B	08/30/17 15:08 / slf
Potassium, sat. paste	1.53	meq/L		0.03		SW6010B	08/30/17 15:08 / slf
Sodium, sat. paste	15.8	meq/L		0.04		SW6010B	08/30/17 15:08 / slf
Sodium Adsorption Ratio (SAR)	2.76	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	340	mg/L		4		ASA10-3	08/31/17 15:58 / bas
Bicarbonate as HCO3	415	mg/L		4		ASA10-3	08/31/17 15:58 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 15:58 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 04:05 / cjm
Chloride	70	mg/L		1		E300.0	08/31/17 04:05 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 04:05 / cjm
Sulfate	3800	mg/L	D	5		E300.0	08/31/17 04:05 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:12 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:02 / slf
Barium	192	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Boron	11	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Chromium	17	mg/kg	D	4		SW6010B	08/25/17 05:02 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 05:02 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:02 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Manganese	390	mg/kg		1		SW6010B	08/25/17 05:02 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:13 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 22:12 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:12 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:12 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.04	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.8	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-018	**Collection Date:**	08/16/17 11:15
Client Sample ID:	TLN-1708-050	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	7.9	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	21.2	meq/L	D	0.07		SW6010B	08/30/17 15:12 / slf
Magnesium, sat. paste	94.0	meq/L		0.08		SW6010B	08/30/17 15:12 / slf
Potassium, sat. paste	1.40	meq/L		0.03		SW6010B	08/30/17 15:12 / slf
Sodium, sat. paste	51.8	meq/L		0.04		SW6010B	08/30/17 15:12 / slf
Sodium Adsorption Ratio (SAR)	6.83	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	89	mg/L		4		ASA10-3	08/31/17 16:03 / bas
Bicarbonate as HCO3	109	mg/L		4		ASA10-3	08/31/17 16:03 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:03 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 04:24 / cjm
Chloride	76	mg/L	D	2		E300.0	08/31/17 04:24 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 04:24 / cjm
Sulfate	8210	mg/L	D	10		E300.0	08/31/17 04:24 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:15 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:06 / slf
Barium	138	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Boron	15	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Chromium	16	mg/kg	D	4		SW6010B	08/25/17 05:06 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 05:06 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:06 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Manganese	398	mg/kg		1		SW6010B	08/25/17 05:06 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:14 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 22:15 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:15 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:15 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	1.6	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.8	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	1.5	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-019	**Collection Date:**	08/16/17 11:25
Client Sample ID:	TLN-1708-051	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.6	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	23.9	meq/L		0.05		SW6010B	08/30/17 15:16 / slf
Magnesium, sat. paste	36.0	meq/L		0.08		SW6010B	08/30/17 15:16 / slf
Potassium, sat. paste	1.11	meq/L		0.03		SW6010B	08/30/17 15:16 / slf
Sodium, sat. paste	15.6	meq/L		0.04		SW6010B	08/30/17 15:16 / slf
Sodium Adsorption Ratio (SAR)	2.84	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	53	mg/L		4		ASA10-3	08/31/17 16:06 / bas
Bicarbonate as HCO3	64	mg/L		4		ASA10-3	08/31/17 16:06 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:06 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 04:44 / cjm
Chloride	21	mg/L		1		E300.0	08/31/17 04:44 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 04:44 / cjm
Sulfate	3730	mg/L	D	5		E300.0	08/31/17 04:44 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:18 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:10 / slf
Barium	135	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Boron	7	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 05:10 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 05:10 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:10 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Manganese	448	mg/kg		1		SW6010B	08/25/17 05:10 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:16 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 22:18 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:18 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:18 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.7	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	1.4	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-020
Client Sample ID: TLN-1708-017

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 11:30
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.3	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	26.9	meq/L		0.05		SW6010B	08/30/17 15:20 / slf
Magnesium, sat. paste	35.0	meq/L		0.08		SW6010B	08/30/17 15:20 / slf
Potassium, sat. paste	1.27	meq/L		0.03		SW6010B	08/30/17 15:20 / slf
Sodium, sat. paste	11.1	meq/L		0.04		SW6010B	08/30/17 15:20 / slf
Sodium Adsorption Ratio (SAR)	2.00	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	269	mg/L		4		ASA10-3	08/31/17 16:09 / bas
Bicarbonate as HCO3	327	mg/L		4		ASA10-3	08/31/17 16:09 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:09 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 05:03 / cjm
Chloride	25	mg/L		1		E300.0	08/31/17 05:03 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 05:03 / cjm
Sulfate	3350	mg/L	D	5		E300.0	08/31/17 05:03 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:20 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:14 / slf
Barium	146	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Boron	6	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Chromium	16	mg/kg	D	4		SW6010B	08/25/17 05:14 / slf
Cobalt	4	mg/kg	D	3		SW6010B	08/25/17 05:14 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:14 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Manganese	490	mg/kg		1		SW6010B	08/25/17 05:14 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 10:18 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 22:20 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:20 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:20 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	1	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-021	**Collection Date:**	08/16/17 11:35
Client Sample ID:	TLN-1708-052	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	8.1	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	21.8	meq/L	D	0.07		SW6010B	08/30/17 15:24 / slf
Magnesium, sat. paste	120	meq/L		0.08		SW6010B	08/30/17 15:24 / slf
Potassium, sat. paste	1.87	meq/L		0.03		SW6010B	08/30/17 15:24 / slf
Sodium, sat. paste	44.7	meq/L		0.04		SW6010B	08/30/17 15:24 / slf
Sodium Adsorption Ratio (SAR)	5.30	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	164	mg/L		4		ASA10-3	08/31/17 16:14 / bas
Bicarbonate as HCO3	200	mg/L		4		ASA10-3	08/31/17 16:14 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:14 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 06:01 / cjm
Chloride	50	mg/L	D	2		E300.0	08/31/17 06:01 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 06:01 / cjm
Sulfate	8560	mg/L	D	20		E300.0	09/01/17 11:31 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:52 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:46 / slf
Barium	161	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Boron	13	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 05:46 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 05:46 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:46 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Manganese	325	mg/kg		1		SW6010B	08/25/17 05:46 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:19 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 22:52 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:52 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:52 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.8	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-022	**Collection Date:**	08/16/17 11:40
Client Sample ID:	TLN-1708-053	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.2	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	13.2	meq/L		0.05		SW6010B	08/30/17 15:32 / slf
Magnesium, sat. paste	23.3	meq/L		0.08		SW6010B	08/30/17 15:32 / slf
Potassium, sat. paste	0.60	meq/L		0.03		SW6010B	08/30/17 15:32 / slf
Sodium, sat. paste	10.9	meq/L		0.04		SW6010B	08/30/17 15:32 / slf
Sodium Adsorption Ratio (SAR)	2.55	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	62	mg/L		4		ASA10-3	08/31/17 16:23 / bas
Bicarbonate as HCO3	76	mg/L		4		ASA10-3	08/31/17 16:23 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:23 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 07:00 / cjm
Chloride	28	mg/L		1		E300.0	08/31/17 07:00 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 07:00 / cjm
Sulfate	2440	mg/L	D	5		E300.0	08/31/17 07:00 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:54 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:50 / slf
Barium	176	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 05:50 / slf
Cobalt	13	mg/kg	D	3		SW6010B	08/25/17 05:50 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:50 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Manganese	1830	mg/kg		1		SW6010B	08/25/17 05:50 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:20 / jh
Molybdenum	ND	mg/kg		4		SW6010B	08/25/17 05:50 / slf
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:54 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:54 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.4	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 11:40
Lab ID:	B17081923-022	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-053	**Matrix:**	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Cobalt	ND	mg/L		0.005		SW6010B	11/03/17 18:39 / slf
Manganese	ND	mg/L		0.002		SW6010B	11/03/17 18:39 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 11:45
DateReceived: 08/17/17
Matrix: Soil

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-023
Client Sample ID: TLN-1708-018

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.7	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	2.8	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	20.3	meq/L		0.05		SW6010B	08/30/17 15:40 / slf
Magnesium, sat. paste	18.2	meq/L		0.08		SW6010B	08/30/17 15:40 / slf
Potassium, sat. paste	1.18	meq/L		0.03		SW6010B	08/30/17 15:40 / slf
Sodium, sat. paste	2.67	meq/L		0.04		SW6010B	08/30/17 15:40 / slf
Sodium Adsorption Ratio (SAR)	0.61	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	289	mg/L		4		ASA10-3	08/31/17 16:25 / bas
Bicarbonate as HCO3	353	mg/L		4		ASA10-3	08/31/17 16:25 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:25 / bas
Bromide	ND	mg/L	D	1		E300.0	08/31/17 07:19 / cjm
Chloride	19	mg/L		1		E300.0	08/31/17 07:19 / cjm
Fluoride	ND	mg/L	D	2		E300.0	08/31/17 07:19 / cjm
Sulfate	1730	mg/L	D	2		E300.0	08/31/17 07:19 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:57 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:54 / slf
Barium	138	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Boron	7	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 05:54 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 05:54 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:54 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Manganese	350	mg/kg		1		SW6010B	08/25/17 05:54 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:22 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 22:57 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:57 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:57 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	1.3	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-024	**Collection Date:**	08/16/17 11:50
Client Sample ID:	TLN-1708-054	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.3	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	6.9	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	22.3	meq/L	D	0.07		SW6010B	08/30/17 15:44 / slf
Magnesium, sat. paste	88.8	meq/L		0.08		SW6010B	08/30/17 15:44 / slf
Potassium, sat. paste	0.99	meq/L		0.03		SW6010B	08/30/17 15:44 / slf
Sodium, sat. paste	34.8	meq/L		0.04		SW6010B	08/30/17 15:44 / slf
Sodium Adsorption Ratio (SAR)	4.66	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	109	mg/L		4		ASA10-3	08/31/17 16:30 / bas
Bicarbonate as HCO3	133	mg/L		4		ASA10-3	08/31/17 16:30 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:30 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 07:39 / cjm
Chloride	28	mg/L	D	2		E300.0	08/31/17 07:39 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 07:39 / cjm
Sulfate	7060	mg/L	D	10		E300.0	08/31/17 07:39 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 22:59 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 05:58 / slf
Barium	176	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Boron	8	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 05:58 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 05:58 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 05:58 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Manganese	315	mg/kg		1		SW6010B	08/25/17 05:58 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:24 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 22:59 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 22:59 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 22:59 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.7	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.8	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-025	**Collection Date:**	08/16/17 12:07
Client Sample ID:	TLN-1708-019	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	1.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	8.12	meq/L		0.05		SW6010B	08/30/17 16:23 / slf
Magnesium, sat. paste	5.12	meq/L		0.08		SW6010B	08/30/17 16:23 / slf
Potassium, sat. paste	1.16	meq/L		0.03		SW6010B	08/30/17 16:23 / slf
Sodium, sat. paste	0.22	meq/L		0.04		SW6010B	08/30/17 16:23 / slf
Sodium Adsorption Ratio (SAR)	0.08	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	368	mg/L		4		ASA10-3	08/31/17 16:33 / bas
Bicarbonate as HCO3	449	mg/L		4		ASA10-3	08/31/17 16:33 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:33 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 07:58 / cjm
Chloride	22	mg/L		1		E300.0	08/31/17 07:58 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 07:58 / cjm
Sulfate	151	mg/L		1		E300.0	08/31/17 07:58 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:02 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:02 / slf
Barium	119	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 06:02 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 06:02 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:02 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Manganese	341	mg/kg		1		SW6010B	08/25/17 06:02 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:25 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:02 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:02 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:02 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 00:47 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca
Radium 228 MDC	0.9	pCi/g-dry				RA-05	09/28/17 00:47 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-026	**Collection Date:**	08/16/17 12:10
Client Sample ID:	TLN-1708-058	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	9.6	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	22.2	meq/L	D	0.07		SW6010B	08/30/17 16:27 / slf
Magnesium, sat. paste	154	meq/L		0.08		SW6010B	08/30/17 16:27 / slf
Potassium, sat. paste	2.33	meq/L		0.03		SW6010B	08/30/17 16:27 / slf
Sodium, sat. paste	66.9	meq/L		0.04		SW6010B	08/30/17 16:27 / slf
Sodium Adsorption Ratio (SAR)	7.13	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	150	mg/L		4		ASA10-3	08/31/17 16:37 / bas
Bicarbonate as HCO3	183	mg/L		4		ASA10-3	08/31/17 16:37 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:37 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 08:18 / cjm
Chloride	92	mg/L	D	2		E300.0	08/31/17 08:18 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 08:18 / cjm
Sulfate	10900	mg/L	D	20		E300.0	09/01/17 11:51 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:05 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:05 / slf
Barium	179	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Boron	6	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 06:05 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 06:05 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:05 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Manganese	292	mg/kg		1		SW6010B	08/25/17 06:05 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:27 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:05 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:05 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:05 / rlh
RADIONUCLIDES							
Radium 226	0.4	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	10/15/17 15:35 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 15:35 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-027	**Collection Date:**	08/16/17 12:13
Client Sample ID:	TLN-1708-059	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.3	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	6.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	23.0	meq/L	D	0.07		SW6010B	08/30/17 16:31 / slf
Magnesium, sat. paste	69.6	meq/L		0.08		SW6010B	08/30/17 16:31 / slf
Potassium, sat. paste	1.41	meq/L		0.03		SW6010B	08/30/17 16:31 / slf
Sodium, sat. paste	24.7	meq/L		0.04		SW6010B	08/30/17 16:31 / slf
Sodium Adsorption Ratio (SAR)	3.63	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	57	mg/L		4		ASA10-3	08/31/17 16:41 / bas
Bicarbonate as HCO3	70	mg/L		4		ASA10-3	08/31/17 16:41 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:41 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 08:37 / cjm
Chloride	24	mg/L	D	2		E300.0	08/31/17 08:37 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 08:37 / cjm
Sulfate	5750	mg/L	D	10		E300.0	08/31/17 08:37 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:07 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:09 / slf
Barium	105	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Boron	8	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 06:09 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 06:09 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:09 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Manganese	261	mg/kg		1		SW6010B	08/25/17 06:09 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:29 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:07 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:07 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:07 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	-0.03	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-028	**Collection Date:**	08/16/17 12:19
Client Sample ID:	TLN-1708-020	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	1.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	7.03	meq/L		0.05		SW6010B	08/30/17 16:35 / slf
Magnesium, sat. paste	3.78	meq/L		0.08		SW6010B	08/30/17 16:35 / slf
Potassium, sat. paste	1.02	meq/L		0.03		SW6010B	08/30/17 16:35 / slf
Sodium, sat. paste	0.11	meq/L		0.04		SW6010B	08/30/17 16:35 / slf
Sodium Adsorption Ratio (SAR)	0.05	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	380	mg/L		4		ASA10-3	08/31/17 16:44 / bas
Bicarbonate as HCO3	464	mg/L		4		ASA10-3	08/31/17 16:44 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:44 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 08:56 / cjm
Chloride	20	mg/L		1		E300.0	08/31/17 08:56 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 08:56 / cjm
Sulfate	29	mg/L		1		E300.0	08/31/17 08:56 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:10 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:13 / slf
Barium	146	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 06:13 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 06:13 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:13 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Manganese	343	mg/kg		1		SW6010B	08/25/17 06:13 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:31 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:10 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:10 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:10 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	1.2	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 12:21
Lab ID:	B17081923-029	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-060	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	4.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	24.0	meq/L		0.05		SW6010B	08/30/17 16:39 / slf
Magnesium, sat. paste	38.2	meq/L		0.08		SW6010B	08/30/17 16:39 / slf
Potassium, sat. paste	1.13	meq/L		0.03		SW6010B	08/30/17 16:39 / slf
Sodium, sat. paste	9.61	meq/L		0.04		SW6010B	08/30/17 16:39 / slf
Sodium Adsorption Ratio (SAR)	1.72	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	178	mg/L		4		ASA10-3	08/31/17 16:48 / bas
Bicarbonate as HCO3	217	mg/L		4		ASA10-3	08/31/17 16:48 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:48 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 09:16 / cjm
Chloride	40	mg/L		1		E300.0	08/31/17 09:16 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 09:16 / cjm
Sulfate	3350	mg/L	D	5		E300.0	08/31/17 09:16 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:21 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:17 / slf
Barium	218	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Boron	2	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Chromium	10	mg/kg	D	4		SW6010B	08/25/17 06:17 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 06:17 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:17 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Manganese	308	mg/kg		1		SW6010B	08/25/17 06:17 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:32 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 23:21 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:21 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:21 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 226 MDC	0.08	pCi/g-dry				E903.0	10/10/17 09:30 / eli-ca
Radium 228	0.6	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-030	**Collection Date:**	08/16/17 12:24
Client Sample ID:	TLN-1708-061	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	14.9	meq/L		0.05		SW6010B	08/30/17 16:43 / slf
Magnesium, sat. paste	21.5	meq/L		0.08		SW6010B	08/30/17 16:43 / slf
Potassium, sat. paste	0.59	meq/L		0.03		SW6010B	08/30/17 16:43 / slf
Sodium, sat. paste	9.57	meq/L		0.04		SW6010B	08/30/17 16:43 / slf
Sodium Adsorption Ratio (SAR)	2.24	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	95	mg/L		4		ASA10-3	08/31/17 16:53 / bas
Bicarbonate as HCO3	116	mg/L		4		ASA10-3	08/31/17 16:53 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:53 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 09:35 / cjm
Chloride	39	mg/L		1		E300.0	08/31/17 09:35 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 09:35 / cjm
Sulfate	2250	mg/L	D	5		E300.0	08/31/17 09:35 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:23 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:21 / slf
Barium	194	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Boron	2	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Chromium	12	mg/kg		1		SW6020	08/25/17 23:23 / rlh
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 06:21 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:21 / slf
Lithium	7	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Manganese	245	mg/kg		1		SW6010B	08/25/17 06:21 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:34 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:23 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:23 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:23 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 228	0.7	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-031	**Collection Date:**	08/16/17 12:30
Client Sample ID:	TLN-1708-021	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	0.9	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	5.56	meq/L		0.05		SW6010B	08/31/17 13:08 / rlh
Magnesium, sat. paste	3.42	meq/L		0.08		SW6010B	08/31/17 13:08 / rlh
Potassium, sat. paste	1.62	meq/L		0.03		SW6010B	08/31/17 13:08 / rlh
Sodium, sat. paste	0.18	meq/L		0.04		SW6010B	08/31/17 13:08 / rlh
Sodium Adsorption Ratio (SAR)	0.09	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	355	mg/L		4		ASA10-3	08/31/17 16:56 / bas
Bicarbonate as HCO3	433	mg/L		4		ASA10-3	08/31/17 16:56 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 16:56 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 10:34 / cjm
Chloride	38	mg/L		1		E300.0	08/31/17 10:34 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 10:34 / cjm
Sulfate	38	mg/L		1		E300.0	08/31/17 10:34 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:26 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 06:56 / slf
Barium	175	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 06:56 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 06:56 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 06:56 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Manganese	327	mg/kg		1		SW6010B	08/25/17 06:56 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:39 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:26 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:26 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:26 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 228	0.8	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-032	**Collection Date:**	08/16/17 12:33
Client Sample ID:	TLN-1708-062	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	8.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	22.8	meq/L	D	0.07		SW6010B	08/30/17 16:55 / slf
Magnesium, sat. paste	111	meq/L		0.08		SW6010B	08/30/17 16:55 / slf
Potassium, sat. paste	3.02	meq/L		0.03		SW6010B	08/30/17 16:55 / slf
Sodium, sat. paste	48.0	meq/L		0.04		SW6010B	08/30/17 16:55 / slf
Sodium Adsorption Ratio (SAR)	5.87	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	130	mg/L		4		ASA10-3	08/31/17 17:06 / bas
Bicarbonate as HCO3	158	mg/L		4		ASA10-3	08/31/17 17:06 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 17:06 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 11:32 / cjm
Chloride	66	mg/L	D	2		E300.0	08/31/17 11:32 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 11:32 / cjm
Sulfate	8680	mg/L	D	10		E300.0	08/31/17 11:32 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:28 / rlh
Arsenic	ND	mg/kg	D	20		SW6010B	08/25/17 07:00 / slf
Barium	167	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 07:00 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 07:00 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:00 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Manganese	271	mg/kg		1		SW6010B	08/25/17 07:00 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:41 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 23:28 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:28 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:28 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/10/17 11:11 / eli-ca
Radium 228	1.6	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	10/09/17 18:55 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-033
Client Sample ID: TLN-1708-022

