SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT FOR OPERABLE UNIT 2 OF THE COLORADO SMELTER SITE PUEBLO, COLORADO

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°F	degrees Fahrenheit
<	less than
%	percent
µg	micrograms
µg/L	microgram per liter
µm	micrometers
ASARCO	American Smelting and Refining Company
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BNSF	Burlington Northern and Santa Fe
BTAG	Biological Technical Assistance Group
CCA	chromated copper arsenate
CCC	Criterion Continuous Concentration
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF&I	Colorado Fuel and Iron
CLP	Contract Laboratory Program
CMC	Criteria Maximum Concentration
COPC	contaminant of potential concern
COPEC	contaminants of potential ecological concern
Cr (VI)	hexavalent chromium
CRC	collision reaction cell
CSC	Colorado Smelting Company
CSM	conceptual site model
CVAA	cold vapor atomic adsorption
DO	dissolved oxygen
DMA	Demonstration of Methods Applicability
DSV	discharger-specific variance
DU	decision units
E. coli	*Escherichia coli*
ECOS	Environmental Conservation Online System
Eco-SSL	Ecological Soil Screening Level
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level

ESV	Ecological Screening Value
FASL	feet above sea level
GC-MS	gas chromatography-mass spectroscopy
HHRA	human health risk assessment
HQ	hazard quotient
I-25	Interstate 25
ICP	inductively coupled plasma
ICP-MS	inductively coupled plasma-mass spectrometry
IPaC	Information for Planning and Consultation system
iROD	Interim Record of Decision
LANL	Los Alamos National Laboratory
LOEC	lowest observed effect concentration
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligram per liter
mL	milliliter
mm	millimeter
NLC	Newton Lumber Company
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
NRWQC	National Recommended Water Quality Criteria
ORNL	Oak Ridge National Laboratory
ORP	oxidation reduction potential
OU	Operational Unit
PAH	polycyclic aromatic hydrocarbon
PEC	probable effect concentration
pH	potential of hydrogen
ppm	parts per million
PWT	Pacific Western Technologies
PWTP	Pueblo Wastewater Treatment Plant
RBSL	risk-based Screening Levels
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROW	Right-of-way
SCDM	Superfund Chemical Data Matrix
SIM	selective ion monitoring
SLERA	Screening Level Ecological Risk Assessment

SMDP	Scientific-Management Decision Point
SQG	Sediment Quality Guidelines
START	Superfund Technical Assessment and Response Team
SVOC	semi volatile organic compound
TAL	target analyte list
TCEQ	Texas Commission on Environmental Quality
TEC	threshold effect concentration
TEL	threshold effect levels
TMDL	total maximum daily load
TRV	toxicity reference value
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
UPRR	Union Pacific Railroad
VOC	volatile organic compound
XRF	X-ray fluorescence

1 Introduction

1.1 Purpose of this Document

This document is a Screening Level Ecological Risk Assessment (SLERA) for Operable Unit 2 (OU2) at the Colorado Smelter site located in Pueblo, Colorado ("the Site"; Figure 1). The purpose of this SLERA is to identify contaminants of potential ecological concern (COPECs) in OU2 soils, surface water, pore water, and sediments. Since a SLERA specific to Operable Unit 1 (OU1) will not be completed, areas within OU1 that contain suitable habitat to support ecological receptors are considered in this SLERA. These undeveloped commercial areas[1] of OU1 include terrestrial habitats and aquatic habitats in the Arkansas River, Runyon Lake, and streams both east and west of the OU2 boundary.

In addition to identifying COPECs, this SLERA evaluates potential data gaps that may need to be addressed to support further evaluation of ecological risk at the Site. This information, along with other relevant site information, will be used by risk managers to support decision-making regarding the need for additional investigations to further characterize the nature and magnitude of risks to ecological receptors from site-related contaminants, and whether any actions may be needed to protect ecological receptors at the Site.

1.2 Overview of the Eight-Step Ecological Risk Assessment Process

The United States Environmental Protection Agency (EPA) has developed specific methods and procedures for completing ecological risk assessments (EPA 1992; 1997; 1998; 2001). Figure 2 shows the eight-step process that is recommended for ecological risk assessments (ERAs) completed at Superfund sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The eight steps shown in Figure 2 are not intended to represent a linear sequence of mandatory tasks. Rather, some tasks may proceed in parallel, some tasks may be performed in a phased or iterative fashion, and some tasks may be judged to be unnecessary at certain sites.

This document is intended to fulfill Steps 1 and 2 of the ERA process presented in Figure 2. These steps are intentionally simplified and conservative. The purpose is to eliminate those factors that are not associated with ecological risk, allowing subsequent efforts to focus on factors that are of potential concern. The SLERA results also assist in identifying the specific types of data needed to complete a more detailed assessment. The SLERA is not intended to support any final quantitative conclusions about the probability or magnitude of potential ecological risks.

1.3 Document Organization

In addition to this introduction, this report is organized in the following sections:

Section 2. **Screening-Level Problem Formulation** – Site overview including the environmental setting, and decision units (DUs) and investigation areas for evaluating screening level risk estimates.

Section 3. Ecological Conceptual Site Model – Contaminants known or suspected to be present at the Site, contaminant fate and transport processes, potential receptors of concern and exposure pathways, and preliminary assessment endpoints and measures of exposure and effects.

[1] Commercial designation based on zoning.

Section 4. **Identification of Contaminants of Potential Ecological Concern (COPECs)** – Evaluation of existing data, summary of the data used in the SLERA, screening-level exposure estimation, and the screening ecotoxicology benchmarks used to identify COPECs.

Section 5. Risk Characterization – Screening-level risk characterization.

Section 6. Uncertainty assessment – Uncertainties in the findings and conclusions of the SLERA.

Section 7. Summary and Data Gap Assessment – Evaluates potential data gaps identified in the SLERA.

Section 8. References – Citations for all documents referred to in the text.

All figures, and appendices cited in the text are provided at the end of the report. Smaller tables are incorporated within the text and the larger media screening tables are presented at the end of the report.

2 Screening Level Problem Formulation

Identifying contaminant risks to ecological populations, communities, and ecosystems can be exceedingly complex. This complexity necessitates some level of planning to ensure that all factors are considered. This first planning step is termed "problem formulation."

2.1 Problem formulation

EPA (1992) describes problem formulation as, "a preliminary characterization of exposure and effects, as well as an examination of scientific data and data needs [and level of detail for these], policy and regulatory issues, and site-specific factors to define the feasibility, scope, and objectives for the ecological risk assessment." The screening level problem formulation process identifies key factors in the beginning of the Superfund assessment and establishes discrete project goals. The identification of project breadth and specific foci are implicit in determining these goals. A screening level problem formulation represents Step 1 of the eight step ERA process (EPA, 1997).

2.2 Site Overview

The first step in the screening-level problem formulation is characterization of the study area. Detailed site background and characteristics are provided in this section. The Site's environmental setting is also described.

2.2.1 Site Location

The Colorado Smelter site comprises two OUs (Figure 1). The Site (OU2) is contained entirely within the boundaries of OU1, which includes residential and commercial properties surrounding the location of the former smelter. OU2 is in the area where the former Colorado Smelter was located. Details of the OU1 and OU2 locations are provided in Section 2.2.3. The City of Pueblo is northwest of historical smelter operations above the confluence of the Arkansas River and Fountain Creek. The area surrounding Pueblo sits at the western edge of the Great Plains and is characterized by rolling plains of semi-arid desert, with an elevation between 4,692 and 4,750 feet. Pueblo County transitions from high plains in the east to the Rocky Mountains in the west.

2.2.2 Site History and Historical Smelter Operations

Five smelters operated in Pueblo between 1878 and 1921. They processed ores to recover gold, silver, copper, zinc, and lead (Figure 1).

The Colorado Smelting Company (CSC; Boston and Colorado Smelting Works, or the Eilers Plant) established the Colorado Smelter at the southern terminus of Santa Fe Avenue south of the Arkansas River, just north of the Colorado Fuel and Iron (CF&I) steel mill in 1883. The plant primarily smelted gold, lead, and silver ore that had been mined from the Madonna Mine in Monarch, Colorado and some of the mines in Leadville, Colorado. At one time, the smelter operated eight blast furnaces, two calcining furnaces, one fusing furnace, and 20 kilns. The Colorado Smelter was acquired by the national smelter trust, American Smelting and Refining Company (ASARCO) in 1889. The smelter continued to operate until 1908. Most of the Colorado Smelter structures were closed in 1908 and dismantled in 1915. Historical smelter features are shown in Figure 3.

The Great Pueblo Flood of 1921 damaged the infrastructure of the Pueblo area, following which ASARCO sold a portion of the Colorado Smelter property (Figure 3) to Newton Lumber Company (NLC), which operated at the location until the 1960s. A portion that included an office building, barn, and smelter's

smokestack was sold to St. Mary Help of Christians, and in 1923, bricks from the former blast furnace smokestack were used to construct St. Mary's School on Mesa Avenue; the office building was converted into a rectory. After the 1960s, the NLC portion of property was sold to individuals and small to medium-sized companies.

In 1989, a 2-3 gallon per minute liquid discharge coming from a concrete pipe under the Santa Fe Avenue bridge was noted by a pedestrian. An orange discoloration was also noted across a bike path directly over a culvert that goes under the bike path and into the Arkansas River. Pueblo County Health Department was notified. The Water Quality Control Division of the Colorado Department of Public Health and Environment (CDPHE) and the Pueblo Wastewater Treatment Plant (PWTP) were subsequently notified. The PWTP collected a grab sample of the liquid for analysis. The sample contained elevated concentrations of iron and zinc. After being contacted, CF&I suggested that the CSC waste slag pile was the source of elevated iron and zinc. CDPHE investigation confirmed that an intermittent seep was draining the slag waste into the culvert and thence into the Arkansas River.

CDPHE contractors collected Site data in 1994 and 1995, which identified elevated lead and arsenic concentrations in surface soil within OU2. Subsequent field investigations found smelter slag piles at OU2, prompting investigation of adjacent residential areas (OU1).

The site was placed into the Comprehensive Environmental Response, Compensation, and Liability Information System as the Santa Fe [Bridge] Culvert site (COD982572513) in 1990 (CDPHE, 1995) and listed on the National Priorities List (NPL) in December of 2014 (CON000802700).

2.2.3 Site Description

2.2.3.1 Operable Unit 1 (OU1)

OU1 includes approximately 640 acres with a perimeter of 5.17 miles. The area of potential ecological concern for OU1 encompasses 678 acres and has a perimeter of 4.63 miles. OU1 has a convoluted border (Figure 1) that includes numerous roads, as well as Bessemer Park to the west, and the Arkansas River, Runyon Lake, and Runyon Field, to the north. It includes approximately 3,400 linear feet of the Arkansas River from just upstream of the Burlington Northern and Santa Fe (BNSF) railroad bridge downstream to just below the Moffat Street pedestrian bridge south of Runyon Lake. This river section is approximately 80 to 250 feet wide and includes wetlands, seasonal riparian areas and islands, a 20-foot high concrete levee and walking path, and artificial fall and riffle zones.

The westernmost boundary of OU1 is roughly 8.5 miles below the Pueblo Reservoir. Multiple discharge conduits from the reservoir release water into the Arkansas River and control flow in the primary channel. Wildhorse Creek, an effluent-dominated creek, flows south into the Arkansas River about 1.75 miles west of the boundary of OU1. Wildhorse Creek flow originates primarily from the Pueblo West wastewater treatment facility. It currently has a Total Maximum Daily Load (TMDL) for *Escherichia coli* (*E. coli*) (COARMA04a).

The Arkansas River flows eastward from Wildhorse Creek through a series of riprap structures to generate whitewater for the Whitewater Park, then through OU1, by the northern edge of OU2, under the Moffat Street pedestrian bridge, over a riprap structure, out of OU1 south of Fountain Lake and west of the BNSF railroad bridge and continues past the confluence with Fountain Creek. The entire section from Wildhorse Creek to Fountain Creek (COARMA03) is currently not attaining water quality standards for selenium, arsenic, *E. coli*, and sulfate. Fountain Creek, a perennial sandy-bottom, warm-water creek, flows into the Arkansas River approximately 800 feet below the easternmost boundary of OU1.

OU1 includes more than 2,000 residential homes, of which approximately 50 percent (%) are rental units (Pacific Western Technologies [PWT] 2020c). A significant majority of the homes in Bessemer and other nearby areas of OU1 were constructed during the years of 1887 to 1909 (DeHerrera et al., 2011).

2.2.3.2 Operable Unit 2 (OU2)

The Site (OU2) includes approximately 45.5 acres with a perimeter of 1.58 miles. It is bounded by South Santa Fe Avenue to the east, the Arkansas River to the north, Interstate 25 (I-25) and the Union Pacific Railroad (UPRR) to the west, and East Mesa Avenue to the south. Benedict Park a small 2.28-acre City of Pueblo owned park is located in the southwest corner of OU2.

The Site is situated at an approximate average of 4,710 feet above sea-level (FASL). The elevation is highest in the south and southeast portions of the Site (approximately 4,761 FASL). The Site grades down in elevation to the north and reaches a low at the Arkansas River (approximately 4,660 FASL). Topography varies east of the UPRR, where moderate depth ravines grade into flat marshy areas.

The Site borders approximately 370 linear feet of the Arkansas River from the I-25 bridge downstream to the South Santa Fe Avenue bridge. This section of the river is approximately 190 feet wide, has a limited amount of seasonal riparian areas and islands, and is flanked by a 20-foot-high concrete levee and walking path to the south. Annual average in-stream temperatures are expected to be like those near the Moffat Street pedestrian bridge, 450 to 811 feet downstream (32 to 82 degrees Fahrenheit [°F]).

Almost 17.9 acres (1.38-mile perimeter) of OU2 are undeveloped, consisting of forest, grassland, and bare ground. Benedict Park, an additional 2.2 acres in the southwest corner of OU2 is covered by manicured grasses. Together, these comprise 44.1% of the total area of OU2. Areas bordering the railroad tracks to the west in OU2 are topographically irregular and include ravine and lower lying collection areas.

Seven irregularly bordered slag piles, some 20 to 30 feet high, have been identified in the ravine and undeveloped areas in OU2 (Figure 4). The two southernmost slag piles are bisected by a social trail (PWT, 2018). A perennial stream flows through these piles and under a culvert into the Arkansas River.

Commercial properties and developed lots (driveways, parking lots, bare spaces) occupy the remainder of OU2. Some entities include St. Mary's Catholic church, CED Greentech electrical supply store, Northern Colorado paper, Ryder Truck Rental and maintenance shops, Chem Way, Inc., Domenic and Sons (paint and body), Angel's Transmission and Auto Repair, State Wide Financing, Ace Enterprises, Inc., and Top Notch Trailers in Pueblo (PWT, 2018; Google search).

In 2015, EPA installed "Caution" and "No Trespassing" signs along the southern edge of the Site to limit access to slag piles. Fencing was also installed north of Benedict Park to discourage access to the slag piles.

2.2.4 Site Meteorology

The area's long-term temperature/precipitation averages range from 30.8 °F/0.34 inches (January) to 74.1 °F/2.01 inches (July). Total annual precipitation averages around 12 inches, mostly from sporadic summer thunderstorms. Tracks of thunderstorms between the South Platte and Arkansas rivers have produced up to 24 inches of rain in 12 hours. Prior to the construction of flood control measures, heavy sporadic rainfall across the drainage basin resulted in water volumes that exceeded stream channel carrying capacity.

A decadal wind rose generated for the Pueblo area (January 1, 2008, to December 31, 2018) demonstrates that prevailing winds are primarily from west to east. Overall, average wind speeds range from 8.0 to 12.9 miles per hour with the highest average wind speeds arising from the north and north-northeast. Other reports suggest prevailing winds are from the northwest and average 7.6 miles per hour (McVehil-Monnett Associates, 2019).

2.2.5 Site Geology and Soils

Pueblo is underlain by lithified sedimentary rocks and surficial deposits. The sedimentary rocks are marine in origin and of the Cretaceous age (70-110 million years ago). The lithified sequences are made up primarily of shale, claystone, and siltstone. Surficial deposits are mostly non-marine alluvial, eolian, and colluvial materials of Quaternary age (1.5 million years ago to present). Artificial fill has also been contributed by human activities (Scott, 1969).

The Colorado Smelter lies within a small ravine draining to the north into the Arkansas River. Quaternary age Slocum Alluvium (composed of coarse sand, gravel, and boulders) and Louviers Alluvium (channel fill composed of fine to coarse gravel with cobbles and pebbly silt) comprises the terrace deposits. The Cretaceous Pierre Shale (calcareous clayey shale, platy, with thin siltstone and bentonite interbeds) underlies the Quaternary Alluvium and has a regional dip to the northeast. The Pierre Shale has low permeability and groundwater seeps are noted along the contact with the upper Quaternary Alluvium. Artificial fill is present on the surface in many areas and is underlain by the Quaternary Alluvium or Pierre Shale depending on the area (PWT, 2023b).

The Pierre Shale and Niobrara are two geological marine formations that underlie Pueblo and the surrounding areas. Both the Pierre Shale and Niobrara formations contain selenium and uranium. Water flowing from seeps that emerge from the interface of member formations with overlying material also have high concentrations of sulfate. Extensive application of irrigation water in use and reuse cycles on areas over these formations is thought to increase the dissolution of selenium and uranium from these soils and rocks. This, in turn, proportionately increases ground- and surface water concentrations of these metals.

2.2.6 Site Hydrology

Pueblo lies within the Arkansas River drainage basin and the Middle Arkansas River sub-basin. It sits at the confluence of three separate drainage basins including the Upper Arkansas River Subbasin, the Middle Arkansas River Subbasin, and the Fountain Creek Subbasin. The 2020 Colorado Segmentation Guide (CDPHE, 2023) identifies a portion of the Arkansas River that flows through OU1 as COARM03_A, and that portions of Runyon Lake, Fountain Lake and Valco Ponds as COARMA_28. COARM03_A is currently on the Colorado 303d list of impaired or threatened waters for selenium (dissolved, site specific chronic standard of 17.1 micrograms per liter [µg/L], aquatic life use), arsenic (total, 0.02 µg/L standard, water supply use), and *E.coli* (126 per 100 milliliters [mL] in at least samples in a two-month period, recreational use). Sulfate is also elevated slightly in this segment (>250 mg/L) in one of three locations.

The City of Pueblo has a discharger-specific variance (DSV) for selenium and sulfate. Infiltration and basement sump pump discharge into the sanitary sewer system are thought to contribute to elevated background levels of selenium in the sewer influent. Pueblo has undertaken extensive pipeline renovation to mitigate this infiltration and inflow issue.

Aquatic areas include a perennial stream that passes through OU2 as well as channelized areas of the Arkansas River to the north of OU2. The stream originates from a storm drain at West Arroyo Avenue, flows north along the base of the ravine, passes under or near slag piles in OU2, and enters a storm drain on the southeast corner of OU2 at the southeast corner of parcel 1501135002 at 771 S Santa Fe Avenue. This culvert goes under Santa Fe Avenue and drains into the Arkansas River east of Santa Fe Avenue and west (upstream) of the pedestrian bridge that crosses the Arkansas River on the Arkansas River Trail (PWT, 2023). Stream flow is expected to oscillate in both water courses with local rain as well as spring snow melt. As with OU1, channelization of the Arkansas river at the northern border of OU2 has changed river hydrodynamics substantially.

The USGS gauging station 7099970 is located at the point of discharge. Four similar ravines with small streams are present in OU1, three to the east and one to the west of OU2, which will also be assessed in conjunction with the sitewide ecological investigation. Runyon Lake and Fountain Lake were both created by sand and gravel operations in the early 1950s (Colorado Geological Survey, 1974).

2.2.6.1 Historical Flooding in Pueblo and Adjacent to the Colorado Smelter Site

Flood events have shaped much of Pueblo's hydrologic history since the area was originally settled. Area flooding after 1883 has affected the distribution of contaminants adjacent to the smelter and that were deposited aerially. Anecdotal observations suggest that the 1894 flood impacted a portion of downtown Pueblo and left flooded cellars, reworked surface soil, and debris in large areas in southern Pueblo (Cohen, 2020). The flood included portions of OU1 and OU2. Flooding may have reworked materials on the western edge of OU1. Debris and silt, sometimes 18 inches deep, was left in flooded areas after the water receded (Figure 5).

Much of the areal flooding has been contemporaneously controlled by alteration of the river course, constructing levees, and constructing a dam/reservoir system to receive and direct upstream flood waters. Re-channelization of the Arkansas River to the south of downtown has also changed the distribution of natural and anthropogenic contaminants in northern portions of the OU sites. Current Federal Emergency Management Agency flood maps (Figure 5) suggest that most future flooding is expected to occur downstream or south of Pueblo.

2.2.7 OU1 Habitat

Several habitat types are within the OU1 site and are considered in the screening level problem formulation: aquatic (in-stream), wetland, riparian, and upland.

Aquatic areas include the Arkansas River, Runyon Lake, Fountain Lake, and perennial and intermittent streams that pass through ravines outside of OU2 (Figure 1). Aquatic areas also include channelized portions of the Arkansas River. In these areas, concrete flood levees have channelized river flow, resulting in hydrodynamics more typical of steep elevation water courses.

Wetland and riparian areas border stream and riverine environments in OU1. Forested areas border riparian areas (Figure 5). These have been classified as "Forested Deciduous," "Forested Evergreen," and "Shrub" riparian areas by Colorado Parks and Wildlife in the Colorado Wetland Inventory Riparian Mapping Layer. Extensive "Herbaceous" areas are denoted in areas bordering the western shores of Runyon Lake.

Upland habitats border riparian areas and areas with higher slopes in areas of OU1.

Aquatic ecological receptors (aquatic plants, macroinvertebrates, and fish) are thought to use aquatic, wetland, and riparian habitats. Terrestrial receptors that are dependent on aquatic environments (piscivorous birds, mammals, amphibians, reptiles, etc.) also use these habitats. Other terrestrial receptors (plants, soil invertebrates, terrestrial birds, mammals, reptiles) use the riparian, and upland habitats.

2.2.8 OU2 Habitat

Several habitat types are within OU2 and are considered in the screening-level problem formulation: aquatic (in-stream), wetland, riparian, midland, and upland.

OU2 has a small wetland of approximately 3,400 square feet in the center of the property to the north of the historic Smelter Buildings (Figure 3). This wetland is not identified on the Colorado Wetland Inventory (Figure 6).

Small riparian areas border the stream and wetlands in OU2. Forested areas border riparian areas and areas with higher slopes in the ravine to the center west of the OU2 property. These have been classified as “Forested Deciduous” riparian areas by Colorado Parks and Wildlife (Figure 6).

Midland and upland habitats border riparian areas and areas with higher slopes in OU2 .

Aquatic ecological receptors (aquatic plants, macro-invertebrates, and fish) are thought to use aquatic, wetland, and riparian habitats. Terrestrial receptors that are dependent on aquatic environments (piscivorous birds, mammals, amphibians, reptiles, etc.) also use these habitats for various purposes. Other terrestrial receptors (plants, soil invertebrates, terrestrial birds, mammals, reptiles) use the riparian, and upland habitats. Mule deer, red fox, wild turkey, and other small mammals and songbirds are thought to inhabit the ravine area. Waterfowl may utilize the wetlands as well as the Arkansas River areas north of OU2 (PWT, 2018).

3 Ecological Conceptual Site Model

The conceptual site model (CSM) is the foundation of the SLERA. It is formulated based on knowledge of sources, contaminants, complete exposure pathways, and receptor groups for the different habitat areas. Figure 6 is a diagrammatic representation of the CSM.

Development of the CSM involves a description of exposure scenarios, or how the contaminant interacts spatially and temporally with ecological components in the area under consideration. Contaminant sources, environmental transport, partitioning, chemical or biological transformation, and potential exposure routes are all considered in these scenarios. CSM exposure scenarios most likely to contribute to risk are used as input to the assessment's analysis phase (EPA, 1992) and may be refined as additional information and data are obtained.

3.1 Contaminants Known or Suspected to be Present at the Site

The primary ecological concerns for this Site involve the potential for wildlife to directly be exposed to COPECs sources from Site activities in various environmental media or indirectly through bioaccumulation in the food web. Primary sources of COPECs include smelter waste, railroad waste, and other miscellaneous activities associated with small businesses on the Site.

3.1.1 Smelter Waste

The former Colorado Smelter operated from 1883 to 1908, smelting lead-iron-carbonate ore that had been extracted from the Madonna Mine in Monarch, Colorado. Waste slag from the process was disposed of into one of seven piles in the nearby ravine. Waste emissions from the smokestacks deposited heterogeneously in the area surrounding the stacks; atmospheric deposition was influenced by weather dependent and smelting processes.

The Water Quality Control Division of CDPHE and the PWTP identified elevated iron and zinc in a surface water grab sample collected in OU2 in 1989. CDPHE and EPA contractors collected data in 1994 and 1995 that suggested there were elevated levels of lead and arsenic in surface waters draining OU2.

A technical memorandum prepared in support of a preliminary human health risk assessment (HHRA) of the smelter site area and OU1 (PWT, 2020b) compared maximum detected concentrations of 17 contaminants to human risk-based screening levels (RBSLs). Antimony, arsenic, cadmium, copper, lead, manganese, nickel, thallium, and zinc exceeded RBSLs and were considered preliminary human health contaminants of potential concern (COPCs). Cobalt and vanadium also exceeded their RBSLs but were not considered preliminary COPCs because the detected concentrations were within the background range. Mercury also exceeded its RBSL, but only in a limited number of samples, so was not considered a preliminary COPC. Barium, beryllium, chromium, selenium, and silver did not exceed their respective RBSLs and were not retained as preliminary human health COPCs.

3.1.2 Railroad Waste

Numerous railroad lines supplied ore and combustible materials to the smelter while it was operating. Historical railroad lines are shown in Figure 3. Potential railroad waste includes coal and coal ash, coke (refined coal), creosote and polycyclic aromatic hydrocarbons (PAHs) from railroad ties, and various metals from railroad bed fills created from slag or other mining waste.

In November 2023 the *Data Summary Report, Focused Site Characterization, Union Pacific Railroad (UPRR) Right-of-Way (ROW)* was finalized (Jacobs, 2023). This site characterization evaluated the ROW

from E. Mesa Avenue on the south, to the I-25 crossover on the north, with the objective of gathering concentrations of potential contaminants within the UPRR ROW to determine if there were contaminant concentrations associated with slag material. Concentration data for the ROW are not included in this SLERA. Incorporation of data from the ROW investigation would not likely impact the list of COPECs in the SLERA; however, these data are expected to be incorporated in the Baseline Ecological Risk Assessment (BERA).

3.1.3 Onsite Housing and Business Waste

A supervisor's house and a boarding house were located near the southern edge of OU2 just north of St. Mary's Church. Waste from the supervisor's house and a boarding house is not thought to have contributed substantially to the overall waste burden from smelter activities.

Businesses in OU2 are identified in the OU2 Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP; PWT, 2018). These businesses include lawn care companies, truck/trailer rental, and auto repair facilities. A lumber company historically operated on OU2. Potential contaminants associated with these activities include pesticides, gasoline, diesel, oil, antifreeze, brake/transmission fluids, other automobile fluids, volatile organic compounds (VOCs), solvents, paints, metals, acids, refrigerants, and chromated copper arsenate (CCA).

3.2 Contaminant Fate and Transport Processes

The goal of the contaminant fate and transport evaluation is to identify the major elements of a complete exposure pathway. These elements include: 1) source(s) of contamination; 2) release and transport mechanisms; 3) contact points and exposure media; 4) routes of entry; and 5) receptors. The ecological conceptual site model for the Site is shown in Figure 7.

3.2.1 Source(s) of Contamination

The primary sources of contamination for OU2 include smelter waste piles and smelter contamination from deposited stack, forge, and kiln emissions. Secondary sources of contamination include railroad-associated debris, including clinkers generated from train engines and coal and coke fuels, and residential and commercial building area debris including solvents, pesticides, liquid fuels, and other materials.