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 12:36
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	1.0	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	6.67	meq/L		0.05		SW6010B	08/30/17 17:11 / slf
Magnesium, sat. paste	3.63	meq/L		0.08		SW6010B	08/30/17 17:11 / slf
Potassium, sat. paste	1.45	meq/L		0.03		SW6010B	08/30/17 17:11 / slf
Sodium, sat. paste	0.21	meq/L		0.04		SW6010B	08/30/17 17:11 / slf
Sodium Adsorption Ratio (SAR)	0.09	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	371	mg/L		4		ASA10-3	08/31/17 17:11 / bas
Bicarbonate as HCO3	452	mg/L		4		ASA10-3	08/31/17 17:11 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 17:11 / bas
Bromide	ND	mg/L		0.5		E300.0	08/31/17 11:52 / cjm
Chloride	42	mg/L		1		E300.0	08/31/17 11:52 / cjm
Fluoride	ND	mg/L	D	1		E300.0	08/31/17 11:52 / cjm
Sulfate	80	mg/L		1		E300.0	08/31/17 11:52 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:31 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:03 / slf
Barium	185	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 07:03 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 07:03 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:03 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Manganese	333	mg/kg		1		SW6010B	08/25/17 07:03 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:43 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:31 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:31 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:31 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	3.0	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	1	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	1.5	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc		**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling		**Report Date:**	10/18/17
Lab ID:	B17081923-034		**Collection Date:**	08/16/17 12:38
Client Sample ID:	TLN-1708-063		**DateReceived:**	08/17/17
			Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	6.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	25.4	meq/L	D	0.07		SW6010B	08/30/17 17:15 / slf
Magnesium, sat. paste	66.4	meq/L		0.08		SW6010B	08/30/17 17:15 / slf
Potassium, sat. paste	2.90	meq/L		0.03		SW6010B	08/30/17 17:15 / slf
Sodium, sat. paste	26.2	meq/L		0.04		SW6010B	08/30/17 17:15 / slf
Sodium Adsorption Ratio (SAR)	3.87	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	146	mg/L		4		ASA10-3	08/31/17 17:17 / bas
Bicarbonate as HCO3	178	mg/L		4		ASA10-3	08/31/17 17:17 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 17:17 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 12:11 / cjm
Chloride	98	mg/L	D	2		E300.0	08/31/17 12:11 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 12:11 / cjm
Sulfate	5510	mg/L	D	10		E300.0	08/31/17 12:11 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:34 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:07 / slf
Barium	259	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Boron	2	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 07:07 / slf
Cobalt	7	mg/kg	D	3		SW6010B	08/25/17 07:07 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:07 / slf
Lithium	7	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Manganese	378	mg/kg		1		SW6010B	08/25/17 07:07 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:44 / jh
Molybdenum	1	mg/kg		1		SW6020	08/25/17 23:34 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:34 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:34 / rlh
RADIONUCLIDES							
Radium 226	0.9	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	2.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.9	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	1.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-035	**Collection Date:**	08/16/17 12:41
Client Sample ID:	TLN-1708-009	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	3.1	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	28.5	meq/L		0.05		SW6010B	08/30/17 17:19 / slf
Magnesium, sat. paste	16.7	meq/L		0.08		SW6010B	08/30/17 17:19 / slf
Potassium, sat. paste	1.96	meq/L		0.03		SW6010B	08/30/17 17:19 / slf
Sodium, sat. paste	2.20	meq/L		0.04		SW6010B	08/30/17 17:19 / slf
Sodium Adsorption Ratio (SAR)	0.46	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as $CaCO_3$	315	mg/L		4		ASA10-3	08/31/17 17:21 / bas
Bicarbonate as HCO_3	384	mg/L		4		ASA10-3	08/31/17 17:21 / bas
Carbonate as CO_3	ND	mg/L		4		ASA10-3	08/31/17 17:21 / bas
Bromide	ND	mg/L	D	2		E300.0	08/31/17 12:31 / cjm
Chloride	32	mg/L		1		E300.0	08/31/17 12:31 / cjm
Fluoride	ND	mg/L	D	5		E300.0	08/31/17 12:31 / cjm
Sulfate	2110	mg/L	D	5		E300.0	08/31/17 12:31 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:36 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:11 / slf
Barium	166	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Boron	4	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Chromium	14	mg/kg	D	4		SW6010B	08/25/17 07:11 / slf
Cobalt	6	mg/kg	D	3		SW6010B	08/25/17 07:11 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:11 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Manganese	348	mg/kg		1		SW6010B	08/25/17 07:11 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:46 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:36 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:36 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:36 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.06	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 12:44
Lab ID:	B17081923-036	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-064	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.5	s.u.		0.1		ASA10-3	08/30/17 14:27 / srm
Conductivity, sat. paste	9.2	mmhos/cm		0.1		ASA10-3	08/30/17 14:27 / srm
Calcium, sat. paste	22.2	meq/L	D	0.07		SW6010B	08/30/17 17:23 / slf
Magnesium, sat. paste	141	meq/L		0.08		SW6010B	08/30/17 17:23 / slf
Potassium, sat. paste	2.60	meq/L		0.03		SW6010B	08/30/17 17:23 / slf
Sodium, sat. paste	62.2	meq/L		0.04		SW6010B	08/30/17 17:23 / slf
Sodium Adsorption Ratio (SAR)	6.88	unitless		0.01		Calculation	09/05/17 16:56 / srm
Alkalinity, Total as CaCO3	135	mg/L		4		ASA10-3	08/31/17 17:26 / bas
Bicarbonate as HCO3	165	mg/L		4		ASA10-3	08/31/17 17:26 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	08/31/17 17:26 / bas
Bromide	ND	mg/L	D	5		E300.0	08/31/17 12:50 / cjm
Chloride	66	mg/L	D	2		E300.0	08/31/17 12:50 / cjm
Fluoride	ND	mg/L	D	10		E300.0	08/31/17 12:50 / cjm
Sulfate	10400	mg/L	D	20		E300.0	09/01/17 12:10 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:39 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:15 / slf
Barium	158	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Boron	6	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Chromium	11	mg/kg	D	4		SW6010B	08/25/17 07:15 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 07:15 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:15 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Manganese	251	mg/kg		1		SW6010B	08/25/17 07:15 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:48 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:39 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:39 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:39 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.08	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 12:46
Lab ID:	B17081923-037	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-008	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	2.3	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	17.8	meq/L		0.05		SW6010B	08/31/17 13:24 / rlh
Magnesium, sat. paste	9.56	meq/L		0.08		SW6010B	08/31/17 13:24 / rlh
Potassium, sat. paste	1.48	meq/L		0.03		SW6010B	08/31/17 13:24 / rlh
Sodium, sat. paste	2.02	meq/L		0.04		SW6010B	08/31/17 13:24 / rlh
Sodium Adsorption Ratio (SAR)	0.54	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	343	mg/L		4		ASA10-3	09/01/17 11:00 / bas
Bicarbonate as HCO3	418	mg/L		4		ASA10-3	09/01/17 11:00 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:00 / bas
Bromide	ND	mg/L	D	1		E300.0	09/01/17 13:09 / cjm
Chloride	23	mg/L		1		E300.0	09/01/17 13:09 / cjm
Fluoride	ND	mg/L	D	2		E300.0	09/01/17 13:09 / cjm
Sulfate	1120	mg/L	D	2		E300.0	09/01/17 13:09 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:42 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:19 / slf
Barium	164	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Boron	5	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Chromium	13	mg/kg	D	4		SW6010B	08/25/17 07:19 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 07:19 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:19 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Manganese	317	mg/kg		1		SW6010B	08/25/17 07:19 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:50 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:42 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:42 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:42 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-038	**Collection Date:**	08/16/17 12:49
Client Sample ID:	TLN-1708-065	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	2.9	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	19.7	meq/L		0.05		SW6010B	08/31/17 13:27 / rlh
Magnesium, sat. paste	17.3	meq/L		0.08		SW6010B	08/31/17 13:27 / rlh
Potassium, sat. paste	1.31	meq/L		0.03		SW6010B	08/31/17 13:27 / rlh
Sodium, sat. paste	3.73	meq/L		0.04		SW6010B	08/31/17 13:27 / rlh
Sodium Adsorption Ratio (SAR)	0.87	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	218	mg/L		4		ASA10-3	09/01/17 11:12 / bas
Bicarbonate as HCO3	265	mg/L		4		ASA10-3	09/01/17 11:12 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:12 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 13:28 / cjm
Chloride	14	mg/L		1		E300.0	09/01/17 13:28 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 13:28 / cjm
Sulfate	1950	mg/L	D	5		E300.0	09/01/17 13:28 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:44 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:23 / slf
Barium	200	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Boron	3	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Chromium	12	mg/kg	D	4		SW6010B	08/25/17 07:23 / slf
Cobalt	5	mg/kg	D	3		SW6010B	08/25/17 07:23 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:23 / slf
Lithium	8	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Manganese	298	mg/kg		1		SW6010B	08/25/17 07:23 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:51 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:44 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:44 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:44 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.06	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.4	pCi/g-dry	U			RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 12:52
Lab ID:	B17081923-039	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-003	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.2	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	6.7	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.6	meq/L	D	0.07		SW6010B	08/31/17 13:39 / rlh
Magnesium, sat. paste	63.4	meq/L		0.08		SW6010B	08/31/17 13:39 / rlh
Potassium, sat. paste	2.14	meq/L		0.03		SW6010B	08/31/17 13:39 / rlh
Sodium, sat. paste	30.9	meq/L		0.04		SW6010B	08/31/17 13:39 / rlh
Sodium Adsorption Ratio (SAR)	4.74	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	366	mg/L		4		ASA10-3	09/01/17 11:17 / bas
Bicarbonate as HCO3	446	mg/L		4		ASA10-3	09/01/17 11:17 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:17 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 13:48 / cjm
Chloride	68	mg/L	D	2		E300.0	09/01/17 13:48 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 13:48 / cjm
Sulfate	5800	mg/L	D	10		E300.0	09/01/17 13:48 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:55 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:26 / slf
Barium	133	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Boron	17	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Chromium	18	mg/kg	D	4		SW6010B	08/25/17 07:26 / slf
Cobalt	7	mg/kg	D	3		SW6010B	08/25/17 07:26 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:26 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Manganese	418	mg/kg		1		SW6010B	08/25/17 07:26 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:53 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:55 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:55 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:55 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.6	pCi/g-dry	U			RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-040	**Collection Date:**	08/16/17 12:55
Client Sample ID:	TLN-1708-066	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.4	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	10.9	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.4	meq/L	D	0.1		SW6010B	08/31/17 13:43 / rlh
Magnesium, sat. paste	147	meq/L		0.08		SW6010B	08/31/17 13:43 / rlh
Potassium, sat. paste	2.35	meq/L		0.03		SW6010B	08/31/17 13:43 / rlh
Sodium, sat. paste	101	meq/L		0.04		SW6010B	08/31/17 13:43 / rlh
Sodium Adsorption Ratio (SAR)	11.0	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	120	mg/L		4		ASA10-3	09/01/17 11:25 / bas
Bicarbonate as HCO3	146	mg/L		4		ASA10-3	09/01/17 11:25 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:25 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 14:07 / cjm
Chloride	103	mg/L	D	2		E300.0	09/01/17 14:07 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 14:07 / cjm
Sulfate	13300	mg/L	D	20		E300.0	09/05/17 15:48 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/25/17 23:57 / rlh
Arsenic	ND	mg/kg		20		SW6010B	08/25/17 07:30 / slf
Barium	112	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Boron	10	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Chromium	15	mg/kg	D	4		SW6010B	08/25/17 07:30 / slf
Cobalt	4	mg/kg	D	3		SW6010B	08/25/17 07:30 / slf
Lead	ND	mg/kg		20		SW6010B	08/25/17 07:30 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Manganese	271	mg/kg		1		SW6010B	08/25/17 07:30 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 11:55 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/25/17 23:57 / rlh
Selenium	ND	mg/kg		1		SW6020	08/25/17 23:57 / rlh
Thallium	ND	mg/kg		1		SW6020	08/25/17 23:57 / rlh
RADIONUCLIDES							
Radium 226	0.4	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.1	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-041	**Collection Date:**	08/16/17 13:48
Client Sample ID:	TLN-1708-012	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.2	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	1.2	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	7.43	meq/L		0.05		SW6010B	08/31/17 13:47 / rlh
Magnesium, sat. paste	7.89	meq/L		0.08		SW6010B	08/31/17 13:47 / rlh
Potassium, sat. paste	0.84	meq/L		0.03		SW6010B	08/31/17 13:47 / rlh
Sodium, sat. paste	0.29	meq/L		0.04		SW6010B	08/31/17 13:47 / rlh
Sodium Adsorption Ratio (SAR)	0.10	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	461	mg/L		4		ASA10-3	09/01/17 11:29 / bas
Bicarbonate as HCO3	562	mg/L		4		ASA10-3	09/01/17 11:29 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:29 / bas
Bromide	ND	mg/L		0.5		E300.0	09/01/17 14:27 / cjm
Chloride	16	mg/L		1		E300.0	09/01/17 14:27 / cjm
Fluoride	ND	mg/L	D	1		E300.0	09/01/17 14:27 / cjm
Sulfate	81	mg/L		1		E300.0	09/01/17 14:27 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:29 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:31 / slf
Barium	139	mg/kg		1		SW6010B	08/25/17 14:31 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:31 / slf
Boron	6	mg/kg		1		SW6020	08/26/17 00:29 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:31 / slf
Chromium	14	mg/kg	D	8		SW6010B	08/25/17 14:31 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 14:31 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:31 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 14:31 / slf
Manganese	346	mg/kg		1		SW6010B	08/25/17 14:31 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:08 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:29 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:29 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:29 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.2	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-042	**Collection Date:**	08/16/17 13:50
Client Sample ID:	TLN-1708-067	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	8.8	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	22.7	meq/L	D	0.07		SW6010B	08/31/17 13:55 / rlh
Magnesium, sat. paste	138	meq/L		0.08		SW6010B	08/31/17 13:55 / rlh
Potassium, sat. paste	2.26	meq/L		0.03		SW6010B	08/31/17 13:55 / rlh
Sodium, sat. paste	45.5	meq/L		0.04		SW6010B	08/31/17 13:55 / rlh
Sodium Adsorption Ratio (SAR)	5.08	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	181	mg/L		4		ASA10-3	09/01/17 11:49 / bas
Bicarbonate as HCO3	221	mg/L		4		ASA10-3	09/01/17 11:49 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:49 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 16:04 / cjm
Chloride	38	mg/L	D	2		E300.0	09/01/17 16:04 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 16:04 / cjm
Sulfate	10500	mg/L	D	20		E300.0	09/05/17 16:08 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:32 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:35 / slf
Barium	174	mg/kg		1		SW6010B	08/25/17 14:35 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:35 / slf
Boron	18	mg/kg		1		SW6020	08/26/17 00:32 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:35 / slf
Chromium	12	mg/kg	D	8		SW6010B	08/25/17 14:35 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 14:35 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:35 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 14:35 / slf
Manganese	327	mg/kg		1		SW6010B	08/25/17 14:35 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:10 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:32 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:32 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:32 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.6	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-043
Client Sample ID: TLN-1708-068

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 13:54
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.2	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	24.7	meq/L		0.05		SW6010B	08/31/17 14:03 / rlh
Magnesium, sat. paste	31.9	meq/L		0.08		SW6010B	08/31/17 14:03 / rlh
Potassium, sat. paste	0.84	meq/L		0.03		SW6010B	08/31/17 14:03 / rlh
Sodium, sat. paste	10.5	meq/L		0.04		SW6010B	08/31/17 14:03 / rlh
Sodium Adsorption Ratio (SAR)	1.97	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	71	mg/L		4		ASA10-3	09/01/17 11:53 / bas
Bicarbonate as HCO3	86	mg/L		4		ASA10-3	09/01/17 11:53 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 11:53 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 16:23 / cjm
Chloride	18	mg/L		1		E300.0	09/01/17 16:23 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 16:23 / cjm
Sulfate	3380	mg/L	D	5		E300.0	09/01/17 16:23 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:34 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:39 / slf
Barium	112	mg/kg		1		SW6010B	08/25/17 14:39 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:39 / slf
Boron	11	mg/kg		1		SW6020	08/26/17 00:34 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:39 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 14:39 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 14:39 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:39 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 14:39 / slf
Manganese	341	mg/kg		1		SW6010B	08/25/17 14:39 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:12 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:34 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:34 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:34 / rlh
RADIONUCLIDES							
Radium 226	0.8	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.6	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-044	**Collection Date:**	08/16/17 13:57
Client Sample ID:	TLN-1708-011	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	2.2	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	14.3	meq/L		0.05		SW6010B	08/31/17 14:07 / rlh
Magnesium, sat. paste	9.99	meq/L		0.08		SW6010B	08/31/17 14:07 / rlh
Potassium, sat. paste	2.05	meq/L		0.03		SW6010B	08/31/17 14:07 / rlh
Sodium, sat. paste	1.83	meq/L		0.04		SW6010B	08/31/17 14:07 / rlh
Sodium Adsorption Ratio (SAR)	0.53	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	450	mg/L		4		ASA10-3	09/01/17 13:51 / bas
Bicarbonate as HCO3	549	mg/L		4		ASA10-3	09/01/17 13:51 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 13:51 / bas
Bromide	ND	mg/L	D	1		E300.0	09/01/17 16:43 / cjm
Chloride	48	mg/L		1		E300.0	09/01/17 16:43 / cjm
Fluoride	ND	mg/L	D	2		E300.0	09/01/17 16:43 / cjm
Sulfate	714	mg/L	D	2		E300.0	09/01/17 16:43 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:37 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:42 / slf
Barium	131	mg/kg		1		SW6010B	08/25/17 14:42 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:42 / slf
Boron	6	mg/kg		1		SW6020	08/26/17 00:37 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:42 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 14:42 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 14:42 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:42 / slf
Lithium	10	mg/kg		1		SW6010B	08/25/17 14:42 / slf
Manganese	358	mg/kg		1		SW6010B	08/25/17 14:42 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:14 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:37 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:37 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:37 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	1	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	09/28/17 11:49 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-045
Client Sample ID: TLN-1708-069

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 13:59
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	9.3	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.6	meq/L	D	0.07		SW6010B	08/31/17 14:11 / rlh
Magnesium, sat. paste	120	meq/L		0.08		SW6010B	08/31/17 14:11 / rlh
Potassium, sat. paste	2.88	meq/L		0.03		SW6010B	08/31/17 14:11 / rlh
Sodium, sat. paste	60.7	meq/L		0.04		SW6010B	08/31/17 14:11 / rlh
Sodium Adsorption Ratio (SAR)	7.23	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	182	mg/L		4		ASA10-3	09/01/17 13:58 / bas
Bicarbonate as HCO3	222	mg/L		4		ASA10-3	09/01/17 13:58 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 13:58 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 17:02 / cjm
Chloride	58	mg/L	D	2		E300.0	09/01/17 17:02 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 17:02 / cjm
Sulfate	10600	mg/L	D	20		E300.0	09/05/17 16:27 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:40 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:53 / slf
Barium	157	mg/kg		1		SW6010B	08/25/17 14:53 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:53 / slf
Boron	15	mg/kg		1		SW6020	08/26/17 00:40 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:53 / slf
Chromium	13	mg/kg	D	8		SW6010B	08/25/17 14:53 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 14:53 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:53 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 14:53 / slf
Manganese	318	mg/kg		1		SW6010B	08/25/17 14:53 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:15 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:40 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:40 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:40 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 10:27 / eli-ca
Radium 228	0.2	pCi/g-dry	U			RA-05	09/28/17 13:29 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:02
Lab ID:	B17081923-046	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-070	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.5	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	23.6	meq/L		0.05		SW6010B	08/31/17 14:15 / rlh
Magnesium, sat. paste	35.4	meq/L		0.08		SW6010B	08/31/17 14:15 / rlh
Potassium, sat. paste	0.98	meq/L		0.03		SW6010B	08/31/17 14:15 / rlh
Sodium, sat. paste	13.7	meq/L		0.04		SW6010B	08/31/17 14:15 / rlh
Sodium Adsorption Ratio (SAR)	2.52	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	74	mg/L		4		ASA10-3	09/01/17 14:10 / bas
Bicarbonate as HCO3	90	mg/L		4		ASA10-3	09/01/17 14:10 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:10 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 17:22 / cjm
Chloride	23	mg/L		1		E300.0	09/01/17 17:22 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 17:22 / cjm
Sulfate	3640	mg/L	D	5		E300.0	09/01/17 17:22 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:42 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 14:57 / slf
Barium	92	mg/kg		1		SW6010B	08/25/17 14:57 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 14:57 / slf
Boron	7	mg/kg		1		SW6020	08/26/17 00:42 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 14:57 / slf
Chromium	12	mg/kg	D	8		SW6010B	08/25/17 14:57 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 14:57 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 14:57 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 14:57 / slf
Manganese	304	mg/kg		1		SW6010B	08/25/17 14:57 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:17 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:42 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:42 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:42 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 13:29 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:05
Lab ID:	B17081923-047	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-013	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.2	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	18.5	meq/L		0.05		SW6010B	08/31/17 14:27 / rlh
Magnesium, sat. paste	19.9	meq/L		0.08		SW6010B	08/31/17 14:27 / rlh
Potassium, sat. paste	2.22	meq/L		0.03		SW6010B	08/31/17 14:27 / rlh
Sodium, sat. paste	5.67	meq/L		0.04		SW6010B	08/31/17 14:27 / rlh
Sodium Adsorption Ratio (SAR)	1.29	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	649	mg/L		4		ASA10-3	09/01/17 14:13 / bas
Bicarbonate as HCO3	791	mg/L		4		ASA10-3	09/01/17 14:13 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:13 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 17:42 / cjm
Chloride	80	mg/L		1		E300.0	09/01/17 17:42 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 17:42 / cjm
Sulfate	1420	mg/L	D	5		E300.0	09/01/17 17:42 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:45 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:00 / slf
Barium	129	mg/kg		1		SW6010B	08/25/17 15:00 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:00 / slf
Boron	12	mg/kg		1		SW6020	08/26/17 00:45 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:00 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 15:00 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 15:00 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:00 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 15:00 / slf
Manganese	394	mg/kg		1		SW6010B	08/25/17 15:00 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:19 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:45 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:45 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:45 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 228	0.09	pCi/g-dry	U			RA-05	09/28/17 13:29 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-048	**Collection Date:**	08/16/17 14:07
Client Sample ID:	TLN-1708-071	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.5	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	10.7	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.6	meq/L	D	0.1		SW6010B	08/31/17 14:30 / rlh
Magnesium, sat. paste	155	meq/L		0.08		SW6010B	08/31/17 14:30 / rlh
Potassium, sat. paste	4.90	meq/L		0.03		SW6010B	08/31/17 14:30 / rlh
Sodium, sat. paste	83.6	meq/L		0.04		SW6010B	08/31/17 14:30 / rlh
Sodium Adsorption Ratio (SAR)	8.88	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	153	mg/L		4		ASA10-3	09/01/17 14:26 / bas
Bicarbonate as HCO3	186	mg/L		4		ASA10-3	09/01/17 14:26 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:26 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 18:01 / cjm
Chloride	108	mg/L	D	2		E300.0	09/01/17 18:01 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 18:01 / cjm
Sulfate	13100	mg/L	D	20		E300.0	09/05/17 16:46 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:47 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:04 / slf
Barium	172	mg/kg		1		SW6010B	08/25/17 15:04 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:04 / slf
Boron	23	mg/kg		1		SW6020	08/26/17 00:47 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:04 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 15:04 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 15:04 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:04 / slf
Lithium	13	mg/kg		1		SW6010B	08/25/17 15:04 / slf
Manganese	362	mg/kg		1		SW6010B	08/25/17 15:04 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:21 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:47 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:47 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:47 / rlh
RADIONUCLIDES							
Radium 226	0.6	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 226 MDC	0.07	pCi/g-dry				E903.0	10/16/17 12:01 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 13:29 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	09/28/17 13:29 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-049
Client Sample ID: TLN-1708-072

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 14:10
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	22.5	meq/L		0.05		SW6010B	08/31/17 14:34 / rlh
Magnesium, sat. paste	32.9	meq/L		0.08		SW6010B	08/31/17 14:34 / rlh
Potassium, sat. paste	0.93	meq/L		0.03		SW6010B	08/31/17 14:34 / rlh
Sodium, sat. paste	13.7	meq/L		0.04		SW6010B	08/31/17 14:34 / rlh
Sodium Adsorption Ratio (SAR)	2.60	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	71	mg/L		4		ASA10-3	09/01/17 14:47 / bas
Bicarbonate as HCO3	87	mg/L		4		ASA10-3	09/01/17 14:47 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:47 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 18:21 / cjm
Chloride	24	mg/L		1		E300.0	09/01/17 18:21 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 18:21 / cjm
Sulfate	3420	mg/L	D	5		E300.0	09/01/17 18:21 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:50 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:08 / slf
Barium	178	mg/kg		1		SW6010B	08/25/17 15:08 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:08 / slf
Boron	8	mg/kg		1		SW6020	08/26/17 00:50 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:08 / slf
Chromium	11	mg/kg	D	8		SW6010B	08/25/17 15:08 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 15:08 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:08 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 15:08 / slf
Manganese	395	mg/kg		1		SW6010B	08/25/17 15:08 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:22 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:50 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:50 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:50 / rlh
RADIONUCLIDES							
Radium 226	25.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	4.8	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:10
Lab ID:	B17081923-049	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-072	**Matrix:**	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
RADIONUCLIDES - TOTAL							
Radium 226	0.2	pCi/L	U			E903.0	11/14/17 10:02 / eli-ca
Radium 226 precision (±)	0.2	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 226 MDC	0.2	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 228	1.4	pCi/L	U			RA-05	11/09/17 10:43 / eli-ca
Radium 228 precision (±)	1.1	pCi/L				RA-05	11/09/17 10:43 / eli-ca
Radium 228 MDC	2.2	pCi/L				RA-05	11/09/17 10:43 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-050	**Collection Date:**	08/16/17 14:15
Client Sample ID:	TLN-1708-010	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	0.8	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	4.71	meq/L		0.05		SW6010B	08/31/17 14:38 / rlh
Magnesium, sat. paste	3.26	meq/L		0.08		SW6010B	08/31/17 14:38 / rlh
Potassium, sat. paste	1.15	meq/L		0.03		SW6010B	08/31/17 14:38 / rlh
Sodium, sat. paste	0.26	meq/L		0.04		SW6010B	08/31/17 14:38 / rlh
Sodium Adsorption Ratio (SAR)	0.13	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	310	mg/L		4		ASA10-3	09/01/17 14:51 / bas
Bicarbonate as HCO3	378	mg/L		4		ASA10-3	09/01/17 14:51 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:51 / bas
Bromide	ND	mg/L		0.5		E300.0	09/01/17 18:40 / cjm
Chloride	16	mg/L		1		E300.0	09/01/17 18:40 / cjm
Fluoride	ND	mg/L	D	1		E300.0	09/01/17 18:40 / cjm
Sulfate	80	mg/L		1		E300.0	09/01/17 18:40 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 00:53 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:12 / slf
Barium	147	mg/kg		1		SW6010B	08/25/17 15:12 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:12 / slf
Boron	5	mg/kg		1		SW6020	08/26/17 00:53 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:12 / slf
Chromium	17	mg/kg	D	8		SW6010B	08/25/17 15:12 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 15:12 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:12 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 15:12 / slf
Manganese	387	mg/kg		1		SW6010B	08/25/17 15:12 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:24 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 00:53 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 00:53 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 00:53 / rlh
RADIONUCLIDES							
Radium 226	6.1	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	1.2	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.2	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.2	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:15
Lab ID:	B17081923-050	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-010	**Matrix:**	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
RADIONUCLIDES - TOTAL							
Radium 226	0.3	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 226 precision (±)	0.2	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 226 MDC	0.2	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 228	2.2	pCi/L				RA-05	11/09/17 10:43 / eli-ca
Radium 228 precision (±)	1.2	pCi/L				RA-05	11/09/17 10:43 / eli-ca
Radium 228 MDC	2.0	pCi/L				RA-05	11/09/17 10:43 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-051
Client Sample ID: TLN-1708-073

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 14:18
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.7	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.5	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	24.4	meq/L		0.05		SW6010B	08/31/17 14:42 / rlh
Magnesium, sat. paste	36.1	meq/L		0.08		SW6010B	08/31/17 14:42 / rlh
Potassium, sat. paste	1.78	meq/L		0.03		SW6010B	08/31/17 14:42 / rlh
Sodium, sat. paste	11.7	meq/L		0.04		SW6010B	08/31/17 14:42 / rlh
Sodium Adsorption Ratio (SAR)	2.13	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	217	mg/L		4		ASA10-3	09/01/17 14:55 / bas
Bicarbonate as HCO3	265	mg/L		4		ASA10-3	09/01/17 14:55 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 14:55 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 19:00 / cjm
Chloride	25	mg/L		1		E300.0	09/01/17 19:00 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 19:00 / cjm
Sulfate	3360	mg/L	D	5		E300.0	09/01/17 19:00 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:03 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:15 / slf
Barium	190	mg/kg		1		SW6010B	08/25/17 15:15 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:15 / slf
Boron	7	mg/kg		1		SW6020	08/26/17 01:03 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:15 / slf
Chromium	18	mg/kg	D	8		SW6010B	08/25/17 15:15 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 15:15 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:15 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 15:15 / slf
Manganese	350	mg/kg		1		SW6010B	08/25/17 15:15 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:29 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:03 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:03 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:03 / rlh
RADIONUCLIDES							
Radium 226	3.5	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.7	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-051	**Collection Date:**	08/16/17 14:18
Client Sample ID:	TLN-1708-073	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
RADIONUCLIDES - TOTAL							
Radium 226	0.1	pCi/L	U			E903.0	11/14/17 10:02 / eli-ca
Radium 226 precision (±)	0.1	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 226 MDC	0.2	pCi/L				E903.0	11/14/17 10:02 / eli-ca
Radium 228	0.71	pCi/L	U			RA-05	11/09/17 10:43 / eli-ca
Radium 228 precision (±)	0.98	pCi/L				RA-05	11/09/17 10:43 / eli-ca
Radium 228 MDC	1.6	pCi/L				RA-05	11/09/17 10:43 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-052	**Collection Date:**	08/16/17 14:20
Client Sample ID:	TLN-1708-007	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.6	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	20.6	meq/L		0.05		SW6010B	08/31/17 14:50 / rlh
Magnesium, sat. paste	26.1	meq/L		0.08		SW6010B	08/31/17 14:50 / rlh
Potassium, sat. paste	1.74	meq/L		0.03		SW6010B	08/31/17 14:50 / rlh
Sodium, sat. paste	7.73	meq/L		0.04		SW6010B	08/31/17 14:50 / rlh
Sodium Adsorption Ratio (SAR)	1.60	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	211	mg/L		4		ASA10-3	09/01/17 15:03 / bas
Bicarbonate as HCO3	258	mg/L		4		ASA10-3	09/01/17 15:03 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:03 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 20:37 / cjm
Chloride	22	mg/L		1		E300.0	09/01/17 20:37 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 20:37 / cjm
Sulfate	2590	mg/L	D	5		E300.0	09/01/17 20:37 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:06 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:19 / slf
Barium	164	mg/kg		1		SW6010B	08/25/17 15:19 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:19 / slf
Boron	6	mg/kg		1		SW6020	08/26/17 01:06 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:19 / slf
Chromium	14	mg/kg	D	8		SW6010B	08/25/17 15:19 / slf
Cobalt	ND	mg/kg	D	6		SW6010B	08/25/17 15:19 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:19 / slf
Lithium	9	mg/kg		1		SW6010B	08/25/17 15:19 / slf
Manganese	334	mg/kg		1		SW6010B	08/25/17 15:19 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:31 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:06 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:06 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:06 / rlh
RADIONUCLIDES							
Radium 226	0.4	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.07	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-053	**Collection Date:**	08/16/17 14:23
Client Sample ID:	TLN-1708-074	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	1.6	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	8.83	meq/L		0.05		SW6010B	08/31/17 14:58 / rlh
Magnesium, sat. paste	8.10	meq/L		0.08		SW6010B	08/31/17 14:58 / rlh
Potassium, sat. paste	1.05	meq/L		0.03		SW6010B	08/31/17 14:58 / rlh
Sodium, sat. paste	1.57	meq/L		0.04		SW6010B	08/31/17 14:58 / rlh
Sodium Adsorption Ratio (SAR)	0.54	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	324	mg/L		4		ASA10-3	09/01/17 15:07 / bas
Bicarbonate as HCO3	395	mg/L		4		ASA10-3	09/01/17 15:07 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:07 / bas
Bromide	ND	mg/L	D	1		E300.0	09/01/17 20:57 / cjm
Chloride	14	mg/L		1		E300.0	09/01/17 20:57 / cjm
Fluoride	ND	mg/L	D	2		E300.0	09/01/17 20:57 / cjm
Sulfate	541	mg/L	D	2		E300.0	09/01/17 20:57 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:09 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:22 / slf
Barium	227	mg/kg		1		SW6010B	08/25/17 15:22 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:22 / slf
Boron	6	mg/kg		1		SW6020	08/26/17 01:09 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:22 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 15:22 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 15:22 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:22 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 15:22 / slf
Manganese	342	mg/kg		1		SW6010B	08/25/17 15:22 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:33 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:09 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:09 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:09 / rlh
RADIONUCLIDES							
Radium 226	0.5	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.2	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-054
Client Sample ID: TLN-1708-006