3.2.2 Release and Transport Mechanisms

Contamination from the smelter or associated waste can physically migrate to other locations, thereby contaminating other environments. The transport processes involved in this are termed release mechanisms. Several release and transport mechanisms potentially affect the levels and spatial distribution of contaminants in the terrestrial and aquatic habitats of the Site. In general, the mechanisms that are associated with smelting and mining-related activities include:

- ***Wind transport of contaminated soil or materials*.** Soil or particulate material may be transported by air following wind erosion events. Disturbance of contaminated soil or materials may facilitate wind erosion, thereby increasing contaminant movement and receptor exposures.
- ***Physical dispersal of contaminated soil or materials.*** Soil or particulate materials may be disturbed by anthropogenic, animal, or plant activity. Burrowing animals may uncover contaminated materials. Fallen trees may expose roots surrounded by contaminated materials. Anthropogenic activities such as construction may also disturb contaminated materials, making it more susceptible to wind and water transport.

- ***Water transport of contaminated soil or materials.*** Soil or particulate material may be transported by rainfall or water runoff. Water activity can transport contaminated materials overland or in the water as sediment.
- ***Leaching of contaminated soil or materials.*** Temporary or permanent immersion in water can result in contaminant transfer from one medium (e.g., air, soil) to an aquatic one. Contaminants can remain in solution in the aquatic environment, re-adsorb to another aquatic media such as sediment or organic matter, be ingested, or partition otherwise into aquatic organisms. Aquatic organisms can be exposed to water or sediment contaminants. Terrestrial organisms can ingest contaminated surface or groundwater.
- ***Trophic transport of contaminants.*** Ingestion, adsorption, or absorption of contaminants into organisms in terrestrial or aquatic food chains can result in organisms that carry a burden of contaminants ("bioaccumulation"). Ingestion of contaminated organisms by organisms higher on the food web can result in biomagnification of the contaminant in higher level organisms.

3.2.3 Contact Points and Exposure Media

The SLERA evaluates the contact points associated with the terrestrial and aquatic habitats at and around smelter waste piles, overbank soils, sediments, water, and other contaminated materials throughout the Colorado Smelter area. The exposure media include mine waste, contaminated soil, sediment, organic debris, and water. As noted in the UFP-QAPP (PWT, 2018), contaminated biota will be considered in assessments after completion of the SLERA, if necessary.

3.2.4 Routes of Entry

The main routes of entry evaluated in this SLERA for terrestrial and aquatic community-level receptors and wildlife receptors feeding on those community level receptors and other prey items include: 1) direct surficial contact with contaminated mine waste, soil, sediment, or organic debris; 2) direct ingestion of contaminated mine waste, soil, sediment, or organic debris; and 3) direct ingestion of contaminated food items.

Exposure to contaminants by wildlife receptors via inhalation is considered to be a minor route of exposure at this Site when compared to ingestion. Therefore, inhalation is not considered in this assessment. More complete exposure models will be used to refine risk estimates in the aquatic and terrestrial BERA, if necessary.

3.2.5 Key Receptors

Terrestrial and aquatic community-level receptors. This SLERA assumes that terrestrial and aquatic plants, animals, and invertebrates are directly exposed to smelter-related contaminants in terrestrial and aquatic habitats associated with mine waste piles, overbank soils, and other materials.

Wildlife receptors feeding on food items. This SLERA assumes that the following general types of wildlife receptors may become exposed to smelting-related contaminants in terrestrial and aquatic habitats associated with smelter waste piles, overbank soils, and other media at the Site: (a) herbivorous birds, mammals, and fish; (b) omnivorous birds, mammals, and fish; (c) carnivorous birds, mammals, and fish.

3.3 Potential Receptors of Concern and Exposure Pathways

Site visits, quantitative surveys, and relevant literature inform assessors as to the occurrence of aquatic and terrestrial species on or adjacent to the OU1 and OU2 sites. Since many receptors are highly mobile geographically, species occurrence in the entire county of Pueblo has been used in some cases to outline species potentially present in OU1 and OU2.

3.3.1 Aquatic Receptors

The aquatic community at the Site is expected to comprise populations with habitats of varied complexity, ranging from tiny seeps and small streams to larger riverine environments. Some of these habitats are ephemeral and reliant on wet-weather events. Other aquatic habitats are perennial. A substantial portion of the Arkansas River system adjacent to the Site is channelized to prevent flooding. Channelization changed natural riparian areas to concrete levee walls, and increased velocities and substrate pass-through in mid-channel environments. The upstream Pueblo Storage Reservoir Dam mitigates periodic flood events. Even so, aquatic receptors in this area are probably affected by periodic catastrophic flood events originating in other drainage basins. Portions of a few impoundments (e.g. Runyon Lake) are also in the area under consideration for ecological risk evaluation. Receptors in lacustrine environments are expected to overlap compositionally to some extent with those from the Arkansas River.

3.3.1.1 Fish

Fish are geographically highly mobile and are abundant in most water bodies that aren't seriously degraded. They prey and/or are preyed upon by invertebrates, other fish, amphibians, reptiles, mammals, and birds.

Surveys by Colorado Parks and Wildlife and CDPHE identified 21 fish species in areas surrounding OU1 and OU2. These are listed in Appendix A.

3.3.1.2 Benthic and Other Invertebrates

Benthic and other aquatic invertebrates hold important positions in the aquatic food web because they process detritus and consume phytoplankton and other aquatic plants. They also are prey for other macroinvertebrates, fish, and other wildlife. Aquatic surveys in 2005 identified 49 aquatic invertebrates in the Arkansas River (Appendix A).

3.3.1.3 Amphibians

Amphibians utilize both aquatic and terrestrial environments at some points in their life cycle. In larval aquatic life-stages they can be phytophagous and opportunistic invertivores. Later, juvenile and adult stages can even be piscivorous and carnivorous (eating fish, other amphibians, birds, and small mammals).

Ten amphibian species in the Pueblo area have been identified as "Research Grade[2]" by iNaturalist (iNaturalist, 2021) (Appendix A).

Hypothetical exposures from the aquatic food chain and being in direct contact with contaminated sediment and water are possible for amphibians. Empirical exposure and toxicity data on amphibians

[2] Research Grade indicates that the identification has agreement among the scientific community.

are not available. In this SLERA, therefore, more attention is given to bird and mammal exposures and potential risk.

3.3.2 Terrestrial Plants and Soil Organisms

Plants provide significant structural and functional benefits for terrestrial ecosystems. Riparian areas for OU1 and OU2 have been classified as "Forested Deciduous," "Forested Evergreen," and "Shrub" riparian areas by Colorado Parks and Wildlife. Extensive "Herbaceous" areas have also been denoted in areas bordering the western shores of Runyon Lake. Soil organisms and insects play important roles in aquatic and terrestrial ecosystems. They function in processing detritus and being the base of both aquatic and terrestrial food webs. Appendix A presents a summary of species in the Pueblo area identified as "Research Grade" by iNaturalist (iNaturalist, 2021), as follows:

- 420 species of plants.
- 905 species of insects.
- 23 species of spiders and mites.

3.3.3 Reptiles

Reptiles occupy terrestrial and riparian habitats in OU1 and OU2. This class includes omnivores, invertivores, herbivores, piscivores, and carnivores. Reptiles are expected to ingest plants, invertebrates, amphibians, reptiles, fish, birds, and mammals. Various life-stages of reptiles may in turn be eaten by other predators. As shown in Appendix A, 30 reptile species have been identified as "Research Grade" by iNaturalist in the Pueblo area. Exposure and toxicity data on reptiles are not available. In this SLERA, therefore, more attention is given to bird and mammal exposures and potential risk.

3.3.4 Birds

Numerous resident and migratory birds use areas on or adjacent to OU1 and OU2. The immense variety of bird species means that exposures occur in a variety of settings. Birds may complete their entire life cycle on the Site (nest, rear young, fledge) or pass-through as migrants. Predatory birds eat fish, reptiles, mammals, and other birds on the Site. Birds associated with aquatic environments eat aquatic plants, benthic invertebrates, and fish in stream, seep, river, and lake environments. Terrestrial birds eat insects, plants, berries, flowers, and other forage found in this environment. Three-hundred forty bird species in the Pueblo area are identified as "Research Grade" by iNaturalist (Appendix A).

3.3.5 Mammals

Terrestrial, aquatic, and riparian-dependent species of mammals occur at the site. Mammals consume plants, invertebrates, amphibians, reptiles, birds, and other mammals. They also may be preyed upon by other mammals, reptiles, amphibians, and birds.

Aquatic and riparian mammals such as muskrat and beavers inhabit floodplain and wetland areas and forage for plants and animals in those corridors. Mammals, such as raccoons, forage in both environments. Terrestrial mammals such as mule deer, red fox, squirrels, and voles have been observed at sites within and adjacent to OU1 and OU2. These and other terrestrial mammals use the upland areas to forage, but also visit riparian areas to drink. Larger mammals are typically not constrained by geography. Domestic mammals, such as cats, dogs, cattle, and horses, may be encountered in areas adjacent to the sites. Forty mammal species (wild and domestic) in the Pueblo area have been identified as "Research Grade" by iNaturalist (Appendix A).

3.3.6 Endangered, Threatened, and Sensitive Species

Sixteen bird, ten mammal, three reptile, one insect, one fish and one amphibian species have been listed in Pueblo County as Federally Endangered, Threatened, Candidate, or Species of Concern species in the Environmental Conservation Online System (ECOS) or in the United States Fish and Wildlife Service Information for Planning and Consultation (IPaC) system. Species lists are provided in Appendix A.

3.4 Potential Exposure Pathways

Complete exposure pathways include the following four elements:

1) ***A source of contamination*** (e.g. slag waste, overbank soils, mine tailings). Sources of environmental exposure are identified in Section 3.1.
2) ***Environmental transport and/or exposure media*** (e.g. leaching of contaminants into water, soil adsorption, and exposure from hydrologic or atmospheric events). Transport and exposure media are identified in Section 3.2.
3) ***Contaminant interaction with a target receptor*** (e.g. direct ingestion, inhalation, dermal contact, secondary contact through contaminated food). Interaction with target receptors is identified in Section 3.3.
4) ***A target receptor and likely route of exposure*** (e.g. animal swimming or feeding in contaminated water, plant growing in contaminated soil). Target receptors are identified in Section 3.3.

This SLERA considers all four elements present at the Colorado Smelter site in OU1, OU2, and other areas outside OU1. Routes of exposure are how a contaminant can be transferred from a contaminated medium to ecological receptors. The principal receptor groups of concern and routes of exposure evaluated in the aquatic and terrestrial SLERA are:

- **Aquatic plants and animals.** Internal contact with particulate mine waste, impacted sediments, impacted debris, or contaminated food items (direct ingestion).
- **Aquatic plants and animals.** Surficial contact with particulate or dissolved mine waste, impacted sediments, or impacted debris.
- **Terrestrial plants and animals.** Surficial contact with particulate mine waste, impacted soils, or impacted dust or debris.
- **Terrestrial plants and animals.** Internal contact with particulate mine waste, impacted soils, impacted dust or debris, or contaminated food items (direct ingestion).

3.5 Preliminary Assessment Endpoints and Measures of Exposure and Effects

3.5.1 Assessment Endpoints

Assessment endpoints are those characteristics in the ecological system that are to be “protected.” These endpoints are synonymous with a healthy and self-sustaining population or community. Assessment endpoints typically include growth, survival, and reproduction, but can be more generic. Using the appropriate assessment endpoints ensures that the risk assessment evaluates the ecological attributes that are of primary importance to risk managers.

3.5.2 Measurement Endpoints

Measurement endpoints (measures of exposure and effects) are quantifiable ecological factors or characteristics that can be compared to assessment endpoints. Choice of the correct measurement endpoint is important in describing potential effects to assessment endpoints.

3.5.3 Compilation of Assessment and Measurement Endpoints

Currently, no assessment data for OU1 and OU2 are available, so concentrations of contaminants in Site media are used to compare to "benchmark" or "reference" concentrations derived from toxicity testing to infer what the potential risk might be in the exposed receptors. The preliminary assessment and measurement endpoints developed for receptors at the site for this SLERA are summarized in Table 3-1.

Table 3-1. Generic Preliminary Assessment and Measurement Endpoints

Assessment Endpoint	Measurement Endpoint
Protection of aquatic plants, benthic invertebrates, fish, and amphibians from adverse effects related to exposure to contaminants in surface water and sediment.	Comparison of contaminant concentrations in surface water and sediment to aquatic toxicity benchmarks.
Protection of terrestrial plants and soil fauna from adverse effects related to exposure to contaminants in surface soil.	Comparison of contaminant concentrations in soil to terrestrial toxicity benchmarks.
Protection of wildlife from adverse effects to growth, reproduction, or survival related to exposure to contaminants in surface water, sediment, soil, and food items.	Comparison of the contaminant concentrations developed using average daily doses of contaminants from surface water, sediment, soil, and food to toxicity reference values.

4 Identification of Contaminants of Potential Ecological Concern

4.1 Evaluation of Existing Data

This SLERA evaluates the 45 acres of OU2 and the entire footprint of OU1. Soil, surface water, sediment, and pore water were evaluated over the entire combined area of OU1 and OU2 shown in Figure 1. Sampling events were conducted by various entities within the areas of OU1 and OU2 from 1991 to 2023. Each of these investigations is described briefly below.

4.1.1 Historical Site Investigations

Several site investigations were performed by CDPHE and by an EPA contractor, Ecology and Environment, between 1991 to 2006. Due to data quality insufficiencies as identified in the UFP-QAPP (PWT, 2018), data from these sources is not included in this SLERA but is briefly described for historical context below.

In 1991, CDPHE conducted a preliminary assessment of the Santa Fe Bridge Culvert site (COD982572513). Through this process, several smelters were identified to have operated in the Pueblo vicinity from 1878 to 1921, including Colorado Smelter. CDPHE pursued further investigation into remaining slag piles, especially in residential areas. Residential soil samples were collected in 1994 across the Pueblo area. Thirteen source samples were collected, including two samples from the Colorado Smelter waste piles. Thirty-five samples were collected within 200 feet of residences, and four background samples were collected. Concentrations of arsenic in all residential soil samples were elevated compared to the Superfund Chemical Data Matrix (SCDM) for cancer risk (0.43 milligrams per kilogram [mg/kg]) and 11 samples were significantly elevated over background. Eight of the samples with elevated arsenic were from locations within 1 mile of the Colorado Smelter.

In 1995, an EPA contractor performed *in situ* x-ray fluorescence (XRF) for lead and arsenic on eight waste pile samples on the Site. No background analysis was performed. Arsenic was not detected in the analyzed samples above the XRF detection limit of 67 mg/kg, though that detection limit was significantly above the SCDM benchmarks for cancer (0.43 mg/kg) and non-cancer (23 mg/kg). Due to this limitation, the full extent of arsenic contamination could not be sufficiently established. Lead analytical results ranged from less than 100 mg/kg to 9,700 mg/kg, with concentrations in two samples exceeding 400 mg/kg, the EPA-recommended screening level at the time.

Later in 1995, the EPA contractor collected 88 soil samples from the Colorado Smelter slag pile and adjacent soils in a systematic grid. The samples were analyzed for arsenic, cadmium, and lead using XRF. Seventeen samples were sent for confirmatory analysis. The laboratory analysis and XRF results showed poor correlation for arsenic and cadmium, limiting their value. The lead XRF analysis correlated well with the laboratory lead results. Lead concentrations in 59 of the 88 samples exceeded 400 mg/kg, with lead in the slag pile ranging from 56 mg/kg to 9,300 mg/kg.

In 2006, researchers at the Colorado State University in Pueblo collected surface soil samples (Diawara et al, 2006). Sixty-eight soil samples were collected at 33 locations and analyzed for arsenic, cadmium, lead, and mercury. Samples were collected every 2 kilometers along four parallel transects running northwest to southeast across the city limits. Two sets of paired samples were collected within 1 mile of the Site. Concentrations of arsenic in all 68 soil samples exceeded the carcinogenic SCDM benchmark, though only 10 samples had arsenic concentrations three times the average background level of 7.2 mg/kg. None of the soil samples exceeded 400 mg/kg for lead.

While these previous investigations played pivotal roles in identifying contamination at the Site and enabling nomination of the Colorado Smelter for the NPL, these data do not meet the data quality standards for use in the SLERA.

4.1.2 CDPHE (2010)

In 2010, CDPHE launched a soil sampling event that included sample collection from waste piles, residential yards, public access road ROWs, and vacant lots, as well as background soil samples for metals analysis. Waste pile samples were collected from four locations. Two background soil samples were collected from an area 2 miles northwest of the Site considered unlikely to be impacted by emissions from the Site. Residential soil samples were collected from 47 residential properties, four road ROWs, or vacant lots. All soil samples were collected using multi-incremental sampling.

Soil and waste pile samples were analyzed at the Superfund Technical Assessment and Response Team (START) laboratory in Denver, Colorado using an XRF analyzer. Samples were then dried, sieved, and composited into 88 multi-increment samples, which were analyzed with the XRF. Forty-four of 439 individual aliquot samples and 11 of the 88 multi-increment samples were sent for confirmatory analysis by EPA's Contract Laboratory Program (CLP). High levels of lead were observed in the waste piles and residential yards.

Six water samples, including one duplicate, were collected from on-Site, probable points of entry, and the Arkansas River. Four co-located sediment samples were also collected. All surface water and sediment samples were submitted for metals analysis through EPA's CLP. Surface water samples at two locations showed elevated cadmium, copper, iron, lead, and zinc. Sediment samples at two locations showed elevated levels of arsenic and lead. Data from the 2010 CDPHE report are considered screening level data and were not used in the SLERA due to different sampling methods utilized and the lack of the supporting analytical data packages.

4.1.3 EPA/PWT Sampling (2015-2020)

4.1.3.1 Demonstration of Methods Applicability (2015)

The Demonstration of Methods Applicability (DMA) was conducted for EPA by PWT (PWT, 2015). For the DMA, soils were assessed at 12 residential properties and six smelter/slag areas in May and June 2015. Soil samples were analyzed for lead, arsenic, antimony, cadmium, copper, and zinc via field based XRF. Target Analyte List (TAL) metals in select soil samples from residential and former smelter area were analyzed under the EPA's CLP program using inductively coupled plasma--mass spectrometry (ICP-MS) by EPA method 6020B. Elevated lead and arsenic levels were measured in slag waste pile samples.

As part of the OU1 DMA, three of the six slag waste pile samples underwent bioavailability and geospeciation analysis. The mean relative bioavailability from three waste pile samples was 55% for lead and 49% for arsenic (PWT, 2017a). Geospeciation results showed that relative arsenic masses were dominated by lead-arsenic oxide (PbAsO), calcium-arsenic oxide (CaAsO), iron hydroxide (FeOOH), and phosphate (PWT, 2017b). Relative lead masses were dominated by PbAsO, galena, cerussite, phosphate, slag, and FeOOH (PWT, 2017b).

4.1.3.2 OU1 Remedial Investigation (RI)

Soil sampling for the OU1 RI began in May 2015, with an early action interim record of decision (iROD) finalized in September 2017 to initiate remedial action for OU1 (EPA ,2017). A Draft RI Report for OU1 (PWT, 2020d) summarized dust sampling results for 1,020 residential properties and soil sampling

results for 1,393 properties, including all the parks, schools, and alleys in OU1. Samples were prepared for analysis in a field laboratory. This including drying and sieving with #10 mesh (excludes material less than [<] 2 millimeters [mm] in diameter) and a #60 mesh (excludes material > 250 micrometers [µm]). The passing #60 mesh sample (<250 µm) was measured using an XRF unit (Niton XL3t 955 GOLD Ultra) with target analytes lead and arsenic. A subset of samples was subsampled for ICP-MS metals analysis by Method 6020b. Samples from Runyon Field also underwent analysis for semivolatile organic compounds (SVOCs) via Method 8270D with selective ion monitoring (SIM), VOCs via Method 5035A/8260B, and hexavalent chromium via Chromium Speciation Analysis (IC-ICP-MS). Soil lead concentrations from individual DUs ranged from 7.27 to 4,870 parts per million (ppm), with a mean of 256.9 ppm. Soil arsenic concentrations from DUs ranged from 1.74 to 642 ppm, with a mean of 19.9 ppm.

In vitro bioaccessibility assays were conducted on 50 residential yard soil samples and three waste pile samples from a range of depths between 0 and 18 inches below ground surface (bgs). Soil samples (n=50) had a lead relative bioavailability mean of 65%, with a standard deviation of 8.2%. The waste pile soil samples (n=3) had a mean lead relative bioavailability of 55%, with a standard deviation of 13.2%. Arsenic relative bioavailability from soil samples (n=45) had a mean of 48%, with a standard deviation of 10.6%. Waste pile soil samples (n=3) had an arsenic relative bioavailability of 49%, with a standard deviation of 7.9% (PWT, 2020b).

Certain locations in the OU2 footprint were sampled as a part of the OU1 RI due to their frequent use and potential for high exposure to residents. Locations relevant to the OU2 SLERA include Benedict Park. Surficial soil in Benedict Park was sampled as part of the OU1 RI in 2017 (PWT, 2020d). Arsenic and lead concentrations detected in soil exceeded the residential cleanup levels established in the iROD (61 ppm for arsenic, 350 ppm for lead). Two playground areas were remediated to a depth of 2 feet by EPA. Soil sampling was performed at several other city parks including Bessemer, Stauter, Little Chief Park, and Bessemer School Park. Soil concentrations of arsenic and lead were below the action levels in the iROD (EPA, 2017) and it was determined that cleanup was not needed at these parks. Soil sampling was conducted at Moynihan Park and Runyon Fields, a county-owned baseball park, in 2018, and a risk assessment determined that cleanup was not needed (PWT, 2020d).

4.1.3.3 OU2 Remedial Investigation (RI)

EPA initiated a sampling event detailed in the OU2 UFP-QAPP (PWT, 2018) to collect samples of surficial soils, surface water, sediment, and pore water. EPA sampled surficial soils in former smelter footprint from 2019 through 2023 (PWT, 2023b). This is an ongoing effort; the following is a summary of the 2023 Revision 3 OU2 UFP-QAPP (PWT, 2023b) sampling strategy elements completed to date:

Table 4-1 Completion Status of OU2 UFP-QAPP Sampling Strategy Elements

OU2 UFP-QAPP Sampling Strategy Elements	OU2 UFP-QAPP Completed Sampling	OU2 UFP-QAPP Sampling Not Completed
Surficial soil characterization of 41.5-acre DUs within OU2 Former Smelter area, excluding Benedict Park.	Sampling of 38 DUs within OU2. Results are summarized in the *Technical Memorandum, Operable Unit 2 Surficial Soil Data Summary* (PWT, 2022a). Benedict Park and three DUs within the St. Mary Parish ownership area were not sampled under OU2; these were sampled under OU1, community soils, as summarized in *Remedial Investigation Report for Colorado Smelter Operable Unit 1* (PWT, 2020d).	

OU2 UFP-QAPP Sampling Strategy Elements	OU2 UFP-QAPP Completed Sampling	OU2 UFP-QAPP Sampling Not Completed
Surficial soil characterization of 89, 1-acre DUs to support Sitewide Ecological Risk Assessment of OU2 Undeveloped Areas	Sampling of 12 DUs. Results are summarized in the *Technical Memorandum, Operable Unit 2 Surficial Soil Data Summary* (PWT, 2022a). The remaining 77 undeveloped DUs were sampled in late 2022 through May 2023 (PWT, 2023b).	.
Sampling of slag and surficial soil exposed on the surface in OU2 Former Smelter using 30-point incremental composite sampling.	March 2023 sampling of exposed slag on the surface inside of OU2 consisting of 12 DUs comprising slag. Exposed surface soils within OU2 consisting of approximately 25, 1/2-acre, DUs have been sampled.	
Data generated from the focused sampling of the former smelter slag/soils area to determine the relative bioavailability of arsenic and lead in smelter-related soils.	Exposed slag sample analytical results from 12 DUs were sampled for determination of the relative bioavailability of arsenic and lead. Exposed surface soils within OU2 consisting of approximately 25, 1/2 - acre, DUs have been sampled for determination of the relative bioavailability of arsenic and lead.	
Sediments characterization at approximately 32 locations.	Sediment sampling at 19 locations. Results provided in the *Technical Memorandum, Surface Water, Pore Water, and Sediment Data Summary Report*. (PWT, 2023a). Thirteen locations near Runyon Lake were sampled in May 2023.	
Pore water characterization at approximately 32 locations.	Pore water sampling at 12 locations. Seven locations did not have sufficient pore water available for sampling. Results provided in the *Technical Memorandum, Surface Water, Pore Water, and Sediment Data Summary Report* (PWT, 2023a). Eleven of 13 locations near Runyon Lake were sampled in May 2023. Two locations did not have sufficient pore water available for sampling	
Surface water characterization at approximately 21 locations and sampled quarterly for one year. Ecological surface water sampling of 19 locations around Runyon Lake, the Arkansas River, and the ravine in OU2 for one-time sampling events.	Surface water sampling at 21 locations quarterly for one year. Results provided in the *Technical Memorandum, Surface Water, Pore Water, and Sediment Data Summary Report* (PWT, 2023a). Approximately 12 locations near Runyon Lake and four locations in the Arkansas River were sampled in May 2023. Three sample locations in the ravine of OU2 were sampled in August 2023.	
Subsurface slag and soils (deeper than 2 feet bgs) characterization for contamination, depth, volume, stability, etc. Subsurface soil characterization using approximately 35 proposed boreholes	Sampling of subsurface slag and soils at 31 out of 35 boreholes in April 2023.	Subsurface slag and soils (deeper than 2 feet bgs) have not been sampled or characterized at four boreholes per EPA Statement of Work Modification P00002. Subsurface slag and soils (deeper than 2 feet bgs) have not been sampled or characterized at 12 boreholes per EPA Statement of Work Modification P00004.

OU2 UFP-QAPP Sampling Strategy Elements	OU2 UFP-QAPP Completed Sampling	OU2 UFP-QAPP Sampling Not Completed
Groundwater to be assessed at approximately 17 monitoring well locations and five well points and sampled quarterly for two years.	Sampling of three upgradient groundwater monitoring wells – one round - in May 2023.	Twelve groundwater monitoring wells and five well points have not been sampled, and no groundwater samples collected quarterly for two years per EPA Statement of Work Mod P00004.
Ecological sampling of approximately 30 composite fish samples, 12 composite invertebrate (terrestrial) samples, up to 12 invertebrate (aquatic) samples; up to five trapping sites will be selected to capture 20 small mammal samples; and up to 12 vegetative receptors of concern will be sampled.	Collection of six composite fish samples at an upstream location in the Arkansas River. Collected nine of 12 invertebrate (aquatic) samples around Runyon Lake and the Arkansas River.	Collection of approximately 24 composite fish samples, 12 composite invertebrate (terrestrial) samples, and up to three invertebrate (aquatic) samples; implementation of up to five trapping sites to capture 20 small mammal samples; and sampling of up to 12 vegetative receptors of concern have not been performed per EPA Statement of Work Mod P00004.
Air quality monitoring to evaluate current fugitive dust emissions from the existing slag piles will be considered part of OU2 and characterized under a separate UFP-QAPP (PWT, 2017c).	Air quality monitoring was completed. Results are reported in *TSP and Metals Air Concentration Summary for March 9,2018 to March 8, 2019 at the Dance Studio Monitoring Station Colorado Superfund Site in Pueblo, Colorado*. (McVehil Monnet Associates Inc., 2019). Air dispersion modeling completed (Stantec, 2023).	

4.2 Summary of Data Used in the SLERA

Field and analytical data from the OU1 and OU2 RI have been uploaded into project-specific EPA Scribe Databases. A summary of data sources considered in this SLERA is found in Table 4-2. Appendix B presents a summary of the data evaluated in the SLERA.

4.2.1 Surface Water

Surface water data included in this SLERA are from the 2019 investigations (PWT, 2023a). This includes 21 locations sampled quarterly (total of 84 samples). Surface water samples were analyzed for:

- ICP-MS metals (total) via EPA Method 1638 Modified. Total includes hardness by calcium and magnesium calculation.
- ICP-MS metals (dissolved) via EPA Method 1638 Modified with in-bottle digestion.
- Mercury (total and dissolved) via EPA Method 1631E using clean-hands dirty-hands sampling protocol (EPA, 2001).
- VOCs via EPA CLP gas chromatography-mass spectroscopy (GC-MS) analysis using EPA Method 8260B, under CLP contract SOM 02.4.
- SVOCs via EPA CLP GC-MS analysis using EPA Method 8270D with SIM for PAHs, under CLP contract SOM 02.4.
- Inorganic anions, chloride, sulfate as SO4, and fluoride, by ESAT under Technical Direction A-202 using EPA Method 300.1.