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 14:25
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.6	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	22.7	meq/L	D	0.07		SW6010B	08/31/17 15:02 / rlh
Magnesium, sat. paste	60.3	meq/L		0.08		SW6010B	08/31/17 15:02 / rlh
Potassium, sat. paste	1.65	meq/L		0.03		SW6010B	08/31/17 15:02 / rlh
Sodium, sat. paste	16.2	meq/L		0.04		SW6010B	08/31/17 15:02 / rlh
Sodium Adsorption Ratio (SAR)	2.52	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	158	mg/L		4		ASA10-3	09/01/17 15:11 / bas
Bicarbonate as HCO3	193	mg/L		4		ASA10-3	09/01/17 15:11 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:11 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 21:16 / cjm
Chloride	19	mg/L	D	2		E300.0	09/01/17 21:16 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 21:16 / cjm
Sulfate	5040	mg/L	D	10		E300.0	09/01/17 21:16 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:11 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 15:26 / slf
Barium	278	mg/kg		1		SW6010B	08/25/17 15:26 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 15:26 / slf
Boron	11	mg/kg		1		SW6020	08/26/17 01:11 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 15:26 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 15:26 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 15:26 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 15:26 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 15:26 / slf
Manganese	353	mg/kg		1		SW6010B	08/25/17 15:26 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:34 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:11 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:11 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:11 / rlh
RADIONUCLIDES							
Radium 226	2.2	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.4	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 04:30
Lab ID:	B17081923-055	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-075	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	26.7	meq/L		0.05		SW6010B	08/31/17 15:14 / rlh
Magnesium, sat. paste	37.9	meq/L		0.08		SW6010B	08/31/17 15:14 / rlh
Potassium, sat. paste	1.45	meq/L		0.03		SW6010B	08/31/17 15:14 / rlh
Sodium, sat. paste	9.13	meq/L		0.04		SW6010B	08/31/17 15:14 / rlh
Sodium Adsorption Ratio (SAR)	1.61	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	270	mg/L		4		ASA10-3	09/01/17 15:23 / bas
Bicarbonate as HCO3	330	mg/L		4		ASA10-3	09/01/17 15:23 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:23 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 21:36 / cjm
Chloride	18	mg/L		1		E300.0	09/01/17 21:36 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 21:36 / cjm
Sulfate	3430	mg/L	D	5		E300.0	09/01/17 21:36 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:14 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:01 / slf
Barium	212	mg/kg		1		SW6010B	08/25/17 16:01 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:01 / slf
Boron	30	mg/kg		1		SW6020	08/26/17 01:14 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:01 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 16:01 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 16:01 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 16:01 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 16:01 / slf
Manganese	300	mg/kg		1		SW6010B	08/25/17 16:01 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:36 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:14 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:14 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:14 / rlh
RADIONUCLIDES							
Radium 226	1.7	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.4	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-056	**Collection Date:**	08/16/17 14:27
Client Sample ID:	TLN-1708-076	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.4	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	1.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	8.16	meq/L		0.05		SW6010B	08/31/17 15:18 / rlh
Magnesium, sat. paste	7.35	meq/L		0.08		SW6010B	08/31/17 15:18 / rlh
Potassium, sat. paste	1.74	meq/L		0.03		SW6010B	08/31/17 15:18 / rlh
Sodium, sat. paste	0.57	meq/L		0.04		SW6010B	08/31/17 15:18 / rlh
Sodium Adsorption Ratio (SAR)	0.21	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	598	mg/L		4		ASA10-3	09/01/17 15:28 / bas
Bicarbonate as HCO3	730	mg/L		4		ASA10-3	09/01/17 15:28 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:28 / bas
Bromide	ND	mg/L		0.5		E300.0	09/01/17 21:55 / cjm
Chloride	37	mg/L		1		E300.0	09/01/17 21:55 / cjm
Fluoride	ND	mg/L	D	1		E300.0	09/01/17 21:55 / cjm
Sulfate	66	mg/L		1		E300.0	09/01/17 21:55 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:17 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:05 / slf
Barium	221	mg/kg		1		SW6010B	08/25/17 16:05 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:05 / slf
Boron	10	mg/kg		1		SW6020	08/26/17 01:17 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:05 / slf
Chromium	19	mg/kg	D	8		SW6010B	08/25/17 16:05 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 16:05 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 16:05 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 16:05 / slf
Manganese	334	mg/kg		1		SW6010B	08/25/17 16:05 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:38 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:17 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:17 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:17 / rlh
RADIONUCLIDES							
Radium 226	1.2	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:32
Lab ID:	B17081923-057	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-005	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.2	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	1.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	8.38	meq/L		0.05		SW6010B	08/31/17 15:22 / rlh
Magnesium, sat. paste	7.54	meq/L		0.08		SW6010B	08/31/17 15:22 / rlh
Potassium, sat. paste	1.96	meq/L		0.03		SW6010B	08/31/17 15:22 / rlh
Sodium, sat. paste	0.53	meq/L		0.04		SW6010B	08/31/17 15:22 / rlh
Sodium Adsorption Ratio (SAR)	0.19	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	619	mg/L		4		ASA10-3	09/01/17 15:35 / bas
Bicarbonate as HCO3	755	mg/L		4		ASA10-3	09/01/17 15:35 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:35 / bas
Bromide	ND	mg/L	D	1		E300.0	09/01/17 22:15 / cjm
Chloride	40	mg/L		1		E300.0	09/01/17 22:15 / cjm
Fluoride	ND	mg/L	D	2		E300.0	09/01/17 22:15 / cjm
Sulfate	56	mg/L	D	2		E300.0	09/01/17 22:15 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:19 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:08 / slf
Barium	403	mg/kg		1		SW6010B	08/25/17 16:08 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:08 / slf
Boron	26	mg/kg		1		SW6020	08/26/17 01:19 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:08 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 16:08 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 16:08 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 16:08 / slf
Lithium	13	mg/kg		1		SW6010B	08/25/17 16:08 / slf
Manganese	392	mg/kg		1		SW6010B	08/25/17 16:08 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:40 / jh
Molybdenum	1	mg/kg		1		SW6020	08/26/17 01:19 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:19 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:19 / rlh
RADIONUCLIDES							
Radium 226	1.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.08	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.5	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-058	**Collection Date:**	08/16/17 14:35
Client Sample ID:	TLN-1708-077	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.9	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	22.7	meq/L	D	0.07		SW6010B	08/31/17 15:25 / rlh
Magnesium, sat. paste	45.8	meq/L		0.08		SW6010B	08/31/17 15:25 / rlh
Potassium, sat. paste	1.94	meq/L		0.03		SW6010B	08/31/17 15:25 / rlh
Sodium, sat. paste	17.2	meq/L		0.04		SW6010B	08/31/17 15:25 / rlh
Sodium Adsorption Ratio (SAR)	2.94	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	262	mg/L		4		ASA10-3	09/01/17 15:41 / bas
Bicarbonate as HCO3	319	mg/L		4		ASA10-3	09/01/17 15:41 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:41 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 22:34 / cjm
Chloride	65	mg/L	D	2		E300.0	09/01/17 22:34 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 22:34 / cjm
Sulfate	4320	mg/L	D	10		E300.0	09/01/17 22:34 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:22 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:12 / slf
Barium	139	mg/kg		1		SW6010B	08/25/17 16:12 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:12 / slf
Boron	17	mg/kg		1		SW6020	08/26/17 01:22 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:12 / slf
Chromium	15	mg/kg	D	8		SW6010B	08/25/17 16:12 / slf
Cobalt	ND	mg/kg	D	6		SW6010B	08/25/17 16:12 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 16:12 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 16:12 / slf
Manganese	311	mg/kg		1		SW6010B	08/25/17 16:12 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:41 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:22 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:22 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:22 / rlh
RADIONUCLIDES							
Radium 226	1.4	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.3	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-059	**Collection Date:**	08/16/17 14:37
Client Sample ID:	TLN-1708-004	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	1.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	4.33	meq/L		0.05		SW6010B	08/31/17 15:29 / rlh
Magnesium, sat. paste	6.08	meq/L		0.08		SW6010B	08/31/17 15:29 / rlh
Potassium, sat. paste	1.78	meq/L		0.03		SW6010B	08/31/17 15:29 / rlh
Sodium, sat. paste	0.68	meq/L		0.04		SW6010B	08/31/17 15:29 / rlh
Sodium Adsorption Ratio (SAR)	0.30	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	418	mg/L		4		ASA10-3	09/01/17 15:46 / bas
Bicarbonate as HCO3	509	mg/L		4		ASA10-3	09/01/17 15:46 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:46 / bas
Bromide	ND	mg/L		0.5		E300.0	09/01/17 22:54 / cjm
Chloride	53	mg/L		1		E300.0	09/01/17 22:54 / cjm
Fluoride	ND	mg/L	D	1		E300.0	09/01/17 22:54 / cjm
Sulfate	66	mg/L		1		E300.0	09/01/17 22:54 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:24 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:16 / slf
Barium	1300	mg/kg		1		SW6010B	08/25/17 16:16 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:16 / slf
Boron	23	mg/kg		1		SW6020	08/26/17 01:24 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:16 / slf
Chromium	20	mg/kg	D	8		SW6010B	08/25/17 16:16 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 16:16 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 16:16 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 16:16 / slf
Manganese	398	mg/kg		1		SW6010B	08/25/17 16:16 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:43 / jh
Molybdenum	ND	mg/kg		8		SW6010B	08/25/17 16:16 / slf
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:24 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:24 / rlh
RADIONUCLIDES							
Radium 226	1.4	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.4	pCi/g-dry	U			RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-059	**Collection Date:**	08/16/17 14:37
Client Sample ID:	TLN-1708-004	**DateReceived:**	08/17/17
		Matrix:	Splp Extract

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, SPLP EXTRACTABLE							
Barium	0.08	mg/L		0.05		SW6010B	11/03/17 18:46 / slf

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-060	**Collection Date:**	08/16/17 14:40
Client Sample ID:	TLN-1708-078	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.3	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.4	meq/L	D	0.07		SW6010B	08/31/17 15:33 / rlh
Magnesium, sat. paste	42.7	meq/L		0.08		SW6010B	08/31/17 15:33 / rlh
Potassium, sat. paste	1.42	meq/L		0.03		SW6010B	08/31/17 15:33 / rlh
Sodium, sat. paste	19.8	meq/L		0.04		SW6010B	08/31/17 15:33 / rlh
Sodium Adsorption Ratio (SAR)	3.50	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	162	mg/L		4		ASA10-3	09/01/17 15:50 / bas
Bicarbonate as HCO3	197	mg/L		4		ASA10-3	09/01/17 15:50 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:50 / bas
Bromide	ND	mg/L	D	5		E300.0	09/01/17 23:13 / cjm
Chloride	24	mg/L	D	2		E300.0	09/01/17 23:13 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/01/17 23:13 / cjm
Sulfate	4370	mg/L	D	10		E300.0	09/01/17 23:13 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 01:27 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 16:19 / slf
Barium	188	mg/kg		1		SW6010B	08/25/17 16:19 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 16:19 / slf
Boron	22	mg/kg		1		SW6020	08/26/17 01:27 / rlh
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 16:19 / slf
Chromium	18	mg/kg	D	8		SW6010B	08/25/17 16:19 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 16:19 / slf
Lead	ND	mg/kg	D	40		SW6010B	08/25/17 16:19 / slf
Lithium	13	mg/kg		1		SW6010B	08/25/17 16:19 / slf
Manganese	466	mg/kg		1		SW6010B	08/25/17 16:19 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 12:45 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 01:27 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 01:27 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 01:27 / rlh
RADIONUCLIDES							
Radium 226	1.6	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 13:15 / eli-ca
Radium 228	0.8	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	09/28/17 15:02 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:43
Lab ID:	B17081923-061	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-002	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.6	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.0	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	30.7	meq/L		0.05		SW6010B	08/31/17 15:37 / rlh
Magnesium, sat. paste	10.3	meq/L		0.08		SW6010B	08/31/17 15:37 / rlh
Potassium, sat. paste	0.76	meq/L		0.03		SW6010B	08/31/17 15:37 / rlh
Sodium, sat. paste	2.96	meq/L		0.04		SW6010B	08/31/17 15:37 / rlh
Sodium Adsorption Ratio (SAR)	0.66	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	198	mg/L		4		ASA10-3	09/01/17 15:55 / bas
Bicarbonate as HCO3	241	mg/L		4		ASA10-3	09/01/17 15:55 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 15:55 / bas
Bromide	ND	mg/L	D	2		E300.0	09/01/17 23:33 / cjm
Chloride	13	mg/L		1		E300.0	09/01/17 23:33 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/01/17 23:33 / cjm
Sulfate	1990	mg/L	D	5		E300.0	09/01/17 23:33 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 02:54 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:11 / slf
Barium	111	mg/kg		1		SW6010B	08/25/17 13:11 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:11 / slf
Boron	6	mg/kg		1		SW6010B	08/30/17 07:16 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:11 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 13:11 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 13:11 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:11 / slf
Lithium	17	mg/kg		1		SW6010B	08/25/17 13:11 / slf
Manganese	332	mg/kg		1		SW6010B	08/25/17 13:11 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:16 / jh
Molybdenum	1	mg/kg		1		SW6020	08/26/17 02:54 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 02:54 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 02:54 / rlh
RADIONUCLIDES							
Radium 226	2.2	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 precision (±)	0.5	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 MDC	0.08	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 228	0.7	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-062	**Collection Date:**	08/16/17 14:45
Client Sample ID:	TLN-1708-079	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.3	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.8	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	26.8	meq/L		0.05		SW6010B	08/31/17 15:45 / rlh
Magnesium, sat. paste	30.0	meq/L		0.08		SW6010B	08/31/17 15:45 / rlh
Potassium, sat. paste	0.97	meq/L		0.03		SW6010B	08/31/17 15:45 / rlh
Sodium, sat. paste	4.19	meq/L		0.04		SW6010B	08/31/17 15:45 / rlh
Sodium Adsorption Ratio (SAR)	0.79	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	234	mg/L		4		ASA10-3	09/01/17 16:04 / bas
Bicarbonate as HCO3	285	mg/L		4		ASA10-3	09/01/17 16:04 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:04 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 01:10 / cjm
Chloride	11	mg/L		1		E300.0	09/02/17 01:10 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 01:10 / cjm
Sulfate	2860	mg/L	D	5		E300.0	09/02/17 01:10 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 02:57 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:15 / slf
Barium	196	mg/kg		1		SW6010B	08/25/17 13:15 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:15 / slf
Boron	31	mg/kg	D	2		SW6010B	08/25/17 13:15 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:15 / slf
Chromium	13	mg/kg	D	8		SW6010B	08/25/17 13:15 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:15 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:15 / slf
Lithium	12	mg/kg		1		SW6010B	08/25/17 13:15 / slf
Manganese	332	mg/kg		1		SW6010B	08/25/17 13:15 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:18 / jh
Molybdenum	1	mg/kg		1		SW6020	08/26/17 02:57 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 02:57 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 02:57 / rlh
RADIONUCLIDES							
Radium 226	1.1	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 228	0.1	pCi/g-dry	U			RA-05	09/28/17 16:37 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

		Revised Date:	12/06/17
Client:	Hydrometrics Inc	**Report Date:**	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 14:48
Lab ID:	B17081923-063	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-080	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.0	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	12.0	meq/L		0.05		SW6010B	08/31/17 16:28 / rlh
Magnesium, sat. paste	18.2	meq/L		0.08		SW6010B	08/31/17 16:28 / rlh
Potassium, sat. paste	0.61	meq/L		0.03		SW6010B	08/31/17 16:28 / rlh
Sodium, sat. paste	9.51	meq/L		0.04		SW6010B	08/31/17 16:28 / rlh
Sodium Adsorption Ratio (SAR)	2.45	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	65	mg/L		4		ASA10-3	09/01/17 16:11 / bas
Bicarbonate as HCO3	80	mg/L		4		ASA10-3	09/01/17 16:11 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:11 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 01:30 / cjm
Chloride	19	mg/L		1		E300.0	09/02/17 01:30 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 01:30 / cjm
Sulfate	1980	mg/L	D	5		E300.0	09/02/17 01:30 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 02:59 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:25 / slf
Barium	91	mg/kg		1		SW6010B	08/25/17 13:25 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:25 / slf
Boron	2	mg/kg		1		SW6010B	08/30/17 07:20 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:25 / slf
Chromium	13	mg/kg	D	8		SW6010B	08/25/17 13:25 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:25 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:25 / slf
Lithium	11	mg/kg		1		SW6010B	08/25/17 13:25 / slf
Manganese	219	mg/kg		1		SW6010B	08/25/17 13:25 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:19 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 02:59 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 02:59 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 02:59 / rlh
RADIONUCLIDES							
Radium 226	1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	-0.2	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.4	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-064	**Collection Date:**	08/16/17 14:53
Client Sample ID:	TLN-1708-001	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.5	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.0	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	26.4	meq/L		0.05		SW6010B	08/31/17 16:32 / rlh
Magnesium, sat. paste	22.0	meq/L		0.08		SW6010B	08/31/17 16:32 / rlh
Potassium, sat. paste	1.03	meq/L		0.03		SW6010B	08/31/17 16:32 / rlh
Sodium, sat. paste	9.29	meq/L		0.04		SW6010B	08/31/17 16:32 / rlh
Sodium Adsorption Ratio (SAR)	1.89	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	281	mg/L		4		ASA10-3	09/01/17 16:15 / bas
Bicarbonate as HCO3	342	mg/L		4		ASA10-3	09/01/17 16:15 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:15 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 01:49 / cjm
Chloride	21	mg/L		1		E300.0	09/02/17 01:49 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 01:49 / cjm
Sulfate	2750	mg/L	D	5		E300.0	09/02/17 01:49 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:02 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:29 / slf
Barium	135	mg/kg		1		SW6010B	08/25/17 13:29 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:29 / slf
Boron	7	mg/kg		1		SW6010B	08/30/17 07:24 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:29 / slf
Chromium	18	mg/kg	D	8		SW6010B	08/25/17 13:29 / slf
Cobalt	7	mg/kg	D	6		SW6010B	08/25/17 13:29 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:29 / slf
Lithium	17	mg/kg		1		SW6010B	08/25/17 13:29 / slf
Manganese	349	mg/kg		1		SW6010B	08/25/17 13:29 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:21 / jh
Molybdenum	1	mg/kg		1		SW6020	08/26/17 03:02 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:02 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:02 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.1	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.05	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	0.1	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.5	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling
Lab ID: B17081923-065
Client Sample ID: TLN-1708-081

Revised Date: 12/06/17
Report Date: 10/18/17
Collection Date: 08/16/17 14:56
DateReceived: 08/17/17
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	7.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	20.7	meq/L	D	0.07		SW6010B	08/31/17 16:36 / rlh
Magnesium, sat. paste	69.8	meq/L		0.08		SW6010B	08/31/17 16:36 / rlh
Potassium, sat. paste	1.46	meq/L		0.03		SW6010B	08/31/17 16:36 / rlh
Sodium, sat. paste	32.9	meq/L		0.04		SW6010B	08/31/17 16:36 / rlh
Sodium Adsorption Ratio (SAR)	4.89	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	129	mg/L		4		ASA10-3	09/01/17 16:20 / bas
Bicarbonate as HCO3	158	mg/L		4		ASA10-3	09/01/17 16:20 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:20 / bas
Bromide	ND	mg/L	D	5		E300.0	09/02/17 02:08 / cjm
Chloride	48	mg/L	D	2		E300.0	09/02/17 02:08 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/02/17 02:08 / cjm
Sulfate	6490	mg/L	D	10		E300.0	09/02/17 02:08 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:04 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:33 / slf
Barium	123	mg/kg		1		SW6010B	08/25/17 13:33 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:33 / slf
Boron	19	mg/kg		1		SW6010B	08/30/17 07:27 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:33 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 13:33 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 13:33 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:33 / slf
Lithium	16	mg/kg		1		SW6010B	08/25/17 13:33 / slf
Manganese	284	mg/kg		1		SW6010B	08/25/17 13:33 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:23 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:04 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:04 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:04 / rlh
RADIONUCLIDES							
Radium 226	1.1	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 228	0.1	pCi/g-dry	U			RA-05	09/28/17 16:37 / eli-ca
Radium 228 precision (±)	0.3	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca
Radium 228 MDC	0.7	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 15:12
Lab ID:	B17081923-066	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-015	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.9	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	21.5	meq/L		0.05		SW6010B	08/31/17 16:40 / rlh
Magnesium, sat. paste	40.1	meq/L		0.08		SW6010B	08/31/17 16:40 / rlh
Potassium, sat. paste	0.77	meq/L		0.03		SW6010B	08/31/17 16:40 / rlh
Sodium, sat. paste	20.0	meq/L		0.04		SW6010B	08/31/17 16:40 / rlh
Sodium Adsorption Ratio (SAR)	3.60	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	224	mg/L		4		ASA10-3	09/01/17 16:24 / bas
Bicarbonate as HCO3	273	mg/L		4		ASA10-3	09/01/17 16:24 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:24 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 02:28 / cjm
Chloride	91	mg/L		1		E300.0	09/02/17 02:28 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 02:28 / cjm
Sulfate	3820	mg/L	D	5		E300.0	09/02/17 02:28 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:07 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:36 / slf
Barium	122	mg/kg		1		SW6010B	08/25/17 13:36 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:36 / slf
Boron	8	mg/kg		1		SW6010B	08/30/17 07:31 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:36 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 13:36 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:36 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:36 / slf
Lithium	13	mg/kg		1		SW6010B	08/25/17 13:36 / slf
Manganese	213	mg/kg		1		SW6010B	08/25/17 13:36 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:25 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:07 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:07 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:07 / rlh
RADIONUCLIDES							
Radium 226	1.1	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 15:43 / eli-ca
Radium 228	-0.08	pCi/g-dry	U			RA-05	09/28/17 16:37 / eli-ca
Radium 228 precision (±)	0.4	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca
Radium 228 MDC	0.6	pCi/g-dry				RA-05	09/28/17 16:37 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 15:15
Lab ID:	B17081923-067	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-083	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	2.8	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	9.80	meq/L		0.05		SW6010B	08/31/17 16:44 / rlh
Magnesium, sat. paste	17.3	meq/L		0.08		SW6010B	08/31/17 16:44 / rlh
Potassium, sat. paste	0.53	meq/L		0.03		SW6010B	08/31/17 16:44 / rlh
Sodium, sat. paste	9.60	meq/L		0.04		SW6010B	08/31/17 16:44 / rlh
Sodium Adsorption Ratio (SAR)	2.61	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	96	mg/L		4		ASA10-3	09/01/17 16:30 / bas
Bicarbonate as HCO3	117	mg/L		4		ASA10-3	09/01/17 16:30 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:30 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 02:47 / cjm
Chloride	26	mg/L		1		E300.0	09/02/17 02:47 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 02:47 / cjm
Sulfate	1780	mg/L	D	5		E300.0	09/02/17 02:47 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:10 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:40 / slf
Barium	118	mg/kg		1		SW6010B	08/25/17 13:40 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:40 / slf
Boron	6	mg/kg		1		SW6010B	08/30/17 07:35 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:40 / slf
Chromium	16	mg/kg	D	7		SW6010B	08/25/17 13:40 / slf
Cobalt	ND	mg/kg		5		SW6010B	08/25/17 13:40 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:40 / slf
Lithium	13	mg/kg		1		SW6010B	08/25/17 13:40 / slf
Manganese	183	mg/kg		1		SW6010B	08/25/17 13:40 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:26 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:10 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:10 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:10 / rlh
RADIONUCLIDES							
Radium 226	1.0	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 13:14 / eli-ca
Radium 228	-0.3	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	1.0	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	1.8	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-068	**Collection Date:**	08/16/17 15:17
Client Sample ID:	TLN-1708-016	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.4	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	19.5	meq/L	D	0.07		SW6010B	08/31/17 16:48 / rlh
Magnesium, sat. paste	36.9	meq/L		0.08		SW6010B	08/31/17 16:48 / rlh
Potassium, sat. paste	0.62	meq/L		0.03		SW6010B	08/31/17 16:48 / rlh
Sodium, sat. paste	18.9	meq/L		0.04		SW6010B	08/31/17 16:48 / rlh
Sodium Adsorption Ratio (SAR)	3.55	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	185	mg/L		4		ASA10-3	09/01/17 16:44 / bas
Bicarbonate as HCO3	225	mg/L		4		ASA10-3	09/01/17 16:44 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:44 / bas
Bromide	ND	mg/L	D	5		E300.0	09/02/17 03:07 / cjm
Chloride	37	mg/L	D	2		E300.0	09/02/17 03:07 / cjm
Fluoride	ND	mg/L	D	10		E300.0	09/02/17 03:07 / cjm
Sulfate	4340	mg/L	D	10		E300.0	09/02/17 03:07 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:12 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:44 / slf
Barium	133	mg/kg		1		SW6010B	08/25/17 13:44 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:44 / slf
Boron	11	mg/kg		1		SW6010B	08/30/17 07:46 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:44 / slf
Chromium	17	mg/kg	D	8		SW6010B	08/25/17 13:44 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:44 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:44 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 13:44 / slf
Manganese	259	mg/kg		1		SW6010B	08/25/17 13:44 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:28 / jh
Molybdenum	1	mg/kg		1		SW6020	08/26/17 03:12 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:12 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:12 / rlh
RADIONUCLIDES							
Radium 226	1.2	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 228	-0.6	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	1	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	1.7	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 15:20
Lab ID:	B17081923-069	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-084	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.0	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	3.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	11.3	meq/L		0.05		SW6010B	08/31/17 16:52 / rlh
Magnesium, sat. paste	19.8	meq/L		0.08		SW6010B	08/31/17 16:52 / rlh
Potassium, sat. paste	0.57	meq/L		0.03		SW6010B	08/31/17 16:52 / rlh
Sodium, sat. paste	10.7	meq/L		0.04		SW6010B	08/31/17 16:52 / rlh
Sodium Adsorption Ratio (SAR)	2.71	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	99	mg/L		4		ASA10-3	09/01/17 16:47 / bas
Bicarbonate as HCO3	120	mg/L		4		ASA10-3	09/01/17 16:47 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:47 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 03:26 / cjm
Chloride	23	mg/L		1		E300.0	09/02/17 03:26 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 03:26 / cjm
Sulfate	2010	mg/L	D	5		E300.0	09/02/17 03:26 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:22 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:48 / slf
Barium	141	mg/kg		1		SW6010B	08/25/17 13:48 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:48 / slf
Boron	7	mg/kg		1		SW6010B	08/30/17 07:50 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:48 / slf
Chromium	17	mg/kg	D	7		SW6010B	08/25/17 13:48 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:48 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:48 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 13:48 / slf
Manganese	180	mg/kg		1		SW6010B	08/25/17 13:48 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:30 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:22 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:22 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:22 / rlh
RADIONUCLIDES							
Radium 226	1	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 precision (±)	0.3	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 MDC	0.2	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 228	0.1	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	1.3	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	1.7	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
Project:	Talen Job # 12072 Soil Sampling	**Report Date:**	10/18/17
Lab ID:	B17081923-070	**Collection Date:**	08/16/17 15:22
Client Sample ID:	TLN-1708-026	**DateReceived:**	08/17/17
		Matrix:	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.7	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	24.7	meq/L		0.05		SW6010B	08/31/17 16:56 / rlh
Magnesium, sat. paste	44.8	meq/L		0.08		SW6010B	08/31/17 16:56 / rlh
Potassium, sat. paste	0.96	meq/L		0.03		SW6010B	08/31/17 16:56 / rlh
Sodium, sat. paste	17.9	meq/L		0.04		SW6010B	08/31/17 16:56 / rlh
Sodium Adsorption Ratio (SAR)	3.03	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	396	mg/L		4		ASA10-3	09/01/17 16:51 / bas
Bicarbonate as HCO3	483	mg/L		4		ASA10-3	09/01/17 16:51 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:51 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 03:46 / cjm
Chloride	44	mg/L		1		E300.0	09/02/17 03:46 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 03:46 / cjm
Sulfate	3900	mg/L	D	5		E300.0	09/02/17 03:46 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:25 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:51 / slf
Barium	141	mg/kg		1		SW6010B	08/25/17 13:51 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:51 / slf
Boron	12	mg/kg		1		SW6010B	08/30/17 07:54 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:51 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 13:51 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 13:51 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:51 / slf
Lithium	14	mg/kg		1		SW6010B	08/25/17 13:51 / slf
Manganese	264	mg/kg		1		SW6010B	08/25/17 13:51 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:32 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:25 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:25 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:25 / rlh
RADIONUCLIDES							
Radium 226	0.9	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 15:44 / eli-ca
Radium 228	-0.02	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.5	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.9	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

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

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 15:23
Lab ID:	B17081923-071	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-085	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	7.8	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	5.1	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	24.8	meq/L		0.05		SW6010B	08/31/17 17:00 / rlh
Magnesium, sat. paste	45.5	meq/L		0.08		SW6010B	08/31/17 17:00 / rlh
Potassium, sat. paste	0.96	meq/L		0.03		SW6010B	08/31/17 17:00 / rlh
Sodium, sat. paste	18.5	meq/L		0.04		SW6010B	08/31/17 17:00 / rlh
Sodium Adsorption Ratio (SAR)	3.12	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	357	mg/L		4		ASA10-3	09/01/17 16:58 / bas
Bicarbonate as HCO3	435	mg/L		4		ASA10-3	09/01/17 16:58 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 16:58 / bas
Bromide	ND	mg/L	D	2		E300.0	09/02/17 04:05 / cjm
Chloride	45	mg/L		1		E300.0	09/02/17 04:05 / cjm
Fluoride	ND	mg/L	D	5		E300.0	09/02/17 04:05 / cjm
Sulfate	4020	mg/L	D	5		E300.0	09/02/17 04:05 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:28 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:55 / slf
Barium	143	mg/kg		1		SW6010B	08/25/17 13:55 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:55 / slf
Boron	12	mg/kg		1		SW6010B	08/30/17 07:58 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:55 / slf
Chromium	17	mg/kg	D	8		SW6010B	08/25/17 13:55 / slf
Cobalt	6	mg/kg	D	6		SW6010B	08/25/17 13:55 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:55 / slf
Lithium	15	mg/kg		1		SW6010B	08/25/17 13:55 / slf
Manganese	271	mg/kg		1		SW6010B	08/25/17 13:55 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:37 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:28 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:28 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:28 / rlh
RADIONUCLIDES							
Radium 226	0.7	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 226 MDC	0.1	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 228	0.08	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.6	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.9	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
MDC - Minimum detectable concentration
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LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client:	Hydrometrics Inc	**Revised Date:**	12/06/17
		Report Date:	10/18/17
Project:	Talen Job # 12072 Soil Sampling	**Collection Date:**	08/16/17 15:25
Lab ID:	B17081923-072	**DateReceived:**	08/17/17
Client Sample ID:	TLN-1708-086	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
SATURATED PASTE EXTRACT							
pH, sat. paste	8.1	s.u.		0.1		ASA10-3	09/05/17 16:59 / srm
Conductivity, sat. paste	4.8	mmhos/cm		0.1		ASA10-3	09/05/17 16:59 / srm
Calcium, sat. paste	25.2	meq/L		0.05		SW6010B	08/31/17 17:16 / rlh
Magnesium, sat. paste	38.5	meq/L		0.08		SW6010B	08/31/17 17:16 / rlh
Potassium, sat. paste	0.81	meq/L		0.03		SW6010B	08/31/17 17:16 / rlh
Sodium, sat. paste	16.1	meq/L		0.04		SW6010B	08/31/17 17:16 / rlh
Sodium Adsorption Ratio (SAR)	2.85	unitless		0.01		Calculation	09/05/17 16:59 / srm
Alkalinity, Total as CaCO3	130	mg/L		4		ASA10-3	09/01/17 17:11 / bas
Bicarbonate as HCO3	159	mg/L		4		ASA10-3	09/01/17 17:11 / bas
Carbonate as CO3	ND	mg/L		4		ASA10-3	09/01/17 17:11 / bas
Bromide	ND	mg/L	D	1		E300.0	09/02/17 05:42 / cjm
Chloride	30	mg/L		1		E300.0	09/02/17 05:42 / cjm
Fluoride	ND	mg/L	D	2		E300.0	09/02/17 05:42 / cjm
Sulfate	3740	mg/L	D	5		E300.0	09/05/17 17:06 / cjm
METALS, TOTAL - EPA SW846							
Antimony	ND	mg/kg		1		SW6020	08/26/17 03:30 / rlh
Arsenic	ND	mg/kg		40		SW6010B	08/25/17 13:59 / slf
Barium	130	mg/kg		1		SW6010B	08/25/17 13:59 / slf
Beryllium	ND	mg/kg		1		SW6010B	08/25/17 13:59 / slf
Boron	3	mg/kg		1		SW6010B	08/30/17 08:02 / slf
Cadmium	ND	mg/kg		1		SW6010B	08/25/17 13:59 / slf
Chromium	16	mg/kg	D	8		SW6010B	08/25/17 13:59 / slf
Cobalt	ND	mg/kg		6		SW6010B	08/25/17 13:59 / slf
Lead	ND	mg/kg		40		SW6010B	08/25/17 13:59 / slf
Lithium	15	mg/kg		1		SW6010B	08/25/17 13:59 / slf
Manganese	389	mg/kg		1		SW6010B	08/25/17 13:59 / slf
Mercury	ND	mg/kg		1		SW7471B	08/24/17 13:38 / jh
Molybdenum	ND	mg/kg		1		SW6020	08/26/17 03:30 / rlh
Selenium	ND	mg/kg		1		SW6020	08/26/17 03:30 / rlh
Thallium	ND	mg/kg		1		SW6020	08/26/17 03:30 / rlh
RADIONUCLIDES							
Radium 226	1	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 226 precision (±)	0.2	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 226 MDC	0.09	pCi/g-dry				E903.0	10/16/17 15:45 / eli-ca
Radium 228	0.8	pCi/g-dry	U			RA-05	10/15/17 17:21 / eli-ca
Radium 228 precision (±)	0.8	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca
Radium 228 MDC	0.9	pCi/g-dry				RA-05	10/15/17 17:21 / eli-ca

Report Definitions:
RL - Analyte reporting limit.
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MDC - Minimum detectable concentration
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QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 113147
Lab ID: LCS-113147	Laboratory Control Sample				Run: AR50_170831A				08/31/17 13:28
Alkalinity, Total as CaCO3	417	mg/L	4.0	98	70	130			
Bicarbonate as HCO3	509	mg/L	4.0	98	70	130			
Carbonate as CO3	ND	mg/L	4.0		70	130			
Lab ID: B17081923-001A DUP	Sample Duplicate				Run: AR50_170831A				08/31/17 14:22
Alkalinity, Total as CaCO3	111	mg/L	4.0				2.9	50	
Bicarbonate as HCO3	136	mg/L	4.0				2.9	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-011A DUP	Sample Duplicate				Run: AR50_170831A				08/31/17 15:19
Alkalinity, Total as CaCO3	312	mg/L	4.0				5.0	50	
Bicarbonate as HCO3	380	mg/L	4.0				5.0	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-021A DUP	Sample Duplicate				Run: AR50_170831A				08/31/17 16:18
Alkalinity, Total as CaCO3	169	mg/L	4.0				3.0	50	
Bicarbonate as HCO3	206	mg/L	4.0				3.0	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-031A DUP	Sample Duplicate				Run: AR50_170831A				08/31/17 17:03
Alkalinity, Total as CaCO3	365	mg/L	4.0				2.6	50	
Bicarbonate as HCO3	444	mg/L	4.0				2.6	50	
Carbonate as CO3	ND	mg/L	4.0					50	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 113195
Lab ID: LCS-113195	Laboratory Control Sample				Run: AR50_170901A				09/01/17 10:52
Alkalinity, Total as CaCO3	432	mg/L	4.0	101	70	130			
Bicarbonate as HCO3	527	mg/L	4.0	101	70	130			
Lab ID: B17081923-041A DUP	Sample Duplicate				Run: AR50_170901A				09/01/17 11:43
Alkalinity, Total as CaCO3	463	mg/L	4.0				0.4	50	
Bicarbonate as HCO3	565	mg/L	4.0				0.4	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-051A DUP	Sample Duplicate				Run: AR50_170901A				09/01/17 14:59
Alkalinity, Total as CaCO3	214	mg/L	4.0				1.5	50	
Bicarbonate as HCO3	261	mg/L	4.0				1.5	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-061A DUP	Sample Duplicate				Run: AR50_170901A				09/01/17 15:59
Alkalinity, Total as CaCO3	208	mg/L	4.0				5.2	50	
Bicarbonate as HCO3	254	mg/L	4.0				5.2	50	
Carbonate as CO3	ND	mg/L	4.0					50	
Lab ID: B17081923-071A DUP	Sample Duplicate				Run: AR50_170901A				09/01/17 17:07
Alkalinity, Total as CaCO3	336	mg/L	4.0				6.0	50	
Bicarbonate as HCO3	410	mg/L	4.0				6.0	50	
Carbonate as CO3	ND	mg/L	4.0					50	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 113147
Lab ID: B17081923-001A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
Conductivity, sat. paste	4.00	mmhos/cm	0.10				0.5	30	
Lab ID: B17081923-011A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
Conductivity, sat. paste	0.930	mmhos/cm	0.10				3.3	30	
Lab ID: B17081923-021A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
Conductivity, sat. paste	8.19	mmhos/cm	0.10				0.9	30	
Lab ID: B17081923-031A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
Conductivity, sat. paste	0.940	mmhos/cm	0.10				2.2	30	
Lab ID: B17081923-001A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
pH, sat. paste	7.40	s.u.	0.10				1.3	10	
Lab ID: B17081923-011A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
pH, sat. paste	7.40	s.u.	0.10				0.0	10	
Lab ID: B17081923-021A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
pH, sat. paste	8.40	s.u.	0.10				0.0	10	
Lab ID: B17081923-031A DUP	Sample Duplicate				Run: MISC-SOIL_170830C				08/30/17 14:27
pH, sat. paste	7.40	s.u.	0.10				0.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: 113195
Lab ID: B17081923-041A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
Conductivity, sat. paste	1.28	mmhos/cm	0.10				3.2	30	
Lab ID: B17081923-051A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
Conductivity, sat. paste	4.35	mmhos/cm	0.10				2.5	30	
Lab ID: B17081923-061A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
Conductivity, sat. paste	3.01	mmhos/cm	0.10				0.0	30	
Lab ID: B17081923-071A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
Conductivity, sat. paste	5.08	mmhos/cm	0.10				0.6	30	
Lab ID: B17081923-041A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
pH, sat. paste	7.00	s.u.	0.10				2.8	10	
Lab ID: B17081923-051A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
pH, sat. paste	7.80	s.u.	0.10				1.3	10	
Lab ID: B17081923-061A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
pH, sat. paste	7.60	s.u.	0.10				0.0	10	
Lab ID: B17081923-071A DUP	Sample Duplicate				Run: MISC-SOIL_170905B				09/05/17 16:59
pH, sat. paste	7.90	s.u.	0.10				1.3	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: Calculation								Batch: R286133	
Lab ID: B17081923-001A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:56	
Sodium Adsorption Ratio (SAR)	1.58	unitless	0.010				1.3	30	
Lab ID: B17081923-011A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:56	
Sodium Adsorption Ratio (SAR)	0.110	unitless	0.010				17	30	
Lab ID: B17081923-021A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:56	
Sodium Adsorption Ratio (SAR)	5.42	unitless	0.010				2.2	30	
Lab ID: B17081923-031A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:56	
Sodium Adsorption Ratio (SAR)	0.0900	unitless	0.010				0.0	30	
Lab ID: LCS-1709051656	Laboratory Control Sample				Run: MISC-SOIL_170905B			09/05/17 16:56	
Sodium Adsorption Ratio (SAR)	8.64	unitless	0.010	92	70	130			
Lab ID: B17081923-041A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:59	
Sodium Adsorption Ratio (SAR)	0.100	unitless	0.010				0.0	30	
Lab ID: B17081923-051A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:59	
Sodium Adsorption Ratio (SAR)	2.08	unitless	0.010				2.4	30	
Lab ID: B17081923-061A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:59	
Sodium Adsorption Ratio (SAR)	0.640	unitless	0.010				3.1	30	
Lab ID: B17081923-071A DUP	Sample Duplicate				Run: MISC-SOIL_170905B			09/05/17 16:59	
Sodium Adsorption Ratio (SAR)	3.09	unitless	0.010				1.0	30	
Lab ID: LCS-1709051659	Laboratory Control Sample				Run: MISC-SOIL_170905B			09/05/17 16:59	
Sodium Adsorption Ratio (SAR)	8.72	unitless	0.010	93	70	130			

Qualifiers:

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ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E300.0**									Batch: 113147
Lab ID: **LCS-113147**	Laboratory Control Sample				Run: IC METROHM 1_170830A				08/30/17 18:19
Bromide	ND	mg/L	2.5		70	130			
Chloride	265	mg/L	1.2	110	70	130			
Fluoride	1.00	mg/L	5.0	108	70	130			
Sulfate	1930	mg/L	5.0	97	70	130			
Lab ID: **B17081923-001AMS**	Sample Matrix Spike				Run: IC METROHM 1_170830A				08/30/17 21:15
Bromide	176	mg/L	2.6	106	70	130			
Chloride	581	mg/L	1.3	107	70	130			
Fluoride	161	mg/L	5.1	106	70	130			
Sulfate	4440	mg/L	5.1	91	70	130			
Lab ID: **B17081923-001ADUP**	Sample Duplicate				Run: IC METROHM 1_170830A				08/30/17 21:34
Bromide	16.2	mg/L	2.5				1.2	30	
Chloride	46.6	mg/L	1.2				4.1	30	
Fluoride	0.900	mg/L	5.0					30	
Sulfate	3010	mg/L	5.0				2.3	30	
Lab ID: **B17081923-011AMS**	Sample Matrix Spike				Run: IC METROHM 1_170830A				08/31/17 01:48
Bromide	31.9	mg/L	0.51	105	70	130			
Chloride	121	mg/L	1.0	107	70	130			
Fluoride	34.0	mg/L	1.0	113	70	130			
Sulfate	393	mg/L	1.0	106	70	130			
Lab ID: **B17081923-011ADUP**	Sample Duplicate				Run: IC METROHM 1_170830A				08/31/17 02:08
Bromide	0.280	mg/L	0.50					30	
Chloride	12.5	mg/L	1.0				9.4	30	
Fluoride	ND	mg/L	1.0					30	
Sulfate	80.2	mg/L	1.0				4.5	30	
Lab ID: **B17081923-021AMS**	Sample Matrix Spike				Run: IC METROHM 1_170830A				08/31/17 06:21
Bromide	317	mg/L	5.1	106	70	130			
Chloride	1120	mg/L	2.6	107	70	130			
Fluoride	334	mg/L	10	111	70	130			
Sulfate	12100	mg/L	10	101	70	130			
Lab ID: **B17081923-021ADUP**	Sample Duplicate				Run: IC METROHM 1_170830A				08/31/17 06:40
Bromide	ND	mg/L	5.0					30	
Chloride	50.6	mg/L	2.5				2.2	30	
Fluoride	ND	mg/L	10					30	
Sulfate	9140	mg/L	10				0.4	30	
Lab ID: **B17081923-031AMS**	Sample Matrix Spike				Run: IC METROHM 1_170830A				08/31/17 10:53
Bromide	31.6	mg/L	0.51	105	70	130			
Chloride	146	mg/L	1.0	108	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**E300.0**									Batch: 113147
Lab ID:	**B17081923-031AMS**	Sample Matrix Spike				Run: IC METROHM 1_170830A				08/31/17 10:53
Fluoride		32.2	mg/L	1.0	107	70	130			
Sulfate		353	mg/L	1.0	105	70	130			
Lab ID:	**B17081923-031ADUP**	Sample Duplicate				Run: IC METROHM 1_170830A				08/31/17 11:13
Bromide		ND	mg/L	0.50					30	
Chloride		41.3	mg/L	1.0				8.4	30	
Fluoride		ND	mg/L	1.0					30	
Sulfate		51.3	mg/L	1.0				30	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0									Batch: 113195
Lab ID: LCS-113195	Laboratory Control Sample				Run: IC METROHM 1_170901A				09/01/17 12:49
Bromide	ND	mg/L	2.5		70	130			
Chloride	270	mg/L	1.2	112	70	130			
Fluoride	0.950	mg/L	5.0	102	70	130			
Sulfate	1970	mg/L	5.0	99	70	130			
Lab ID: B17081923-041AMS	Sample Matrix Spike				Run: IC METROHM 1_170901A				09/01/17 14:46
Bromide	31.4	mg/L	0.51	105	70	130			
Chloride	122	mg/L	1.0	106	70	130			
Fluoride	33.4	mg/L	1.0	111	70	130			
Sulfate	393	mg/L	1.0	104	70	130			
Lab ID: B17081923-041ADUP	Sample Duplicate				Run: IC METROHM 1_170901A				09/01/17 15:44
Bromide	ND	mg/L	0.50					30	
Chloride	15.8	mg/L	1.0				0.1	30	
Fluoride	0.970	mg/L	1.0					30	
Sulfate	80.2	mg/L	1.0				1.5	30	
Lab ID: B17081923-051AMS	Sample Matrix Spike				Run: IC METROHM 1_170901A				09/01/17 19:19
Bromide	156	mg/L	2.6	104	70	130			
Chloride	550	mg/L	1.3	105	70	130			
Fluoride	159	mg/L	5.1	106	70	130			
Sulfate	4650	mg/L	5.1	86	70	130			
Lab ID: B17081923-051ADUP	Sample Duplicate				Run: IC METROHM 1_170901A				09/01/17 20:18
Bromide	ND	mg/L	2.5					30	
Chloride	25.8	mg/L	1.2				4.2	30	
Fluoride	ND	mg/L	5.0					30	
Sulfate	3470	mg/L	5.0				3.1	30	
Lab ID: B17081923-061AMS	Sample Matrix Spike				Run: IC METROHM 1_170901A				09/01/17 23:52
Bromide	156	mg/L	2.6	104	70	130			
Chloride	534	mg/L	1.3	104	70	130			
Fluoride	180	mg/L	5.1	120	70	130			
Sulfate	3490	mg/L	5.1	100	70	130			
Lab ID: B17081923-061ADUP	Sample Duplicate				Run: IC METROHM 1_170901A				09/02/17 00:51
Bromide	ND	mg/L	2.5					30	
Chloride	11.0	mg/L	1.2				16	30	
Fluoride	ND	mg/L	5.0					30	
Sulfate	1970	mg/L	5.0				0.9	30	
Lab ID: B17081923-071AMS	Sample Matrix Spike				Run: IC METROHM 1_170901A				09/02/17 04:25
Bromide	157	mg/L	2.6	105	70	130			
Chloride	574	mg/L	1.3	106	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**E300.0**									Batch: 113195
Lab ID:	**B17081923-071AMS**	Sample Matrix Spike				Run: IC METROHM 1_170901A				09/02/17 04:25
Fluoride		158	mg/L	5.1	106	70	130			
Sulfate		5270	mg/L	5.1	83	70	130			E
Lab ID:	**B17081923-071ADUP**	Sample Duplicate				Run: IC METROHM 1_170901A				09/02/17 05:23
Bromide		ND	mg/L	2.5					30	
Chloride		42.6	mg/L	1.2				5.7	30	
Fluoride		ND	mg/L	5.0					30	
Sulfate		3950	mg/L	5.0				1.8	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