Surface water detection limits for arsenic, cadmium, mercury, and silver were required to be low enough to meet Code of Colorado Regulations (CCR) 5 CCR 1002-31 and 5 CCR 1002-32 standards.

Field parameters measured during sample collection included potential of hydrogen (pH), dissolved oxygen (DO), oxidation reduction potential (ORP), temperature, specific conductivity, turbidity, and color. Further details are found in the OU2 QAPP (PWT 2023b) and Data Summary Report (PWT 2023a).

4.2.2 Pore Water

Pore water sample data are from the 2019 investigation (PWT, 2023a), as no other pore water sampling data were available. Samples were analyzed and using the same methods as described for surface water samples in section 4.2.1.

Field parameters measured during sample collection included pH, DO, ORP, temperature, specific conductivity, turbidity, and color.

4.2.3 Sediment Data

Sediment data was used from the 2019 investigation (PWT, 2023a). Sediment samples were analyzed for:

- ICP-MS metals via EPA Method 6020B per CLP SOW ISM 02.4.
- Mercury via EPA Method 7471B per CLP SOW ISM 02.4.
- VOCs via EPA CLP GC-MS analysis using EPA Method 5035A/8260B, under CLP contract SOM 02.4.
- SVOCs via EPA CLP GC-MS analysis using EPA Method 8270D with SIM for PAHs, under CLP contract SOM 02.4.

4.2.4 Surficial Soil Data

OU2 surficial soil sampling data (0-1, 1-6, 6-12, 12-18, and 18-24 inches) used for the SLERA were obtained from the 2023 EPA/PWT OU2 RI sampling (PWT, 2023b). Additionally, OU1 soil sampling data (0-1, 1-6, 6-12, and 12-18 inches) were used from parks and other vacant spaces that have the potential to have ecological value were considered in the SLERA. Data from both XRF and CLP analyses were considered in the SLERA for screening purposes and COPEC identification.

Results from sampling of the waste pile at four locations were considered in this SLERA.

Most of the residential soil sampling data from the OU1 RI was not utilized for the OU2 SLERA analysis. However, parks and undeveloped areas in OU1 can provide suitable habitat for ecological receptors of concern. Data from soil samples collected in these areas, including Stauter Field, Bessemer Park, Benedict Park, Moynihan Park, and Runyon Sports Complex were included in the dataset for this SLERA.

The bulk of the soil data considered is from the OU2 RI sampling (Figure 8). This includes the sampling of 38 half-acre DUs within the former smelter area of OU2. Additionally, sampling has been completed for 89 1-acre DUs in OU2 undeveloped areas.

Incremental sampling was performed using a 30-point systematic grid with one sample collected from each of five horizons bgs:

- 0 to 1 inch
- 1 to 6 inches

- 6 to 12 inches
- 12 to 18 inches
- 18 to 24 inches

For shallow horizons (0-1 and 1-6 inches), soil samples were sieved with a #10 mesh (2mm opening) , then sieved further using a #60 mesh (0.25mm opening), producing a fine fraction. Subsamples of samples collected between 2018 and 2020 were analyzed for target analytes (lead, arsenic, copper, manganese, and zinc) using XRF, and a 2-gram subsample was then analyzed for metals by EPA Method 6020B via ICP-MS. After 2020, the 2-gram subsamples were analyzed in the same manner, but XRF was used only to analyze surface soil samples for the same target analytes. (PWT, 2018; 2020a; 2020c; 2022a; 2022b; 2023b).

Samples (not sieved) from all five depth horizons within the 38 half-acre DUs in the former smelter area of OU2 were analyzed for:

- Mercury by EPA method 7471B cold vapor atomic adsorption (CVAA).
- Hexavalent chromium Cr (VI) analysis via chromium speciation analysis using a modified EPA Method 3060A extraction and subsequent analysis by ion chromatography coupled to an inductively coupled plasma collision reaction cell mass spectrometer (ICP-CRC-MS)
- SVOCs and PAH compounds using EPA CLP GC-MS analysis by EPA Method 8270D with SIM
- One discrete sample from each of the five horizons from the center of each DU was analyzed for VOCs using EPA CLP GC-MS analysis by EPA Method 5035A/8260B.

Soil samples collected from undeveloped 1-acre DUs outside of the former smelter area were **not** analyzed for the following:

- Mercury
- Chromium speciation
- SVOCs/PAHs
- VOCs

A total of 132 soil samples from the 0-to-1-inch and 1-to-6-inch depth intervals were analyzed by XRF. However, since samples from these intervals were also analyzed by ICP-MS, a decision was made to only use the ICP-MS metals data for the SLERA. A total of 664 soil samples were analyzed by ICP-MS Method 6020B for metals (16 target analytes), 208 samples from within OU2 were analyzed by CVAA Method 7471B for mercury, 209 samples from within OU2 for VOCs by GC-MS analysis by Method 5035A/8260B, and 208 samples from within OU2 for SVOCs by GC-MS analysis by Method 8270D with SIM via the EPA's CLP Statement of Work for Inorganic Superfund Methods Multi-Media Multi-Concentration (ISM 02.4) (EPA, 2016a) and CLP Statement of Work for Organic Superfund Methods Multi-Media Multi-Concentration (SOM 02.4) (EPA, 2016b). A total of 208 samples from within OU2 for Cr VI analysis were analyzed by ICP-CRC-MS by BAL SOP No. BAL-4300.

At the time this SLERA was prepared, surficial soils from 38 half-acre DUs were sampled within OU2 Former Smelter Area to support the HHRA and ERA, and 89 1-acre DUs were sampled from the undeveloped areas of OU2 for the Sitewide ERA.

Table 4-2. Source and Summary of Data Used in OU2 SLERA by Media

Media	Data Source	Year of Sampling	# of Sampling Locations/ DUs	# of Depths	# Over Time (per year)	Total Samples	Metals	SVOCs/ PAHs	VOCs
Surface Water	PWT (2023a)	2019	21	N/A	4	84	X	X	X
Pore Water	PWT (2023a)	2019	12	N/A	1	12	X	X	X
Sediment	PWT (2023a)	2019	19	2	1	38	X	X	X
Slag*	OU1 DMA (2015)	2015	3	1	1		X		
Surficial Soil	OU1 RI PWT (2020c)	2015-2020			1		X	X (subset)	X (subset)
	OU2 Surficial soil sampling pilot PWT (2022a)	2019	18	5	1		X	X	X
	OU2 Surficial Soil Sampling PWT (2022a)	2020	32	5	1		X	X	X
	OU2 Surficial Soil Sampling PWT (2022b)	2022-2023	77	5	1		X	X	X

* Sample data from slag were not included in the SLERA; however, soil data that had slag material incorporated into the sample were included in the SLERA data.

4.3 Methodology

4.3.1 Evaluation of qualified and coded data

All data qualified with detected values ("J", etc.) were retained in the SLERA. Data with a "U" qualifier was classified as non-detect. "R" qualified results were rejected and not used in the SLERA. No "R" qualified results were in the sediment, 1,4-dioxane (one soil result) was qualified with an "R", indicating that they were rejected.

4.3.2 Treatment of Field Replicates

In accordance with the UFP-QAPP(s), field replicates were collected in duplicate/triplicate from all four depths for OU1 and all five depths for OU2 at approximately 5% of the DUs for quality assurance/quality control purposes. As all soil results were detected, the three results for a parent, field duplicate, and field triplicate were reduced to a single value by averaging. Surface water, pore water, and sediment had field duplicates collected at a frequency of 5% for all samples. Duplicates were averaged to a single value prior to screening.

4.4 Screening-Level Exposure Estimation

For the SLERA, the highest measured contaminant concentrations were identified for each medium as a conservative assumption for COPEC identification.

4.4.1 Exposure of Aquatic Receptors to Surface Water & Pore Water

There is consensus that the level of dissolved contaminants dictates the toxicity to aquatic receptors (Prothro, 1993), since contaminants that are adsorbed onto particulate matter may be less toxic than dissolved forms. On this basis, the maximum concentrations for each contaminant based on the dissolved fraction were used to estimate exposures to aquatic receptors, unless otherwise specified by the surface water benchmark. Several Colorado Surface Water Table Value Standards specify that the total metal concentration should be compared to the standard instead. As shown in Table C-1, that includes aluminum, beryllium, iron, and mercury. For those metals, the maximum concentration in the total fraction was used for screening.

4.4.2 Exposure of Benthic Insects to Sediment

All available sediment data were considered collectively, and the maximum detected concentrations of each contaminant observed across all sediment samples were used in the screening assessment.

4.4.3 Exposure of Plants, Soil Invertebrates and Wildlife to Soils

All available soil data were considered collectively. The maximum detected concentrations of each contaminant from the soil column were used to compare to the benchmark for COPEC identification.

4.5 Screening-Level Ecotoxicity Benchmarks

Appendix C provides the ecotoxicity benchmarks, supporting references and selection criteria. Tables 4-3 through 4-6 display the detected analytes in the soil, surface water, pore water, and sediment, and their respective benchmarks. Soil, surface water, pore water, and sediment samples were analyzed for metals, VOCs and SVOCs.

4.6 Screening-Level Risk Estimation

The screening-level risk estimation compares the screening level exposure estimates (in this case the maximum detected contaminant in each medium) to screening ecotoxicity benchmarks to identify COPECs. The hazard quotient (HQ) is the ratio between the exposure point concentration and the screening benchmark. To estimate the HQ in this SLERA, the maximum detected concentration is considered the exposure point concentration. The following equation describes the determination of the HQ.

$$Screening\text{-}Level\ Hazard\ Quotient\ (HQ) = \frac{Highest\ Concentration\ in\ Media}{Screening\ Benchmark}$$

If the maximum detected concentration is equal to or exceeds the available benchmark (HQ $\geq$ 1.0), then the contaminant is identified as a COPEC for that medium. If the maximum detected concentration does not exceed the benchmark, the contaminant is considered to be of negligible concern and is excluded as a COPEC.

If a contaminant was detected in fewer than 5% of the Site samples, it is unlikely that the contaminant will pose a significant ecological risk and is therefore excluded as a COPEC.

Contaminants detected in 5% or more of the Site samples and considered to be bioaccumulative are identified as COPECs and retained for further analysis in the BERA without regard to whether the maximum value exceeds the benchmark (EPA 2001). This is because many benchmark values do not adequately account for food web exposure of contaminants that tend to biomagnify in the food web. Of

the metals at this Site, only mercury and selenium are considered as bioaccumulative contaminants for ecological risk assessment. Among the detected organic analytes, only pentachlorophenol is considered bioaccumulative. Contaminants were considered bioaccumulative in accordance with EPA (1995).

Several of the analytes measured in environmental media are essential physiological electrolytes for birds, mammals, plants, and/or soil invertebrates. These analytes include calcium, magnesium, potassium, and sodium (EPA, 2001). As these chemicals typically pose little ecological risk at physiological concentrations, physiological electrolytes are eliminated as COPECs.

5 Risk Characterization

Table 5-1 displays the screening results for the risk evaluation for ecological exposure to soil, sediment, surface water and pore water. The HQ values for COPECs identified in this screening assessment are summarized for each medium in Tables 4-3 through 4-6 (at end of document).

Table 5-1. Summary of COPECs by Media

Surficial Soil	Sediment	Surface Water	Pore Water
Antimony	Antimony	Aluminum	Aluminum
Arsenic	Arsenic	Cadmium	Copper
Barium	Barium	Copper	Iron
Beryllium	Cadmium	Iron	Lead
Cadmium	Chromium	Lead	Manganese
Chromium	Copper	Mercury	Selenium
Hexavalent Chromium	Lead	Selenium	Zinc
Cobalt	Manganese	Vanadium	Pentachlorophenol*
Copper	Mercury	Zinc	
Lead	Nickel	Atrazine	
Manganese	Selenium	Benzo(b)Fluoranthene	
Mercury	Silver		
Nickel	Vanadium		
Selenium	Zinc		
Silver	Acenaphthene		
Thallium	Acenaphthylene		
Vanadium	Benzo(a)anthracene		
Zinc	Benzo(a)pyrene		
High Molecular Weight PAHs	Benzo(g,h,i)pyrene		
Bis(2-ethylhexyl)phthalate	Benzo(k)fluoranthene		
Acetone	Chrysene		
Toluene	Fluoranthene		
Pentachlorophenol*	Fluorene		
	Naphthalene		
	Phenanthrene		
	Pyrene		
	Bis(2-ethylhexyl)phthalate		
	Carbon disulfide		
	Pentachlorophenol*		

*Carried forward based on bioaccumulation potential.

6 Uncertainty Assessment

This section summarizes uncertainties in the representativeness of the environmental data and in the toxicological benchmarks used to identify COPECs.

6.1 Representativeness of Environmental Data

6.1.1 Surficial Soil

Surface soil data considered in this SLERA were collected from each of the 38 half-acre DUs within OU2, and data from 89 1-acre, DUs in outlying undeveloped areas of OU2. Data for discrete samples collected directly from the slag piles within OU2 were not evaluated in the SLERA because 1) it is unlikely that slag material represents ecologically relevant exposures and 2) the incorporation of these slag samples would not alter the list of COPECs in soil. If additional soil data is collected from these areas and used in the BERA it is not considered to be a major source of uncertainty for the purpose of identifying COPECs in the SLERA.

The UPRR ROW Focused Site Characterization (Jacobs, 2023) was limited to evaluating the ROW from E. Mesa Avenue on the south, to the I-25 crossover on the north, with the objective of gathering potential contaminant-level information on the slag within the UPRR ROW. Analytical data associated with the ROW are not included in the SLERA. Incorporation of data generated from the ROW investigation would not likely impact the list of COPECs in the SLERA.

Areas assumed to have the highest contamination (i.e., OU2) are well-represented in the data; therefore, it is not likely that COPECs within outlying areas including the UPRR ROW, assumed to have a lesser degree of contamination, were missed.

6.1.2 Sediments, Surface Water, and Pore Water

Sediment and pore water data were collected at a single time point (March to April 2019). Surface water samples were collected quarterly in 2019. Because sediment, pore water, and surface water concentrations may vary over time, samples collected at a single time point or over a single year may not provide a clear understanding of the range of concentrations that may occur over time. Therefore, concentrations of certain contaminants may be higher at different points in time. As such, it is possible that additional COPECs could be identified if data representative of a wider time frame were evaluated. Given the conservative nature of the screening benchmarks however, this is not expected to represent a significant source of uncertainty in the COPEC selection process.

6.2 Uncertainties in Benchmarks

All of the benchmarks used to screen for COPECs in sediment and soil were the lowest that could be located from available sources (identified in Appendix C). In general, this strategy is likely to result in the retention of some COPECs that are of low concern but is unlikely to result in the omission of chemicals that are of significant concern.

For surface water, the Colorado water quality criteria were given priority followed by the National Ambient Water Quality Criteria and then compilations such as EPA Region 4. The use of the state criteria as the primary source best represents the use of standards developed on Colorado native species. One uncertainty noted was the use of the Colorado surface water benchmark for selenium (4.6 µg/L). Footnote 9 of Table III in 5 CCR 1002-31 states that selenium is subject to a range of toxicity values

depending on site-specific variables due to its bioaccumulative nature. Consequently, the benchmark value of 4.6 µg/L may not be sufficiently conservative. Selenium is a surface water COPEC.

6.3 Uncertainties with COPECs

Based on Site history, metals are expected to be the primary COPECs; however, several other chemicals are considered COPECs following the screening analysis. These COPECs may or may not be site related.

- Soil - high molecular weight PAHs, bis(2-ethylhexyl)phthalate, acetone and toluene
- Sediment – Acenaphthene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, bis(2-ethylhexyl)phthalate, carbon disulfide
- Surface water – atrazine and benzo(b)fluoranthene

Additionally, pentachlorophenol is listed as a COPEC. Although it is unknown if pentachlorophenol is a site related chemical, it was detected in the environmental media investigated. Pentachlorophenol is a known bioaccumulative and retaining pentachlorophenol as a COPEC is warranted.

7 Summary and Data Gap Assessment

7.1 SLERA Summary

Table 5-1 summarizes the COPECs identified in this SLERA. These COPECs may pose a potential risk to ecological receptors at the Site. Ecological risks are negligible for the assessed contaminants that do not result in HQs $\geq$ 1.0 when compared with available screening benchmarks. No conclusion regarding potential ecological risks can be made for contaminants lacking screening benchmarks; however, metals are the primary COPECs based on past use of the Site and metals are represented in each media as COPECs.

7.2 Data Gaps

The SLERA has identified COPECs in OU1/OU2 soils, sediments, surface waters, and pore waters that may pose potential risks to terrestrial and aquatic receptors at the Site. However, this conclusion is based on a single line of evidence (i.e., HQs). Confidence in the risk conclusions would be higher if additional lines of evidence were available and supported the risk predictions. Additional lines of evidence include toxicity assessment, habitat assessment, and collection of additional community data.

7.2.1 Runyon Lake

Currently, no sampling consistent with data quality requirements of this SLERA has been conducted at Runyon Lake. Surface water and sediment sampling from Runyon Lake is planned as part of the BERA.

7.2.2 Aquatic and Terrestrial Biota Sampling

To measure food chain effects, biota sampling is recommended, and is planned as part of the BERA. Fish samples will be taken from the Arkansas River, both upstream and downstream of the Site. Fish will also be collected from Runyon Lake. Aquatic invertebrates will be collected from the surface water on site, the Arkansas River, and Runyon Lake. Samples of terrestrial plants, invertebrates, and small mammals will also be collected from locations around OU2, primarily focused on the former smelter area.

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TABLES

Table 4-3. COPEC Identification for Surficial Soil

Chemical Group	Analyte	CAS Number	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
Metals	Antimony	7440-36-0	94%	19.500	0.061	0.27	Y	N	Y	Y	**72**	**COPEC**
Metals	Arsenic	7440-38-2	100%	1,180.000	0.059	6.8	Y	N	Y	Y	**174**	**COPEC**
Metals	Barium	7440-39-3	100%	1,540.000	0.255	110	Y	N	Y	Y	**14**	**COPEC**
Metals	Beryllium	7440-41-7	91%	3.300	0.040	2.5	Y	N	Y	Y	**1**	**COPEC**
Metals	Cadmium	7440-43-9	100%	69.800	0.058	0.36	Y	N	Y	Y	**194**	**COPEC**
Metals	Chromium	7440-47-3	100%	390.000	0.086	0.4	Y	N	Y	Y	**975**	**COPEC**
Metals	Chromium, Hexavalent	18540-29-9	69%	3.270	0.012	0.34	Y	N	Y	Y	**10**	**COPEC**
Metals	Cobalt	7440-48-4	100%	15.000	0.032	13	Y	N	Y	Y	**1.2**	**COPEC**
Metals	Copper	7440-50-8	100%	2,130.000	0.127	28	Y	N	Y	Y	**76**	**COPEC**
Metals	Lead	7439-92-1	100%	9,290.000	0.211	11	Y	N	Y	Y	**845**	**COPEC**
Metals	Manganese	7439-96-5	100%	8,630.000	0.236	220	Y	N	Y	Y	**39**	**COPEC**
Metals	Mercury	7439-97-6	96%	11.500	0.018	0.013	Y	Y	Y	Y	**885**	**COPEC**
Metals	Nickel	7440-02-0	100%	5,300.000	0.064	38	Y	N	Y	Y	**139**	**COPEC**
Metals	Selenium	7782-49-2	91%	11.300	0.356	0.52	Y	Y	Y	Y	**22**	**COPEC**
Metals	Silver	7440-22-4	96%	36.700	0.033	4.2	Y	N	Y	Y	**9**	**COPEC**
Metals	Thallium	7440-28-0	89%	1.600	0.042	0.05	Y	N	Y	Y	**32**	**COPEC**
Metals	Vanadium	7440-62-2	100%	55.000	0.151	7.8	Y	N	Y	Y	**7**	**COPEC**
Metals	Zinc	7440-66-6	100%	11,900.000	0.631	46	Y	N	Y	Y	**259**	**COPEC**
SVOCs	Low Molecular Weight PAHs	PAH_Low	100%	1.060	0.003	29	Y	N	Y	N	0.04	Not a COPEC
SVOCs	Acenaphthene	83-32-9	98%	0.260	0.001	-	N	N	Y	-	-	-
SVOCs	Anthracene	120-12-7	98%	0.300	0.001	-	N	N	Y	-	-	-
SVOCs	Fluorene	86-73-7	85%	0.200	0.000	-	N	N	Y	-	-	-
SVOCs	2-Methylnaphthalene	91-57-6	100%	0.410	0.001	-	N	N	Y	-	-	-
SVOCs	Naphthalene	91-20-3	92%	0.160	0.001	-	N	N	Y	-	-	-
SVOCs	High Molecular Weight PAHs	PAH_High	100%	13.843	0.020	1.1	Y	N	Y	Y	**13**	**COPEC**
SVOCs	Benzo(a)anthracene	56-55-3	100%	1.500	0.001	-	N	N	Y	-	-	-
SVOCs	Benzo(a)pyrene	50-32-8	100%	1.400	0.002	-	N	N	Y	-	-	-
SVOCs	Benzo(b)fluoranthene	205-99-2	100%	2.100	0.003	-	N	N	Y	-	-	-
SVOCs	Benzo(k)fluoranthene	207-08-9	100%	0.800	0.002	-	N	N	Y	-	-	-
SVOCs	Chrysene	218-01-9	100%	1.800	0.002	-	N	N	Y	-	-	-
SVOCs	Dibenzo(a,h)anthracene	53-70-3	1%	0.019	0.002	-	N	N	N	-	-	-
SVOCs	Fluoranthene	206-44-0	100%	2.700	0.002	-	N	N	Y	-	-	-
SVOCs	Indeno(1,2,3-cd)pyrene	193-39-5	100%	0.840	0.004	-	N	N	Y	-	-	-
SVOCs	Pyrene	129-00-0	100%	2.900	0.002	-	N	N	Y	-	-	-
SVOCs	Acetophenone	98-86-2	0%	-	0.023	-	N	N	N	-	-	Not a COPEC
SVOCs	Atrazine	1912-24-9	0%	-	0.023	-	N	N	N	-	-	Not a COPEC
SVOCs	Benzaldehyde	100-52-7	2%	0.028	0.020	-	N	N	N	-	-	Not a COPEC
SVOCs	1,1'-Biphenyl	92-52-4	2%	0.450	0.030	0.2	Y	N	N	Y	-	Not a COPEC
SVOCs	bis(2-Chloroethoxy)methane	111-91-1	0%	-	0.026	-	N	N	N	-	-	Not a COPEC
SVOCs	Bis(2-Chloroethyl) ether	111-44-4	1%	0.019	0.024	-	N	N	N	-	-	Not a COPEC

Table 4-3. COPEC Identification for Surficial Soil

Chemical Group	Analyte	CAS Number	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	bis(2-Ethylhexyl)phthalate	117-81-7	52%	0.990	0.027	0.02	Y	N	Y	Y	**50**	**COPEC**
SVOCs	Butylbenzylphthalate	85-68-7	11%	0.072	0.026	0.59	Y	N	Y	N	0.1	Not a COPEC
SVOCs	Caprolactam	105-60-2	1%	0.041	0.028	-	N	N	N	-	-	Not a COPEC
SVOCs	4-Chloroaniline	106-47-8	0%	-	0.025	-	N	N	N	-	-	Not a COPEC
SVOCs	4-Chloro-3-methylphenol	59-50-7	0%	-	0.027	-	N	N	N	-	-	Not a COPEC
SVOCs	2-Chloronaphthalene	91-58-7	0%	-	0.029	-	N	N	N	-	-	Not a COPEC
SVOCs	2-Chlorophenol	95-57-8	0%	-	0.027	-	N	N	N	-	-	Not a COPEC
SVOCs	Dibenzofuran	132-64-9	9%	0.140	0.028	0.15	Y	N	Y	N	0.9	Not a COPEC
SVOCs	3,3'-Dichlorobenzidine	91-94-1	0%	-	0.029	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4-Dichlorophenol	120-83-2	0%	-	0.029	-	N	N	N	-	-	Not a COPEC
SVOCs	Diethylphthalate	84-66-2	0%	-	0.023	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4-Dimethylphenol	105-67-9	0%	-	0.032	-	N	N	N	-	-	Not a COPEC
SVOCs	Di-n-butylphthalate	84-74-2	2%	0.036	0.022	0.011	Y	N	N	Y	-	Not a COPEC
SVOCs	4,6-Dinitro-2-methylphenol	534-52-1	0%	-	0.038	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4-Dinitrophenol	51-28-5	0%	-	0.023	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4-Dinitrotoluene	121-14-2	0%	-	0.026	-	N	N	N	-	-	Not a COPEC
SVOCs	2,6-Dinitrotoluene	606-20-2	0%	-	0.024	-	N	N	N	-	-	Not a COPEC
SVOCs	Di-n-octylphthalate	117-84-0	1%	0.046	0.029	0.91	Y	N	N	N	-	Not a COPEC
SVOCs	1,4-Dioxane	123-91-1	0%	-	0.012	-	N	N	N	-	-	Not a COPEC
SVOCs	Hexachlorobenzene	118-74-1	0%	-	0.026	-	N	Y	N	-	-	Not a COPEC
SVOCs	Hexachlorobutadiene	87-68-3	0%	-	0.028	-	N	Y	N	-	-	Not a COPEC
SVOCs	Hexachlorocyclo-pentadiene	77-47-4	0%	-	0.052	-	N	N	N	-	-	Not a COPEC
SVOCs	Hexachloroethane	67-72-1	0%	-	0.022	-	N	N	N	-	-	Not a COPEC
SVOCs	Isophorone	78-59-1	0%	-	0.024	-	N	N	N	-	-	Not a COPEC
SVOCs	2-Methylphenol	95-48-7	0%	-	0.027	-	N	N	N	-	-	Not a COPEC
SVOCs	3-Methylphenol + 4-Methylphenol	106-44-5	1%	0.018	0.026	0.69	Y	N	N	N	-	Not a COPEC
SVOCs	2-Nitroaniline	88-74-4	0%	-	0.029	-	N	N	N	-	-	Not a COPEC
SVOCs	4-Nitroaniline	100-01-6	0%	-	0.023	-	N	N	N	-	-	Not a COPEC
SVOCs	Nitrobenzene	98-95-3	0%	-	0.025	-	N	N	N	-	-	Not a COPEC
SVOCs	N-Nitroso-di-n propylamine	621-64-7	0%	-	0.022	-	N	N	N	-	-	Not a COPEC
SVOCs	N-Nitrosodiphenylamine	86-30-6	2%	0.021	0.027	0.545	Y	N	N	N	-	Not a COPEC
SVOCs	2,2'-Oxybis(1-chloropropane)	108-60-1	0%	-	0.025	-	N	N	N	-	-	Not a COPEC
SVOCs	Pentachlorophenol	87-86-5	36%	0.077	0.005	2.1	Y	N	Y	N	0.04	Not a COPEC
SVOCs	Phenol	108-95-2	0%	-	0.028	-	N	N	N	-	-	Not a COPEC
SVOCs	1,2,4,5-Tetrachlorobenzene	95-94-3	0%	-	0.030	-	N	N	N	-	-	Not a COPEC
SVOCs	2,3,4,6-Tetrachlorophenol	58-90-2	0%	-	0.026	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4,5-Trichlorophenol	95-95-4	0%	-	0.026	-	N	N	N	-	-	Not a COPEC
SVOCs	2,4,6-Trichlorophenol	88-06-2	0%	-	0.031	-	N	N	N	-	-	Not a COPEC
VOCs	Acetone	67-64-1	42%	0.170	0.047	0.04	Y	N	Y	Y	**4**	**COPEC**
VOCs	Benzene	71-43-2	0%	-	0.007	0.12	Y	N	N	-	-	Not a COPEC