E - Estimated value. Result exceeds the instrument upper quantitation limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B								Batch: 113147	
Lab ID: LCS-113147	Laboratory Control Sample				Run: ICP204-B_170830A			08/30/17 13:03	
Calcium, sat. paste	14.6	meq/L	0.050	91	70	130			
Magnesium, sat. paste	8.54	meq/L	0.082	117	70	130			
Potassium, sat. paste	2.26	meq/L	0.026	94	70	130			
Sodium, sat. paste	29.4	meq/L	0.043	101	70	130			
Lab ID: B17081923-001A DUP	Sample Duplicate				Run: ICP204-B_170830A			08/30/17 13:38	
Calcium, sat. paste	28.8	meq/L	0.050				0.5	30	
Magnesium, sat. paste	32.2	meq/L	0.082				0.4	30	
Potassium, sat. paste	0.760	meq/L	0.026				1.0	30	
Sodium, sat. paste	8.74	meq/L	0.043				0.5	30	
Lab ID: B17081923-002AMS2	Sample Matrix Spike				Run: ICP204-B_170830A			08/30/17 13:46	
Calcium, sat. paste	13.7	meq/L	0.050	98	75	125			
Magnesium, sat. paste	15.3	meq/L	0.082	101	75	125			
Potassium, sat. paste	3.06	meq/L	0.026	101	75	125			
Sodium, sat. paste	6.17	meq/L	0.043	102	75	125			
Lab ID: B17081923-011A DUP	Sample Duplicate				Run: ICP204-B_170830A			08/30/17 14:33	
Calcium, sat. paste	8.29	meq/L	0.050				3.5	30	
Magnesium, sat. paste	2.32	meq/L	0.082				4.9	30	
Potassium, sat. paste	0.610	meq/L	0.026				0.3	30	
Sodium, sat. paste	0.252	meq/L	0.043				15	30	
Lab ID: B17081923-012AMS2	Sample Matrix Spike				Run: ICP204-B_170830A			08/30/17 14:41	
Calcium, sat. paste	4.99	meq/L	0.050	97	75	125			
Magnesium, sat. paste	5.41	meq/L	0.082	102	75	125			
Potassium, sat. paste	1.56	meq/L	0.026	101	75	125			
Sodium, sat. paste	2.38	meq/L	0.043	104	75	125			
Lab ID: B17081923-021A DUP	Sample Duplicate				Run: ICP204-B_170830A			08/30/17 15:28	
Calcium, sat. paste	22.2	meq/L	0.070				1.5	30	
Magnesium, sat. paste	122	meq/L	0.082				1.7	30	
Potassium, sat. paste	1.94	meq/L	0.026				3.5	30	
Sodium, sat. paste	46.0	meq/L	0.043				3.1	30	
Lab ID: B17081923-022AMS2	Sample Matrix Spike				Run: ICP204-B_170830A			08/30/17 15:36	
Calcium, sat. paste	25.2	meq/L	0.050	96	75	125			
Magnesium, sat. paste	43.6	meq/L	0.082	99	75	125			
Potassium, sat. paste	6.96	meq/L	0.026	99	75	125			
Sodium, sat. paste	21.7	meq/L	0.043	100	75	125			
Lab ID: B17081923-032AMS2	Sample Matrix Spike				Run: ICP204-B_170830A			08/30/17 16:59	
Calcium, sat. paste	47.7	meq/L	0.072	100	75	125			
Magnesium, sat. paste	153	meq/L	0.082	101	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 113147
Lab ID: B17081923-032AMS2	Sample Matrix Spike				Run: ICP204-B_170830A				08/30/17 16:59
Potassium, sat. paste	15.9	meq/L	0.026	101	75	125			
Sodium, sat. paste	70.0	meq/L	0.043	101	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/06/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 113147
Lab ID: B17081923-031A DUP	Sample Duplicate				Run: ICP204-B_170831A				08/31/17 13:12
Calcium, sat. paste	5.51	meq/L	0.050				0.8	30	
Magnesium, sat. paste	3.56	meq/L	0.082				3.8	30	
Potassium, sat. paste	1.57	meq/L	0.026				3.6	30	
Sodium, sat. paste	0.197	meq/L	0.043				7.9	30	
Method: SW6010B									Batch: 113195
Lab ID: LCS-113195	Laboratory Control Sample				Run: ICP204-B_170831A				08/31/17 13:20
Calcium, sat. paste	14.5	meq/L	0.050	91	70	130			
Magnesium, sat. paste	8.57	meq/L	0.082	117	70	130			
Potassium, sat. paste	2.37	meq/L	0.026	99	70	130			
Sodium, sat. paste	29.9	meq/L	0.043	103	70	130			
Lab ID: B17081923-041A DUP	Sample Duplicate				Run: ICP204-B_170831A				08/31/17 13:51
Calcium, sat. paste	6.96	meq/L	0.050				6.5	30	
Magnesium, sat. paste	7.37	meq/L	0.082				6.9	30	
Potassium, sat. paste	0.801	meq/L	0.026				4.8	30	
Sodium, sat. paste	0.276	meq/L	0.043				4.8	30	
Lab ID: B17081923-042AMS2	Sample Matrix Spike				Run: ICP204-B_170831A				08/31/17 13:59
Calcium, sat. paste	47.5	meq/L	0.072	99	75	125			
Magnesium, sat. paste	181	meq/L	0.082	105	75	125			
Potassium, sat. paste	15.4	meq/L	0.026	103	75	125			
Sodium, sat. paste	68.4	meq/L	0.043	105	75	125			
Lab ID: B17081923-051A DUP	Sample Duplicate				Run: ICP204-B_170831A				08/31/17 14:46
Calcium, sat. paste	23.6	meq/L	0.050				3.3	30	
Magnesium, sat. paste	34.8	meq/L	0.082				3.6	30	
Potassium, sat. paste	1.71	meq/L	0.026				4.0	30	
Sodium, sat. paste	11.2	meq/L	0.043				4.0	30	
Lab ID: B17081923-052AMS2	Sample Matrix Spike				Run: ICP204-B_170831A				08/31/17 14:54
Calcium, sat. paste	32.3	meq/L	0.050	94	75	125			
Magnesium, sat. paste	46.2	meq/L	0.082	98	75	125			
Potassium, sat. paste	8.12	meq/L	0.026	100	75	125			
Sodium, sat. paste	18.7	meq/L	0.043	101	75	125			
Lab ID: B17081923-061A DUP	Sample Duplicate				Run: ICP204-B_170831A				08/31/17 15:41
Calcium, sat. paste	29.8	meq/L	0.050				2.9	30	
Magnesium, sat. paste	10.2	meq/L	0.082				1.2	30	
Potassium, sat. paste	0.746	meq/L	0.026				1.6	30	
Sodium, sat. paste	2.88	meq/L	0.043				3.0	30	
Lab ID: B17081923-062AMS2	Sample Matrix Spike				Run: ICP204-B_170831A				08/31/17 15:49
Calcium, sat. paste	38.8	meq/L	0.050	97	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc | **Report Date:** 09/06/17

Project: Talen Job # 12072 Soil Sampling | **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 113195
Lab ID: B17081923-062AMS2	Sample Matrix Spike				Run: ICP204-B_170831A				08/31/17 15:49
Magnesium, sat. paste	50.5	meq/L	0.082	100	75	125			
Potassium, sat. paste	7.35	meq/L	0.026	100	75	125			
Sodium, sat. paste	15.2	meq/L	0.043	101	75	125			
Lab ID: B17081923-071A DUP	Sample Duplicate				Run: ICP204-B_170831A				08/31/17 17:04
Calcium, sat. paste	24.5	meq/L	0.050				1.1	30	
Magnesium, sat. paste	44.6	meq/L	0.082				2.0	30	
Potassium, sat. paste	0.963	meq/L	0.026				0.5	30	
Sodium, sat. paste	18.1	meq/L	0.043				1.9	30	
Lab ID: B17081923-072AMS2	Sample Matrix Spike				Run: ICP204-B_170831A				08/31/17 17:20
Calcium, sat. paste	36.9	meq/L	0.050	94	75	125			
Magnesium, sat. paste	57.6	meq/L	0.082	93	75	125			
Potassium, sat. paste	7.09	meq/L	0.026	98	75	125			
Sodium, sat. paste	26.6	meq/L	0.043	96	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Revised Date: 12/06/17
Client: Hydrometrics Inc **Report Date:** 10/18/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Analytical Run: ICP203-B_171103A
Lab ID: QCS	3	Initial Calibration Verification Standard								11/03/17 12:48
Barium		0.782	mg/L	0.10	98	90	110			
Cobalt		0.771	mg/L	0.021	96	90	110			
Manganese		4.01	mg/L	0.010	100	90	110			
Lab ID: ICSA	3	Interference Check Sample A								11/03/17 12:52
Barium		-0.000320	mg/L	0.10						
Cobalt		-0.00361	mg/L	0.021						
Manganese		-0.0255	mg/L	0.010						
Lab ID: ICSAB	3	Interference Check Sample AB								11/03/17 12:56
Barium		0.461	mg/L	0.10	92	80	120			
Cobalt		0.432	mg/L	0.021	86	80	120			
Manganese		0.434	mg/L	0.010	87	80	120			
Method: SW6010B										Batch: 115421
Lab ID: MB-115421	3	Method Blank				Run: ICP203-B_171103A				11/03/17 17:29
Barium		0.001	mg/L	0.001						
Cobalt		ND	mg/L	0.005						
Manganese		0.003	mg/L	0.001						
Lab ID: LCS-115421	3	Laboratory Control Sample				Run: ICP203-B_171103A				11/03/17 17:32
Barium		5.26	mg/L	0.050	96	80	120			
Cobalt		0.470	mg/L	0.0051	94	80	120			
Manganese		2.36	mg/L	0.0010	94	80	120			
Lab ID: LCSD-115421	3	Laboratory Control Sample Duplicate				Run: ICP203-B_171103A				11/03/17 17:36
Barium		5.16	mg/L	0.050	94	80	120	1.8	20	
Cobalt		0.469	mg/L	0.0051	94	80	120	0.1	20	
Manganese		2.35	mg/L	0.0010	94	80	120	0.4	20	
Lab ID: B17081923-005BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 17:43
Barium		5.15	mg/L	0.050	92	75	125			
Cobalt		0.460	mg/L	0.0051	92	75	125			
Manganese		2.35	mg/L	0.0010	92	75	125			
Lab ID: B17081923-006BDIL	3	Serial Dilution				Run: ICP203-B_171103A				11/03/17 17:57
Barium		0.0680	mg/L	0.050				5.6	10	
Cobalt		ND	mg/L	0.026					10	
Manganese		0.0970	mg/L	0.0052				7.7	10	
Lab ID: B17081923-006BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:00
Barium		5.17	mg/L	0.050	93	75	125			
Cobalt		0.463	mg/L	0.0051	93	75	125			
Manganese		2.40	mg/L	0.0010	92	75	125			
Lab ID: B17081923-007BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:07
Barium		5.18	mg/L	0.050	94	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling

Revised Date: 12/06/17
Report Date: 10/18/17
Work Order: B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 115421
Lab ID: B17081923-007BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:07
Cobalt		0.465	mg/L	0.0051	93	75	125			
Manganese		2.36	mg/L	0.0010	93	75	125			
Lab ID: B17081923-008BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:15
Barium		5.11	mg/L	0.050	92	75	125			
Cobalt		0.461	mg/L	0.0051	92	75	125			
Manganese		2.34	mg/L	0.0010	93	75	125			
Lab ID: B17081923-009BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:22
Barium		4.90	mg/L	0.050	89	75	125			
Cobalt		0.431	mg/L	0.0051	86	75	125			
Manganese		2.16	mg/L	0.0010	86	75	125			
Lab ID: B17081923-010BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:29
Barium		5.05	mg/L	0.050	91	75	125			
Cobalt		0.455	mg/L	0.0051	91	75	125			
Manganese		2.27	mg/L	0.0010	91	75	125			
Lab ID: B17081923-022BMS3	3	Sample Matrix Spike				Run: ICP203-B_171103A				11/03/17 18:43
Barium		4.99	mg/L	0.050	91	75	125			
Cobalt		0.458	mg/L	0.0051	92	75	125			
Manganese		2.27	mg/L	0.0010	91	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Analytical Run: ICP203-B_170824A
Lab ID: QCS	12	Initial Calibration Verification Standard								08/24/17 15:08
Antimony		0.809	mg/L	0.021	101	90	110			
Arsenic		0.783	mg/L	0.10	98	90	110			
Barium		0.801	mg/L	0.10	100	90	110			
Beryllium		0.404	mg/L	0.010	101	90	110			
Boron		0.774	mg/L	0.10	97	90	110			
Cadmium		0.384	mg/L	0.010	96	90	110			
Chromium		0.784	mg/L	0.050	98	90	110			
Cobalt		0.770	mg/L	0.021	96	90	110			
Lead		0.778	mg/L	0.050	97	90	110			
Lithium		0.808	mg/L	0.10	101	90	110			
Manganese		3.92	mg/L	0.010	98	90	110			
Molybdenum		0.788	mg/L	0.10	98	90	110			
Lab ID: ICSA	12	Interference Check Sample A								08/24/17 15:11
Antimony		0.00512	mg/L	0.021						
Arsenic		-0.000210	mg/L	0.10						
Barium		-0.000200	mg/L	0.10						
Beryllium		-0.0000200	mg/L	0.010						
Boron		0.0184	mg/L	0.10						
Cadmium		-0.00602	mg/L	0.010						
Chromium		-0.00232	mg/L	0.050						
Cobalt		-0.00551	mg/L	0.021						
Lead		0.0230	mg/L	0.050						
Lithium		-0.0143	mg/L	0.10						
Manganese		-0.00436	mg/L	0.010						
Molybdenum		0.000120	mg/L	0.10						
Lab ID: ICSAB	12	Interference Check Sample AB								08/24/17 15:15
Antimony		0.996	mg/L	0.021	100	80	120			
Arsenic		0.945	mg/L	0.10	94	80	120			
Barium		0.471	mg/L	0.10	94	80	120			
Beryllium		0.463	mg/L	0.010	93	80	120			
Boron		0.966	mg/L	0.10	97	80	120			
Cadmium		0.852	mg/L	0.010	85	80	120			
Chromium		0.447	mg/L	0.050	89	80	120			
Cobalt		0.430	mg/L	0.021	86	80	120			
Lead		0.910	mg/L	0.050	91	80	120			
Lithium		0.985	mg/L	0.10	98	80	120			
Manganese		0.438	mg/L	0.010	88	80	120			
Molybdenum		0.910	mg/L	0.10	91	80	120			
Method: SW6010B										Batch: 112894
Lab ID: MB-112894	12	Method Blank				Run: ICP203-B_170824A				08/25/17 03:38
Antimony		ND	mg/kg	1						
Arsenic		ND	mg/kg	1.0						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112894
Lab ID: MB-112894	12	Method Blank				Run: ICP203-B_170824A				08/25/17 03:38
Barium		0.05	mg/kg	0.04						
Beryllium		ND	mg/kg	0.009						
Boron		ND	mg/kg	0.8						
Cadmium		ND	mg/kg	0.07						
Chromium		ND	mg/kg	0.3						
Cobalt		ND	mg/kg	0.3						
Lead		ND	mg/kg	1						
Lithium		ND	mg/kg	0.3						
Manganese		0.2	mg/kg	0.06						
Molybdenum		ND	mg/kg	0.2						
Lab ID: SRM3-112894	12	Standard Reference Material				Run: ICP203-B_170824A				08/25/17 03:42
Antimony		80.8	mg/kg	20	34	0	93			
Arsenic		170	mg/kg	20	87	71	105			
Barium		204	mg/kg	1.0	109	78	113			
Beryllium		83.1	mg/kg	1.0	99	76	108			
Boron		106	mg/kg	1.0	82	59	106			
Cadmium		90.5	mg/kg	1.0	91	73.2	105			
Chromium		107	mg/kg	4.0	91	73	109			
Cobalt		104	mg/kg	3.0	96	74	106			
Lead		100	mg/kg	20	95	74	109			
Lithium		89.4	mg/kg	1.0	89	80	120			
Manganese		415	mg/kg	1.0	96	81	117			
Molybdenum		114	mg/kg	4.0	90	66	104			
Lab ID: B17081923-020ADIL	12	Serial Dilution				Run: ICP203-B_170824A				08/25/17 05:17
Antimony		ND	mg/kg	95					10	
Arsenic		9.78	mg/kg	95					10	N
Barium		153	mg/kg	1.4				4.8	10	
Beryllium		0.752	mg/kg	1.0					10	
Boron		10.9	mg/kg	3.8					10	N
Cadmium		ND	mg/kg	2.4					10	
Chromium		16.7	mg/kg	19					10	
Cobalt		7.30	mg/kg	14					10	N
Lead		15.9	mg/kg	95					10	N
Lithium		9.97	mg/kg	1.3					10	N
Manganese		536	mg/kg	2.4				9.0	10	
Molybdenum		1.34	mg/kg	19					10	N
Lab ID: B17081923-020APDS	12	Post Digestion/Distillation Spike				Run: ICP203-B_170824A				08/25/17 05:21
Antimony		48.5	mg/kg	20	99	75	125			
Arsenic		52.0	mg/kg	20	95	75	125			
Barium		190	mg/kg	1.0	89	75	125			
Beryllium		22.8	mg/kg	1.0	90	75	125			
Boron		54.7	mg/kg	1.0	99	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112894
Lab ID: B17081923-020APDS	12	Post Digestion/Distillation Spike				Run: ICP203-B_170824A				08/25/17 05:21
Cadmium		20.1	mg/kg	1.0	82	75	125			
Chromium		56.7	mg/kg	3.9	83	75	125			
Cobalt		47.5	mg/kg	2.9	88	75	125			
Lead		52.5	mg/kg	20	92	75	125			
Lithium		57.1	mg/kg	1.0	94	75	125			
Manganese		702	mg/kg	1.0	87	75	125			
Molybdenum		44.9	mg/kg	3.9	90	75	125			
Lab ID: B17081923-020AMS3	12	Sample Matrix Spike				Run: ICP203-B_170824A				08/25/17 05:25
Antimony		19.8	mg/kg	20	40	75	125			S
Arsenic		54.1	mg/kg	20	98	75	125			
Barium		198	mg/kg	1.0	105	75	125			
Beryllium		24.4	mg/kg	1.0	95	75	125			
Boron		60.0	mg/kg	1.0	108	75	125			
Cadmium		21.2	mg/kg	1.0	85	75	125			
Chromium		65.1	mg/kg	4.0	99	75	125			
Cobalt		50.1	mg/kg	3.0	92	75	125			
Lead		55.8	mg/kg	20	97	75	125			
Lithium		62.1	mg/kg	1.0	103	75	125			
Manganese		669	mg/kg	1.0	72	75	125			S
Molybdenum		44.2	mg/kg	4.0	87	75	125			
Lab ID: B17081923-020AMSD	12	Sample Matrix Spike Duplicate				Run: ICP203-B_170824A				08/25/17 05:29
Antimony		19.7	mg/kg	20	40	75	125		20	S
Arsenic		53.6	mg/kg	20	97	75	125	1.0	20	
Barium		195	mg/kg	1.0	99	75	125	1.5	20	
Beryllium		23.7	mg/kg	1.0	92	75	125	2.8	20	
Boron		58.1	mg/kg	1.0	104	75	125	3.2	20	
Cadmium		20.8	mg/kg	1.0	84	75	125	1.7	20	
Chromium		63.1	mg/kg	4.0	95	75	125	3.1	20	
Cobalt		49.0	mg/kg	3.0	90	75	125	2.1	20	
Lead		53.1	mg/kg	20	92	75	125	4.8	20	
Lithium		60.1	mg/kg	1.0	99	75	125	3.1	20	
Manganese		641	mg/kg	1.0	61	75	125	4.3	20	S
Molybdenum		43.7	mg/kg	4.0	86	75	125	1.2	20	
Method: SW6010B										Batch: 112895
Lab ID: MB-112895	11	Method Blank				Run: ICP203-B_170824A				08/25/17 05:32
Arsenic		ND	mg/kg	1.0						
Barium		0.05	mg/kg	0.04						
Beryllium		ND	mg/kg	0.009						
Boron		ND	mg/kg	0.8						
Cadmium		ND	mg/kg	0.07						
Chromium		ND	mg/kg	0.3						
Cobalt		ND	mg/kg	0.3						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **SW6010B**										Batch: 112895
Lab ID: **MB-112895**	11	Method Blank				Run: ICP203-B_170824A				08/25/17 05:32
Lead		ND	mg/kg	1						
Lithium		ND	mg/kg	0.3						
Manganese		0.2	mg/kg	0.06						
Molybdenum		ND	mg/kg	0.2						
Lab ID: **SRM3-112895**	11	Standard Reference Material				Run: ICP203-B_170824A				08/25/17 05:36
Arsenic		168	mg/kg	20	86	71	105			
Barium		176	mg/kg	1.0	94	78	113			
Beryllium		82.6	mg/kg	1.0	99	76	108			
Boron		107	mg/kg	1.0	83	59	106			
Cadmium		90.1	mg/kg	1.0	91	73.2	105			
Chromium		107	mg/kg	3.9	91	73	109			
Cobalt		104	mg/kg	2.9	96	74	106			
Lead		99.5	mg/kg	20	95	74	109			
Lithium		89.4	mg/kg	1.0	89	80	120			
Manganese		417	mg/kg	1.0	96	81	117			
Molybdenum		117	mg/kg	3.9	92	66	104			
Lab ID: **B17081923-040ADIL**	11	Serial Dilution				Run: ICP203-B_170824A				08/25/17 07:41
Arsenic		5.73	mg/kg	97					10	N
Barium		116	mg/kg	1.5				3.9	10	
Beryllium		0.595	mg/kg	1.0					10	
Boron		16.2	mg/kg	3.8					10	N
Cadmium		ND	mg/kg	2.4					10	
Chromium		15.6	mg/kg	19					10	
Cobalt		6.58	mg/kg	15					10	N
Lead		ND	mg/kg	97					10	
Lithium		11.0	mg/kg	1.3					10	N
Manganese		294	mg/kg	2.4				7.9	10	
Molybdenum		ND	mg/kg	19					10	
Lab ID: **B17081923-040APDS**	11	Post Digestion/Distillation Spike				Run: ICP203-B_170824A				08/25/17 07:44
Arsenic		48.9	mg/kg	20	90	75	125			
Barium		155	mg/kg	1.0	86	75	125			
Beryllium		22.4	mg/kg	1.0	88	75	125			
Boron		59.9	mg/kg	1.0	100	75	125			
Cadmium		20.0	mg/kg	1.0	80	75	125			
Chromium		56.5	mg/kg	4.0	84	75	125			
Cobalt		46.4	mg/kg	3.0	85	75	125			
Lead		50.7	mg/kg	20	89	75	125			
Lithium		58.8	mg/kg	1.0	94	75	125			
Manganese		479	mg/kg	1.0	83	75	125			
Molybdenum		43.8	mg/kg	4.0	87	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112895
Lab ID: B17081923-040AMS3	11	Sample Matrix Spike				Run: ICP203-B_170824A				08/25/17 07:48
Arsenic		50.4	mg/kg	20	94	75	125			
Barium		155	mg/kg	1.0	87	75	125			
Beryllium		22.8	mg/kg	1.0	90	75	125			
Boron		64.3	mg/kg	1.0	110	75	125			
Cadmium		20.3	mg/kg	1.0	82	75	125			
Chromium		61.8	mg/kg	4.0	95	75	125			
Cobalt		47.3	mg/kg	3.0	88	75	125			
Lead		52.6	mg/kg	20	93	75	125			
Lithium		61.2	mg/kg	1.0	99	75	125			
Manganese		538	mg/kg	1.0	108	75	125			
Molybdenum		41.9	mg/kg	4.0	84	75	125			
Lab ID: B17081923-040AMSD	11	Sample Matrix Spike Duplicate				Run: ICP203-B_170824A				08/25/17 07:52
Arsenic		51.3	mg/kg	20	95	75	125	1.8	20	
Barium		161	mg/kg	1.0	98	75	125	3.6	20	
Beryllium		23.2	mg/kg	1.0	91	75	125	1.8	20	
Boron		63.6	mg/kg	1.0	108	75	125	1.1	20	
Cadmium		20.4	mg/kg	1.0	82	75	125	0.4	20	
Chromium		62.0	mg/kg	4.0	95	75	125	0.3	20	
Cobalt		47.3	mg/kg	3.0	88	75	125	0.1	20	
Lead		53.0	mg/kg	20	94	75	125	0.8	20	
Lithium		62.6	mg/kg	1.0	102	75	125	2.1	20	
Manganese		515	mg/kg	1.0	98	75	125	4.4	20	
Molybdenum		42.3	mg/kg	4.0	85	75	125	0.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Analytical Run: ICP203-B_170825A
Lab ID: QCS	11	Initial Calibration Verification Standard								08/25/17 12:10
Arsenic		0.786	mg/L	0.10	98	90	110			
Barium		0.765	mg/L	0.10	96	90	110			
Beryllium		0.404	mg/L	0.010	101	90	110			
Boron		0.770	mg/L	0.10	96	90	110			
Cadmium		0.390	mg/L	0.010	97	90	110			
Chromium		0.765	mg/L	0.050	96	90	110			
Cobalt		0.779	mg/L	0.021	97	90	110			
Lead		0.752	mg/L	0.050	94	90	110			
Lithium		0.792	mg/L	0.10	99	90	110			
Manganese		3.92	mg/L	0.010	98	90	110			
Molybdenum		0.797	mg/L	0.10	100	90	110			
Lab ID: ICSA	11	Interference Check Sample A								08/25/17 12:13
Arsenic		0.00114	mg/L	0.10						
Barium		-0.000360	mg/L	0.10						
Beryllium		0.000100	mg/L	0.010						
Boron		-0.0800	mg/L	0.10						
Cadmium		-0.00448	mg/L	0.010						
Chromium		-0.0570	mg/L	0.050						
Cobalt		-0.00617	mg/L	0.021						
Lead		0.0278	mg/L	0.050						
Lithium		0.0114	mg/L	0.10						
Manganese		-0.0307	mg/L	0.010						
Molybdenum		0.00322	mg/L	0.10						
Lab ID: ICSAB	11	Interference Check Sample AB								08/25/17 12:17
Arsenic		0.974	mg/L	0.10	97	80	120			
Barium		0.458	mg/L	0.10	92	80	120			
Beryllium		0.471	mg/L	0.010	94	80	120			
Boron		0.920	mg/L	0.10	92	80	120			
Cadmium		0.869	mg/L	0.010	87	80	120			
Chromium		0.464	mg/L	0.050	93	80	120			
Cobalt		0.439	mg/L	0.021	88	80	120			
Lead		0.914	mg/L	0.050	91	80	120			
Lithium		0.999	mg/L	0.10	100	80	120			
Manganese		0.421	mg/L	0.010	84	80	120			
Molybdenum		0.924	mg/L	0.10	92	80	120			
Method: SW6010B										Batch: 112940
Lab ID: MB-112940	10	Method Blank				Run: ICP203-B_170825A				08/25/17 14:24
Arsenic		ND	mg/kg	1.0						
Barium		ND	mg/kg	0.04						
Beryllium		ND	mg/kg	0.009						
Cadmium		ND	mg/kg	0.07						
Chromium		ND	mg/kg	0.3						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112940
Lab ID: MB-112940	10	Method Blank				Run: ICP203-B_170825A				08/25/17 14:24
Cobalt		ND	mg/kg	0.3						
Lead		ND	mg/kg	1						
Lithium		ND	mg/kg	0.3						
Manganese		0.1	mg/kg	0.06						
Molybdenum		ND	mg/kg	0.2						
Lab ID: SRM3-112940	10	Standard Reference Material				Run: ICP203-B_170825A				08/25/17 14:28
Arsenic		177	mg/kg	20	90	71	105			
Barium		172	mg/kg	1.0	92	78	113			
Beryllium		82.9	mg/kg	1.0	99	76	108			
Cadmium		92.3	mg/kg	1.0	93	73.2	105			
Chromium		108	mg/kg	4.0	92	73	109			
Cobalt		108	mg/kg	3.0	100	74	106			
Lead		103	mg/kg	20	98	74	109			
Lithium		94.1	mg/kg	1.0	94	80	120			
Manganese		417	mg/kg	1.0	96	81	117			
Molybdenum		119	mg/kg	4.0	94	66	104			
Lab ID: B17081923-060ADIL	10	Serial Dilution				Run: ICP203-B_170825A				08/25/17 16:23
Arsenic		ND	mg/kg	200					10	
Barium		201	mg/kg	3.0				6.2	10	
Beryllium		0.814	mg/kg	2.0					10	N
Cadmium		ND	mg/kg	5.0					10	
Chromium		19.5	mg/kg	40					10	N
Cobalt		8.04	mg/kg	30					10	N
Lead		ND	mg/kg	200					10	
Lithium		11.7	mg/kg	2.8					10	N
Manganese		506	mg/kg	5.0				8.3	10	
Molybdenum		ND	mg/kg	40					10	
Lab ID: B17081923-060APDS	10	Post Digestion/Distillation Spike				Run: ICP203-B_170825A				08/25/17 16:26
Arsenic		99.4	mg/kg	41	92	75	125			
Barium		283	mg/kg	1.0	93	75	125			
Beryllium		47.7	mg/kg	1.0	92	75	125			
Cadmium		44.3	mg/kg	1.0	87	75	125			
Chromium		113	mg/kg	8.2	93	75	125			
Cobalt		97.1	mg/kg	6.1	89	75	125			
Lead		105	mg/kg	41	89	75	125			
Lithium		113	mg/kg	1.0	97	75	125			
Manganese		919	mg/kg	1.0	89	75	125			
Molybdenum		94.7	mg/kg	8.2	92	75	125			
Lab ID: B17081923-060AMS3	10	Sample Matrix Spike				Run: ICP203-B_170825A				08/25/17 16:30
Arsenic		55.3	mg/kg	40	100	75	125			
Barium		250	mg/kg	1.0	124	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112940
Lab ID: B17081923-060AMS3	10	Sample Matrix Spike				Run: ICP203-B_170825A				08/25/17 16:30
Beryllium		25.2	mg/kg	1.0	99	75	125			
Cadmium		22.7	mg/kg	1.0	92	75	125			
Chromium		71.8	mg/kg	7.9	109	75	125			
Cobalt		53.3	mg/kg	5.9	94	75	125			
Lead		60.9	mg/kg	40	96	75	125			
Lithium		65.8	mg/kg	1.0	106	75	125			
Manganese		706	mg/kg	1.0	97	75	125			
Molybdenum		46.3	mg/kg	7.9	92	75	125			
Lab ID: B17081923-060AMSD	10	Sample Matrix Spike Duplicate				Run: ICP203-B_170825A				08/25/17 16:33
Arsenic		53.8	mg/kg	40	97	75	125	2.8	20	
Barium		241	mg/kg	1.0	106	75	125	3.7	20	
Beryllium		24.6	mg/kg	1.0	96	75	125	2.6	20	
Cadmium		22.2	mg/kg	1.0	89	75	125	2.3	20	
Chromium		70.2	mg/kg	7.9	106	75	125	2.3	20	
Cobalt		52.3	mg/kg	6.0	92	75	125	1.8	20	
Lead		57.6	mg/kg	40	89	75	125	5.7	20	
Lithium		64.5	mg/kg	1.0	103	75	125	2.1	20	
Manganese		663	mg/kg	1.0	79	75	125	6.4	20	
Molybdenum		45.5	mg/kg	7.9	90	75	125	1.8	20	
Method: SW6010B										Batch: 112941
Lab ID: MB-112941	10	Method Blank				Run: ICP203-B_170825A				08/25/17 12:53
Arsenic		ND	mg/kg	1.0						
Barium		ND	mg/kg	0.04						
Beryllium		ND	mg/kg	0.009						
Boron		ND	mg/kg	0.8						
Cadmium		ND	mg/kg	0.07						
Chromium		ND	mg/kg	0.3						
Cobalt		ND	mg/kg	0.3						
Lead		ND	mg/kg	1						
Lithium		ND	mg/kg	0.3						
Manganese		1	mg/kg	0.06						
Lab ID: SRM3-112941	10	Standard Reference Material				Run: ICP203-B_170825A				08/25/17 12:57
Arsenic		170	mg/kg	20	87	71	105			
Barium		177	mg/kg	1.0	95	78	113			
Beryllium		83.1	mg/kg	1.0	99	76	108			
Boron		107	mg/kg	1.0	83	59	106			
Cadmium		89.9	mg/kg	1.0	91	73.2	105			
Chromium		107	mg/kg	3.9	91	73	109			
Cobalt		105	mg/kg	2.9	97	74	106			
Lead		99.6	mg/kg	20	95	74	109			
Lithium		92.2	mg/kg	1.0	92	80	120			
Manganese		429	mg/kg	1.0	99	81	117			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 112941
Lab ID: SRM3-112941	10	Standard Reference Material				Run: ICP203-B_170825A				08/25/17 12:57
Lab ID: B17081923-072ADIL	10	Serial Dilution				Run: ICP203-B_170825A				08/25/17 14:10
Arsenic		12.5	mg/kg	200					10	N
Barium		136	mg/kg	2.9				4.9	10	
Beryllium		0.756	mg/kg	2.0					10	N
Boron		ND	mg/kg	7.8					10	
Cadmium		ND	mg/kg	4.9					10	
Chromium		15.9	mg/kg	39					10	N
Cobalt		7.50	mg/kg	29					10	N
Lead		19.2	mg/kg	200					10	N
Lithium		13.4	mg/kg	2.7					10	N
Manganese		416	mg/kg	4.9				6.7	10	
Lab ID: B17081923-072APDS	10	Post Digestion/Distillation Spike				Run: ICP203-B_170825A				08/25/17 14:13
Arsenic		101	mg/kg	40	95	75	125			
Barium		217	mg/kg	1.0	87	75	125			
Beryllium		48.0	mg/kg	1.0	94	75	125			
Boron		99.2	mg/kg	1.6	98	75	125			
Cadmium		44.5	mg/kg	1.0	88	75	125			
Chromium		106	mg/kg	8.1	88	75	125			
Cobalt		98.0	mg/kg	6.1	93	75	125			
Lead		102	mg/kg	40	93	75	125			
Lithium		114	mg/kg	1.0	98	75	125			
Manganese		832	mg/kg	1.0	88	75	125			
Lab ID: B17081923-072AMS3	10	Sample Matrix Spike				Run: ICP203-B_170825A				08/25/17 14:17
Arsenic		53.0	mg/kg	39	98	75	125			
Barium		180	mg/kg	1.0	103	75	125			
Beryllium		24.2	mg/kg	1.0	96	75	125			
Boron		49.4	mg/kg	1.6	101	75	125			
Cadmium		21.3	mg/kg	1.0	87	75	125			
Chromium		64.7	mg/kg	7.8	99	75	125			
Cobalt		50.2	mg/kg	5.9	94	75	125			
Lead		56.5	mg/kg	39	97	75	125			
Lithium		64.2	mg/kg	1.0	100	75	125			
Manganese		651	mg/kg	1.0	107	75	125			
Lab ID: B17081923-072AMSD	10	Sample Matrix Spike Duplicate				Run: ICP203-B_170825A				08/25/17 14:20
Arsenic		53.4	mg/kg	39	99	75	125	0.7	20	
Barium		179	mg/kg	1.0	99	75	125	0.8	20	
Beryllium		23.8	mg/kg	1.0	94	75	125	1.5	20	
Boron		51.4	mg/kg	1.6	105	75	125	4.0	20	
Cadmium		21.7	mg/kg	1.0	88	75	125	1.7	20	
Chromium		64.0	mg/kg	7.9	97	75	125	1.2	20	
Cobalt		51.2	mg/kg	5.9	95	75	125	1.8	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 112941	
Lab ID: B17081923-072AMSD	10	Sample Matrix Spike Duplicate				Run: ICP203-B_170825A			08/25/17 14:20	
Lead		56.0	mg/kg	39	96	75	125	0.9	20	
Lithium		64.7	mg/kg	1.0	101	75	125	0.7	20	
Manganese		616	mg/kg	1.0	92	75	125	5.5	20	
Method: SW6010B									Analytical Run: ICP203-B_170829A	
Lab ID: QCS		Initial Calibration Verification Standard							08/29/17 12:06	
Boron		0.761	mg/L	0.10	95	90	110			
Lab ID: ICSA		Interference Check Sample A							08/29/17 12:09	
Boron		-0.0592	mg/L	0.10						
Lab ID: ICSAB		Interference Check Sample AB							08/29/17 12:13	
Boron		0.887	mg/L	0.10	89	80	120			
Method: SW6010B									Batch: 112941	
Lab ID: MB-112941		Method Blank				Run: ICP203-B_170829A			08/30/17 07:09	
Boron		ND	mg/kg	0.8						
Lab ID: SRM3-112941		Standard Reference Material				Run: ICP203-B_170829A			08/30/17 07:13	
Boron		104	mg/kg	1.0	81	59	106			
Lab ID: B17081923-072ADIL		Serial Dilution				Run: ICP203-B_170829A			08/30/17 08:06	
Boron		ND	mg/kg	3.9					10	
Lab ID: B17081923-072APDS		Post Digestion/Distillation Spike				Run: ICP203-B_170829A			08/30/17 08:10	
Boron		54.9	mg/kg	1.0	102	75	125			
Lab ID: B17081923-072AMS3		Sample Matrix Spike				Run: ICP203-B_170829A			08/30/17 08:14	
Boron		54.3	mg/kg	1.0	104	75	125			
Lab ID: B17081923-072AMSD		Sample Matrix Spike Duplicate				Run: ICP203-B_170829A			08/30/17 08:18	
Boron		53.1	mg/kg	1.0	102	75	125	2.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Analytical Run: ICPMS202-B_170825A
Lab ID: QCS	8	Initial Calibration Verification Standard								08/25/17 11:42
Antimony		0.0514	mg/L	0.0010	103	90	110			
Boron		0.0528	mg/L	0.0014	106	90	110			
Chromium		0.0514	mg/L	0.0010	103	90	110			
Cobalt		0.0520	mg/L	0.0010	104	90	110			
Lead		0.0505	mg/L	0.0010	101	90	110			
Molybdenum		0.0487	mg/L	0.0010	97	90	110			
Selenium		0.0524	mg/L	0.0010	105	90	110			
Thallium		0.0503	mg/L	0.0010	101	90	110			
Lab ID: ICSA	8	Interference Check Sample A								08/25/17 12:03
Antimony		0.0000800	mg/L	0.0010						
Boron		-0.00231	mg/L	0.0014						
Chromium		0.00130	mg/L	0.0010						
Cobalt		0.000110	mg/L	0.0010						
Lead		0.000320	mg/L	0.0010						
Molybdenum		0.809	mg/L	0.0010	101	70	130			
Selenium		0.0000700	mg/L	0.0010						
Thallium		0.0000900	mg/L	0.0010						
Lab ID: ICSAB	8	Interference Check Sample AB								08/25/17 12:05
Antimony		0.0000200	mg/L	0.0010						
Boron		-0.00370	mg/L	0.0014						
Chromium		0.0209	mg/L	0.0010	104	70	130			
Cobalt		0.0200	mg/L	0.0010	100	70	130			
Lead		0.000260	mg/L	0.0010						
Molybdenum		0.820	mg/L	0.0010	102	70	130			
Selenium		0.00956	mg/L	0.0010	96	70	130			
Thallium		0.0000100	mg/L	0.0010						
Method: SW6020										Batch: 112894
Lab ID: MB-112894	7	Method Blank				Run: ICPMS202-B_170825A				08/25/17 21:12
Antimony		0.02	mg/kg	0.01						
Chromium		0.2	mg/kg	0.1						
Cobalt		0.01	mg/kg	0.004						
Lead		ND	mg/kg	0.04						
Molybdenum		0.02	mg/kg	0.009						
Selenium		ND	mg/kg	0.04						
Thallium		0.06	mg/kg	0.005						
Lab ID: B17081923-020ADIL	7	Serial Dilution				Run: ICPMS202-B_170825A				08/25/17 22:23
Antimony		ND	mg/kg	1.0					10	
Chromium		19.2	mg/kg	1.4				2.7	10	
Cobalt		8.42	mg/kg	1.0				2.3	10	
Lead		12.0	mg/kg	1.0				1.0	10	
Molybdenum		1.02	mg/kg	1.0					10	N