Table 4-3. COPEC Identification for Surficial Soil

Chemical Group	Analyte	CAS Number	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
VOCs	Bromochloromethane	74-97-5	0%	-	0.006	-	N	N	N	-	-	Not a COPEC
VOCs	Bromodichloromethane	75-27-4	0%	-	0.005	-	N	N	N	-	-	Not a COPEC
VOCs	Bromoform	75-25-2	0%	-	0.005	0.07	Y	N	N	-	-	Not a COPEC
VOCs	Bromomethane	74-83-9	0%	-	0.013	0.002	Y	N	N	-	-	Not a COPEC
VOCs	2-Butanone	78-93-3	11%	0.091	0.031	1	Y	N	Y	N	0.09	Not a COPEC
VOCs	Carbon disulfide	75-15-0	3%	0.007	0.006	0.005	Y	N	N	Y	-	Not a COPEC
VOCs	Carbon tetrachloride	56-23-5	0%	-	0.007	0.05	Y	N	N	-	-	Not a COPEC
VOCs	Chlorobenzene	108-90-7	0%	-	0.005	2.4	Y	N	N	-	-	Not a COPEC
VOCs	Chloroethane	75-00-3	0%	-	0.009	-	N	N	N	-	-	Not a COPEC
VOCs	Chloroform	67-66-3	1%	0.006	0.007	0.05	Y	N	N	N	-	Not a COPEC
VOCs	Chloromethane	74-87-3	0%	-	0.007	-	N	N	N	-	-	Not a COPEC
VOCs	Cyclohexane	110-82-7	0%	-	0.010	-	N	N	N	-	-	Not a COPEC
VOCs	Dibromochloromethane	124-48-1	0%	-	0.006	-	N	N	N	-	-	Not a COPEC
VOCs	1,2-Dibromo-3-chloropropane	96-12-8	0%	-	0.008	-	N	N	N	-	-	Not a COPEC
VOCs	1,2-Dibromoethane	106-93-4	0%	-	0.005	-	N	N	N	-	-	Not a COPEC
VOCs	1,2-Dichlorobenzene	95-50-1	0%	-	0.006	0.09	Y	N	N	-	-	Not a COPEC
VOCs	1,4-Dichlorobenzene	106-46-7	0%	-	0.006	0.89	Y	N	N	-	-	Not a COPEC
VOCs	Dichlorodifluoromethane	75-71-8	0%	-	0.010	-	N	N	N	-	-	Not a COPEC
VOCs	1,1-Dichloroethane	75-34-3	0%	-	0.006	0.14	Y	N	N	-	-	Not a COPEC
VOCs	1,2-Dichloroethane	107-06-2	0%	-	0.006	0.4	Y	N	N	-	-	Not a COPEC
VOCs	1,1-Dichloroethene	75-35-4	0%	-	0.008	0.04	Y	N	N	-	-	Not a COPEC
VOCs	cis-1,2-Dichloroethene	156-59-2	1%	0.031	0.006	0.04	Y	N	N	N	-	Not a COPEC
VOCs	trans-1,2-Dichloroethene	156-60-5	0%	-	0.007	0.04	Y	N	N	-	-	Not a COPEC
VOCs	1,2-Dichloropropane	78-87-5	0%	-	0.006	0.28	Y	N	N	-	-	Not a COPEC
VOCs	Ethylbenzene	100-41-4	1%	0.750	0.006	0.27	Y	N	N	Y	-	Not a COPEC
VOCs	2-Hexanone	591-78-6	13%	0.019	0.031	0.36	Y	N	Y	N	0.05	Not a COPEC
VOCs	Isopropylbenzene	98-82-8	1%	0.800	0.005	-	N	N	N	-	-	Not a COPEC
VOCs	Methyl acetate	79-20-9	8%	0.006	0.007	-	N	N	Y	-	-	Source of Uncertainty
VOCs	Methyl tert-butyl ether	1634-04-4	0%	-	0.006	-	N	N	N	-	-	Not a COPEC
VOCs	Methylene chloride	75-09-2	31%	0.019	0.005	2.6	Y	N	Y	N	0.01	Not a COPEC
VOCs	4-Methyl-2-pentanone	108-10-1	0%	-	0.010	9.7	Y	N	N	-	-	Not a COPEC
VOCs	Styrene	100-42-5	0%	-	0.005	1.2	Y	N	N	-	-	Not a COPEC
VOCs	Tetrachloroethene	127-18-4	1%	0.010	0.006	0.06	Y	N	N	N	-	Not a COPEC
VOCs	1,1,2,2-Tetrachloroethane	79-34-5	0%	-	0.006	0.127	Y	N	N	-	-	Not a COPEC
VOCs	Toluene	108-88-3	8%	0.420	0.006	0.15	Y	N	Y	Y	**3**	**COPEC**
VOCs	1,1,1-Trichloroethane	71-55-6	0%	-	0.005	0.04	Y	N	N	-	-	Not a COPEC
VOCs	1,1,2-Trichloroethane	79-00-5	0%	-	0.005	0.32	Y	N	N	-	-	Not a COPEC
VOCs	1,2,3-Trichlorobenzene	87-61-6	0%	-	0.006	20	Y	N	N	-	-	Not a COPEC
VOCs	1,2,4-Trichlorobenzene	120-82-1	0%	-	0.006	0.27	Y	N	N	-	-	Not a COPEC
VOCs	Trichloroethene	79-01-6	0%	-	0.005	0.06	Y	N	N	-	-	Not a COPEC

Table 4-3. COPEC Identification for Surficial Soil

Chemical Group	Analyte	CAS Number	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
VOCs	Trichlorofluoromethane	75-69-4	0%	-	0.008	52	Y	N	N	-	-	Not a COPEC
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	0%	-	0.012	-	N	N	N	-	-	Not a COPEC
VOCs	Vinyl chloride	75-01-4	1%	0.039	0.008	0.03	Y	N	N	Y	-	Not a COPEC
VOCs	o-Xylene	95-47-6	2%	2.400	0.005	0.1	Y	N	N	Y	-	Not a COPEC

Table 4-4. COPEC Identification for Surface Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
Metals	Aluminum	T	37%	1,580	49.4	87	Y	N	Y	Y	**18**	**COPEC**
Metals	Antimony	D	25%	4.87	1.68	190	Y	N	Y	N	0.03	Not a COPEC
Metals	Arsenic	D	57%	11.1	1.18	150	Y	N	Y	N	0.07	Not a COPEC
Metals	Barium	D	99%	67.2	1.97	220	Y	N	Y	N	0.3	Not a COPEC
Metals	Beryllium	T	1%	0.254	1.76	3.6	Y	N	N	N	0.07	Not a COPEC
Metals	Cadmium	D	24%	1.42	0.691	0.77	Y	N	Y	Y	**2**	**COPEC**
Metals	Chromium	D	11%	2.18	2.47	11	Y	N	Y	N	0.20	Not a COPEC
Metals	Cobalt	D	38%	0.962	0.985	19	Y	N	Y	N	0.05	Not a COPEC
Metals	Copper	D	32%	90.6	3.9	9.64	Y	N	Y	Y	**9**	**COPEC**
Metals	Iron	T	57%	17,600	39	1,000	Y	N	Y	Y	**18**	**COPEC**
Metals	Lead	D	27%	91.1	0.494	2.76	Y	N	Y	Y	**33**	**COPEC**
Metals	Manganese	D	85%	511	2.07	1,698	Y	N	Y	N	0.3	Not a COPEC
Metals	Mercury	T	97%	0.0274	0.00013	0.01	Y	Y	Y	Y	**3**	**COPEC**
Metals	Nickel	D	52%	31.61	4.72	55.49	Y	N	Y	N	0.6	Not a COPEC
Metals	Selenium	D	95%	107	1.77	4.6	Y	Y	Y	Y	**23**	**COPEC**
Metals	Silver	D	0%	--	0.703	0.09	Y	N	N	--	--	Not a COPEC
Metals	Thallium	D	0%	--	1.28	6	Y	N	N	--	--	Not a COPEC
Metals	Vanadium	D	36%	44	2.36	27	Y	N	Y	Y	**2**	**COPEC**
Metals	Zinc	D	37%	929	19.7	131	Y	N	Y	Y	**7**	**COPEC**
SVOCs	1,1'-Biphenyl	--	0%	--	0.85	--	N	N	N	--	--	Not a COPEC
SVOCs	1,1-Biphenyl	--	0%	--	0.92	--	N	N	N	--	--	Not a COPEC
SVOCs	1,2,4,5-Tetrachlorobenzene	--	0%	--	0.88	--	N	N	N	--	--	Not a COPEC
SVOCs	1,4-Dioxane	--	0%	--	0.6	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Chloronaphthalene	--	0%	--	0.9	620	Y	N	N	--	--	Not a COPEC
SVOCs	2-Chlorophenol	--	0%	--	0.88	2,000	Y	N	N	--	--	Not a COPEC
SVOCs	2-Methylnaphthalene	--	1%	0.04	0.44	4.7	Y	N	N	N	0.009	Not a COPEC
SVOCs	2-Methylphenol	--	0%	--	0.82	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitroaniline	--	0%	--	0.89	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitrophenol	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	2,2'-Oxybis(1-Chloropropane)	--	0%	--	0.91	--	N	N	N	--	--	Not a COPEC
SVOCs	2,2-Oxybis(1-Chloropropane)	--	0%	--	0.91	--	N	N	N	--	--	Not a COPEC
SVOCs	2,3,4,6-Tetrachlorophenol	--	0%	--	0.94	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dichlorophenol	--	0%	--	0.93	365	Y	N	N	--	--	Not a COPEC
SVOCs	2,4-Dimethylphenol	--	0%	--	0.72	2,120	Y	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrophenol	--	0%	--	0.82	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrotoluene	--	0%	--	0.94	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4,5-Trichlorophenol	--	0%	--	0.87	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4,6-Trichlorophenol	--	0%	--	0.86	970	Y	N	N	--	--	Not a COPEC
SVOCs	2,6-Dinitrotoluene	--	0%	--	0.84	230	Y	N	N	--	--	Not a COPEC
SVOCs	3-Methylphenol + 4-Methylphenol	--	0%	--	0.61	--	N	N	N	--	--	Not a COPEC

Table 4-4. COPEC Identification for Surface Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	3-Nitroaniline	--	0%	--	0.76	--	N	N	N	--	--	Not a COPEC
SVOCs	3,3'-Dichlorobenzidine	--	0%	--	1.14	--	N	N	N	--	--	Not a COPEC
SVOCs	3,3-Dichlorobenzidine	--	0%	--	0.73	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Bromophenyl-Phenylether	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chloro-3-Methylphenol	--	0%	--	0.84	30	Y	N	N	--	--	Not a COPEC
SVOCs	4-Chloroaniline	--	0%	--	0.87	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chlorophenyl-Phenyl Ether	--	0%	--	1.04	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chlorophenyl-Phenylether	--	0%	--	0.84	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Methylphenol	--	1%	6.75	0.87	53	Y	N	N	N	0.1	Not a COPEC
SVOCs	4-Nitroaniline	--	0%	--	0.84	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Nitrophenol	--	0%	--	1.02	--	N	N	N	--	--	Not a COPEC
SVOCs	4,6-Dinitro-2-Methylphenol	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	Acenaphthene	--	2%	0.031	0.44	520	Y	N	N	N	0.00006	Not a COPEC
SVOCs	Acenaphthylene	--	1%	0.015	0.47	13	Y	N	N	N	0.0012	Not a COPEC
SVOCs	Acetophenone	--	0%	--	0.93	--	N	N	N	--	--	Not a COPEC
SVOCs	Anthracene	--	1%	0.02	0.46	--	N	N	N	--	--	Not a COPEC
SVOCs	Atrazine	--	6%	11	0.86	5	Y	N	Y	Y	**2**	**COPEC**
SVOCs	Benzaldehyde	--	0%	--	0.86	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(a)Anthracene	--	3%	0.13	0.44	4.7	Y	N	N	N	0.03	Not a COPEC
SVOCs	Benzo(a)Pyrene	--	3%	4.8	0.47	0.06	Y	N	**N**	Y	80	Not a COPEC
SVOCs	Benzo(b)Fluoranthene	--	7%	5.05	0.45	2.6	Y	N	Y	Y	**2**	**COPEC**
SVOCs	Benzo(g,h,i)Perylene	--	3%	4.8	0.45	0.012	Y	N	**N**	Y	400	Not a COPEC
SVOCs	Benzo(k)Fluoranthene	--	2%	4.8	0.46	0.06	Y	N	**N**	Y	80	Not a COPEC
SVOCs	Bis(2-Chloroethoxy)Methane	--	0%	--	0.87	--	N	N	N	--	--	Not a COPEC
SVOCs	Bis(2-Chloroethyl) Ether	--	0%	--	0.94	--	N	N	N	--	--	Not a COPEC
SVOCs	Bis(2-Chloroethyl)Ether	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	Bis(2-Ethylhexyl)Phthalate	--	0%	--	0.83	--	N	N	N	--	--	Not a COPEC
SVOCs	Butylbenzylphthalate	--	0%	--	0.83	--	N	N	N	--	--	Not a COPEC
SVOCs	Caprolactam	--	0%	--	0.91	--	N	N	N	--	--	Not a COPEC
SVOCs	Carbazole	--	0%	--	0.85	--	N	N	N	--	--	Not a COPEC
SVOCs	Chrysene	--	2%	0.18	0.44	4.7	Y	N	N	N	0.04	Not a COPEC
SVOCs	Di-N-Butylphthalate	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	Di-N-Octyl Phthalate	--	0%	--	0.74	--	N	N	N	--	--	Not a COPEC
SVOCs	Di-N-Octylphthalate	--	0%	--	0.84	--	N	N	N	--	--	Not a COPEC
SVOCs	Dibenzo(a,h)Anthracene	--	2%	4.8	0.45	0.012	Y	N	**N**	Y	400	Not a COPEC
SVOCs	Dibenzofuran	--	0%	--	0.86	--	N	N	N	--	--	Not a COPEC
SVOCs	Diethylphthalate	--	0%	--	0.89	--	N	N	N	--	--	Not a COPEC
SVOCs	Dimethylphthalate	--	38%	5.5	0.93	1100	Y	N	Y	N	0.005	Not a COPEC
SVOCs	Fluoranthene	--	3%	0.22	0.43	0.8	Y	N	N	N	0.3	Not a COPEC
SVOCs	Fluorene	--	0%	--	0.44	--	N	N	N	--	--	Not a COPEC

Table 4-4. COPEC Identification for Surface Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	Hexachlorobenzene	--	0%	--	0.87	--	N	Y	N	--	--	Not a COPEC
SVOCs	Hexachlorobutadiene	--	0%	--	0.82	--	N	Y	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclo-Pentadiene	--	0%	--	2.04	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclo-Pentadiene	--	0%	--	2.04	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclopentadiene	--	0%	--	0.76	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclopentadiene	--	0%	--	0.76	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachloroethane	--	0%	--	0.87	--	N	N	N	--	--	Not a COPEC
SVOCs	Indeno(1,2,3-Cd)Pyrene	--	2%	4.8	0.46	0.012	Y	N	**N**	Y	400	Not a COPEC
SVOCs	Isophorone	--	0%	--	0.89	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitroso-Di-N-Propylamine	--	0%	--	0.95	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitroso-Di-N Propylamine	--	0%	--	0.95	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitrosodiphenylamine	--	0%	--	0.88	--	N	N	N	--	--	Not a COPEC
SVOCs	Naphthalene	--	2%	0.16	0.44	620	Y	N	N	N	0.0003	Not a COPEC
SVOCs	Nitrobenzene	--	0%	--	0.9	--	N	N	N	--	--	Not a COPEC
SVOCs	Pentachlorophenol	--	1%	0.06	0.41	15	Y	N	N	N	0.004	Not a COPEC
SVOCs	Phenanthrene	--	1%	0.1	0.42	--	N	N	N	--	--	Not a COPEC
SVOCs	Phenol	--	10%	1.8	0.88	2,560	Y	N	Y	N	0.0007	Not a COPEC
SVOCs	Pyrene	--	4%	5.05	0.51	--	N	N	N	--	--	Not a COPEC
VOCs	1,1-Dichloroethane	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	1,1-Dichloroethene	--	0%	--	0.09	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,1-Trichloroethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloroethane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2,2-Tetrachloroethane	--	0%	--	0.11	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromo-3-Chloropropane	--	0%	--	0.24	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromoethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichlorobenzene	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichloroethane	--	5%	0.32	0.07	20,000	Y	N	Y	N	0.00002	Not a COPEC
VOCs	1,2-Dichloropropane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	1,2,3-Trichlorobenzene	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	1,2,4-Trichlorobenzene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	1,3-Dichlorobenzene	--	1%	0.41	0.07	22	Y	N	N	N	0.02	Not a COPEC
VOCs	1,4-Dichlorobenzene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	2-Butanone	--	0%	--	1.07	--	N	N	N	--	--	Not a COPEC
VOCs	2-Hexanone	--	0%	--	0.51	--	N	N	N	--	--	Not a COPEC
VOCs	4-Methyl-2-Pentanone	--	0%	--	0.66	--	N	N	N	--	--	Not a COPEC
VOCs	Acetone	--	4%	5.6	1.14	1,700	Y	N	N	N	0.003	Not a COPEC
VOCs	Benzene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	Bromochloromethane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Bromodichloromethane	--	0%	--	0.05	--	N	N	N	--	--	Not a COPEC

Table 4-4. COPEC Identification for Surface Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
VOCs	Bromoform	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Bromomethane	--	0%	--	0.11	--	N	N	N	--	--	Not a COPEC
VOCs	Carbon Disulfide	--	5%	2.3	0.06	15	Y	N	Y	N	0.2	Not a COPEC
VOCs	Carbon Tetrachloride	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Chlorobenzene	--	0%	--	0.05	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroethane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroform	--	11%	2.1	0.09	1,240	Y	N	Y	N	0.002	Not a COPEC
VOCs	Chloromethane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Cis-1,2-Dichloroethene	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Cis-1,3-Dichloropropene	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Cyclohexane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Dibromochloromethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Dichlorodifluoromethane	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Ethylbenzene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	Isopropylbenzene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	M, P-Xylene	--	0%	--	0.04	--	N	N	N	--	--	Not a COPEC
VOCs	M,P-Xylene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl Acetate	--	0%	--	0.19	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl Tert-Butyl Ether	--	5%	1.7	0.06	730	Y	N	Y	N	0.002	Not a COPEC
VOCs	Methylcyclohexane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Methylene Chloride	--	0%	--	0.09	--	N	N	N	--	--	Not a COPEC
VOCs	O-Xylene	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Styrene	--	0%	--	0.05	--	N	N	N	--	--	Not a COPEC
VOCs	Tetrachloroethene	--	1%	0.05	0.06	840	Y	N	N	N	0.0001	Not a COPEC
VOCs	Toluene	--	4%	0.22	0.06	62	Y	N	N	N	0.004	Not a COPEC
VOCs	Trans-1,2-Dichloroethene	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC
VOCs	Trans-1,3-Dichloropropene	--	0%	--	0.05	--	N	N	N	--	--	Not a COPEC
VOCs	Trichloroethene	--	0%	--	0.08	--	Y	N	N	--	--	Not a COPEC
VOCs	Trichlorofluoromethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Vinyl Chloride	--	0%	--	0.08	--	N	N	N	--	--	Not a COPEC

Table 4-5. COPEC Identification for Pore Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
Metals	Aluminum	T	15%	406	126	87	Y	N	Y	Y	**5**	**COPEC**
Metals	Antimony	D	8%	21.7	4.34	190	Y	N	Y	N	0.1	Not a COPEC
Metals	Arsenic	D	23%	22.4	3.06	150	Y	N	Y	N	0.1	Not a COPEC
Metals	Barium	D	100%	78.7	5.1	220	Y	N	Y	N	0.4	Not a COPEC
Metals	Beryllium	T	0%	--	4.59	3.60	Y	N	N	--	--	Not a COPEC
Metals	Cadmium	D	0%	--	1.79	0.77	Y	N	N	--	--	Not a COPEC
Metals	Chromium	D	0%	--	6.18	11	Y	N	N	--	--	Not a COPEC
Metals	Cobalt	D	8%	3.13	2.47	19	Y	N	Y	N	0.2	Not a COPEC
Metals	Copper	D	15%	80.7	9.89	9.64	Y	N	Y	Y	**8**	**COPEC**
Metals	Iron	T	46%	29,400.00	100	1,000	Y	N	Y	Y	**29**	**COPEC**
Metals	Lead	D	15%	67.1	1.28	2.76	Y	N	Y	Y	**24**	**COPEC**
Metals	Manganese	D	85%	3340	5.28	1,698	Y	N	Y	Y	**2**	**COPEC**
Metals	Mercury	T	100%	0.00369	0.00013	0.01	Y	Y	Y	N	0.4	Not a COPEC
Metals	Nickel	D	0%	--	11.8	55.49	Y	N	N	--	--	Not a COPEC
Metals	Selenium	D	77%	93	4.59	4.60	Y	Y	Y	Y	**20**	**COPEC**
Metals	Silver	D	0%	--	1.79	--	N	N	N	--	--	Not a COPEC
Metals	Thallium	D	0%	--	3.32	--	N	N	N	--	--	Not a COPEC
Metals	Vanadium	D	0%	--	6.12	--	N	N	N	--	--	Not a COPEC
Metals	Zinc	D	15%	662	51	131	Y	N	Y	Y	**5**	**COPEC**
SVOCs	1,1'-Biphenyl	--	0%	--	0.582	--	N	N	N	--	--	Not a COPEC
SVOCs	1,2,4,5-Tetrachlorobenzene	--	0%	--	0.522	--	N	N	N	--	--	Not a COPEC
SVOCs	1,4-Dioxane	--	0%	--	0.482	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Chloronaphthalene	--	0%	--	0.552	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Chlorophenol	--	0%	--	0.502	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Methylnaphthalene	--	0%	--	0.263	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Methylphenol	--	0%	--	0.552	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitroaniline	--	0%	--	0.512	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitrophenol	--	0%	--	0.658	--	N	N	N	--	--	Not a COPEC
SVOCs	2,2'-Oxybis(1-chloropropane)	--	0%	--	0.592	--	N	N	N	--	--	Not a COPEC
SVOCs	2,3,4,6-Tetrachlorophenol	--	0%	--	0.778	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dichlorophenol	--	0%	--	0.652	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dimethylphenol	--	0%	--	0.592	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrophenol	--	0%	--	0.492	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrotoluene	--	0%	--	0.712	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4,5-Trichlorophenol	--	0%	--	0.492	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4,6-Trichlorophenol	--	0%	--	0.572	--	N	N	N	--	--	Not a COPEC
SVOCs	2,6-Dinitrotoluene	--	0%	--	0.572	--	N	N	N	--	--	Not a COPEC
SVOCs	3-Methylphenol + 4-Methylphenol	--	0%	--	0.609	--	N	N	N	--	--	Not a COPEC
SVOCs	3-Nitroaniline	--	0%	--	0.668	--	N	N	N	--	--	Not a COPEC
SVOCs	3,3'-Dichlorobenzidine	--	0%	--	0.863	--	N	N	N	--	--	Not a COPEC

Table 4-5. COPEC Identification for Pore Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	4-Bromophenyl-phenylether	--	0%	--	0.632	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chloro-3-methylphenol	--	0%	--	0.562	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chloroaniline	--	0%	--	0.562	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chlorophenyl-phenyl ether	--	0%	--	0.672	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Methylphenol	--	0%	--	0.63	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Nitroaniline	--	0%	--	0.638	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Nitrophenol	--	0%	--	0.818	--	N	N	N	--	--	Not a COPEC
SVOCs	4,6-Dinitro-2-methylphenol	--	0%	--	0.658	--	N	N	N	--	--	Not a COPEC
SVOCs	Acenaphthene	--	0%	--	0.279	--	N	N	N	--	--	Not a COPEC
SVOCs	Acenaphthylene	--	0%	--	0.303	--	N	N	N	--	--	Not a COPEC
SVOCs	Acetophenone	--	0%	--	0.642	--	N	N	N	--	--	Not a COPEC
SVOCs	Anthracene	--	0%	--	0.324	--	N	N	N	--	--	Not a COPEC
SVOCs	Atrazine	--	0%	--	0.738	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzaldehyde	--	0%	--	0.648	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(a)anthracene	--	0%	--	0.309	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(a)pyrene	--	0%	--	0.395	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(b)fluoranthene	--	0%	--	0.425	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(g,h,i)perylene	--	0%	--	0.409	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzo(k)fluoranthene	--	0%	--	0.406	--	N	N	N	--	--	Not a COPEC
SVOCs	bis(2-Chloroethoxy)methane	--	0%	--	0.512	--	N	N	N	--	--	Not a COPEC
SVOCs	Bis(2-Chloroethyl) ether	--	0%	--	0.548	--	N	N	N	--	--	Not a COPEC
SVOCs	bis(2-Ethylhexyl)phthalate	--	0%	--	0.678	--	N	N	N	--	--	Not a COPEC
SVOCs	Butylbenzylphthalate	--	0%	--	0.698	--	N	N	N	--	--	Not a COPEC
SVOCs	Caprolactam	--	0%	--	1.56	--	N	N	N	--	--	Not a COPEC
SVOCs	Carbazole	--	0%	--	0.512	--	N	N	N	--	--	Not a COPEC
SVOCs	Chrysene	--	0%	--	0.306	--	N	N	N	--	--	Not a COPEC
SVOCs	Di-n-butylphthalate	--	0%	--	0.628	--	N	N	N	--	--	Not a COPEC
SVOCs	Di-n-octylphthalate	--	0%	--	0.863	--	N	N	N	--	--	Not a COPEC
SVOCs	Dibenzo(a,h)anthracene	--	0%	--	0.393	--	N	N	N	--	--	Not a COPEC
SVOCs	Dibenzofuran	--	0%	--	0.552	--	N	N	N	--	--	Not a COPEC
SVOCs	Diethylphthalate	--	0%	--	0.662	--	N	N	N	--	--	Not a COPEC
SVOCs	Dimethylphthalate	--	0%	--	0.758	--	N	N	N	--	--	Not a COPEC
SVOCs	Fluoranthene	--	0%	--	0.267	--	N	N	N	--	--	Not a COPEC
SVOCs	Fluorene	--	0%	--	0.25	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachlorobenzene	--	0%	--	0.532	--	N	Y	N	--	--	Not a COPEC
SVOCs	Hexachlorobutadiene	--	0%	--	0.522	--	N	Y	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclo-pentadiene	--	0%	--	2.96	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachloroethane	--	0%	--	0.658	--	N	N	N	--	--	Not a COPEC
SVOCs	Indeno(1,2,3-cd)pyrene	--	0%	--	0.4	--	N	N	N	--	--	Not a COPEC
SVOCs	Isophorone	--	0%	--	0.562	--	N	N	N	--	--	Not a COPEC

Table 4-5. COPEC Identification for Pore Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	N-Nitroso-di-n propylamine	--	0%	--	0.688	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitrosodiphenylamine	--	0%	--	0.582	--	N	N	N	--	--	Not a COPEC
SVOCs	Naphthalene	--	0%	--	0.286	--	N	N	N	--	--	Not a COPEC
SVOCs	Nitrobenzene	--	0%	--	0.512	--	N	N	N	--	--	Not a COPEC
SVOCs	Pentachlorophenol	--	4%	0.82	0.403	15	Y	N	N	N	0.05	Not a COPEC
SVOCs	Phenanthrene	--	0%	--	0.263	--	N	N	N	--	--	Not a COPEC
SVOCs	Phenol	--	8%	12	0.482	2,560	Y	N	Y	N	0.005	Not a COPEC
SVOCs	Pyrene	--	0%	--	0.431	--	N	N	N	--	--	Not a COPEC
VOCs	1,1-Dichloroethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	1,1-Dichloroethene	--	0%	--	0.085	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,1-Trichloroethane	--	0%	--	0.061	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	--	0%	--	0.065	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloroethane	--	0%	--	0.094	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2,2-Tetrachloroethane	--	0%	--	0.17	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromo-3-chloropropane	--	0%	--	0.27	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromoethane	--	0%	--	0.057	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichlorobenzene	--	0%	--	0.072	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichloroethane	--	0%	--	0.083	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichloropropane	--	0%	--	0.093	--	N	N	N	--	--	Not a COPEC
VOCs	1,2,3-Trichlorobenzene	--	0%	--	0.071	--	N	N	N	--	--	Not a COPEC
VOCs	1,2,4-Trichlorobenzene	--	0%	--	0.052	--	N	N	N	--	--	Not a COPEC
VOCs	1,3-Dichlorobenzene	--	8%	0.19	0.06	22	Y	N	Y	N	0.01	Not a COPEC
VOCs	1,4-Dichlorobenzene	--	0%	--	0.05	--	N	N	N	--	--	Not a COPEC
VOCs	2-Butanone	--	0%	--	1.6	--	N	N	N	--	--	Not a COPEC
VOCs	2-Hexanone	--	0%	--	0.4	--	N	N	N	--	--	Not a COPEC
VOCs	4-Methyl-2-pentanone	--	0%	--	0.5	--	N	N	N	--	--	Not a COPEC
VOCs	Acetone	--	25%	36	1.4	1,700	Y	N	Y	N	0.02	Not a COPEC
VOCs	Benzene	--	0%	--	0.051	--	N	N	N	--	--	Not a COPEC
VOCs	Bromochloromethane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Bromodichloromethane	--	0%	--	0.067	--	N	N	N	--	--	Not a COPEC
VOCs	Bromoform	--	0%	--	0.088	--	N	N	N	--	--	Not a COPEC
VOCs	Bromomethane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Carbon disulfide	--	8%	0.185	0.076	15	Y	N	Y	N	0.01	Not a COPEC
VOCs	Carbon tetrachloride	--	0%	--	0.035	--	N	N	N	--	--	Not a COPEC
VOCs	Chlorobenzene	--	0%	--	0.03	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroethane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroform	--	0%	--	0.036	--	N	N	N	--	--	Not a COPEC
VOCs	Chloromethane	--	0%	--	0.092	--	N	N	N	--	--	Not a COPEC
VOCs	cis-1,2-Dichloroethene	--	0%	--	0.075	--	N	N	N	--	--	Not a COPEC