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **SW6020**										Batch: 112894
Lab ID: **B17081923-020ADIL**	7	Serial Dilution				Run: ICPMS202-B_170825A				08/25/17 22:23
Selenium		0.689	mg/kg	1.0					10	N
Thallium		ND	mg/kg	1.0					10	
Lab ID: **B17081923-020APDS1**	7	Post Digestion/Distillation Spike				Run: ICPMS202-B_170825A				08/25/17 22:26
Antimony		12.1	mg/kg	1.0	98	75	125			
Chromium		31.3	mg/kg	1.0	104	75	125			
Cobalt		20.2	mg/kg	1.0	98	75	125			
Lead		24.5	mg/kg	1.0	102	75	125			
Molybdenum		13.8	mg/kg	1.0	103	75	125			
Selenium		11.4	mg/kg	1.0	89	75	125			
Thallium		10.9	mg/kg	1.0	89	75	125			
Lab ID: **SRM3-112894**	7	Standard Reference Material				Run: ICPMS202-B_170825A				08/25/17 22:28
Antimony		85.1	mg/kg	1.0	35	0	120			
Chromium		118	mg/kg	1.0	101	73	120			
Cobalt		115	mg/kg	1.0	106	74	120			
Lead		106	mg/kg	1.0	101	74	120			
Molybdenum		120	mg/kg	1.0	94	66	120			
Selenium		199	mg/kg	1.0	97	71	120			
Thallium		90.4	mg/kg	1.0	91	71	120			
Lab ID: **B17081923-020AMS3**	7	Sample Matrix Spike				Run: ICPMS202-B_170825A				08/25/17 22:31
Antimony		20.4	mg/kg	1.0	41	75	125			S
Chromium		76.3	mg/kg	1.0	116	75	125			
Cobalt		58.8	mg/kg	1.0	102	75	125			
Lead		64.9	mg/kg	1.0	106	75	125			
Molybdenum		50.3	mg/kg	1.0	99	75	125			
Selenium		47.0	mg/kg	1.0	93	75	125			
Thallium		49.2	mg/kg	1.0	99	75	125			
Lab ID: **B17081923-020AMSD**	7	Sample Matrix Spike Duplicate				Run: ICPMS202-B_170825A				08/25/17 22:33
Antimony		20.7	mg/kg	1.0	41	75	125	1.6	20	S
Chromium		77.0	mg/kg	1.0	117	75	125	0.9	20	
Cobalt		59.2	mg/kg	1.0	102	75	125	0.6	20	
Lead		64.7	mg/kg	1.0	106	75	125	0.4	20	
Molybdenum		50.8	mg/kg	1.0	100	75	125	0.9	20	
Selenium		47.8	mg/kg	1.0	95	75	125	1.6	20	
Thallium		49.2	mg/kg	1.0	99	75	125	0.0	20	
Method: **SW6020**										Batch: 112895
Lab ID: **MB-112895**	5	Method Blank				Run: ICPMS202-B_170825A				08/25/17 22:49
Antimony		ND	mg/kg	0.01						
Chromium		0.3	mg/kg	0.1						
Molybdenum		0.02	mg/kg	0.009						
Selenium		ND	mg/kg	0.04						

Qualifiers:

RL - Analyte reporting limit.

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

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: 112895
Lab ID: MB-112895	5	Method Blank				Run: ICPMS202-B_170825A				08/25/17 22:49
Thallium		0.02	mg/kg	0.005						
Lab ID: B17081923-040ADIL	5	Serial Dilution				Run: ICPMS202-B_170825A				08/26/17 00:00
Antimony		ND	mg/kg	1.0					10	
Chromium		18.1	mg/kg	1.4				1.8	10	
Molybdenum		0.431	mg/kg	1.0					10	N
Selenium		ND	mg/kg	1.0					10	
Thallium		ND	mg/kg	1.0					10	
Lab ID: B17081923-040APDS1	5	Post Digestion/Distillation Spike				Run: ICPMS202-B_170825A				08/26/17 00:03
Antimony		12.1	mg/kg	1.0	97	75	125			
Chromium		30.6	mg/kg	1.0	99	75	125			
Molybdenum		13.2	mg/kg	1.0	101	75	125			
Selenium		11.2	mg/kg	1.0	88	75	125			
Thallium		11.2	mg/kg	1.0	90	75	125			
Lab ID: SRM3-112895	5	Standard Reference Material				Run: ICPMS202-B_170825A				08/26/17 00:05
Antimony		86.8	mg/kg	1.0	36	0	120			
Chromium		120	mg/kg	1.0	103	73	120			
Molybdenum		123	mg/kg	1.0	97	66	120			
Selenium		197	mg/kg	1.0	96	71	120			
Thallium		92.3	mg/kg	1.0	93	71	120			
Lab ID: B17081923-040AMS3	5	Sample Matrix Spike				Run: ICPMS202-B_170825A				08/26/17 00:08
Antimony		20.3	mg/kg	1.0	41	75	125			S
Chromium		74.1	mg/kg	1.0	113	75	125			
Molybdenum		47.9	mg/kg	1.0	95	75	125			
Selenium		45.3	mg/kg	1.0	91	75	125			
Thallium		47.8	mg/kg	1.0	96	75	125			
Lab ID: B17081923-040AMSD	5	Sample Matrix Spike Duplicate				Run: ICPMS202-B_170825A				08/26/17 00:10
Antimony		20.8	mg/kg	1.0	42	75	125	2.6	20	S
Chromium		75.6	mg/kg	1.0	115	75	125	1.9	20	
Molybdenum		50.2	mg/kg	1.0	100	75	125	4.8	20	
Selenium		47.7	mg/kg	1.0	95	75	125	5.1	20	
Thallium		48.5	mg/kg	1.0	98	75	125	1.5	20	
Method: SW6020										Batch: 112940
Lab ID: MB-112940	5	Method Blank				Run: ICPMS202-B_170825A				08/26/17 00:18
Antimony		ND	mg/kg	0.01						
Boron		ND	mg/kg	0.08						
Molybdenum		0.02	mg/kg	0.009						
Selenium		ND	mg/kg	0.04						
Thallium		0.06	mg/kg	0.005						

Qualifiers:

RL - Analyte reporting limit.

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

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: 112940
Lab ID: B17081923-060ADIL	5	Serial Dilution				Run: ICPMS202-B_170825A				08/26/17 01:38
Antimony		ND	mg/kg	1.0					10	
Boron		16.6	mg/kg	1.1				28	10	R
Molybdenum		0.425	mg/kg	1.0					10	N
Selenium		ND	mg/kg	1.0					10	
Thallium		ND	mg/kg	1.0					10	
Lab ID: B17081923-060APDS1	5	Post Digestion/Distillation Spike				Run: ICPMS202-B_170825A				08/26/17 01:40
Antimony		12.3	mg/kg	1.0	97	75	125			
Boron		32.8	mg/kg	1.0	85	75	125			
Molybdenum		13.5	mg/kg	1.0	101	75	125			
Selenium		11.5	mg/kg	1.0	88	75	125			
Thallium		11.3	mg/kg	1.0	89	75	125			
Lab ID: SRM3-112940	5	Standard Reference Material				Run: ICPMS202-B_170825A				08/26/17 01:43
Antimony		93.4	mg/kg	1.0	39	0	120			
Boron		124	mg/kg	1.0	96	59	120			
Molybdenum		129	mg/kg	1.0	101	66	120			
Selenium		208	mg/kg	1.0	101	71	120			
Thallium		96.6	mg/kg	1.0	97	71	120			
Lab ID: B17081923-060AMS3	5	Sample Matrix Spike				Run: ICPMS202-B_170825A				08/26/17 01:46
Antimony		17.9	mg/kg	1.0	36	75	125			S
Boron		73.2	mg/kg	1.0	104	75	125			
Molybdenum		49.6	mg/kg	1.0	99	75	125			
Selenium		46.1	mg/kg	1.0	93	75	125			
Thallium		48.9	mg/kg	1.0	99	75	125			
Lab ID: B17081923-060AMSD	5	Sample Matrix Spike Duplicate				Run: ICPMS202-B_170825A				08/26/17 01:48
Antimony		17.9	mg/kg	1.0	36	75	125	0.1	20	S
Boron		71.6	mg/kg	1.0	100	75	125	2.3	20	
Molybdenum		48.7	mg/kg	1.0	97	75	125	1.9	20	
Selenium		46.0	mg/kg	1.0	92	75	125	0.2	20	
Thallium		47.7	mg/kg	1.0	96	75	125	2.5	20	
Method: SW6020										Batch: 112941
Lab ID: MB-112941	4	Method Blank				Run: ICPMS202-B_170825A				08/26/17 02:49
Antimony		ND	mg/kg	0.01						
Molybdenum		0.1	mg/kg	0.009						
Selenium		ND	mg/kg	0.04						
Thallium		ND	mg/kg	0.005						
Lab ID: B17081923-072ADIL	4	Serial Dilution				Run: ICPMS202-B_170825A				08/26/17 03:33
Antimony		ND	mg/kg	1.0					10	
Molybdenum		0.724	mg/kg	1.0					10	N
Selenium		ND	mg/kg	1.0					10	
Thallium		ND	mg/kg	1.0					10	

Qualifiers:

RL - Analyte reporting limit.