Table 4-5. COPEC Identification for Pore Water

Chemical Group	Analyte	Total or Dissolved	Detection Frequency	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)	Benchmark (µg/L)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
VOCs	cis-1,3-Dichloropropene	--	0%	--	0.06	--	N	N	N	--	--	Not a COPEC
VOCs	Cyclohexane	--	0%	--	0.1	--	N	N	N	--	--	Not a COPEC
VOCs	Dibromochloromethane	--	0%	--	0.053	--	N	N	N	--	--	Not a COPEC
VOCs	Dichlorodifluoromethane	--	0%	--	0.07	--	N	N	N	--	--	Not a COPEC
VOCs	Ethylbenzene	--	0%	--	0.041	--	N	N	N	--	--	Not a COPEC
VOCs	Isopropylbenzene	--	0%	--	0.053	--	N	N	N	--	--	Not a COPEC
VOCs	m, p-Xylene	--	0%	--	0.043	--	N	N	N	--	--	Not a COPEC
VOCs	m,p-Xylene	--	0%	--	0.043	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl acetate	--	0%	--	0.2	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl tert-butyl ether	--	0%	--	0.048	--	N	N	N	--	--	Not a COPEC
VOCs	Methylcyclohexane	--	0%	--	0.051	--	N	N	N	--	--	Not a COPEC
VOCs	Methylene chloride	--	0%	--	0.069	--	N	N	N	--	--	Not a COPEC
VOCs	o-Xylene	--	0%	--	0.045	--	N	N	N	--	--	Not a COPEC
VOCs	Styrene	--	0%	--	0.035	--	N	N	N	--	--	Not a COPEC
VOCs	Tetrachloroethene	--	0%	--	0.034	--	N	N	N	--	--	Not a COPEC
VOCs	Toluene	--	17%	0.53	0.034	62	Y	N	Y	N	0.01	Not a COPEC
VOCs	trans-1,2-Dichloroethene	--	0%	--	0.056	--	N	N	N	--	--	Not a COPEC
VOCs	trans-1,3-Dichloropropene	--	0%	--	0.044	--	N	N	N	--	--	Not a COPEC
VOCs	Trichloroethene	--	0%	--	0.043	--	N	N	N	--	--	Not a COPEC
VOCs	Trichlorofluoromethane	--	0%	--	0.051	--	N	N	N	--	--	Not a COPEC
VOCs	Vinyl chloride	--	0%	--	0.097	--	N	N	N	--	--	Not a COPEC

Table 4-6. COPEC Identification for Sediment

Chemical Group	Analyte	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
Metals	Antimony	88%	59.6	0.36	2	Y	N	Y	Y	**30**	**COPEC**
Metals	Arsenic	100%	772	0.22	9.79	Y	N	Y	Y	**79**	**COPEC**
Metals	Barium	100%	2,510	1.73	20	Y	N	Y	Y	**126**	**COPEC**
Metals	Beryllium	78%	0.81	0.21	--	N	N	Y	--	--	Source of Uncertainty
Metals	Cadmium	94%	14	0.17	0.99	Y	N	Y	Y	**14**	**COPEC**
Metals	Chromium	100%	37.1	0.42	43.4	Y	N	Y	Y	**1**	**COPEC**
Metals	Cobalt	100%	11.1	0.19	50	Y	N	Y	N	0.2	Not a COPEC
Metals	Copper	100%	3,510	0.36	31.6	Y	N	Y	Y	**111**	**COPEC**
Metals	Lead	100%	11,500	0.21	35.8	Y	N	Y	Y	**321**	**COPEC**
Metals	Manganese	100%	7,700	0.39	460	Y	N	Y	Y	**17**	**COPEC**
Metals	Mercury	84%	0.58	0.01	0.18	Y	N	Y	Y	**3**	**COPEC**
Metals	Nickel	100%	53.9	0.28	22.7	Y	N	Y	Y	**2**	**COPEC**
Metals	Selenium	97%	72.8	1.05	0.72	Y	N	Y	Y	**101**	**COPEC**
Metals	Silver	81%	53.7	0.14	1	Y	N	Y	Y	**54**	**COPEC**
Metals	Thallium	72%	1.2	0.14	--	N	N	Y	--	--	Source of Uncertainty
Metals	Vanadium	100%	114	0.58	27.3	Y	N	Y	Y	**4**	**COPEC**
Metals	Zinc	100%	17,700	0.56	121	Y	N	Y	Y	**146**	**COPEC**
SVOCs	1,1'-Biphenyl	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	1,2,4,5-Tetrachlorobenzene	0%	--	0.03	--	N	N	N	--	--	Not a COPEC
SVOCs	1,4-Dioxane	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Chloronaphthalene	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Chlorophenol	0%	--	0.02	0.03	Y	N	N	--	--	Not a COPEC
SVOCs	2-Methylnaphthalene	41%	0.285	0.01	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	2-Methylphenol	3%	0.074	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitroaniline	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	2-Nitrophenol	0%	--	0.03	--	N	N	N	--	--	Not a COPEC
SVOCs	2,2'-Oxybis(1-chloropropane)	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	2,3,4,6-Tetrachlorophenol	0%	--	0.03	--	N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dichlorophenol	0%	--	0.03	0.12	Y	N	N	--	--	Not a COPEC
SVOCs	2,4-Dimethylphenol	0%	--	0.04	0.03	Y	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrophenol	0%	--	0.03		N	N	N	--	--	Not a COPEC
SVOCs	2,4-Dinitrotoluene	0%	--	0.03	0.04	Y	N	N	--	--	Not a COPEC
SVOCs	2,4,5-Trichlorophenol	0%	--	0.02		N	N	N	--	--	Not a COPEC
SVOCs	2,4,6-Trichlorophenol	0%	--	0.03	0.21	Y	N	N	--	--	Not a COPEC
SVOCs	2,6-Dinitrotoluene	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	3-Methylphenol + 4-Methylphenol	6%	0.380	0.02	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	3-Nitroaniline	0%	--	0.03		N	N	N	--	--	Not a COPEC
SVOCs	3,3'-Dichlorobenzidine	0%	--	0.09	0.13	Y	N	N	--	--	Not a COPEC
SVOCs	4-Bromophenyl-phenylether	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chloro-3-methylphenol	0%	--	0.03	--	N	N	N	--	--	Not a COPEC

Table 4-6. COPEC Identification for Sediment

Chemical Group	Analyte	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	4-Chloroaniline	0%	--	0.04	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Chlorophenyl-phenyl ether	0%	--	0.02	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Nitroaniline	0%	--	0.04	--	N	N	N	--	--	Not a COPEC
SVOCs	4-Nitrophenol	0%	--	0.04	--	N	N	N	--	--	Not a COPEC
SVOCs	4,6-Dinitro-2-methylphenol	0%	--	0.04	--	N	N	N	--	--	Not a COPEC
SVOCs	Acenaphthene	44%	0.285	0.01	0.0067	Y	N	Y	Y	**43**	**COPEC**
SVOCs	Acenaphthylene	49%	0.285	0.01	0.0059	Y	N	Y	Y	**48**	**COPEC**
SVOCs	Acetophenone	3%	0.27	0.03	--	N	N	N	--	--	Not a COPEC
SVOCs	Anthracene	56%	0.19	0.01	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	Atrazine	0%	--	0.03	--	N	N	N	--	--	Not a COPEC
SVOCs	Benzaldehyde	6%	0.16	0.03	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	Benzo(a)anthracene	81%	0.58	0.01	0.108	Y	N	Y	Y	**5**	**COPEC**
SVOCs	Benzo(a)pyrene	84%	0.68	0.01	0.15	Y	N	Y	Y	**5**	**COPEC**
SVOCs	Benzo(b)fluoranthene	88%	0.85	0.02	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	Benzo(g,h,i)perylene	82%	0.54	0.01	0.17	Y	N	Y	Y	**3**	**COPEC**
SVOCs	Benzo(k)fluoranthene	76%	0.36	0.01	0.24	Y	N	Y	Y	**2**	**COPEC**
SVOCs	bis(2-Chloroethoxy)methane	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Bis(2-Chloroethyl) ether	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	bis(2-Ethylhexyl)phthalate	44%	0.280	0.020	0.18	Y	N	Y	Y	**2**	**COPEC**
SVOCs	Butylbenzylphthalate	12%	0.054	0.030	10.9	Y	N	Y	N	0.005	Not a COPEC
SVOCs	Caprolactam	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Carbazole	9%	0.110	0.030	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	Chrysene	85%	0.670	0.010	0.166	Y	N	Y	Y	**4**	**COPEC**
SVOCs	Di-n-butylphthalate	0%	--	0.020	--	N	N	N	--	--	Not a COPEC
SVOCs	Di-n-octylphthalate	0%	--	0.130	--	N	N	N	--	--	Not a COPEC
SVOCs	Dibenzo(a,h)anthracene	0%	--	0.010	--	N	N	N	--	--	Not a COPEC
SVOCs	Dibenzofuran	6%	0.053	0.020	0.415	Y	N	Y	N	0.1	Not a COPEC
SVOCs	Diethylphthalate	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Dimethylphthalate	0%	--	0.020	--	N	N	N	--	--	Not a COPEC
SVOCs	Fluoranthene	85%	1.500	0.020	0.423	Y	N	Y	**Y**	**4**	**COPEC**
SVOCs	Fluorene	34%	0.285	0.010	0.0774	Y	N	Y	**Y**	**4**	**COPEC**
SVOCs	Hexachlorobenzene	0%	--	0.020	0.02	Y	N	N	--	--	Not a COPEC
SVOCs	Hexachlorobutadiene	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachlorocyclo-pentadiene	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Hexachloroethane	0%	--	0.020	1	Y	N	N	--	--	Not a COPEC
SVOCs	Indeno(1,2,3-cd)pyrene	82%	0.450	0.020	--	N	N	Y	--	--	Source of Uncertainty
SVOCs	Isophorone	0%	--	0.020	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitroso-di-n propylamine	3%	0.037	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	N-Nitrosodiphenylamine	0%	--	0.020	2.7	Y	N	N	--	--	Not a COPEC
SVOCs	Naphthalene	37%	0.285	0.010	0.176	Y	N	Y	Y	**2**	**COPEC**

Table 4-6. COPEC Identification for Sediment

Chemical Group	Analyte	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
SVOCs	Nitrobenzene	0%	--	0.030	--	N	N	N	--	--	Not a COPEC
SVOCs	Pentachlorophenol	22%	0.036	0.010	0.504	Y	N	Y	N	0.07	Source of Uncertainty
SVOCs	Phenanthrene	79%	0.790	0.020	0.204	Y	N	Y	Y	**4**	**COPEC**
SVOCs	Phenol	9%	0.092	0.030	0.42	Y	N	Y	N	0.2	Not a COPEC
SVOCs	Pyrene	85%	1.100	0.020	0.195	Y	N	Y	Y	**6**	**COPEC**
VOCs	1,1-Dichloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,1-Dichloroethene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,1-Trichloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	0%	--	0.010	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2-Trichloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,1,2,2-Tetrachloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromo-3-chloropropane	3%	0.006	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dibromoethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichlorobenzene	3%	0.006	0.000	0.0165	Y	N	N	N	0.4	Not a COPEC
VOCs	1,2-Dichloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,2-Dichloropropane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	1,2,3-Trichlorobenzene	3%	0.006	0.000	0.858	Y	N	N	N	0.01	Not a COPEC
VOCs	1,2,4-Trichlorobenzene	3%	0.006	0.000	2.1	Y	N	N	N	0.003	Not a COPEC
VOCs	1,3-Dichlorobenzene	3%	0.006	0.000	4.43	Y	N	N	N	0.001	Not a COPEC
VOCs	1,4-Dichlorobenzene	3%	0.006	0.000	0.599	Y	N	N	N	0.01	Not a COPEC
VOCs	2-Butanone	47%	0.054	0.010	--	N	N	Y	--	--	Source of Uncertainty
VOCs	2-Hexanone	12%	0.019	0.010	--	N	N	Y	--	--	Source of Uncertainty
VOCs	4-Methyl-2-pentanone	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Acetone	59%	0.110	0.010	--	N	N	Y	--	--	Source of Uncertainty
VOCs	Benzene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Bromochloromethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Bromodichloromethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Bromoform	3%	0.006	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Bromomethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Carbon disulfide	9%	0.008	0.000	0.000851	Y	N	Y	Y	**9**	**COPEC**
VOCs	Carbon tetrachloride	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Chlorobenzene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Chloroform	6%	0.004	0.000	--	N	N	Y	--	--	Source of Uncertainty
VOCs	Chloromethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	cis-1,2-Dichloroethene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	cis-1,3-Dichloropropene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Cyclohexane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Dibromochloromethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Dichlorodifluoromethane	0%	--	0.010	--	N	N	N	--	--	Not a COPEC

Table 4-6. COPEC Identification for Sediment

Chemical Group	Analyte	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	Benchmark (mg/kg)	Available Benchmark	Bioacc.	Detect >= 5%	Max Detect > Benchmark	Hazard Quotient	COPEC Identification
VOCs	Ethylbenzene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Isopropylbenzene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	m, p-Xylene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	m,p-Xylene	0%	--	0.010	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl acetate	3%	0.002	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Methyl tert-butyl ether	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Methylcyclohexane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Methylene chloride	6%	0.005	0.000	--	N	N	Y	--	--	Source of Uncertainty
VOCs	o-Xylene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Styrene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Tetrachloroethene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Toluene	25%	0.026	0.000	--	N	N	Y	--	--	Source of Uncertainty
VOCs	trans-1,2-Dichloroethene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	trans-1,3-Dichloropropene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Trichloroethene	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Trichlorofluoromethane	0%	--	0.000	--	N	N	N	--	--	Not a COPEC
VOCs	Vinyl chloride	0%	--	0.000	--	N	N	N	--	--	Not a COPEC

FIGURES

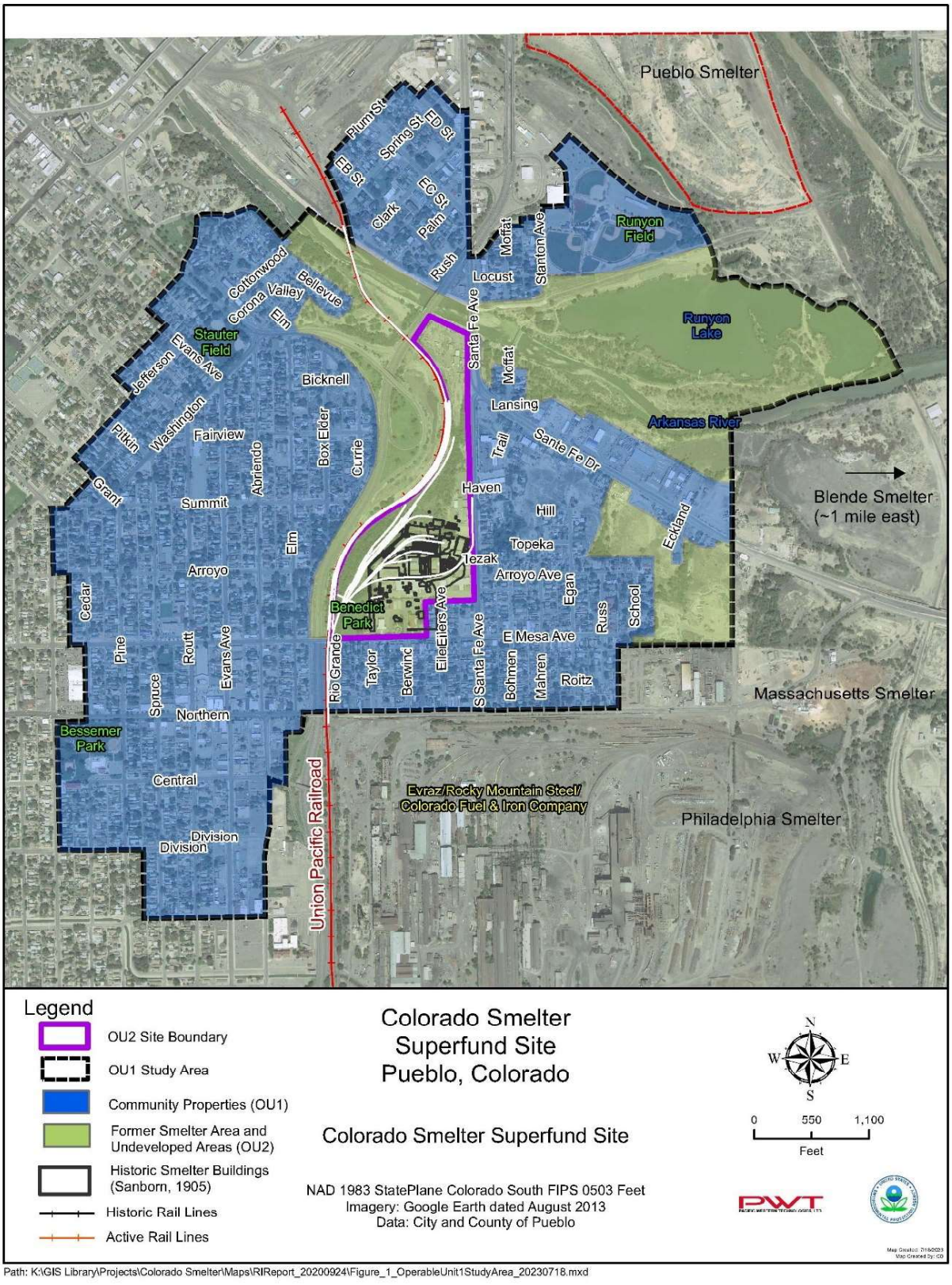
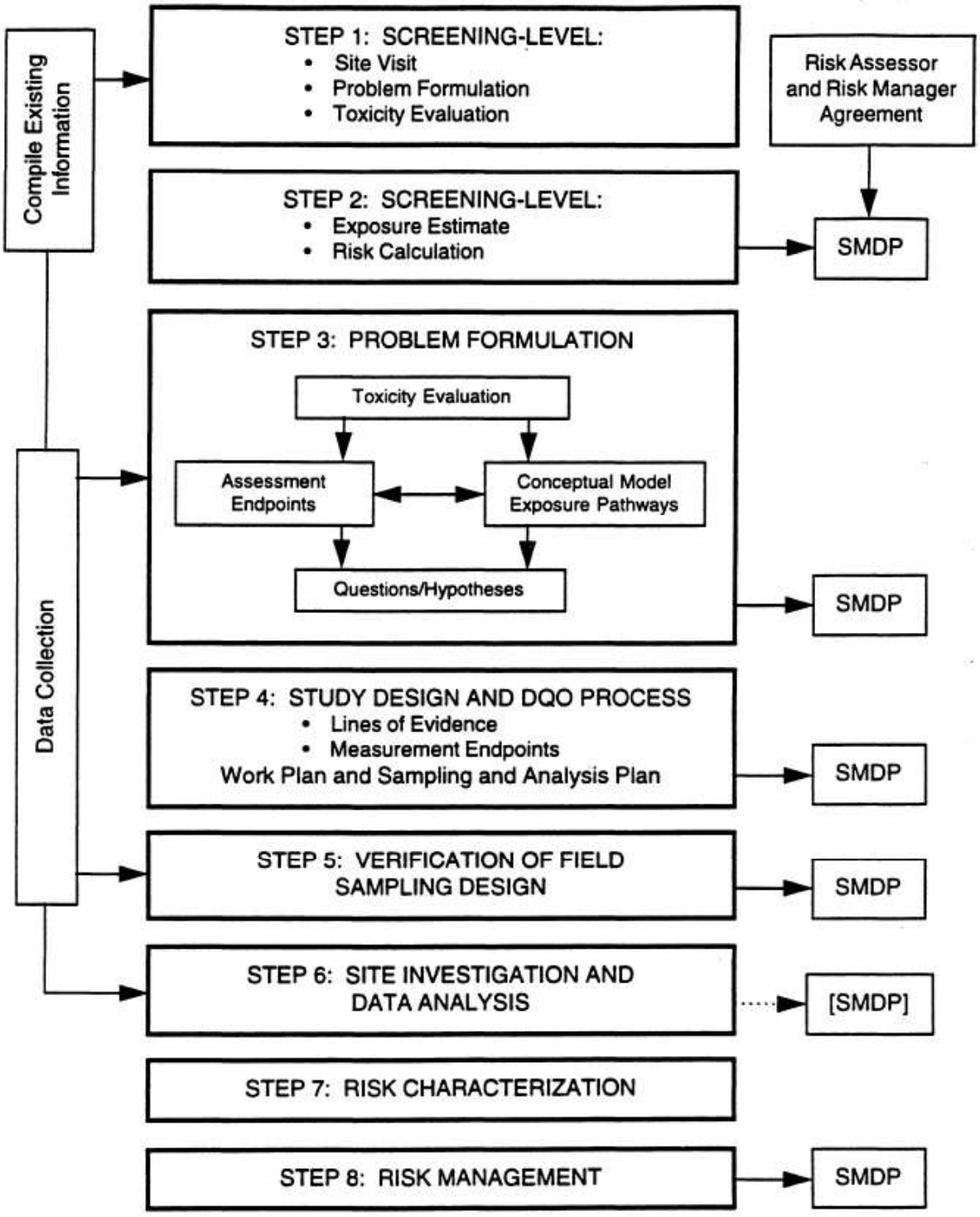


Figure 1 Colorado Smelter Site Map



Note: SMDP – Scientific Management Decision Point

Figure 2 Eight-step Ecological Risk Assessment for Superfund (EPA, 1997)

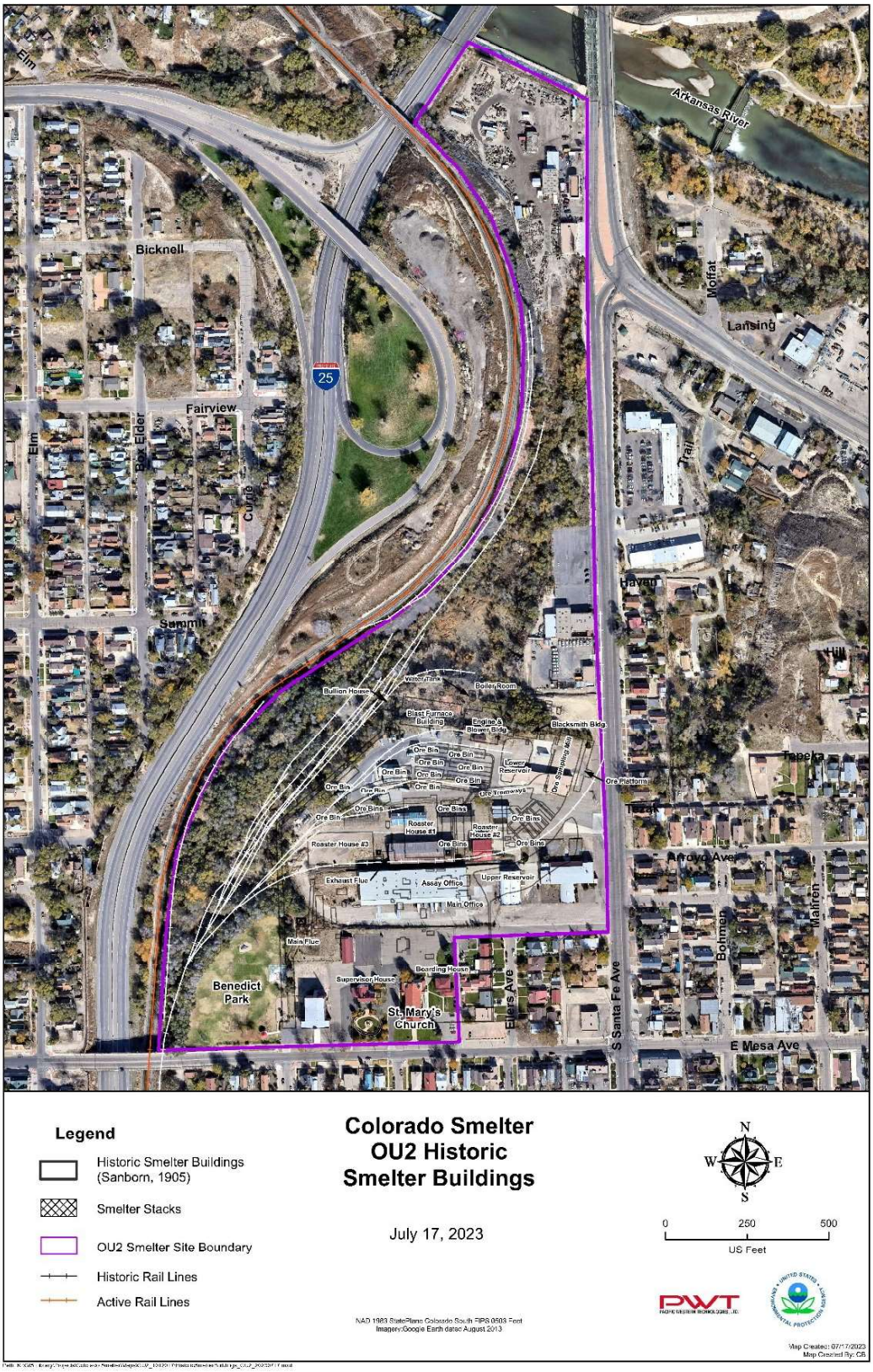


Figure 3 OU2 Historic Smelter Features

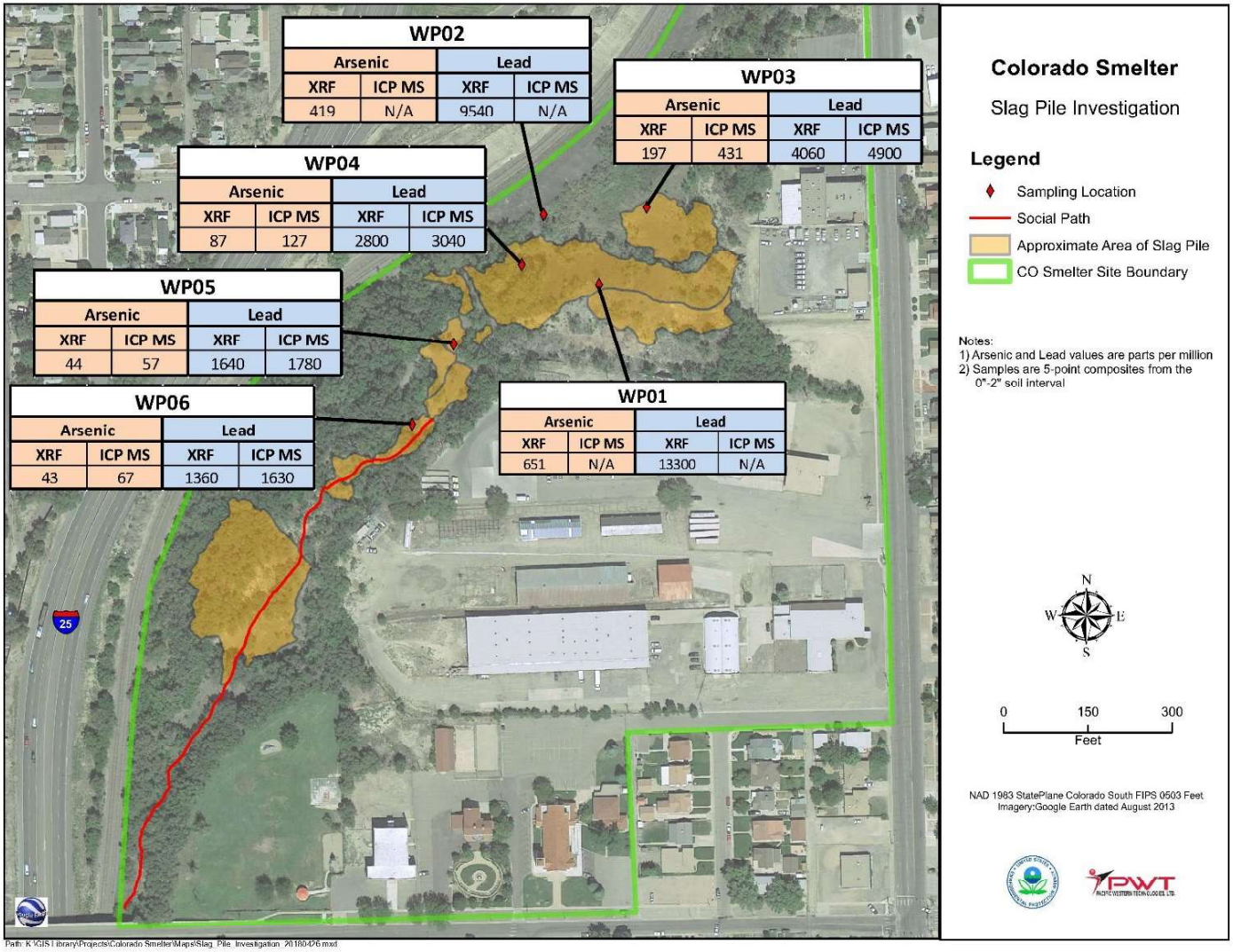


Figure 4 OU2 Slag Areas

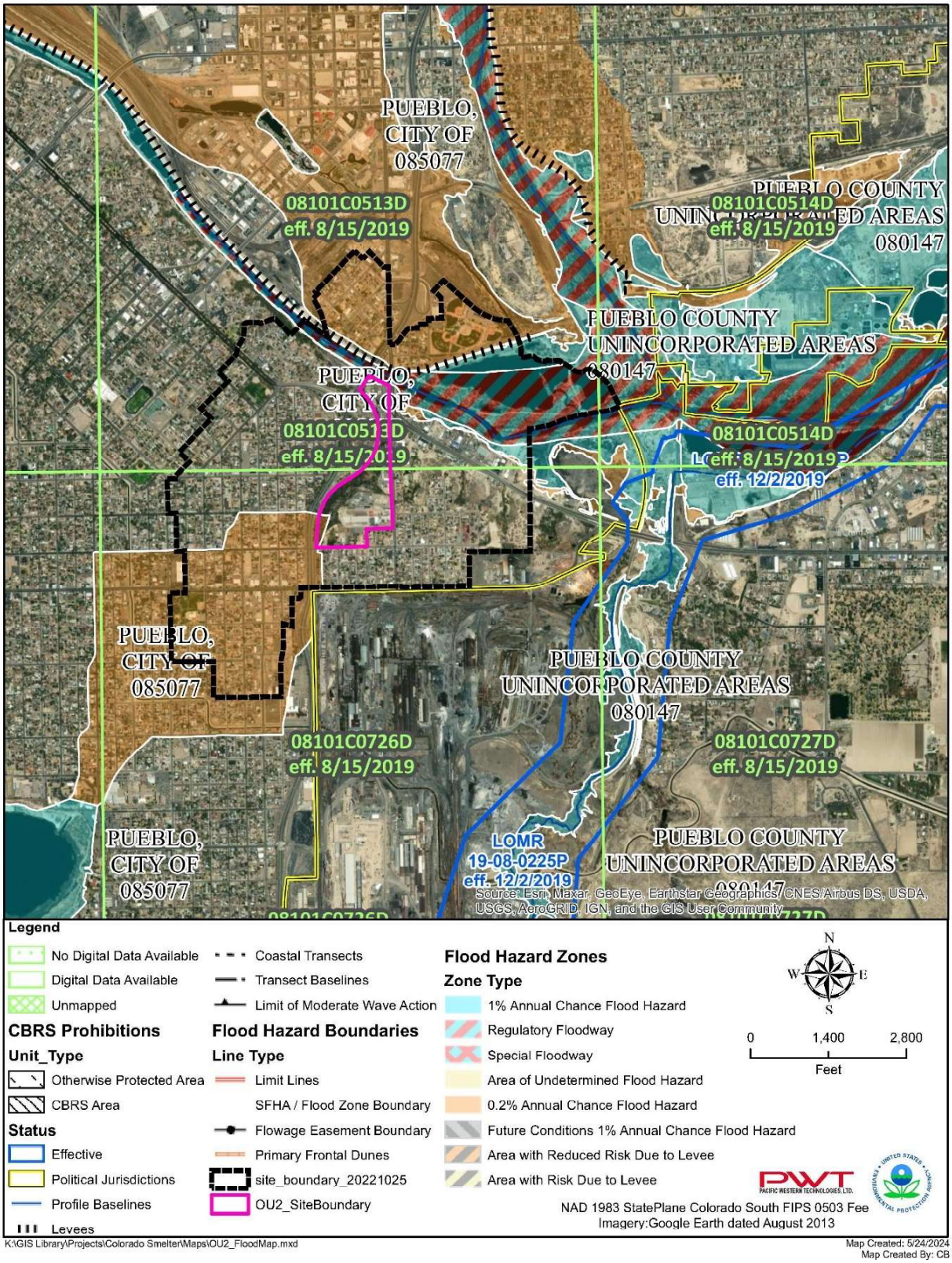


Figure 5 Flood Areas

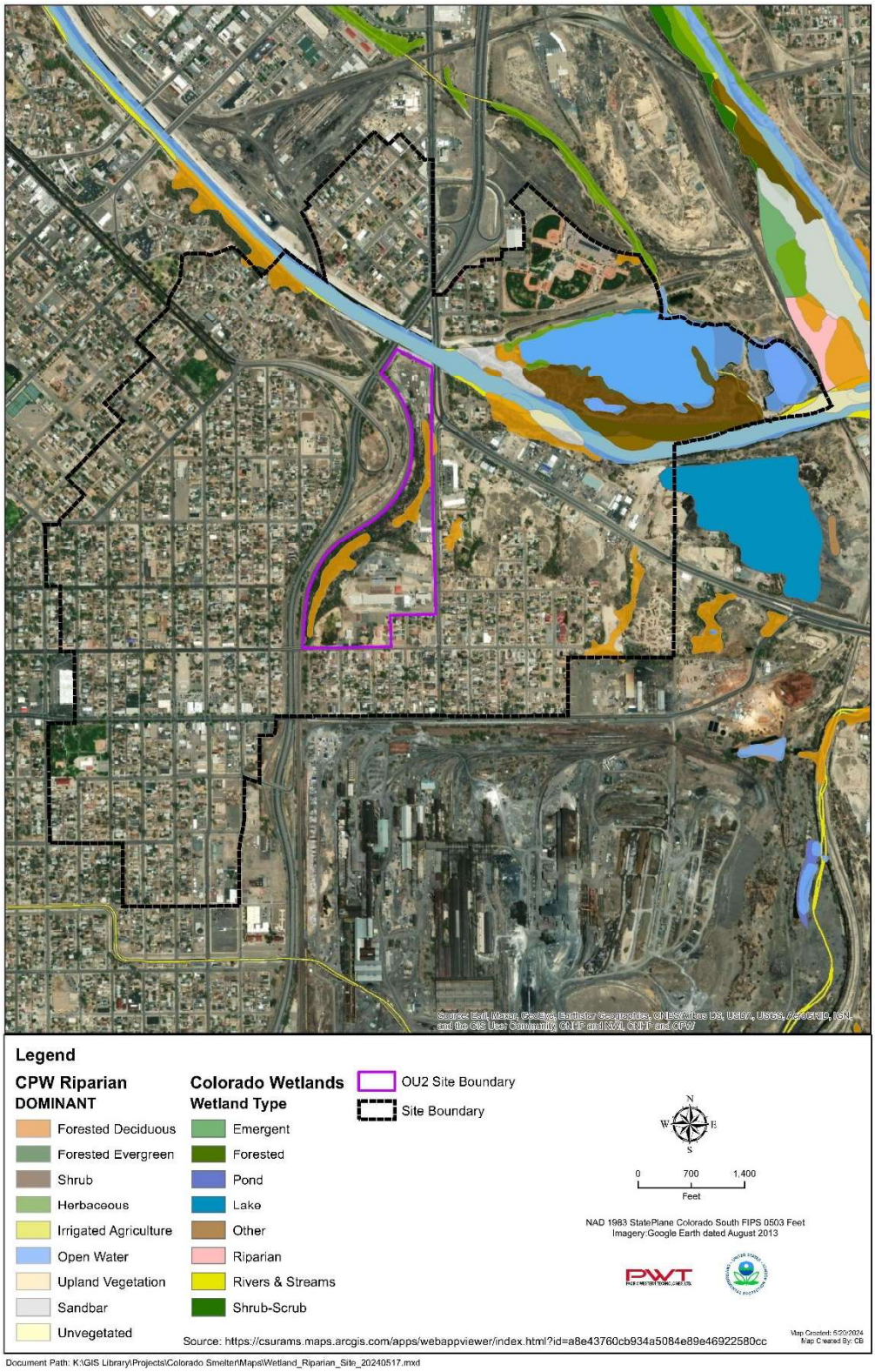
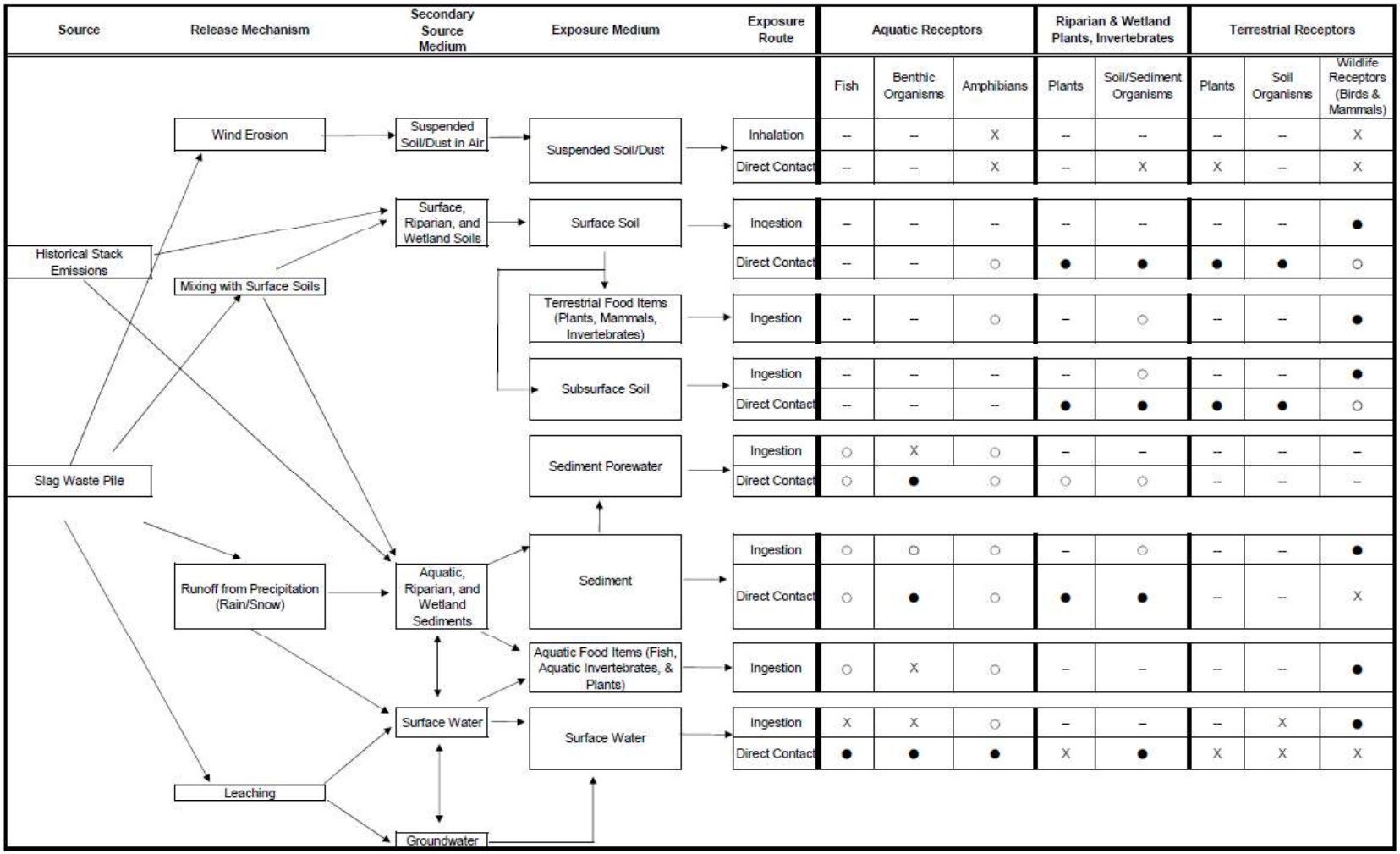


Figure 6 Wetland and Riparian Areas



Source	Release Mechanism	Secondary Source Medium	Exposure Medium	Exposure Route	Aquatic Receptors			Riparian & Wetland Plants, Invertebrates		Terrestrial Receptors		
					Fish	Benthic Organisms	Amphibians	Plants	Soil/Sediment Organisms	Plants	Soil Organisms	Wildlife Receptors (Birds & Mammals)
Historical Stack Emissions, Slag Waste Pile	Wind Erosion	Suspended Soil/Dust in Air	Suspended Soil/Dust	Inhalation	–	–	X	–	–	–	–	X
				Direct Contact	–	–	X	–	X	X	–	X
	Mixing with Surface Soils	Surface, Riparian, and Wetland Soils	Surface Soil	Ingestion	–	–	–	–	–	–	–	●
				Direct Contact	–	–	○	●	●	●	●	○
			Terrestrial Food Items (Plants, Mammals, Invertebrates)	Ingestion	–	–	○	–	○	–	–	●
			Subsurface Soil	Ingestion	–	–	–	–	○	–	–	●
				Direct Contact	–	–	–	●	●	●	●	○
			Sediment Porewater	Ingestion	○	X	○	–	–	–	–	–
				Direct Contact	○	●	○	○	○	–	–	–
	Runoff from Precipitation (Rain/Snow)	Aquatic, Riparian, and Wetland Sediments	Sediment	Ingestion	○	○	○	–	○	–	–	●
				Direct Contact	○	●	○	●	●	–	–	X
			Aquatic Food Items (Fish, Aquatic Invertebrates, & Plants)	Ingestion	○	X	○	–	–	–	–	●
	Leaching	Surface Water	Surface Water	Ingestion	X	X	○	–	–	–	X	●
				Direct Contact	●	●	●	X	●	X	X	X
		Groundwater										

LEGEND

–	Pathway is not complete, no evaluation required
X	Pathway is complete, but minor when compared to other pathways; qualitative evaluation
○	Pathway is complete and potentially significant; but insufficient data (exposure or toxicity) are available for quantitative evaluation
●	Pathway is complete and potentially significant; sufficient data available for quantitative evaluation

Figure 7 Conceptual Site Model

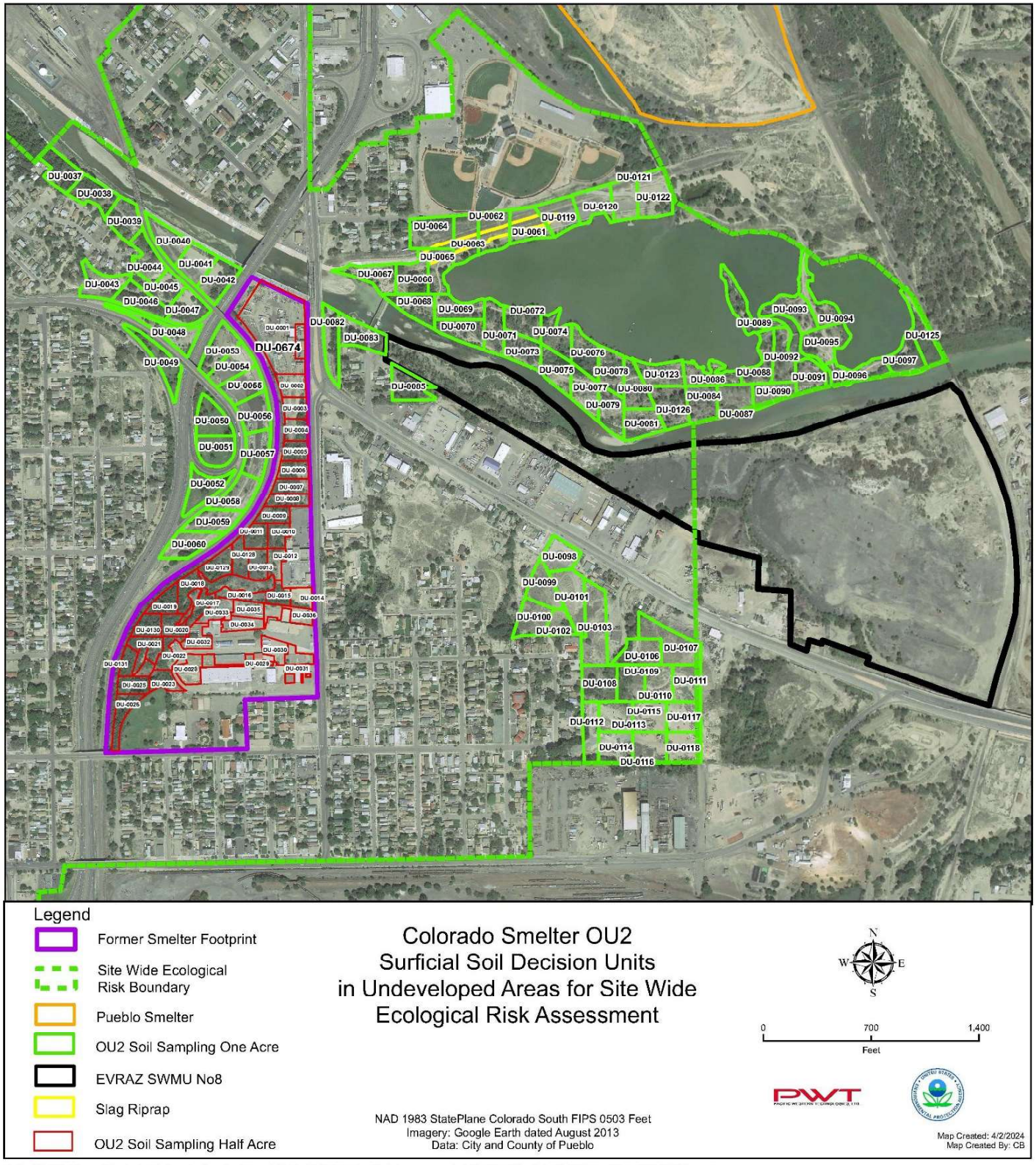


Figure 8 Colorado Smelter OU2 Surficial Soil Decision Units

APPENDICES

APPENDIX A - SPECIES LISTS

Table A-1 Fish Species Records (22) in the Arkansas River or Runyon Lake (2013)

Common name	Scientific name	Common name	Scientific name
Black bullhead	*Ameiurus melas*	Saugeye	*Sander vitreus/Sander canadensis*
Channel catfish	*Ictalurus punctatus*	Central stoneroller	*Campostoma anomalum*
Brook trout	*Salvelinus fontinalis*	Fathead minnow	*Pimephales promelas*
Brown trout	*Salmo trutta*	Longnose dace	*Rhinichthys cataractae*
Rainbow/cutbow trout	*Oncorhynchus mykiss*	Longnose sucker	*Catostomus catostomus*
Common carp	*Cyprinus carpio*	Plains killifish	*Fundulus zebrinus*
Green sunfish	*Lepomis cyanellus*	Red shiner	*Cyprinella lutrensis*
Largemouth bass	*Micropterus salmoides*	Sand shiner	*Notropis stramineus*
Smallmouth bass	*Micropterus dolomieu*	Flathead chub	*Platygobio gracilis*
Black crappie	*Pomoxis nigromaculatus*	Speckled chub	*Macrhybopsis aestivalis*
White crappie	*Pomoxis annularis*	White sucker	*Catostomus commersonii*

Table A-2 Aquatic Invertebrate Species Records (49) in the Arkansas River at Moffat Bridge (2005)

Common name	Scientific name	Common name	Scientific name
Amphipod	*Hyalella azteca*	Non-biting Midge	*Cryptochironomus*
Black fly	*Simulium*	Non-biting Midge	*Diamesa*
Brine fly	*Ephydridae*	Non-biting Midge	*Dicrotendipes*
Caddisfly	*Cheumatopsyche*	Non-biting Midge	*Eukiefferiella*
Caddisfly	*Hydropsyche*	Non-biting Midge	*Microtendipes*
Caddisfly	*Oecetis*	Non-biting Midge	*Orthocladius (Euorthocladius)*
Caddisfly	*Psychomyia flavida*	Non-biting Midge	*Orthocladius/Cricotopus*
Clam	*Pisidium*	Non-biting Midge	*Parakiefferiella*
Clam	*Sphaerium striatinum*	Non-biting Midge	*Pentaneurini*
Dance Fly	*Hemerodromia*	Non-biting Midge	*Phaenopsectra*
Dragonfly	*Ophiogomphus severus*	Non-biting Midge	*Polypedilum*
Drain fly	*Psychodidae*	Non-biting Midge	*Pseudochironomus*
Earthworm	*Eiseniella tetraedra*	Non-biting Midge	*Rheotanytarsus*
Mayfly	*Acentrella insignificans*	Non-biting Midge	*Tvetenia*
Mayfly	*Baetis tricaudatus*	Oligochaete worm	*Enchytraeidae*
Mayfly	*Fallceon quilleri*	Oligochaete worm	*Lumbriculidae*
Mayfly	*Heptagenia*	Oligochaete worm	*Megadrile*
Mayfly	*Tricorythodes minutus*	Oligochaete worm	*Tubificidae w/o hair chaetae*
Microcaddisfly	*Hydroptila*	Roundworm	*Nematoda*
Moth	*Petrophila*	Sludge worm	*Nais*
Non-biting Midge	*Cardiocladius*	Sludge worm	*Nais bretscheri*
Non-biting Midge	*Cladotanytarsus*	Spider	*Sperchon*
Non-biting Midge	*Cricotopus*	Spider	*Sperchon/Sperchonopsis*
Non-biting Midge	*Cricotopus bicinctus*	Water beetle	*Laccophilus maculosus*
Non-biting Midge	*Cricotopus trifascia*		

Table A-3 iNaturalist Amphibian Species Research-Grade Records (10) in Pueblo, Colorado

Common name	Scientific name	Common name	Scientific name
Great plains toad	*Anaxyrus cognatus*	Northern leopard frog	*Lithobates pipiens*
Woodhouse's toad	*Anaxyrus woodhousii*	Couch's spadefoot	*Scaphiopus couchii*
Boreal chorus frog	*Pseudacris maculata*	Plains spadefoot	*Spea bombifrons*
Plains leopard frog	*Lithobates blairi*	Mexican spadefoot	*Spea multiplicata*
American bullfrog	*Lithobates catesbeianus*	Western tiger salamander	*Ambystoma mavortium*

Table A-4 iNaturalist Plant Species Research-Grade Records (424) in Pueblo, Colorado

Common name	Scientific name	Common name	Scientific name
Mountain spring parsley	*Vesper montanus*	Eastern black walnut	*Juglans nigra*
Nodding onion	*Allium cernuum*	Spreading dogbane	*Apocynum androsaemifolium*
Geyer's onion	*Allium geyeri*	Hemp dogbane	*Apocynum cannabinum*
Textile onion	*Allium textile*	Antelope-horns	*Asclepias asperula asperula*
Common starlily	*Leucocrinum montanum*	Engelmann's milkweed	*Asclepias engelmanniana*
Solomon's plume	*Maianthemum racemosum*	Swamp milkweed	*Asclepias incarnata*
Star-flowered lily-of-the-valley	*Maianthemum stellatum*	Broadleaf milkweed	*Asclepias latifolia*
Garden grape-hyacinth	*Muscari armeniacum*	Showy milkweed	*Asclepias speciosa*
Common grape hyacinth	*Muscari botryoides*	Horsetail milkweed	*Asclepias subverticillata*
Narrowleaf yucca	*Yucca angustissima*	Butterfly milkweed	*Asclepias tuberosa*
Buckley's yucca	*Yucca constricta*	Green comet milkweed	*Asclepias viridiflora*
Great plains yucca	*Yucca glauca*	Lesser periwinkle	*Vinca minor*
Bearded iris	*Iris germanica*	Monument plant	*Frasera speciosa*
Western blue flag	*Iris missouriensis*	Arctic gentian	*Gentiana algida*
Yellow iris	*Iris pseudacorus*	Northern bedstraw	*Galium boreale*
Spotted coralroot	*Corallorhiza maculata*	Redstem stork's-bill	*Erodium cicutarium*
Striped coralroot	*Corallorhiza striata*	Pinewoods geranium	*Geranium caespitosum*
Vreeland's coralroot	*Corallorhiza striata vreelandii*	Richardson's geranium	*Geranium richardsonii*
Western rattlesnake plantain	*Goodyera oblongifolia*	Sticky geranium	*Geranium viscosissimum*
Common yarrow	*Achillea millefolium*	Delicate fern moss	*Thuidium delicatulum*
Western ragweed	*Ambrosia psilostachya*	American trumpet vine	*Campsis radicans*
Giant ragweed	*Ambrosia trifida*	Southern catalpa	*Catalpa bignonioides*
Greater burdock	*Arctium lappa*	Northern catalpa	*Catalpa speciosa*
Lesser burdock	*Arctium minus*	American dragonhead	*Dracocephalum parviflorum*
Heartleaf arnica	*Arnica cordifolia*	Henbit deadnettle	*Lamium amplexicaule*
Silver sagebrush	*Artemisia cana*	White horehound	*Marrubium vulgare*
Sand sagebrush	*Artemisia filifolia*	Wild bergamot	*Monarda fistulosa*
Fringed sagebrush	*Artemisia frigida*	Catnip	*Nepeta cataria*
Silver wormwood	*Artemisia ludoviciana*	Oregano	*Origanum vulgare*