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

S - Spike recovery outside of advisory limits.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 09/07/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: 112941
Lab ID: B17081923-072ADIL	4	Serial Dilution				Run: ICPMS202-B_170825A				08/26/17 03:33
Lab ID: B17081923-072APDS1	4	Post Digestion/Distillation Spike				Run: ICPMS202-B_170825A				08/26/17 03:35
Antimony		12.2	mg/kg	1.0	96	75	125			
Molybdenum		13.4	mg/kg	1.0	101	75	125			
Selenium		10.8	mg/kg	1.0	84	75	125			
Thallium		11.3	mg/kg	1.0	90	75	125			
Lab ID: SRM3-112941	4	Standard Reference Material				Run: ICPMS202-B_170825A				08/26/17 03:38
Antimony		86.6	mg/kg	1.0	36	0	120			
Molybdenum		120	mg/kg	1.0	95	66	120			
Selenium		197	mg/kg	1.0	96	71	120			
Thallium		93.8	mg/kg	1.0	95	71	120			
Lab ID: B17081923-072AMS3	4	Sample Matrix Spike				Run: ICPMS202-B_170825A				08/26/17 03:40
Antimony		21.2	mg/kg	1.0	43	75	125			S
Molybdenum		48.2	mg/kg	1.0	96	75	125			
Selenium		44.9	mg/kg	1.0	91	75	125			
Thallium		48.5	mg/kg	1.0	99	75	125			
Lab ID: B17081923-072AMSD	4	Sample Matrix Spike Duplicate				Run: ICPMS202-B_170825A				08/26/17 03:43
Antimony		21.2	mg/kg	1.0	43	75	125	0.1	20	S
Molybdenum		47.6	mg/kg	1.0	95	75	125	1.3	20	
Selenium		44.2	mg/kg	1.0	89	75	125	1.5	20	
Thallium		47.5	mg/kg	1.0	96	75	125	2.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc **Report Date:** 10/18/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte		Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**SW7471B**						Analytical Run: HGCV202-B_170824A				
Lab ID:	**ICV**		Initial Calibration Verification Standard								08/24/17 09:33
Mercury			0.00207	mg/kg	1.0	104	90	110			
Method:	**SW7471B**										Batch: 112872
Lab ID:	**MB-112872**		Method Blank				Run: HGCV202-B_170824A				08/24/17 09:38
Mercury			ND	mg/kg	0.003						
Lab ID:	**LCS3-112872**		Laboratory Control Sample				Run: HGCV202-B_170824A				08/24/17 09:40
Mercury			0.225	mg/kg	1.0	112	80	120			
Lab ID:	**B17081923-020ADIL**		Serial Dilution				Run: HGCV202-B_170824A				08/24/17 10:20
Mercury			0.0192	mg/kg	1.0					10	
Lab ID:	**B17081923-020AMS3**		Sample Matrix Spike				Run: HGCV202-B_170824A				08/24/17 10:21
Mercury			0.229	mg/kg	1.0	103	80	120			
Lab ID:	**B17081923-020AMSD**		Sample Matrix Spike Duplicate				Run: HGCV202-B_170824A				08/24/17 10:23
Mercury			0.231	mg/kg	1.0	104	80	120		20	
Method:	**SW7471B**										Batch: 112885
Lab ID:	**MB-112885**		Method Blank				Run: HGCV202-B_170824A				08/24/17 11:15
Mercury			ND	mg/kg	0.003						
Lab ID:	**LCS3-112885**		Laboratory Control Sample				Run: HGCV202-B_170824A				08/24/17 11:17
Mercury			0.212	mg/kg	1.0	106	80	120			
Lab ID:	**B17081923-040ADIL**		Serial Dilution				Run: HGCV202-B_170824A				08/24/17 11:57
Mercury			0.0177	mg/kg	1.0					10	
Lab ID:	**B17081923-040AMS3**		Sample Matrix Spike				Run: HGCV202-B_170824A				08/24/17 11:58
Mercury			0.229	mg/kg	1.0	104	80	120			
Lab ID:	**B17081923-040AMSD**		Sample Matrix Spike Duplicate				Run: HGCV202-B_170824A				08/24/17 12:00
Mercury			0.232	mg/kg	1.0	106	80	120		20	
Method:	**SW7471B**										Batch: 112922
Lab ID:	**MB-112922**		Method Blank				Run: HGCV202-B_170824A				08/24/17 12:02
Mercury			ND	mg/kg	0.003						
Lab ID:	**LCS3-112922**		Laboratory Control Sample				Run: HGCV202-B_170824A				08/24/17 12:03
Mercury			0.225	mg/kg	1.0	113	80	120			
Lab ID:	**B17081923-060ADIL**		Serial Dilution				Run: HGCV202-B_170824A				08/24/17 12:46
Mercury			ND	mg/kg	1.0					10	
Lab ID:	**B17081923-060AMS3**		Sample Matrix Spike				Run: HGCV202-B_170824A				08/24/17 12:48
Mercury			0.226	mg/kg	1.0	104	80	120			
Lab ID:	**B17081923-060AMSD**		Sample Matrix Spike Duplicate				Run: HGCV202-B_170824A				08/24/17 12:50
Mercury			0.225	mg/kg	1.0	104	80	120		20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Hydrometrics Inc — **Report Date:** 10/18/17

Project: Talen Job # 12072 Soil Sampling — **Work Order:** B17081923

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **SW7471B**										Batch: 112922
Lab ID: **B17081923-060AMSD**		Sample Matrix Spike Duplicate				Run: HGCV202-B_170824A				08/24/17 12:50
Method: **SW7471B**										Batch: 112925
Lab ID: **MB-112925**		Method Blank				Run: HGCV202-B_170824A				08/24/17 13:13
Mercury		ND	mg/kg	0.003						
Lab ID: **LCS3-112925**		Laboratory Control Sample				Run: HGCV202-B_170824A				08/24/17 13:14
Mercury		0.216	mg/kg	1.0	108	80	120			
Lab ID: **B17081923-072ADIL**		Serial Dilution				Run: HGCV202-B_170824A				08/24/17 13:40
Mercury		ND	mg/kg	1.0					10	
Lab ID: **B17081923-072AMS3**		Sample Matrix Spike				Run: HGCV202-B_170824A				08/24/17 13:42
Mercury		0.234	mg/kg	1.0	109	80	120			
Lab ID: **B17081923-072AMSD**		Sample Matrix Spike Duplicate				Run: HGCV202-B_170824A				08/24/17 13:44
Mercury		0.232	mg/kg	1.0	108	80	120		20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Hydrometrics Inc **Report Date:** 10/18/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0									Batch: 50431
Lab ID: MB-50431	Method Blank				Run: G5000W_171004A				10/10/17 09:30
Radium 226	0.007	pCi/g-dry							U
Radium 226 precision (±)	0.007	pCi/g-dry							
Radium 226 MDC	0.01	pCi/g-dry							
Lab ID: LCS1-50431	Laboratory Control Sample				Run: G5000W_171004A				10/10/17 09:30
Radium 226	2.2	pCi/g-dry		88	67	120			
Lab ID: B17081923-018AMS1	Sample Matrix Spike				Run: G5000W_171004A				10/10/17 09:30
Radium 226	9.1	pCi/g-dry		86	70	130			
Lab ID: B17081923-018AMS1D	Sample Matrix Spike Duplicate				Run: G5000W_171004A				10/10/17 09:30
Radium 226	8.7	pCi/g-dry		87	70	130	4.7	20	
Method: E903.0									Batch: 50451
Lab ID: MB-50451	Method Blank				Run: G5000W_171010C				10/16/17 13:13
Radium 226	0.003	pCi/g-dry							U
Radium 226 precision (±)	0.006	pCi/g-dry							
Radium 226 MDC	0.010	pCi/g-dry							
Lab ID: LCS1-50451	Laboratory Control Sample				Run: G5000W_171010C				10/16/17 13:13
Radium 226	2.0	pCi/g-dry		80	67	120			
Lab ID: B17081923-067AMS1	Sample Matrix Spike				Run: G5000W_171010C				10/16/17 13:14
Radium 226	9.4	pCi/g-dry		87	70	130			
Lab ID: B17081923-067AMS1D	Sample Matrix Spike Duplicate				Run: G5000W_171010C				10/16/17 15:44
Radium 226	10	pCi/g-dry		96	70	130	0.0	20	
Method: E903.0									Batch: 50430
Lab ID: B17081923-003AMS1	Sample Matrix Spike				Run: G542M_170923C				10/02/17 14:21
Radium 226	9.2	pCi/g-dry		89	70	130			
Lab ID: B17081923-003AMS1D	Sample Matrix Spike Duplicate				Run: G542M_170923C				10/02/17 14:21
Radium 226	8.9	pCi/g-dry		89	70	130	3.5	20	
Lab ID: LCS1-50430	Laboratory Control Sample				Run: G542M_170923C				10/02/17 16:04
Radium 226	2.2	pCi/g-dry		88	67	120			
Lab ID: MB-50430	Method Blank				Run: G542M_170923C				10/02/17 16:04
Radium 226	0.002	pCi/g-dry							U
Radium 226 precision (±)	0.009	pCi/g-dry							
Radium 226 MDC	0.02	pCi/g-dry							

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Hydrometrics Inc **Report Date:** 10/18/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0									Batch: 50436
Lab ID: MB-50436	Method Blank				Run: G542M_171010B				10/16/17 13:15
Radium 226	0.008	pCi/g-dry							U
Radium 226 precision (±)	0.007	pCi/g-dry							
Radium 226 MDC	0.009	pCi/g-dry							
Lab ID: LCS1-50436	Laboratory Control Sample				Run: G542M_171010B				10/16/17 13:15
Radium 226	2.5	pCi/g-dry		100	67	120			
Lab ID: B17081923-049AMS1	Sample Matrix Spike				Run: G542M_171010B				10/16/17 13:15
Radium 226	41	pCi/g-dry		166	70	130			S
- Sample activity for this radionuclide is much larger than the spike activity added therefore the matrix spike recovery could not be calculated accurately.									
Lab ID: B17081923-049AMS1D	Sample Matrix Spike Duplicate				Run: G542M_171010B				10/16/17 13:15
Radium 226	38	pCi/g-dry		131	70	130	8.7	20	S
- Sample activity for this radionuclide is much larger than the spike activity added therefore the matrix spike recovery could not be calculated accurately.									
Method: E903.0									Batch: 50435
Lab ID: MB-50435	Method Blank				Run: G542M-2_171010A				10/16/17 10:27
Radium 226	0.006	pCi/g-dry							U
Radium 226 precision (±)	0.005	pCi/g-dry							
Radium 226 MDC	0.008	pCi/g-dry							
Lab ID: LCS1-50435	Laboratory Control Sample				Run: G542M-2_171010A				10/16/17 10:27
Radium 226	2.3	pCi/g-dry		94	67	120			
Lab ID: B17081923-033AMS1	Sample Matrix Spike				Run: G542M-2_171010A				10/16/17 10:27
Radium 226	8.9	pCi/g-dry		93	70	130			
Lab ID: B17081923-033AMS1D	Sample Matrix Spike				Run: G542M-2_171010A				10/16/17 10:27
Radium 226	10	pCi/g-dry		94	70	130			

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration
U - Not detected at minimum detectable concentration
ND - Not detected at the reporting limit.
S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Hydrometrics Inc **Report Date:** 10/18/17

Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: RA-05									Batch: 50430
Lab ID: MB-50430	Method Blank				Run: TENNELEC-3_170923B				09/27/17 17:34
Radium 228	0.06	pCi/g-dry							U
Radium 228 precision (±)	0.03	pCi/g-dry							
Radium 228 MDC	0.06	pCi/g-dry							
Lab ID: B17081923-004AMS4	Sample Matrix Spike				Run: TENNELEC-3_170923B				09/27/17 17:34
Radium 228	7.0	pCi/g-dry		68	70	130			S
- Spike response is outside of the acceptance range for this analysis. Since the LCS and the RPD recoveries are acceptable, the response is considered to be matrix related. The batch is approved.									
Lab ID: B17081923-004AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_170923B				09/27/17 17:34
Radium 228	7.5	pCi/g-dry		74	70	130	7.3	20	
Lab ID: LCS4-50430	Laboratory Control Sample				Run: TENNELEC-3_170923B				09/27/17 19:16
Radium 228	2.7	pCi/g-dry		115	80	120			
Method: RA-05									Batch: 50431
Lab ID: MB-50431	Method Blank				Run: TENNELEC-3_170924A				09/28/17 00:47
Radium 228	0.06	pCi/g-dry							U
Radium 228 precision (±)	0.04	pCi/g-dry							
Radium 228 MDC	0.08	pCi/g-dry							
Lab ID: LCS4-50431	Laboratory Control Sample				Run: TENNELEC-3_170924A				09/28/17 00:47
Radium 228	2.1	pCi/g-dry		84	80	120			
Lab ID: B17081923-019AMS4	Sample Matrix Spike				Run: TENNELEC-3_170924A				09/28/17 00:47
Radium 228	8.4	pCi/g-dry		85	70	130			
Lab ID: B17081923-019AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_170924A				09/28/17 00:47
Radium 228	8.0	pCi/g-dry		79	70	130	5.3	20	
Method: RA-05									Batch: R227806
Lab ID: MB-50435	Method Blank				Run: TENNELEC-3_170925A				09/28/17 11:49
Radium 228	0.05	pCi/g-dry							U
Radium 228 precision (±)	0.04	pCi/g-dry							
Radium 228 MDC	0.07	pCi/g-dry							
Lab ID: LCS4-50435	Laboratory Control Sample				Run: TENNELEC-3_170925A				09/28/17 11:49
Radium 228	2.1	pCi/g-dry		84	80	120			
Lab ID: B17081923-034AMS4	Sample Matrix Spike				Run: TENNELEC-3_170925A				09/28/17 11:49
Radium 228	8.7	pCi/g-dry		70	70	130			
Lab ID: B17081923-034AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_170925A				09/28/17 11:49
Radium 228	9.6	pCi/g-dry		73	70	130	9.3	20	

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

U - Not detected at minimum detectable concentration

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Hydrometrics Inc **Report Date:** 10/18/17
Project: Talen Job # 12072 Soil Sampling **Work Order:** B17081923

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: RA-05									Batch: R227812
Lab ID: MB-50436	Method Blank				Run: TENNELEC-3_170925B				09/28/17 15:02
Radium 228	0.02	pCi/g-dry							U
Radium 228 precision (±)	0.07	pCi/g-dry							
Radium 228 MDC	0.1	pCi/g-dry							
Lab ID: LCS4-50436	Laboratory Control Sample				Run: TENNELEC-3_170925B				09/28/17 15:02
Radium 228	2.6	pCi/g-dry		107	80	120			
Lab ID: B17081923-050AMS4	Sample Matrix Spike				Run: TENNELEC-3_170925B				09/28/17 15:02
Radium 228	10	pCi/g-dry		128	70	130			
Lab ID: B17081923-050AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_170925B				09/28/17 15:02
Radium 228	13	pCi/g-dry		134	70	130	23	20	SR

- Spike response is outside of the acceptance range for this analysis. Since the LCS and the RER recoveries are acceptable, the response is considered to be matrix related. The batch is approved.

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: RA-05									Batch: 50431
Lab ID: MB-50431	Method Blank				Run: TENNELEC-3_171005A				10/09/17 18:55
Radium 228	0.01	pCi/g-dry							U
Radium 228 precision (±)	0.04	pCi/g-dry							
Radium 228 MDC	0.07	pCi/g-dry							
Lab ID: LCS4-50431	Laboratory Control Sample				Run: TENNELEC-3_171005A				10/09/17 18:55
Radium 228	2.0	pCi/g-dry		83	80	120			
Lab ID: B17081923-019AMS4	Sample Matrix Spike				Run: TENNELEC-3_171005A				10/09/17 18:55
Radium 228	8.7	pCi/g-dry		82	70	130			
Lab ID: B17081923-019AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_171005A				10/09/17 18:55
Radium 228	10	pCi/g-dry		98	70	130	18	20	
Method: RA-05									Batch: 50451
Lab ID: MB-50451	Method Blank				Run: TENNELEC-3_171011B				10/15/17 15:35
Radium 228	-0.05	pCi/g-dry							U
Radium 228 precision (±)	0.04	pCi/g-dry							
Radium 228 MDC	0.07	pCi/g-dry							
Lab ID: LCS4-50451	Laboratory Control Sample				Run: TENNELEC-3_171011B				10/15/17 15:35
Radium 228	2.4	pCi/g-dry		98	80	120			
Lab ID: B17081923-068AMS4	Sample Matrix Spike				Run: TENNELEC-3_171011B				10/15/17 17:21
Radium 228	10	pCi/g-dry		119	70	130			
Lab ID: B17081923-068AMS4D	Sample Matrix Spike Duplicate				Run: TENNELEC-3_171011B				10/15/17 17:21
Radium 228	11	pCi/g-dry		129	70	130	8.0	20	

Qualifiers:

RL - Analyte reporting limit.
MDC - Minimum detectable concentration
S - Spike recovery outside of advisory limits.
ND - Not detected at the reporting limit.
R - RPD exceeds advisory limit.
U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Revised Date: 11/15/17
Report Date: 10/18/17
Work Order: B17081923

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0									Batch: RA226-8738
Lab ID: LCS-RA226-8738	Laboratory Control Sample				Run: G542M-2_171103B				11/14/17 10:02
Radium 226	9.3	pCi/L		92	80	120			
Lab ID: MB-RA226-8738	Method Blank				Run: G542M-2_171103B				11/14/17 10:02
Radium 226	0.05	pCi/L							U
Radium 226 precision (±)	0.1	pCi/L							
Radium 226 MDC	0.2	pCi/L							
Lab ID: B17081923-049BMS	Sample Matrix Spike				Run: G542M-2_171103B				11/14/17 10:02
Radium 226	21	pCi/L		84	70	130			
Lab ID: B17081923-049BMSD	Sample Matrix Spike Duplicate				Run: G542M-2_171103B				11/14/17 10:02
Radium 226	20	pCi/L		79	70	130	6.1	20	

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Revised Date: 11/15/17
Report Date: 10/18/17
Work Order: B17081923

Client: Hydrometrics Inc
Project: Talen Job # 12072 Soil Sampling

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: RA-05								Batch: RA228-5662	
Lab ID: LCS-228-RA226-8738	Laboratory Control Sample				Run: TENNELEC-3_171103A			11/09/17 10:43	
Radium 228	9.6	pCi/L		94	80	120			
Lab ID: MB-RA226-8738	Method Blank				Run: TENNELEC-3_171103A			11/09/17 10:43	
Radium 228	0.5	pCi/L							U
Radium 228 precision (±)	1	pCi/L							
Radium 228 MDC	2	pCi/L							
Lab ID: B17081923-050BMS	Sample Matrix Spike				Run: TENNELEC-3_171103A			11/09/17 10:43	
Radium 228	22	pCi/L		82	70	130			
Lab ID: B17081923-050BMSD	Sample Matrix Spike Duplicate				Run: TENNELEC-3_171103A			11/09/17 10:43	
Radium 228	22	pCi/L		80	70	130	1.2	20	

Qualifiers:

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

Work Order Receipt Checklist

Hydrometrics Inc

B17081923

Login completed by:	Gina McCartney	Date Received:	8/17/2017
Reviewed by:	BL2000\cindy	Received by:	wcj
Reviewed Date:	8/22/2017	Carrier name:	Hand Del

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

Standard Reporting Procedures:

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

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

Contact and Corrective Action Comments:

The Temperature Blank temperature for shipping container 1 was 21.9°C, shipping container 2 was 22.0°C, shipping container 3 was 21.7°C and shipping container 4 was 8.6°C.

Chain of Custody and Analytical Request Record

ENERGY LABORATORIES

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: **Talen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: **Gary Hoffmann 5602 Hesper Road Billings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
Invoice Address: **Hydrometrics** ATTN: Karen Sable 5602 Hesper Road Billings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other _____

Special Report Formats – ELI must be notified prior to sample submittal for the following: NELAC ☐ A2LA ☐ Level IV ☐ Other _____ EDD/EDT ☐ Format _____

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments: **Please email copy of sample results to Jenny Vanek jvanek@hydrometrics.com, rlabbe@hydrometrics.com, ahilty@hydrometrics.com, ghoffmagnn@hydrometrics.com**

Shipped by: _____ Receipt Temp _____ °C Cooler ID(s) _____ Custody Seal Y N Intact Y N Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	Comments	LABORATORY USE ONLY LAB ID
TLN-1708-032	8/16/2017	925	Soil		X	X		See Attached Table of Sample Parameters	B1708192300/
TLN-1708-040	8/16/2017	930	Soil		X	X			-002
TLN-1708-031	8/16/2017	935	Soil		X	X			-003
TLN-1708-041	8/16/2017	940	Soil		X	X			-004
TLN-1708-033	8/16/2017	945	Soil		X	X			-005
TLN-1708-042	8/16/2017	950	Soil		X	X			-006
TLN-1708-030	8/16/2017	955	Soil		X	X			-007
TLN-1708-044	8/16/2017	955	Soil		X	X			-008
TLN-1708-043	8/16/2017	1000	Soil		X	X			-009
TLN-1708-045	8/16/2017	1000	Soil		X	X			-010

Custody Record MUST be Signed						
Relinquished by (print): Gary Hoffmann	Date/Time: 8/17/17 1155	Signature:	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time: 8/17/17 1155	Signature:

Sample Disposal: Return to Client ☐ Lab Disposal ☐

LABORATORY USE ONLY: Sample Type _____ # of fractions _____

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ENERGY LABORATORIES Chain of Custody and Analytical Request Record

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: **Talen Montana, LLC**

Project Name, PWS#, Permit #, Etc.: **Talen Job # 12072, Soil Sampling**

Sample Origin State: **Montana**

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address: **Gary Hoffmann, 5602 Hesper Road, Billings, MT 59106**

Contact Name: Gary Hoffmann RG
Voice: 406.656-1172 Ext. 302
Email: ghoffmann@hydrometrics.com

Sampler Name if other than Contact: Gary Hoffmann RG

Invoice Address: **Hydrometrics**
ATTN: Karen Sable
5602 Hesper Road
Billings, MT 59106

Invoice Contact & Phone #: Karen Sable 406-656-1172

Purchase Order #:

ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other _____

Special Report Formats – ELI must be notified prior to sample submittal for the following: NELAC ☐ A2LA ☐ Level IV ☐ Other _____ EDD/EDT ☐ Format _____

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments: **Please email copy of sample results to Jenny Vanek jvanek@hydrometrics.com, rlabbe@hydrometrics.com, ahilty@hydrometrics.com, ghoffmagnn@hydrometrics.com**

Shipped by: _____
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Cooler ID(s) _____
Custody Seal Y N
Intact Y N
Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O — Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	Comments	LABORATORY USE ONLY LAB ID
TLN-1708-029	8/16/2017	1010	Soil		X	X		See Attached Table of Sample Parameters	B17081923-011
TLN-1708-046	8/16/2017	1015	Soil		X	X			-012
TLN-1708-028	8/16/2017	1025	Soil		X	X			-013
TLN-1708-047	8/16/2017	1030	Soil		X	X			-014
TLN-1708-027	8/16/2017	1035	Soil		X	X			-015
TLN-1708-048	8/16/2017	1040	Soil		X	X			-016
TLN-1708-049	8/16/2017	1045	Water		X	X			separate workorder
TLN-1708-014	8/16/2017	1110	Soil		X	X			-017
TLN-1708-050	8/16/2017	1115	Soil		X	X			-018
TLN-1708-051	8/16/2017	1125	Soil		X	X			-019

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Gary Hoffmann	8/17/17 1155				
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time: 8/17/17 1155	Signature:

Sample Disposal: Return to Client ☐ Lab Disposal ☐

LABORATORY USE ONLY: Sample Type _____ # of fractions _____

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Chain of Custody and Analytical Request Record

ENERGY LABORATORIES

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: **Talen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: **Gary Hoffmann 5602 Hesper Road Billings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
Invoice Address: **Hydrometrics** ATTN: Karen Sable 5602 Hesper Road Billings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other ____

Special Report Formats – ELI must be notified prior to sample submittal for the following: NELAC ☐ A2LA ☐ Level IV ☐ Other ____ EDD/EDT ☐ Format ____

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments: **Please email copy of sample results to Jenny Vanek jvanek@hydrometrics.com, rlabbe@hydrometrics.com, ahilty@hydrometrics.com, ghoffmaqnn@hydrometrics.com**

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SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O — Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	Comments	LABORATORY USE ONLY — LAB ID
TLN-1708-017	8/16/2017	1130	Soil		X	X		See Attached Table of Sample Parameters	B1708123-020
TLN-1708-052	8/16/2017	1135	Soil		X	X			-021
TLN-1708-053	8/16/2017	1140	Soil		X	X			-022
TLN-1708-018	8/16/2017	1145	Soil		X	X			-023
TLN-1708-054	8/16/2017	1150	Soil		X	X			-024
TLN-1708-019	8/16/2017	1207	Soil		X	X			-025
TLN-1708-058	8/16/2017	1210	Soil		X	X			-026
TLN-1708-059	8/16/2017	1213	Soil		X	X			-027
TLN-1708-020	8/16/2017	1219	Soil		X	X			-028
TLN-1708-060	8/16/2017	1221	Soil		X	X			-029

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Gary Hoffmann	8/17/17 1155	[signature]			
			Received by (print): [signature]	Date/Time: 8/17/17	Signature: 1155

Sample Disposal: Return to Client ☐ Lab Disposal ☐

LABORATORY USE ONLY: Sample Type ____ # of fractions ____

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ENERGY LABORATORIES Chain of Custody and Analytical Request Record

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: **Talen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: **Gary Hoffmann** **2602 Hesper Road** **Billings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
Invoice Address: **Hydrometrics** ATTN: Karen Sable 2602 Hesper Road Billings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other ____

Special Report Formats – ELI must be notified prior to sample submittal for the following:
NELAC ☐ A2LA ☐ Level IV ☐ Other ____ EDD/EDT ☐ Format ____

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments: **Please email copy of sample results to Jenny Vanek jvanek@hydrometrics.com, rlabbe@hydrometrics.com, ahilty@hydrometrics.com, ghoffmagnn@hydrometrics.com**

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Intact Y N
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SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O — Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	Comments	LAB ID (LABORATORY USE ONLY)
TLN-1708-061	8/16/2017	1224	Soil		X	X		See Attached Table of Sample Parameters	B17081923-036
TLN-1708-021	8/16/2017	1230	Soil		X	X			-031
TLN-1708-062	8/16/2017	1233	Soil		X	X			-032
TLN-1708-022	8/16/2017	1236	Soil		X	X			-033
TLN-1708-063	8/16/2017	1238	Soil		X	X			-034
TLN-1708-009	8/16/2017	1241	Soil		X	X			-035
TLN-1708-064	8/16/2017	1244	Soil		X	X			-036
TLN-1708-008	8/16/2017	1246	Soil		X	X			-037
TLN-1708-065	8/16/2017	1249	Soil		X	X			-038
TLN-1708-003	8/16/2017	1252	Soil		X	X			-039

Custody Record MUST be Signed

Relinquished by (print): Gary Hoffmann Date/Time: 8/17/17 1155 Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: 8/17/17 Signature: 1155

Sample Disposal: Return to Client ☐ Lab Disposal ☐

LABORATORY USE ONLY: Sample Type ____ # of fractions ____

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ENERGY LABORATORIES Chain of Custody and Analytical Request Record

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name: **Talen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: **Gary Hoffmann 602 Hesper Road Billings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
Invoice Address: **Hydrometrics** ATTN: Karen Sable 602 Hesper Road Billings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other _____

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Notify ELI prior to RUSH sample submittal for additional charges and scheduling

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TLN-1708-066	8/16/2017	1255	Soil		X	X		See Attached Table of Sample Parameters	B17081923-040
TLN-1708-012	8/16/2017	1348	Soil		X	X			-041
TLN-1708-067	8/16/2017	1350	Soil		X	X			-042
TLN-1708-068	8/16/2017	1354	Soil		X	X			-043
TLN-1708-011	8/16/2017	1357	Soil		X	X			-044
TLN-1708-069	8/16/2017	1359	Soil		X	X			-045
TLN-1708-070	8/16/2017	1402	Soil		X	X			-046
TLN-1708-013	8/16/2017	1405	Soil		X	X			-047
TLN-1708-071	8/16/2017	1407	Soil		X	X			-048
TLN-1708-072	8/16/2017	1410	Soil		X	X			~~-049~~ -050

Custody Record MUST be Signed

Relinquished by (print): Gary Hoffmann Date/Time: 8/17/17 1155 Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: 8/17/17 1155 Signature:

Sample Disposal: Return to Client ☐ Lab Disposal ☐

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ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

PLEASE PRINT; provide as much information as possible. Refer to corresponding notes on reverse side.

:ompany Name: **:alen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
:eport Mail Address: **:ary Hoffmann 602 Hesper Road :illings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
:voice Address: **Hydrometrics** :TTN: Karen Sable 602 Hesper Road :illings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

:eport Required For: POTW/WWTP ☐ DW ☐ Other _____
:pecial Report Formats – ELI must be notified prior to :ample submittal for the following:
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:ther _____
:DD/EDT ☐ Format _____

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Comments:
Please email copy of sample results to Jenny Vanek
jvanek@hydrometrics.com,
rlabbe@hydrometrics.com,
ahilty@hydrometrics.com,
ghoffmagnn@hydrometrics.com

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Custody Seal Intact Y N
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SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers, Sample Type: A W S V B O — Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED									SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)		LAB ID (LABORATORY USE ONLY)
TLN-1708-010	8/16/2017	1415	Soil										X	X		See Attached Table of Sample Parameters	B1708 1923-050
TLN-1708-073	8/16/2017	1418	Soil										X	X			-051
TLN-1708-007	8/16/2017	1420	Soil										X	X			-052
TLN-1708-074	8/16/2017	1423	Soil										X	X			-053
TLN-1708-006	8/16/2017	1425	Soil										X	X			-054
TLN-1708-075	8/16/2017	1430	Soil										X	X			-055
TLN-1708-076	8/16/2017	1427	Soil										X	X			-056
TLN-1708-005	8/16/2017	1432	Soil										X	X			-057
TLN-1708-077	8/16/2017	1435	Soil										X	X			-058
TLN-1708-004	8/16/2017	1437	Soil										X	X			-059

Custody Record MUST be Signed

Gary Hoffmann 8/17/17 1155
Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: 8/17/17 1155 Signature:

Sample Disposal: Return to Client ☐ Lab Disposal ☐

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Chain of Custody and Analytical Request Record

ENERGY LABORATORIES

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Company Name: **Talen Montana, LLC**	Project Name, PWS#, Permit #, Etc. **Talen Job # 12072, Soil Sampling**	Sample Origin State: **Montana**	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: **Gary Hoffmann 5602 Hesper Road Billings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
Invoice Address: **Hydrometrics** ATTN: Karen Sable 5602 Hesper Road Billings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

Report Required For: POTW/WWTP ☐ DW ☐ Other _____

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SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O — Air, Water, Soils/Solids, Vegetation, Bioassay, Other)	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)		LABORATORY USE ONLY — LAB ID
TLN-1708-078	8/16/2017	1440	Soil		X	X		See Attached Table of Sample Parameters	B1708I923-060
TLN-1708-002	8/16/2017	1443	Soil		X	X			-061
TLN-1708-079	8/16/2017	1445	Soil		X	X			-062
TLN-1708-080	8/16/2017	1448	Soil		X	X			-063
TLN-1708-001	8/16/2017	1453	Soil		X	X			-064
TLN-1708-081	8/16/2017	1456	Soil		X	X			-065
TLN-1708-082	8/16/2017	1500	Water		X	X			Separate workorder
TLN-1708-015	8/16/2017	1512	Soil		X	X			-066
TLN-1708-083	8/16/2017	1515	Soil		X	X			-067
TLN-1708-016	8/16/2017	1517	Soil		X	X			-068

Custody Record MUST be Signed

Relinquished by (print): Gary Hoffmann	Date/Time: 8/17/17 1155	Signature: [signature]	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print): [signature]	Date/Time: 8/17/17	Signature: 1155

Sample Disposal: Return to Client ☐ Lab Disposal ☐

LABORATORY USE ONLY: Sample Type ______ # of fractions ______

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eport Mail Address: **ary Hoffmann** **602 Hesper Road** **illings, MT 59106**	Contact Name: Gary Hoffmann RG Voice: 406.656-1172 Ext. 302 Email: ghoffmann@hydrometrics.com	Sampler Name if other than Contact: Gary Hoffmann RG	
nvoice Address: **Hydrometrics** TTN: Karen Sable 602 Hesper Road illings, MT 59106	Invoice Contact & Phone #: Karen Sable 406-656-1172	Purchase Order #:	ELI Quote #: **B4274**

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ELAC ☐ A2LA ☐ Level IV ☐
ther _____
DD/EDT ☐ Format _____

SAMPLE IDENTIFICATION (Name, Location, Interval, etc)	Collection Date	Collection Time	Number of Containers Sample Type: A W S V B O Air, Water, Soils/Solids, Vegetation, Bioassay, Other MATRIX	ANALYSIS REQUESTED	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	Notify ELI prior to RUSH sample submittal for additional charges and scheduling. Comments: **Please email copy of sample results to Jenny Vanek** **jvanek@hydrometrics.com, rlabbe@hydrometrics.com, ahilty@hydrometrics.com, ghoffmagnn@hydrometrics.com**	Shipped by: Receipt Temp °C Cooler ID(s) Custody Seal Y N Intact Y N Signature Match Y N LAB ID
TLN-1708-084	8/16/2017	1520	Soil		X	X		See Attached Table of Sample Parameters	B17080923 -069
TLN-1708-026	8/16/2017	1522	Soil		X	X			-070
TLN-1708-085	8/16/2017	1523	Soil		X	X			~~071~~-069 gm
TLN-1708-086	8/16/2017	1525	Soil		X	X			~~072~~-070

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Gary Hoffmann	8/17/17 1155	[signature]			
			[signature]	8/17/17 1155	

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TABLE 1. Soil Sampling Parameter List

Analyte	*Analytical Method*	*Reporting Limit*	*Units*	*Holding Time*
PHYSICAL PARAMETERS				
EC (lab), (saturated paste)	ASAM 10-3	0.01	mmhos/cm	NA
pH (lab), (saturated paste)	ASAM 10-3.2	0.01	S.U.	NA
COMMON IONS				
Bicarbonate as HCO3, (saturated paste)	ASAM 10-3	2	mg/L	14 Days
Bromide	E300.0	0.5	mg/kg	28 Days
Carbonate as CO3, (saturated paste)	ASAM 10-3	2	mg/L	14 Days
Calcium, (saturated paste)	E6010.20	0.01	meq/L	6 Month
Chloride	E300.0	1	mg/kg	28 Days
Fluoride	E300.0	0.1	mg/kg	28 Days
Magnesium, (saturated paste)	E6010.20	0.01	meq/L	6 Month
Potassium, (saturated paste)	E6010.20	0.01	meq/L	6 Month
SAR	Calculation	0.01	NA	6 Month
Sodium, (saturated paste)	E6010.20	0.01	meq/L	6 Month
Sulfate	E300.0	1	mg/kg	28 Days
TRACE METALS				
Antimony	E6010.20	1	mg/Kg	6 Month
Arsenic	E6010.20	1	mg/Kg	6 Month
Barium	E6010.20	1	mg/Kg	6 Month
Beryllium	E6010.20	1	mg/Kg	6 Month
Boron	E6010.20	1	mg/Kg	6 Month
Cadmium	E6010.20	1	mg/Kg	6 Month
Chromium	E6010.20	1	mg/Kg	6 Month
Cobalt	E6010.20	1	mg/Kg	6 Month
Lead	E6010.20	1	mg/Kg	6 Month
Manganese	E6010.20	1	mg/Kg	6 Month
Mercury	SW7471B	1	mg/Kg	6 Month
Selenium	E6010.20	1	mg/Kg	6 Month
Thallium	E6010.20	1	mg/Kg	6 Month
Lithium	E6010.20	1	mg/Kg	6 Month
Molybdenum	E6010.20	1	mg/Kg	6 Month
RADIONUCLIDES				
Radium 226	E903.0	-1000 - 0	pCi/g-dry	180 days
Radium 228	RA-05	-1000 - 0	pCi/g-dry	180 days

pCi/g = pico- curies/gram
Each sample requires a one gallon zip-lock bag half full of sediment.

Appendix J

Responses to DEQ Comments on the SOEP/STEP CCRA Work Plan and Report

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment Work Plan dated 9/20/2017
DEQ Comments dated 10/20/2017

Comments

1) "Potential SOEP/STEP Wastewater COIs/COPCs and Screening Criteria" Table: Regarding the footnote for Appendix III, chloride should still be retained in the Table, but a footnote should be included that indicates that chloride is a secondary indicator parameter.

   Accepted. Chloride, and a footnote, have been added to the table.

2) Exposure Units: Please indicate how the groundwater will be evaluated (e.g., through the SOEP/STEP area by water-bearing unit).

   Accepted. Similar to the Plant Site CCRA, groundwater Exposure Units were not defined for the SOEP/STEP area and forward risks associated with groundwater were not conducted. The capture well system presently prevents migration of groundwater from the SOEP/STEP area and modeling of groundwater migration without the capture well system would need to be conducted adding substantial uncertainty into the forward calculation of human health risks associated with groundwater. Rather, based on discussions with DEQ, Cleanup Criteria for groundwater were developed by hydrostratigraphic unit for use in the Remedy Evaluation. This process in discussed in the CCRA in various locations, including Section 5.0 Risk Assessment Approach and Guidelines, Section 6.1.1 Description of an Exposure Unit, and Section 12.5 Groundwater Cleanup Criteria.

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 12/19/2017 DEQ Comments dated 4/12/2018

General Comments

1. Please include a discussion regarding the use of BSLs in the Executive Summary, and include an explanation that describes the use of BSLs from the final BSL report, which differ from the BSLs used in the Plant Site Report. Please call out the BSLs that changed between the two reports, and cite the agreement between DEQ and Talen to use the revised BSLs for the 1&2 and 3&4 Reports.

   Accepted. A discussion of the use of the BSLs, the revisions to the BSLs, and BSL differences between the Plant Site and SOEP/STEP CCRA has been added to the Executive Summary. In addition, a discussion has been added describing the differences in the groundwater Proposed Cleanup Criteria resulting from the revision of the BSLs. Text has been added to "Section 6.1.3 References/Background Samples" and a new "Section 12.5.4 Cleanup Criteria Comparison of the SOEP/STEP and Plant Site Areas" has also been added to the CCRA to describe the aforementioned items. Lastly, a reference has been added to cite the discussion and agreement between DEQ and Talen regarding the use of the 2016 BSLs and the revised 2017 BSLs.

Specific Comments

2. Page vii, Executive Summary, 2nd paragraph, 3rd sentence: Please change "Two ecological COCs, boron and manganese…" to "Two ecological COPCs, boron and manganese…"

   Accepted. Suggested change has been made.

3. Page vii, Executive Summary, 2nd paragraph: Please refer to the surface water comments submitted for the Plant Site CCRA.

   Accepted. Changes have been made to the SOEP/STEP CCRA regarding DEQ's surface water comments for the Plant Site CCRA. This paragraph is in agreement with these changes.

4. Page vii, Executive Summary, 3rd paragraph, 3rd sentence: Please change "One ecological COC, manganese…" to "One ecological COPC, manganese…"

   Accepted. Suggested change has been made.

5. Page 16, 2nd paragraph, 5th sentence: Please change "coria" to "scoria".

   Accepted. Suggested change has been made.

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 12/19/2017
DEQ Comments dated 4/12/2018

6. Page 28, Section 4.1.1, 1st paragraph, last sentence: Please refer to the surface water comments submitted for the Plant Site CCRA.

   Accepted. The last two sentences of the 1st paragraph of Section 4.1.1 have been removed to be in agreement with DEQ's surface water comments for the Plant Site CCRA.

7. Page 39, Section 6.1.2, Table 6.2: Please explain why soil samples were collected from 0-7 ft bgs at the North 1AD Pipeline Drain Pond former spill site, when the other spill sites only sampled from 0-2 ft bgs.

   Accepted. A footnote has been added to Table 6.2 explaining the reasoning for the soil sampling depth intervals. Specifically, the following footnote has been added:

   "Soil sampling depth intervals were selected based on the type of spill. The spill near North 1AD Pipeline Drain Pond was collected in an excavated shallow trench and the release was, therefore, more likely to infiltrate into deeper soil. The spills at the STEP Main Dam and near Capture Well 932D were spills followed by overland flow with less likelihood to infiltrate into deeper soils."

8. Page 40, Section 6.1.2, 1st paragraph, 2nd bullet, last sentence: Please provide a citation for the DEQ request for additional evaluation of the SOEP/STEP capture system.

   Accepted. A citation has been added that DEQ requested the SOEP/STEP area (as well as the Plant Site and the 3&4 EHP) be evaluated in the CCRA without the capture well system in place.

9. Page 40, Section 6.1.3, 2nd bullet: Please refer to the surface water comments submitted for the Plant Site CCRA.

   Accepted. The 2nd bullet has been revised per the DEQ Plant Site CCRA comments.

10. Page 49, Section 7.2.5.1, 2nd set of bullets, 3rd bullet: DEQ does not require evaluation of construction worker exposure to sediment; however, construction worker exposure to radium 226 in soil was evaluated. The exposure parameters used to calculate radium 226 preliminary remediation goals (PRGs) should be discussed here. Exposure frequencies provided in DEQ's Frequently Asked Questions (FAQs) should be used for these calculations.

    Accepted. The bullet regarding construction worker exposure to sediment has been removed. A statement has been added indicating that the DEQ recommended exposure parameters were used to calculate the PRGs.

11. Page 57, Section 10.1, 2nd paragraph, 2nd sentence: Based on the shallow potentiometric surface maps provided in the Site Characterization report, AR-9 appears to be

upgradient of the SOEP/STEP area. Based on the map, surface water sites AR-8, AR-7 and AR-6 would be more appropriate for analysis of SOEP/STEP impacts to the creek.

While we agree that AR-9 (as well as AR-1) appears to be located upgradient of the SOEP/STEP area, all of the surface water sites in EU5 at the SOEP/STEP area are located downgradient of the Plant Site area. As such, we have conservatively chosen to use all of the surface water sampling locations in EU5 (AR-1, AR-9, AR-8, AR-7, AR-6, AR-11 and AR-10) to evaluate potential impacts to the Creek that may have originated from either the Plant Site or the SOEP/STEP area.

12. Page 57, Section 10.1, 3rd paragraph, 2nd sentence: Please refer to the surface water comments submitted for the Plant Site CCRA.

    Accepted. Section 10.1 has been revised per the DEQ Plant Site CCRA comments.

13. Page 57, Section 10.1, 4th paragraph: This statement contradicts the previous statement in Section 6.1.3 (1st bullet, 4th sentence: "spring water monitoring sites were not included in the calculation of the surface water BSLs: rather, spring water monitoring sites were included in the groundwater BSL calculations"). Please remove this sentence.

    Accepted. This sentence has been removed.

14. Page 58, Section 10.1, Table 10-2: Please see Specific Comment #10.

    Accepted. Table 10-2 has been removed and Table 10-1 has been revised to include the appropriate data from previous Table 10-2. Information in (previous) Table-2 that was relevant to the surface water comments submitted for the Plant Site CCRA has been revised and/or removed, as appropriate.

15. Page 66, Section 10.2, Table 10-8: Please include the Leachate Criterion and DAF values used to calculate the Site-Specific Impact to Groundwater Soil Remediation Standards.

    Accepted. The Leachate Criterion and DAF values have been added to the Table 10-8 that has been re-numbered to Table 10-4.

16. Page 66, Section 10.2, Table 10-8, Radium Footnote: Please indicate whether the assumption that converting pCi to picograms is an EPA or a DEQ-accepted practice. If so, please cite the appropriate reference.

    Accepted. The activity-to-mass conversion follows USEPA-accepted practice. The appropriate reference has been added. In addition, Table 10-8 has been re-numbered to Table 10-4.

17. Page 68, Table 10-10: Please clarify whether these are discreet or composite samples.

Accepted. The sample type has been clarified, which is composite samples over the specified depth intervals.

18. Page 68, Section 10.4, Table 10-10: Please remove the bold type for the USEPA Remediation Goal for Surface Soil for the DP1AD Subsurface Soil (>12 in) row. This concentration does not exceed the remediation goal.

    Accepted. The bold type has been removed in the DP1AD Subsurface Soil (>12 in) row.

19. Page 70, Section 12.1, 1st paragraph, 2nd sentence: Please change "COCs" to "COPCs". Also, please remove "boron" from this sentence, boron concentrations were below the RSL and are therefore not a COPC.

    Partially accepted. "COCs" has been changed to "COPCs". While boron was not identified as a human health COPC because surface water concentrations were below the tapwater RSL, boron was identified as an ecological COPC and should remain in the sentence.

20. Page 72, Section 12.5.3, 4th paragraph, last sentence: Please change "…for hydrostratigraphic units in which the BSL is greater than the RSL, then the *BSL* was selected as the Cleanup Criteria…"

    Accepted. "RSL" was changed to "BSL" in the described sentence.

Tables

21. Table 1A: Where possible, field pH should be used in lieu of lab pH. The holding time for pH samples is 15 minutes, indicating that the lab samples were likely out of the holding time, and field pH is more representative of actual pond chemistry.

    Accepted. The pH of the pond samples was routinely measured in the laboratory, rather than in the field. A limited number of field pH measurements were available for the STEP ponds. A comparison of the laboratory and field pH measurements for those samples, including the relative percent differences, have been added to Section 3.0. The relative percent differences between the laboratory and field pH measurements are within acceptable limits for duplicate samples.

22. Table 3, Radium data: Radium was screened out on the basis that the pond concentrations were below DEQ-7. However, the fly ash itself may represent a source of radium that could explain the higher radium concentrations in downgradient CCR wells versus concentrations in background CCR wells. The CCR well concentrations were above DEQ-7. These represent total concentrations and an assumption was made that the dissolved concentrations would be below DEQ-7. Dissolved concentrations should be sampled to confirm this before screening out radium on this basis. Additionally, the CCR wells also exceed EPA MCLs, which are total concentrations, indicating that radium should not be screened out.

**Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 12/19/2017
DEQ Comments dated 4/12/2018**

An incorrect assumption was made in the CCRA regarding the radium DEQ-7 standard. Radium was screened out based on the assumption that dissolved groundwater concentrations would be below 5 pCi/L (the DEQ-7). However, the DEQ-7 standard for radium is based on the total recoverable concentration. Both the DEQ-7 and the MCL are based on a total recoverable radium concentration of 5 pCi/L. As such, groundwater samples should not be collected and analyzed for dissolved radium concentrations.

An expanded evaluation of radium concentrations in groundwater was performed for the Plant Site area and is presented in the Revised Plant Site CCRA dated May 11, 2018. The further evaluation concluded that Radium 226/228 concentrations in groundwater at the Plant Site were consistent with background levels and Radium 226/228 was not retained as a groundwater COI. An expanded evaluation of radium concentrations in groundwater at the SOEP/STEP area has also been performed similar to the one performed at the Plant Site to assess if Radium 226/228 should be retained as a groundwater COI at the SOEP/STEP area. Radium 226/228 was not retained as a groundwater COI at the SOEP/STEP area.

Figures

23. Figure 10: If these samples have already been collected, please remove the word "proposed" in the legend.

    Accepted. Figure 10 has been revised.

Appendix B

24. Table B-2.1 and Table B-2.2: Please explain why radium was not evaluated in surface water or sediment, when it was evaluated for the spill areas. Additionally, the constituents evaluated for the spill areas in these tables are different than those evaluated in spill areas in the Plant Site CCRA; eight constituents are missing in the Plant Site CCRA tables. The same type of analysis should be included in the Plant Site CCRA.

    Radium was not evaluated in surface water or sediment primarily because radium was not identified as a groundwater COI. In addition, DEQ has not required monitoring of radium at the facility in surface water, groundwater, soil, or sediment under the AOC or the Talen Water Resources Monitoring Plan. Historically, the radiological content of bottom ash (alpha, beta, and gamma radiological characteristics) was measured and determined to be within the range of naturally occurring soil and geological materials in the Colstrip area. Please note that radium was only one contributor to the total radiological content. Based on the results of the radiological measurements, DEQ previously (2004) determined that no land-use controls over development, population, waste disposal, or special safeguards or monitoring were required for radiation impacts associated with the ash.

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 12/19/2017
DEQ Comments dated 4/12/2018

Monitoring for radium in groundwater at the Facility began in 2016 under the Federal CCR Rule solely in wells used for this Rule. The CCR Rule includes requirements for monitoring two sets of parameters. One set is used for "detection" monitoring and is referred to as Appendix III parameters. Detection monitoring (Appendix III) does not require analysis of radium. Assessment monitoring is triggered when there is a statistically significant increase detected through statistical analysis of the Appendix III parameters. Radium is included as an analyte of the Appendix IV parameter list that is used for assessment monitoring. To date, radium analyses have been conducted on groundwater samples collected from the CCR wells at the Facility solely for the purpose of developing a baseline dataset for the Appendix IV parameters.

Radium was included in the analyte list for the soil samples collected in the spill areas of the Units 1&2 SOEP/STEP area as a conservative measure to include the analytes listed in the Federal CCR Rule. During a meeting with the DEQ in February 2017, it was decided that the CCR Rule Appendices III/IV constituents should be included in the COI screening process. Although groundwater radium data were available from the dataset collected as part of the Federal CCR Rule, radium data in soil (or surface water or sediment) were not available. Various analytes were added to the soil sampling analyte list for the Units 1&2 SOEP/STEP former spill sites that were not included in the soil sampling analyte list for the Plant Site former spill sites based on the February 2017 meeting. At the time of that meeting, the soil samples collected from the Plant Site former spill sites had already been collected and analyzed (sampling event conducted in April 2016). However, the Units 1&2 SOEP/STEP former spill site soil samples had not yet been collected and the CCR Appendices III/IV Constituents were added to that soil sampling event as a conservative measure.

Appendix C
General Comment: Please refer to the surface water comments for the Plant Site CCRA.

25. Appendix C Cover Page: Please remove "Work Plan" from the title.

    Accepted.

26. Page 20, Section C-4.1.1, 2nd paragraph, 2nd sentence: This sentence indicates that manganese and boron both had maximum concentrations greater than concentrations observed at upstream location AR-12. However, Table C-12 indicates that this is the case only for boron. Please clarify.

    Accepted. The text has been revised to clarify that boron was the only constituent in surface water with Site concentrations exceeding upstream AR-12 concentrations, while manganese concentrations in Site sediment also exceeded upstream AR-12 concentrations. Boron has been retained as a surface water COPC and manganese has been retained as a sediment COPC following the preliminary screening due to potential risk to aquatic organisms. Please note also that the background discussion for surface water and sediment in the SOEP/STEP portion of East Fork Armells Creek has been

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 12/19/2017
DEQ Comments dated 4/12/2018

revised so that AR-5 is included as an upstream location for comparison purposes, consistent with recent revisions to the Plant Site approach.

27. Page 26, Table C-15: Several constituents are flagged "Yes" in the COPC column, but have concentrations below the detection limit. Please correct as appropriate.

    Accepted. Table C-15 has been corrected so that the COPC Status column for lead, mercury, and selenium was changed to "No".

Appendix G

28. Please change the exposure frequencies used to calculate the PRGs to those provided in DEQ's FAQs of 270 days/year for residential, 187 days/year for industrial, and 124 days/year for construction worker.

    Accepted. The exposure frequencies have been changed to the Montana-specific values listed in the comment. The revised radium PRGs are included.

Appendix H

29. Per DEQ Guidance, please change the default DAF to 10, or calculate a site-specific DAF if data is available.

    Accepted. The DAF has been changed to the DEQ default of 10 and the SPLP calculations have been re-run.

Responses to DEQ Comments on the SOEP/STEP Site Cleanup Criteria and Risk Assessment dated 6/11/2018
DEQ Comments dated 8/2/2018

General Comments

Based on the data presented in Section 10, DEQ believes that radium should be included as a COC. DEQ had previously approved an approach for the Plant Site CCRA that allowed individual wells with a 95 UCL below the DEQ-7 standard of 5 pCi/L. However, 15 of the 26 CCR wells related to the STEP had 95 UCLs above the DEQ-7 standard. Per the discussion between DEQ and Talen dated June 22, 2018, DEQ requests that additional samples be collected to further assess if radium should be identified as a COC, and that radium remain a COPC in the interim. Please collect and analyze additional samples of fly ash, bottom ash, and paste from the paste plants in order to determine whether the ash is a source of radium.

On July 10, 2018, additional samples were collected and analyzed for radium, as requested by the DEQ, and are presented in Section 10.5. Based on the sampling results, there is no evidence to substantiate that the source of radium in groundwater is the fly ash or plant paste. Radium concentrations in groundwater at the SOEP/STEP area appear to be consistent with background levels and radium was not identified as a groundwater COI/COC. However, because a radium groundwater BSL was not available for comparison, as a conservative measure radium will continue to be monitored and evaluated in groundwater as part of the Federal CCR Rule compliance monitoring.

Previous Comments

1) Please address Appendix C, Comment #25 (Please remove “Work Plan” from title).

“Work Plan” has been removed from the Appendix C Title Page.

New Comments

1) Page 13, Section 3.0, 3rd paragraph, 4th sentence: Although comparisons of CCR well data (total concentrations) to screening levels (dissolved concentrations) generally does results in a conservative bias, this is not the case for radium, which has a DEQ-7 standard based on total concentrations. Please edit this sentence accordingly.

A sentence has been added to Section 3.0, 3rd paragraph clarifying that the conservative bias does not apply to radium.

2) Page 60, Section 10.5: A non-existent or negative linear relationship between boron and radium does not necessarily mean that radium is not seeping from the ponds. Fate and transport of radium is different than that of boron, so it should be expected that the two COIs may not always be present in the same well.

Comment noted. Section 10.5 has been revised and no longer presents linear regression relationships between boron and radium.