Common name	Scientific name	Common name	Scientific name
Big sagebrush	*Artemisia tridentata*	Common selfheal	*Prunella vulgaris*
Willow baccharis	*Baccharis salicina*	Mintweed	*Salvia reflexa*
False boneset	*Brickellia eupatorioides*	Britton's skullcap	*Scutellaria brittonii*
Musk thistle	*Carduus nutans*	Cut-leaf germander	*Teucrium laciniatum*
Common yellow chaenactis	*Chaenactis glabriuscula*	Common devil's-claw	*Proboscidea louisianica*
Heath-leaved chaetopappa	*Chaetopappa ericoides*	Green ash	*Fraxinus pennsylvanica*
Yellow rabbitbrush	*Chrysothamnus viscidiflorus*	Common privet	*Ligustrum vulgare*
Chicory	*Cichorium intybus*	Rough menodora	*Menodora scabra*
Creeping thistle	*Cirsium arvense*	Common lilac	*Syringa vulgaris*
Wavyleaf thistle	*Cirsium undulatum*	Louisiana broomrape	*Aphyllon ludovicianum*
Bull thistle	*Cirsium vulgare*	Many flower broomrape	*Aphyllon multiflorum*
Plains coreopsis	*Coreopsis tinctoria*	Wholeleaf paintbrush	*Castilleja integra*
Garden cosmos	*Cosmos bipinnatus*	Downy paintbrush	*Castilleja sessiliflora*
Dogweed	*Dyssodia papposa*	Yellow owl's-clover	*Orthocarpus luteus*
Rubber rabbitbrush	*Ericameria nauseosa*	Canadian wood betony	*Pedicularis canadensis*
Horseweed	*Erigeron canadensis*	Pond water-starwort	*Callitriche stagnalis*
Spreading fleabane	*Erigeron divergens*	Small-flowered blue-eyed mary	*Collinsia parviflora*
Plains fleabane	*Erigeron modestus*	Gilia beardtongue	*Penstemon ambiguus*
Pale felicia	*Felicia muricata*	Broadbeard beardtongue	*Penstemon angustifolius*
Red dome blanketflower	*Gaillardia pinnatifida*	Brandegee's penstemon	*Penstemon glaber brandegeei*
Indian blanket	*Gaillardia pulchella*	Lilac penstemon	*Penstemon gracilis*
Shaggy soldier	*Galinsoga quadriradiata*	Desert penstemon	*Penstemon pseudospectabilis*
Curlytop gumweed	*Grindelia nuda*	Rydberg penstemon	*Penstemon rydbergii*
Curlycup gumweed	*Grindelia squarrosa*	Sidebells penstemon	*Penstemon secundiflorus*
Broom snakeweed	*Gutierrezia sarothrae*	Rocky Mountain penstemon	*Penstemon strictus*
Common sunflower	*Helianthus annuus*	Ribwort plantain	*Plantago lanceolata*
Prairie sunflower	*Helianthus petiolaris*	Greater plantain	*Plantago major*
Showy goldeneye	*Heliomeris multiflora*	Woolly plantain	*Plantago patagonica*
Hoary false goldenaster	*Heterotheca canescens*	Blue water-speedwell	*Veronica anagallis-aquatica*

Common name	Scientific name	Common name	Scientific name
Sessile flower false goldenaster	*Heterotheca sessiliflora*	Bird's-eye speedwell	*Veronica persica*
Hairy goldenaster	*Heterotheca villosa*	Butterfly bush	*Buddleja davidii*
Hairy false goldenaster	*Heterotheca villosa foliosa*	Lanceleaf figwort	*Scrophularia lanceolata*
Pumice alpine gold	*Hulsea vestita*	Great mullein	*Verbascum thapsus*
Dusty miller	*Jacobaea maritima*	Dakota mock vervain	*Glandularia bipinnatifida*
Prickly lettuce	*Lactuca serriola*	Prostrate vervain	*Verbena bracteata*
Dotted gayfeather	*Liatris punctata*	Blue vervain	*Verbena hastata*
Rush skeleton plant	*Lygodesmia juncea*	Hoary vervain	*Verbena stricta*
Tahoka daisy	*Machaeranthera tanacetifolia*	Gunnison's mariposa lily	*Calochortus gunnisonii*
Blackfoot daisy	*Melampodium leucanthum*	White twisted-stalk	*Streptopus amplexifolius*
Prairie false dandelion	*Nothocalais cuspidata*	Corn lily	*Veratrum californicum*
Lemonscent	*Pectis angustifolia*	David's spurge	*Euphorbia davidii*
Feltleaf everlasting	*Pseudognaphalium microcephalum*	Green poinsettia	*Euphorbia dentata*
Upright prairie coneflower	*Ratibida columnifera*	Fendler's sandmat	*Euphorbia fendleri*
Black-eyed susan	*Rudbeckia hirta*	Ribseed sandmat	*Euphorbia glyptosperma*
Milk thistle	*Silybum marianum*	Spotted spurge	*Euphorbia maculata*
Canada goldenrod	*Solidago canadensis*	Snow-on-the-mountain	*Euphorbia marginata*
Giant goldenrod	*Solidago gigantea*	Prairie sandmat	*Euphorbia missurica*
Smooth field sowthistle	*Sonchus arvensis uliginosus*	Donkey tail	*Euphorbia myrsinites*
Prickly sow thistle	*Sonchus asper*	Prostrate sandmat	*Euphorbia prostrata*
Pacific aster	*Symphyotrichum chilense*	Matted sandmat	*Euphorbia serpens*
White heath aster	*Symphyotrichum ericoides*	Wormseed sandmat	*Euphorbia vermiculata*
Smooth blue aster	*Symphyotrichum laeve*	Lewis flax	*Linum lewisii*
Hairy white oldfield aster	*Symphyotrichum pilosum*	Eastern cottonwood	*Populus deltoides*
Tansy	*Tanacetum vulgare*	Plains cottonwood	*Populus deltoides monilifera*
Red-seeded dandelion	*Taraxacum erythrospermum*	Fremont cottonwood	*Populus fremontii*
Common dandelion	*Taraxacum officinale*	Trembling aspen	*Populus tremuloides*
Stemless four-nerve daisy	*Tetraneuris acaulis*	Peachleaf willow	*Salix amygdaloides*
Largeflower ground-daisy	*Townsendia grandiflora*	Narrowleaf willow	*Salix exigua*

Common name	Scientific name	Common name	Scientific name
Yellow salsify	*Tragopogon dubius*	Canada violet	*Viola canadensis*
Cowpen daisy	*Verbesina encelioides*	Nuttall's violet	*Viola nuttallii*
Rough cocklebur	*Xanthium strumarium*	Prairie violet	*Viola pedatifida*
Mojave aster	*Xylorhiza tortifolia*	Flower-of-an-hour	*Hibiscus trionum*
Rocky Mountain zinnia	*Zinnia grandiflora*	Dwarf mallow	*Malva neglecta*
Harebell	*Campanula rotundifolia*	Small mallow	*Malva pusilla*
Hound's-tongue	*Cynoglossum officinale*	Common mallow	*Malva sylvestris*
Flatspine stickseed	*Lappula occidentalis*	Narrowleaf globemallow	*Sphaeralcea angustifolia*
Fringed puccoon	*Lithospermum incisum*	Scarlet globemallow	*Sphaeralcea coccinea*
Many flowered gromwell	*Lithospermum multiflorum*	Purple loosestrife	*Lythrum salicaria*
Miner's candle	*Oreocarya virgata*	Fireweed	*Chamaenerion angustifolium*
Desert madwort	*Alyssum desertorum*	Fragrant evening primrose	*Oenothera caespitosa*
Shepherd's-purse	*Capsella bursa-pastoris*	Velvet weed	*Oenothera curtiflora*
Crossflower	*Chorispora tenella*	Lavender leaf sundrops	*Oenothera lavandulifolia*
Flixweed	*Descurainia sophia*	Pink ladies	*Oenothera speciosa*
Western wallflower	*Erysimum capitatum*	Scarlet beeblossom	*Oenothera suffrutescens*
Sanddune wallflower	*Erysimum capitatum capitatum*	Hairy evening primrose	*Oenothera villosa*
Heart-podded hoary cress	*Lepidium draba*	Common juniper	*Juniperus communis*
Broadleaved pepperweed	*Lepidium latifolium*	One-seed juniper	*Juniperus monosperma*
Watercress	*Nasturtium officinale*	Rocky Mountain juniper	*Juniperus scopulorum*
Wild radish	*Raphanus sativus*	White fir	*Abies concolor*
Tumble mustard	*Sisymbrium altissimum*	Blue spruce	*Picea pungens*
Prince's plume	*Stanleya pinnata*	Lodgepole pine	*Pinus contorta*
Field penny-cress	*Thlaspi arvense*	Colorado pinyon	*Pinus edulis*
Rocky Mountain beeplant	*Peritoma serrulata*	Limber pine	*Pinus flexilis*
Redwhisker clammyweed	*Polanisia dodecandra*	Ponderosa pine	*Pinus ponderosa*
Prostrate pigweed	*Amaranthus albus*	Douglas fir	*Pseudotsuga menziesii*
Palmer's amaranth	*Amaranthus palmeri*	Three-way sedge	*Dulichium arundinaceum*
Fourwing saltbush	*Atriplex canescens*	Panicled bulrush	*Scirpus microcarpus*

Common name	Scientific name	Common name	Scientific name
Common orache	*Atriplex patula*	Purple three-awn	*Aristida purpurea*
Summer-cypress	*Bassia scoparia*	Silver bluestem	*Bothriochloa laguroides*
Common lamb's-quarters	*Chenopodium album*	Sideoats grama	*Bouteloua curtipendula*
Winterfat	*Krascheninnikovia lanata*	Buffalograss	*Bouteloua dactyloides*
Slender Russian-thistle	*Salsola collina*	Blue grama	*Bouteloua gracilis*
Tumbleweed	*Salsola tragus*	Rescue grass	*Bromus catharticus catharticus*
Tree cholla	*Cylindropuntia imbricata*	Smooth brome	*Bromus inermis*
Scarlet hedgehog cactus	*Echinocereus coccineus coccineus*	Cheatgrass	*Bromus tectorum*
Lace cactus	*Echinocereus reichenbachii perbellus*	Buffelgrass	*Cenchrus ciliaris*
Kingcup cactus	*Echinocereus triglochidiatus triglochidiatus*	Kikuyu grass	*Cenchrus clandestinus*
Green-flower hedgehog cactus	*Echinocereus viridiflorus viridiflorus*	Orchard grass	*Dactylis glomerata*
Spinystar	*Escobaria vivipara*	Canada wild rye	*Elymus canadensis*
Grassland prickly pear	*Opuntia cymochila*	Squirreltail	*Elymus elymoides*
Engelmann's prickly pear	*Opuntia engelmannii*	Quack grass	*Elymus repens*
Twisted-spine prickly pear	*Opuntia macrorhiza*	Western wheatgrass	*Elymus smithii*
Brown-spined prickly pear	*Opuntia phaeacantha*	Indian ricegrass	*Eriocoma hymenoides*
Hairspine prickly pear	*Opuntia polyacantha*	Needle-and-thread	*Hesperostipa comata*
Twist-spined prickly pear	*Opuntia tortispina*	New Mexico feathergrass	*Hesperostipa neomexicana*
James' nailwort	*Paronychia jamesii*	Squirreltail	*Hordeum jubatum*
Creeping nailwort	*Paronychia sessiliflora*	Prairie junegrass	*Koeleria macrantha*
Common soapwort	*Saponaria officinalis*	Ring muhly	*Muhlenbergia torreyi*
White campion	*Silene latifolia*	Reed canary grass	*Phalaris arundinacea*
Bladder campion	*Silene vulgaris*	Timothy grass	*Phleum pratense*
Western spring beauty	*Claytonia rosea*	Common reed	*Phragmites australis*
Snowball sand verbena	*Abronia fragrans*	Muttongrass	*Poa fendleriana*
Narrowleaf four o'clock	*Mirabilis linearis*	Tumble grass	*Schedonnardus paniculatus*
Colorado four o'clock	*Mirabilis multiflora*	Little bluestem	*Schizachyrium scoparium*

Common name	Scientific name	Common name	Scientific name
Smooth spreading four o'clock	*Mirabilis oxybaphoides*	Green bristle grass	*Setaria viridis*
Roundleaf four o'clock	*Mirabilis rotundifolia*	Sand dropseed	*Sporobolus cryptandrus*
Small-flowered sand-verbena	*Tripterocalyx micranthus*	Prairie dropseed	*Sporobolus heterolepis*
Black-bindweed	*Fallopia convolvulus*	Narrow-leaved cattail	*Typha angustifolia*
Longroot smartweed	*Persicaria amphibia emersa*	Brittle bladder fern	*Cystopteris fragilis*
Pinkweed	*Persicaria pensylvanica*	American sycamore	*Platanus occidentalis*
Japanese knotweed	*Reynoutria japonica*	Oregon grape	*Berberis aquifolium*
Curly dock	*Rumex crispus*	Creeping mahonia	*Berberis repens*
Common purslane	*Portulaca oleracea*	Scrambled eggs	*Corydalis aurea*
Greasewood	*Sarcobatus vermiculatus*	California poppy	*Eschscholzia californica*
Chinese saltcedar	*Tamarix chinensis*	Yellow horned Poppy	*Glaucium flavum*
Saltcedar	*Tamarix ramosissima*	Red baneberry	*Actaea rubra*
Maiten tree	*Maytenus boaria*	Meadow anemone	*Anemonastrum canadense*
Pediastrum algae	*Pediastrum duplex*	Blue columbine	*Aquilegia coerulea*
Western spiderwort	*Tradescantia occidentalis*	Blue clematis	*Clematis columbiana*
Canadian bunchberry	*Cornus canadensis*	Scott's clematis	*Clematis hirsutissima scottii*
Red osier dogwood	*Cornus sericea*	Western virgin's bower	*Clematis ligusticifolia*
Cliff fendlerbush	*Fendlera rupicola*	Prairie larkspur	*Delphinium carolinianum virescens*
Ten-petal stickleaf	*Mentzelia decapetala*	Nuttall's larkspur	*Delphinium nuttallianum*
Giant blazingstar	*Mentzelia laevicaulis*	Prairie pasqueflower	*Pulsatilla nuttaliana*
Bractless blazingstar	*Mentzelia nuda*	Lesser meadow-rue	*Thalictrum minus*
Buffalo gourd	*Cucurbita foetidissima*	Netleaf hackberry	*Celtis reticulata*
Wild teasel	*Dipsacus fullonum*	Common hops	*Humulus lupulus*
Twinberry honeysuckle	*Lonicera involucrata*	Russian olive	*Elaeagnus angustifolia*
Red-berried elder	*Sambucus racemosa*	White mulberry	*Morus alba*
Western scouring rush	*Equisetum hyemale affine*	Fendler's ceanothus	*Ceanothus fendleri*
Bearberry	*Arctostaphylos uva-ursi*	Black chokeberry	*Aronia melanocarpa*
Pinesap	*Monotropa hypopitys*	Alder-leaved mountain-mahogany	*Cercocarpus montanus*
Woodland pinedrops	*Pterospora andromedea*	Mountain ninebark	*Physocarpus monogynus*

Common name	Scientific name	Common name	Scientific name
Narrow-leaf mountain trumpet	*Collomia linearis*	American plum	*Prunus americana*
Scarlet gilia	*Ipomopsis aggregata*	Sour cherry	*Prunus cerasus*
Iron ipomopsis	*Ipomopsis laxiflora*	Peach	*Prunus persica*
Dwarf ipomopsis	*Ipomopsis pumila*	Chokecherry	*Prunus virginiana*
Spiny phlox	*Phlox hoodii*	Woods' rose	*Rosa woodsii*
Longleaf phlox	*Phlox longifolia*	Rocky Mountain raspberry	*Rubus deliciosus*
Blackwood	*Acacia melanoxylon*	European raspberry	*Rubus idaeus*
Desert false indigo	*Amorpha fruticosa*	European mountain ash	*Sorbus aucuparia*
Two-grooved milkvetch	*Astragalus bisulcatus*	American elm	*Ulmus americana*
Licorice milkvetch	*Astragalus glycyphyllos*	Siberian elm	*Ulmus pumila*
Missouri milkvetch	*Astragalus missouriensis*	Western dwarf mistletoe	*Arceuthobium campylopodum*
Nuttall's milkvetch	*Astragalus nuttallii*	Ponderosa pine dwarf mistletoe	*Arceuthobium vaginatum cryptopodium*
Racemose milkvetch	*Astragalus racemosus*	Fragrant sumac	*Rhus aromatica*
White prairie clover	*Dalea candida*	Skunkbush sumac	*Rhus trilobata*
Honey locust	*Gleditsia triacanthos*	Western poison ivy	*Toxicodendron rydbergii*
Wild licorice	*Glycyrrhiza lepidota*	Rocky Mountain maple	*Acer glabrum*
Indian rushpea	*Hoffmannseggia glauca*	Boxelder	*Acer negundo*
White peavine	*Lathyrus lanszwertii leucanthus*	Goldenrain tree	*Koelreuteria paniculata*
Black medick	*Medicago lupulina*	Tree-of-heaven	*Ailanthus altissima*
Alfalfa	*Medicago sativa*	Spearleaf stonecrop	*Sedum lanceolatum*
White sweet clover	*Melilotus albus*	Golden currant	*Ribes aureum*
Yellow sweetclover	*Melilotus officinalis*	Swamp currant	*Ribes lacustre*
Sainfoin	*Onobrychis viciifolia*	Littleleaf alumroot	*Heuchera parvifolia*
Slimflower scurfpea	*Pediomelum tenuiflorum*	Hillside false bindweed	*Calystegia subacaulis*
Black locust	*Robinia pseudoacacia*	Field bindweed	*Convolvulus arvensis*
Purple crown vetch	*Securigera varia*	Dodders	*Cuscuta*
Silky sophora	*Sophora nuttalliana*	Tropical speedwell	*Evolvulus alsinoides*
Japanese pagoda tree	*Styphnolobium japonicum*	Shaggy dwarf morning-glory	*Evolvulus nuttallianus*
Mountain goldenbean	*Thermopsis montana*	Bush morning-glory	*Ipomoea leptophylla*
False lupine	*Thermopsis rhombifolia*	Common morning-glory	*Ipomoea purpurea*

Common name	Scientific name	Common name	Scientific name
Strawberry clover	*Trifolium fragiferum*	Sacred datura	*Datura wrightii*
Alsike clover	*Trifolium hybridum*	Long-leaved ground cherry	*Physalis longifolia*
Red clover	*Trifolium pratense*	Purple ground cherry	*Quincula lobata*
White clover	*Trifolium repens*	Bittersweet nightshade	*Solanum dulcamara*
Common vetch	*Vicia sativa*	Buffalo-bur	*Solanum rostratum*
Water birch	*Betula occidentalis*	Red buffalo-bur	*Solanum sisymbriifolium*
Siberian birch	*Betula platyphylla*	Thicket creeper	*Parthenocissus inserta*
Beaked hazelnut	*Corylus cornuta*	Virginia creeper	*Parthenocissus quinquefolia*
Gambel oak	*Quercus gambelii*	Riverbank grape	*Vitis riparia*
Bur oak	*Quercus macrocarpa*	Puncture vine	*Tribulus terrestris*

Table A-5 iNaturalist Insect Species Research-Grade Records (905) in Pueblo, Colorado

Common name	Scientific name	Common name	Scientific name
Oriental cockroach	*Blatta orientalis*	Emerald moth	*Eulithis luteolata*
Cloudy flower beetle	*Anthicus cervinus*	Brown-bordered geometer moth	*Eumacaria madopata*
Earth-boring scarab beetle	*Bolbocerosoma pusillum*	Geometrid moth	*Eupithecia anticaria*
Apple twig borer	*Amphicerus bicaudatus*	Geometrid moth	*Eupithecia coloradensis*
Horned powder-post beetle	*Lichenophanes armiger*	Geometrid moth	*Fernaldella stalachtaria*
Hollyhock weevil	*Rhopalapion longirostre*	Chickweed geometer moth	*Haematopis grataria*
Metallic wood-boring beetle	*Agrilus gibbicollis*	Brown bark carpet moth	*Horisme intestinata*
Flatheaded pine borer	*Phaenops gentilis*	Geometrid moth	*Hydriomena macdunnoughi*
Flatheaded borer	*Poecilonota thureura*	Geometrid moth	*Idaea gemmata*
Colorado soldier beetle	*Chauliognathus basalis*	Geometrid moth	*Idaea occidentaria*
Podabrus soldier beetle	*Podabrus tomentosus*	Ochre wave	*Idaea productata*
Agonum ground beetle	*Agonum decorum*	Pale-winged gray	*Iridopsis ephyraria*
Agonum ground beetle	*Agonum extensicolle*	Speckled wave	*Lobocleta peralbata*
Great Plains giant tiger beetle	*Amblycheila cylindriformis*	Straight-lined wave	*Lobocleta plemyraria*
Green pubescent ground beetle	*Chlaenius sericeus*	Lychnosea moth	*Lychnosea helveolaria*
Green claybank tiger beetle	*Cicindela denverensis*	Angle moth	*Macaria adonis*
Crimson saltflat tiger beetle	*Cicindela fulgida*	Split-lined angle	*Macaria bitactata*
Common claybank tiger beetle	*Cicindela limbalis*	Geometrid moth	*Mericisca gracea*
Black sky tiger beetle	*Cicindela nigrocoerulea*	Pale metanema moth	*Metanema inatomaria*
Large grassland tiger beetle	*Cicindela obsoleta*	Monostoecha moth	*Monostoecha semipectinata*
Western tiger beetle	*Cicindela oregona*	Gem moth	*Orthonama obstipata*
Punctured tiger beetle	*Cicindela punctulata*	Geometrid moth	*Perizoma custodiata*
Chihuahua tiger beetle	*Cicindela punctulata chihuahuae*	Geometrid moth	*Perizoma oxygramma*
Purple tiger beetle	*Cicindela purpurea*	Honest pero moth	*Pero honestaria*
Bronzed tiger beetle	*Cicindela repanda*	Geometrid moth	*Pero modestus*
Festive tiger beetle	*Cicindela scutellaris*	Geometrid moth	*Phaeoura mexicanaria*
Splendid tiger beetle	*Cicindela splendida*	Geometrid moth	*Prorella gypsata*
Oblique-lined tiger beetle	*Cicindela tranquebarica*	Virgin moth	*Protitame virginalis*
Colorful foliage ground beetle	*Lebia guttula*	Geometrid moth	*Sabulodes niveostriata*

Common name	Scientific name	Common name	Scientific name
Lined stenolophus	*Stenolophus lineola*	Angled wave	*Scopula ancellata*
Longhorned beetle	*Astyleiopus variegatus*	Geometrid moth	*Snowia montanaria*
Ataxia longhorned beetle	*Ataxia hubbardi*	Geometrid moth	*Stamnodes formosata*
Batyle longhorned beetle	*Batyle suturalis*	White-striped black	*Trichodezia albovittata*
Small mulberry borer	*Dorcaschema alternatum*	Geometrid moth	*Vinemina opacaria*
Yellow velvet beetle	*Lepturobosca chrysocoma*	Acrocercops moth	*Acrocercops quinquistrigella*
Giant cactus longhorn beetle	*Moneilema gigas*	Chinese tallow leaf miner	*Caloptilia triadicae*
Spotted pine sawyer	*Monochamus clamator*	Aetole moth	*Aetole bella*
White-spotted sawyer beetle	*Monochamus scutellatus*	Phymatopus moth	*Phymatopus hectoides*
Pole borer	*Neandra brunnea*	Dotted roadside-skipper	*Amblyscirtes eos*
Oeme beetle	*Oeme rigida*	Common roadside-skipper	*Amblyscirtes vialis*
Elm borer	*Saperda tridentata*	Least skipper	*Ancyloxypha numitor*
Red-shouldered pine borer	*Stictoleptura canadensis*	Sachem	*Atalopedes campestris*
Tetraopes beetle	*Tetraopes annulatus*	Viereck's skipper	*Atrytonopsis vierecki*
Red milkweed beetle	*Tetraopes tetrophthalmus*	Common checkered-skipper	*Burnsius communis*
Tragidion beetle	*Tragidion coquus*	Silver-spotted skipper	*Epargyreus clarus*
Spined woodborer	*Trichocnemis spiculatus*	Sleepy duskywing	*Erynnis brizo*
Spotted tylosis beetle	*Tylosis maculatus*	Horace's duskywing	*Erynnis horatius*
Striped cucumber beetle	*Acalymma vittatum*	Pacuvius duskywing	*Erynnis pacuvius*
Leaf beetle	*Amblycerus robiniae*	Dun skipper	*Euphyes vestris*
Coreopsis beetle	*Calligrapha californica*	Uncas skipper	*Hesperia uncas*
Argus tortoise beetle	*Chelymorpha cassidea*	Taxiles skipper	*Lon taxiles*
Dogbane leaf beetle	*Chrysochus auratus*	Common sootywing	*Pholisora catullus*
Spotted asparagus beetle	*Crioceris duodecimpunctata*	Russet skipperling	*Piruna pirus*
Spotted cucumber beetle	*Diabrotica undecimpunctata*	Northern cloudywing	*Thorybes pylades*
Western corn rootworm beetle	*Diabrotica virgifera*	Sonoran tent caterpillar	*Malacosoma tigris*
Redbud seed weevil	*Gibbobruchus mimus*	American lappet moth	*Phyllodesma americana*
Red megacerus	*Megacerus discoidus*	Large tolype moth	*Tolype velleda*
Checkered melon beetle	*Paranapiacaba tricincta*	Western pygmy-blue	*Brephidium exilis*
Rabbitbrush beetle	*Trirhabda nitidicollis*	Western pine elfin	*Callophrys eryphon*
Rabbitbrush beetle	*Trirhabda nitidicollis*	Reakirt's blue	*Echinargus isola*
Elm leaf beetle	*Xanthogaleruca luteola*	Silvery blue	*Glaucopsyche lygdamus*

Common name	Scientific name	Common name	Scientific name
Red-blue checkered beetle	*Trichodes nuttalli*	Lupine blue	*Icaricia lupini*
LeConte's giant lady beetle	*Anatis lecontei*	Marine blue	*Leptotes marina*
Seven-spotted lady beetle	*Coccinella septempunctata*	Melissa blue	*Plebejus melissa*
Asian lady beetle	*Harmonia axyridis*	Banded hairstreak	*Satyrium calanus*
Convergent lady beetle	*Hippodamia convergens*	Gray hairstreak	*Strymon melinus*
Parenthesis lady beetle	*Hippodamia parenthesis*	Momphid moth	*Mompha brevivittella*
Painted ladybird	*Mulsantina picta*	Circumscript mompha	*Mompha circumscriptella*
Broken-dashed lady beetle	*Myzia interrupta*	White-based mompha	*Mompha murtfeldtella*
Broken-dashed lady beetle	*Myzia interrupta*	Cutworm/dart moth	*Abagrotis bimarginalis*
Ashy gray lady beetle	*Olla v-nigrum*	Abagrotis moth	*Abagrotis discoidalis*
Splendid tamarisk weevil	*Coniatus splendidulus*	Abagrotis moth	*Abagrotis mirabilis*
Poplar-and-willow borer	*Cryptorhynchus lapathi*	Coastal heathland cutworm moth	*Abagrotis nefascia*
European elm flea weevil	*Orchestes steppensis*	Well-marked cutworm moth	*Abagrotis orbis*
Clay-colored billbug	*Sphenophorus aequalis*	Reed's dart	*Abagrotis reedi*
Disintegrated diving beetle	*Agabus disintegratus*	Abagrotis moth	*Abagrotis striata*
Laccophilus predaceous diving beetle	*Laccophilus fasciatus*	Chalky bird dropping moth	*Acontia cretata*
Neoporus predaceous diving beetle	*Neoporus dimidiatus*	Barrens dagger moth	*Acronicta albarufa exempta*
Texas eyed click beetle	*Alaus lusciosus*	Cottonwood dagger	*Acronicta lepusculina*
Eastern eyed click beetle	*Alaus oculatus*	Ochre dagger	*Acronicta morula*
Ampedus click beetle	*Ampedus areolatus*	Ipsilon dart	*Agrotis ipsilon*
Wireworm beetle	*Conoderus bellus*	Pale western cutworm moth	*Agrotis orthogonia*
Tobacco wireworm	*Conoderus vespertinus*	Venerable dart	*Agrotis venerabilis*
Hemicrepidus click beetle	*Hemicrepidius nemnonius*	Old man dart	*Agrotis vetusta*
Heteroderes click beetle	*Heteroderes sordidus*	Eight-spotted forester moth	*Alypia octomaculata*
Blue fungus beetle	*Cypherotylus californicus*	Celery looper moth	*Anagrapha falcifera*
Whirlygig beetle	*Dineutus*	The mutant	*Anarta mutata*
Water scavenger beetle	*Berosus*	Nutmeg moth	*Anarta trifolii*
Giant water scavenger beetle	*Hydrophilus triangularis*	Andropolia moth	*Andropolia diversilineata*

Common name	Scientific name	Common name	Scientific name
Hydrophilid beetle	*Tropisternus lateralis*	Noctuid moth	*Anicla mus*
Winter firefly	*Ellychnia corrusca*	Yellow-headed cutworm moth	*Apamea amputatrix*
Reticulated net-winged beetle	*Calopteron reticulatum*	Noctuid moth	*Apamea atrosuffusa*
Epicauta blister beetle	*Epicauta andersoni*	Noctuid moth	*Apamea auranticolor*
Brown blister beetle	*Epicauta immaculata*	Noctuid moth	*Apamea digitula*
Black blister beetle	*Epicauta pensylvanica*	Noctuid moth	*Apamea inordinata semilunata*
Yellow blister beetle	*Zonitis sayi*	Snowy-veined apamea moth	*Apamea niveivenosa*
Two-spotted melyrid	*Collops bipunctatus*	Alfalfa looper	*Autographa californica*
False blister beetle	*Ischnomera puncticollis*	Owlet moth	*Azenia implora*
False blister beetle	*Xanthochroina bicolor*	Owlet moth	*Bagisara buxea*
Kern's flower scarab	*Euphoria kernii*	Gilded seedcropper	*Basilodes chrysopis*
Ten-lined june beetle	*Polyphylla decemlineata*	Half-banded bryolymnia moth	*Bryolymnia semifascia*
Japanese beetle	*Popillia japonica*	Civil rustic moth	*Caradrina montana*
Common carrion beetle	*Thanatophilus lapponicus*	Fine-lined sallow	*Catabena lineolata*
Darkling beetle	*Eleodes carbonaria*	Tobacco budworm moth	*Chloridea virescens*
Darkling beetle	*Eleodes hispilabris*	Soybean looper moth	*Chrysodeixis includens*
Darkling beetle	*Eleodes longicollis*	Owlet moth	*Condica discistriga*
Darkling beetle	*Eleodes obscura*	Grote's sallow	*Copivaleria grotei*
Sand darkling beetle	*Eusattus reticulatus*	American dun-bar moth	*Cosmia calami*
Darkling beetle	*Stenomorpha opaca*	Cutworm/dart moth	*Cosmia praeacuta*
Robber fly	*Stichopogon colei*	Verbena moth	*Crambodes talidiformis*
White-winged march fly	*Bibio albipennis*	Noctuiid moth	*Cryphia olivacea*
Sinuous bee fly	*Hemipenthes sinuosa*	Owlet moth	*Cucullia dorsalis*
Bee fly	*Thyridanthrax pallidus*	Wheat head armyworm	*Dargida diffusa*
Black blow fly	*Phormia regina*	American bird's-wing	*Dypterygia rozmani*
Coelotanypus midge fly	*Coelotanypus concinnus*	Cutworm/dart moth	*Egira rubrica*
Thick-headed fly	*Physoconops fronto*	Cutworm/dart moth	*Egira rubrica*
Inland floodwater mosquito	*Aedes vexans*	Cutworm/dart moth	*Egira variabilis*
House fly	*Musca domestica*	Pale-winged midget	*Elaphria alapallida*
Tangle-veined fly	*Trichopsidea clausa*	Festive midget	*Elaphria festivoides*

Common name	Scientific name	Common name	Scientific name
Bathroom moth fly	*Clogmia albipunctata*	Cutworm/dart moth	*Epidemas obscurus*
Soldier fly	*Hedriodiscus binotatus*	Fringed dart	*Eucoptocnemis fimbriaris*
European drone fly	*Eristalis arbustorum*	Owlet moth	*Eulithosia papago*
Western aphideater	*Eupeodes fumipennis*	Purslane moth	*Euscirrhopterus gloveri*
Large-tailed aphideater	*Eupeodes volucris*	Army cutworm moth	*Euxoa auxiliaris*
Broad-headed marsh fly	*Helophilus latifrons*	Owlet moth	*Euxoa basalis*
Western band-winged hover fly	*Hypocritanus lemur*	Scarred dart	*Euxoa cicatricosa*
Common bog fly	*Parhelophilus laetus*	Median-banded dart	*Euxoa medialis*
Dimorphic sickleleg	*Polydontomyia curvipes*	Reaper dart	*Euxoa messoria*
Margined calligrapher	*Toxomerus marginatus*	Obelisk dart	*Euxoa obeliscoides*
Western black horse fly	*Tabanus punctifer*	Owlet moth	*Euxoa pluralis*
Hedgehog fly	*Adejeania vexatrix*	Dart moth	*Euxoa quadridentata*
Swift feather-legged fly	*Trichopoda pennipes*	Cutworm/dart moth	*Euxoa satis*
Primitive cfrane fly	*Protanyderus margarita*	Tessellate dart	*Euxoa tessellata*
Tephritid fruit fly	*Trupanea bisetosa*	Master's dart	*Feltia herilis*
Peacock fly	*Callopistromyia annulipes*	Dingy cutworm moth	*Feltia jaculifera*
Picture-winged fly	*Ceroxys latiusculus*	Capsule moth	*Hadena capsularis*
Common picture-winged fly	*Delphinia picta*	Small ranunculus	*Hecatera dysodea*
Lupine bug	*Megalotomus quinquespinosus*	Corn earworm moth	*Helicoverpa zea*
Hackberry nipplegall psyllid	*Pachypsylla celtidismamma*	Paradoxical grass moth	*Heliocheilus paradoxus*
Oleander aphid	*Aphis nerii*	Darker-spotted straw moth	*Heliothis phloxiphaga*
Grass sharpshooter	*Draeculacephala minerva*	Creaky dart	*Hemieuxoa rudens*
Painted leafhopper	*Endria inimicus*	Black wedge-spot	*Homophoberia apicosa*
Erythroneura leafhopper	*Erythroneura elegans*	Cutworm/dart moth	*Homorthodes reliqua*
Privet leafhopper	*Fieberiella florii*	Common hyppa moth	*Hyppa xylinoides*
Cuerna species blue	*Graphocephala lugubris*	Cutworm/dart moth	*Lacinipolia lepidula*
Gyponana leafhopper	*Gyponana gladia*	Olive arches moth	*Lacinipolia olivacea*
Eight-lined leafhopper	*Gyponana octolineata*	Bristly cutworm moth	*Lacinipolia renigera*
Japanese maple leafhopper	*Japananus hyalinus*	Collared arches moth	*Lacinipolia strigicollis*
Norvellina leafhopper	*Norvellina helenae*	Two-lined wainscot	*Leucania commoides*
Norvellina leafhopper	*Norvellina perelegantis*	Wainscot moth	*Leucania stolata*
Norvellina leafhopper	*Norvellina scitula*	Veiled ear moth	*Loscopia velata*

Common name	Scientific name	Common name	Scientific name
Tamarix leafhopper	*Opsius stactogalus*	Variable narrow-wing	*Magusa divaricata*
Ossiannilssonola leafhopper	*Ossiannilssonola australis*	Bilobed looper moth	*Megalographa biloba*
Penestragania leafhopper	*Penestragania alabamensis*	Armyworm moth	*Mythimna unipuncta*
Xerophloea leafhopper	*Xerophloea peltata*	Cutworm/dart moth	*Neleucania patricia*
Aridland cicada	*Beameria venosa*	Cutworm/dart moth	*Nephelodes carminata*
Common cactus dodger	*Cacama valvata*	Bronzed cutworm moth	*Nephelodes minians*
Plains cicada	*Megatibicen dealbatus*	Large yellow underwing	*Noctua pronuba*
Walking cicada	*Okanagana synodica*	Speckled green fruitworm moth	*Orthosia hibisci*
Putnam's cicada	*Platypedia putnami*	Panthea moth	*Panthea greyi*
Common bed bug	*Cimex lectularius*	Variegated cutworm moth	*Peridroma saucia*
Squash bug	*Anasa tristis*	Black-barred brown	*Plagiomimicus pityochromus*
Western leaf-footed bug	*Leptoglossus clypealis*	Frothy moth	*Plagiomimicus spumosum*
Western conifer seed bug	*Leptoglossus occidentalis*	Ponometia moth	*Ponometia altera*
Two-lined burrowing bug	*Pangaeus bilineatus*	Prairie Bird-dropping moth	*Ponometia binocula*
Delphacid leafhopper	*Bostaera nasuta*	Bird dropping moth	*Ponometia libedis*
Flatid planthopper	*Flatormenis saucia*	Bird dropping moth	*Ponometia nannodes*
Metcracis planthopper	*Metcracis fusca*	Half-yellow moth	*Ponometia semiflava*
Big-eyed toad bug	*Gelastocoris oculatus*	Noctuiid moth	*Protorthodes alfkenii*
Big-eyed bug	*Geocoris barberi*	Noctuiid moth	*Protorthodes curtica*
Water strider	*Gerrini*	Miranda moth	*Proxenus miranda*
Water strider	*Gerris*	Pink-barred pseudeustrotia moth	*Pseudeustrotia carneola*
Small milkweed bug	*Lygaeus kalmii*	Brother moth	*Raphia frater*
Western small milkweed bug	*Lygaeus kalmii kalmii*	Noctuiid moth	*Schinia albafascia*
Charcoal seed bug	*Melacoryphus lateralis*	Bina flower moth	*Schinia bina*
Large milkweed bug	*Oncopeltus fasciatus*	Citrus gem	*Schinia citrinellus*
Helira treehopper	*Heliria praealta*	Noctuiid moth	*Schinia coercita*
Ceratocapsus plant bug	*Ceratocapsus apicatus*	Silver-banded gem moth	*Schinia cumatilis*
Clivinema plant bug	*Clivinema villosum*	Noctuiid moth	*Schinia errans*
Clouded plant bug	*Neurocolpus nubilus*	Rockies boneset flower moth	*Schinia grandimedia*

Common name	Scientific name	Common name	Scientific name
Orthotylus leaf bug	*Orthotylus coagulatus*	Jaguar flower moth	*Schinia jaguarina*
Orthotylus leaf bug	*Orthotylus ornatus*	Mead's flower moth	*Schinia meadi*
Ornate plant bug	*Reuteroscopus ornatus*	Regina primrose moth	*Schinia regina*
Common damsel bug	*Nabis americoferus*	Noctuiid moth	*Schinia simplex*
Backswimmer	*Buenoa*	Third flower moth	*Schinia tertia*
Milky backswimmers	*Notonecta*	Painted schinia moth	*Schinia volupia*
Juniper stink bug	*Banasa euchlora*	Setagrotis dart moth	*Setagrotis vocalis*
Green stink bug	*Chinavia hilaris*	Maroonwing moth	*Sideridis maryx*
Conchuela bug	*Chlorochroa ligata*	Beet armyworm moth	*Spodoptera exigua*
Say's stink bug	*Chlorochroa sayi*	Fall armyworm moth	*Spodoptera frugiperda*
Twice-stabbed stink bug	*Cosmopepla lintneriana*	Yellow-striped armyworm moth	*Spodoptera ornithogalli*
Holcostethus stink bug	*Holcostethus limbolarius*	Yellow sunflower moth	*Stiria rugifrons*
Elf shoe stink bug	*Menecles insertus*	Bicolored sallow	*Sunira bicolorago*
Harlequin bug	*Murgantia histrionica*	Owlet moth	*Sympistis augustus*
Red-shouldered stink bug	*Thyanta custator*	Owlet moth	*Sympistis definita*
Blue shield bug	*Zicrona caerulea*	Owlet moth	*Sympistis melalutea*
Mesquite psyllid	*Heteropsylla texana*	Harrow moth	*Sympistis occata*
Apiomerus assassin bug	*Apiomerus montanus*	Owlet moth	*Sympistis punctilinea*
Apiomerus assassin bug	*Apiomerus spissipes*	Brown sallow	*Sympistis stabilis*
Wheel bug	*Arilus cristatus*	Owlet moth	*Sympistis umbrifascia*
Jagged ambush bug	*Phymata americana*	Owlet moth	*Syngrapha angulidens*
Masked bed-bug hunter	*Reduvius personatus*	Exposed bird dropping moth	*Tarache aprica*
Pale green assassin bug	*Zelus luridus*	Narrow-winged midget moth	*Tarache augustipennis*
Four-spurred assassin bug	*Zelus tetracanthus*	Bird dropping moth	*Tarache huachuca*
Eastern boxelder bug	*Boisea trivittata*	Four-spotted bird-dropping moth	*Tarache tetragona*
Red-shouldered bug	*Jadera haematoloma*	Cabbage looper moth	*Trichoplusia ni*
Dirt-colored seed bugs	*Tempyra biguttula*	Triocnemis moth	*Triocnemis saporis*
Shield-backed bug	*Homaemus parvulus*	Ululonche moth	*Ululonche fasciata*
Mining bee	*Andrena*	Xestia moth	*Xestia bolteri*
Calliopsis mining bee	*Calliopsis subalpina*	Xestia moth	*Xestia conchis*

Common name	Scientific name	Common name	Scientific name
Walsh's digger bee	*Anthophora walshii*	Black-olive caterpillar moth	*Garella nilotica*
Western honey bee	*Apis mellifera*	Common gluphisia moth	*Gluphisia septentrionis*
Golden northern bumble bee	*Bombus fervidus*	Gluphisia moth	*Gluphisia wrightii*
Southern plains bumble bee	*Bombus fraternus*	Hyparpax moth	*Hyparpax venus*
Hunt's bumble bee	*Bombus huntii*	Macrurocampa moth	*Macrurocampa dorothea*
Morrison's bumble bee	*Bombus morrisoni*	White-dotted prominent	*Nadata gibbosa*
American bumble bee	*Bombus pensylvanicus*	Black-rimmed prominent	*Pheosia rimosa*
Caesalpinia oil-digger	*Centris caesalpiniae*	Elegant prominent	*Pheosidea elegans*
Chimney bee	*Diadasia*	Unicorn prominent	*Schizura unicornis*
Long-horned bee	*Melissodes*	Milbert's tortoiseshell	*Aglais milberti*
Great plains turret bee	*Melitoma grisella*	Goatweed leafwing	*Anaea andria*
Nomad bees	*Nomada*	Hackberry emperor	*Asterocampa celtis*
Cuckoo wasp	*Chrysis angolensis*	Meadas wood-nymph	*Cercyonis meadii*
Weevil wasp	*Cerceris bicornuta*	Small wood-nymph	*Cercyonis oetus*
Western cicada-killer wasp	*Sphecius grandis*	Common wood-nymph	*Cercyonis pegala*
Eastern cicada-killer wasp	*Sphecius speciosus*	Fulvia checkerspot	*Chlosyne fulvia*
Sand wasp	*Stizoides renicinctus*	Gorgone checkerspot	*Chlosyne gorgone*
Oak cynipid wasp	*Xanthoteras eburneum*	Common ringlet	*Coenonympha california*
Western carpenter ant	*Camponotus modoc*	Queen	*Danaus gilippus*
Carpenter ant	*Camponotus sayi*	Monarch	*Danaus plexippus*
Honey ant	*Myrmecocystus mexicanus*	Variegated fritillary	*Euptoieta claudia*
Red harvester ant	*Pogonomyrmex barbatus*	Common buckeye	*Junonia coenia*
Western harvester ant	*Pogonomyrmex occidentalis*	Viceroy	*Limenitis archippus*
Rough harvester ant	*Pogonomyrmex rugosus*	Weidemeyer's admiral	*Limenitis weidemeyerii*
Odorous house ant	*Tapinoma sessile*	Mourning cloak	*Nymphalis antiopa*
Immigrant pavement ant	*Tetramorium immigrans*	Northern crescent	*Phyciodes cocyta*
Sweat bee	*Agapostemon*	Phaon crescent	*Phyciodes phaon*
Metallic sweat bee	*Dialictus*	Phaon crescent	*Phyciodes phaon*
Ligated furrow bee	*Halictus ligatus*	Painted crescent	*Phyciodes picta*
Lasioglossum sweat bee	*Lasioglossum*	Pearl crescent	*Phyciodes tharos*
Ichneumon wasp	*Enicospilus purgatus*	Hoary comma	*Polygonia gracilis*

Common name	Scientific name	Common name	Scientific name
Long-tailed giant ichneumonid wasp	*Megarhyssa macrurus*	Question mark	*Polygonia interrogationis*
Spotted woolcarder	*Anthidium maculosum*	Aphrodite fritillary	*Speyeria aphrodite*
European woolcarder bee	*Anthidium manicatum*	Painted lady	*Vanessa cardui*
Porter's wool-carder bee	*Anthidium porterae*	American lady	*Vanessa virginiensis*
Trachusa resin bee	*Heteranthidium*	Reticulated decantha moth	*Decantha stonda*
Alfalfa leafcutter bee	*Megachile rotundata*	Reticulated decantha moth	*Decantha tistra*
Mason, leafcutter, carder bee	*Megachilinae*	Skunk moth	*Polix coloradella*
Bufflehead mason bee	*Osmia bucephala*	Pipevine swallowtail	*Battus philenor*
Common eastern velvet ant	*Dasymutilla occidentalis*	Two-tailed swallowtail	*Papilio multicaudata*
Four-spotted velvet ant	*Dasymutilla quadriguttata*	Black swallowtail	*Papilio polyxenes*
Velvet ant	*Dasymutilla stevensi*	Orange sulphur	*Colias eurytheme*
Red velvet ant	*Dasymutilla vestita*	Dainty sulphur	*Nathalis iole*
Sphaeropthalma velvet ant	*Sphaeropthalma marpesia*	Pine white	*Neophasia menapia*
Thisbe's tarantula-hawk wasp	*Pepsis thisbe*	Cabbage white	*Pieris rapae*
Spider wasp	*Poecilopompilus algidus*	Checkered white	*Pontia protodice*
Club-horned cuckoo wasp	*Sapyga louisi*	Southern dogface	*Zerene cesonia*
Eight-spotted scoliid wasp	*Colpa octomaculata*	Diamondback moth	*Plutella xylostella*
Scoliid wasp	*Colpa pollenifera*	Lobed plume moth	*Dejongia lobidactylus*
Scoliid wasp	*Crioscolia alcione*	Sulphur plume moth	*Hellinsia sulphureodactylus*
Noble scoliid wasp	*Scolia nobilitata*	Eupatorium plume moth	*Oidaematophorus eupatorii*
Pigeon horntail	*Tremex columba*	Artichoke plume moth	*Platyptilia carduidactylus*
Common blue mud-dauber wasp	*Chalybion californicum*	Snout moth	*Aglossa electalis*
Steel-blue cricket-hunter wasp	*Chlorion aerarium*	Large tabby	*Aglossa pinguinalis*
Gold-marked thread-waisted wasp	*Eremnophila aureonotata*	Sugarbeet crown borer moth	*Ancylosis undulatella*
Elegant grass-carrying wasp	*Isodontia elegans*	Heath knot-horn	*Apomyelois bistriatella*
Digger wasp	*Prionyx*	Ponderosa pine coneworm moth	*Dioryctria auranticella*
Yellow-legged mud-dauber wasp	*Sceliphron caementarium*	Snout moth	*Dioryctria pseudotsugella*

Common name	Scientific name	Common name	Scientific name
Great golden digger wasp	*Sphex ichneumoneus*	Snout moth	*Dioryctria rossi*
Great black digger wasp	*Sphex pensylvanicus*	Zimmerman pine moth	*Dioryctria zimmermani*
Potter wasp	*Euodynerus annulatus*	Gold-banded etiella moth	*Etiella zinckenella*
Western paper wasp	*Mischocyttarus flavitarsis*	Boxwood leaftier moth	*Galasa nigrinodis*
Golden paper wasp	*Polistes aurifer*	Greater wax moth	*Galleria mellonella*
European paper wasp	*Polistes dominula*	Snout moth	*Honora mellinella*
Metric paper wasp	*Polistes metricus*	Pink-fringed dolichomia moth	*Hypsopygia binodulalis*
Purbeck mason wasp	*Pseudepipona herrichii*	Clover hayworm moth	*Hypsopygia costalis*
Western yellowjacket	*Vespula pensylvanica*	Yellow-fringed dolichomia moth	*Hypsopygia olinalis*
Montana six-plume moth	*Alucita montana*	Spruce needleworm moth	*Hypsopygia thymetusalis*
Shiny head-standing moth	*Argyresthia inscriptella*	Snout moth	*Laetilia dilatifasciella*
Ailanthus webworm moth	*Atteva aurea*	Orange-tufted oneida moth	*Oneida lunulalis*
Gerdana moth	*Gerdana caritella*	Pyralid moth	*Phycitodes mucidella*
Triangle-marked twirler moth	*Taygete attributella*	Indian meal moth	*Plodia interpunctella*
Taygete moth	*Taygete decemmaculella*	Maple webworm moth	*Pococera asperatella*
Morning-glory leafminer moth	*Bedellia somnulentella*	Meal moth	*Pyralis farinalis*
Prune limb borer	*Bondia comonana*	Pyralid moth	*Quasisalebria admixta*
Peach fruit moth	*Carposina ottawana*	Red-splashed leafroller moth	*Sciota rubrisparsella*
Skullcap skeletonizer moth	*Prochoreutis inflatella*	Pyralid moth	*Toripalpus breviornatalis*
Everlasting tebenna moth	*Tebenna gnaphaliella*	Pyralid moth	*Toripalpus trabalis*
Eralea moth	*Eralea albalineella*	Nais metalmark	*Apodemia nais*
Shy cosmet moth	*Limnaecia phragmitella*	Polyphemus moth	*Antheraea polyphemus*
Stilbosis moth	*Stilbosis tesquella*	Pandora pinemoth	*Coloradia pandora*
Sweet clover root borer moth	*Walshia miscecolorella*	Glover's silk moth	*Hyalophora gloveri*
Givira moth	*Givira lucretia*	Coronopus borer	*Carmenta mimuli*
Carpenterworm moth	*Prionoxystus robiniae*	Lilac borer moth	*Podosesia syringae*
Abegesta moth	*Abegesta reluctalis*	Peachtree borer moth	*Synanthedon exitiosa*
Water veneer	*Acentria ephemerella*	Elm sphinx	*Ceratomia amyntor*
Garden webworm moth	*Achyra rantalis*	Waved sphinx	*Ceratomia undulosa*

Common name	Scientific name	Common name	Scientific name
Webworm moth	*Agriphila plumbifimbriellus*	Achemon sphinx	*Eumorpha achemon*
Vagabond sod webworm moth	*Agriphila vulgivagellus*	White-lined sphinx	*Hyles lineata*
Sesame leafroller	*Antigastra catalaunalis*	Five-spotted hawk moth	*Manduca quinquemaculatus*
Sooty-winged chalcoela moth	*Chalcoela iphitalis*	Carolina sphinx	*Manduca sexta*
Topiary grass-veneer	*Chrysoteuchia topiarius*	Modest sphinx	*Pachysphinx modesta*
Eight-barred lygropia moth	*Conchylodes octonalis*	Western poplar sphinx	*Pachysphinx occidentalis*
Sod webworm moth	*Crambus cyrilellus*	Blinded sphinx	*Paonias excaecata*
Leach's grass-veneer	*Crambus leachellus*	One-eyed sphinx	*Smerinthus cerisyi*
Common grass-veneer	*Crambus praefectellus*	Twin-spotted sphinx	*Smerinthus jamaicensis*
Grape leafroller moth	*Desmia maculalis*	Vashti sphinx	*Sphinx vashti*
White-spotted orange	*Diastictis argyralis*	Tubeworm moth	*Acrolophus griseus*
Fractured western snout	*Diastictis fracturalis*	Brown-blotched amydria moth	*Amydria effrentella*
White-spotted brown	*Diastictis ventralis*	Amydria moth	*Amydria obliquella*
Belted grass-veneer	*Euchromius ocellea*	Curved-lined homostinea moth	*Homostinea curviliniella*
Crambid snout moth	*Eudonia spaldingalis*	Skunkback monopis moth	*Monopis dorsistrigella*
Crambid snout moth	*Eudonia torniplagalis*	Nemapogon moth	*Nemapogon defectella*
Cross-striped cabbageworm moth	*Evergestis rimosalis*	Clemens' bark moth	*Xylesthia pruniramiella*
Crambid snout moth	*Evergestis simulatilis*	Tortricid moth	*Aethes deutschiana*
Crambid snout moth	*Evergestis vinctalis*	Tortricid moth	*Anopina silvertonana*
Crambid snout moth	*Frechinia laetalis*	Tortricid moth	*Anopina wrighti*
Crambid snout moth	*Hahncappsia coloradensis*	Fruit-tree leafroller moth	*Archips argyrospila*
Crambid snout moth	*Hahncappsia pergilvalis*	Oak leafroller moth	*Archips semiferanus*
Spotted beet webworm moth	*Hymenia perspectalis*	Tortricid moth	*Argyrotaenia dorsalana*
Interrupted lineodes moth	*Lineodes interrupta*	Javelin moth	*Bactra verutana*
Crambid snout moth	*Loxocrambus coloradellus*	Douglas-fir cone moth	*Barbara colfaxiana*
Alfalfa webworm moth	*Loxostege cereralis*	Tortricid moth	*Catastega marmoreana*
Beet webworm moth	*Loxostege sticticalis*	Large aspen tortrix	*Choristoneura conflictana*
Crambid snout moth	*Mecyna mustelinalis*	Western spruce budworm moth	*Choristoneura freemani*

Common name	Scientific name	Common name	Scientific name
Yellow-veined moth	*Microtheoris ophionalis*	Spruce budworm moth	*Choristoneura fumiferana*
Rufous-banded crambid moth	*Mimoschinia rufofascialis*	Oblique-banded leafroller moth	*Choristoneura rosaceana*
Crambid snout moth	*Noctueliopsis puertalis*	Clemens' clepsis moth	*Clepsis clemensiana*
Lucerne moth	*Nomophila nearctica*	Garden tortrix	*Clepsis peritana*
Four-spotted palpita moth	*Palpita quadristigmalis*	White triangle tortrix	*Clepsis persicana*
Bluegrass webworm moth	*Parapediasia teterrellus*	Tortricid moth	*Cochylis bucera*
Sod webworm moth	*Pediasia trisecta*	Tortricid moth	*Cydia lacustrina*
Titian peale's moth	*Perispasta caeculalis*	Filbertworm moth	*Cydia latiferreana*
Spring petrophila	*Petrophila avernalis*	Ponderosa pine seedworm moth	*Cydia piperana*
Kearfott's petrophila	*Petrophila kearfottalis*	Codling moth	*Cydia pomonella*
Crambid snout moth	*Platytes vobisne*	Goldenrod gall moth	*Epiblema scudderiana*
Crambid snout moth	*Procymbopteryx belialis*	Ragweed borer moth	*Epiblema strenuana*
Southern purple mint moth	*Pyrausta laticlavia*	Three-parted epiblema moth	*Epiblema tripartitana*
Lethal pyrausta	*Pyrausta lethalis*	Tortricid moth	*Epinotia cercocarpana*
Raspberry pyrausta moth	*Pyrausta signatalis*	Tortricid moth	*Eucosma mormonensis*
Volupial mint moth	*Pyrausta volupialis*	Tortricid moth	*Eugnosta mexicana*
Dusky saucrobotys moth	*Saucrobotys fumoferalis*	Sculptured moth	*Eumarozia malachitana*
Dimorphic sitochroa moth	*Sitochroa chortalis*	Tortricid moth	*Eupinivora ponderosae*
Crambid snout moth	*Stegea salutalis*	Willow-and-poplar leafroller	*Gypsonoma fasciolana*
Woolly grass-veneer moth	*Thaumatopsis pexellus*	Cottonwood twig borer moth	*Gypsonoma haimbachiana*
Celery leaftier moth	*Udea rubigalis*	Small gypsonoma moth	*Gypsonoma salicicolana*
Genista broom moth	*Uresiphita reversalis*	Henricus infernalis	*Henricus infernalis*
Poison hemlock moth	*Agonopterix alstromeriana*	Tortricid moth	*Hystrichophora ochreicostana*
Canadian agonopterix moth	*Agonopterix canadensis*	Tortricid moth	*Hystrichophora vestaliana*
Yarrow webworm	*Depressaria alienella*	Twelve-lined ofatulena	*Ofatulena duodecemstriata*
Depressariodes moth	*Depressariodes gracilis*	Olethreutes moth	*Olethreutes glaciana*

Common name	Scientific name	Common name	Scientific name
Mountain-mahogany moth	*Ethmia discostrigella*	Pelochrista moth	*Pelochrista agassizii*
Ambrosia seed moth	*Exaeretia gracilis*	Pelochrista moth	*Pelochrista argenteana*
Black-fringed leaftier moth	*Psilocorsis cryptolechiella*	Pelochrista moth	*Pelochrista aurilineana*
Glorious habrosyne moth	*Habrosyne gloriosa*	Pelochrista moth	*Pelochrista costastriata*
Blake's tiger moth	*Apantesis blakei*	Triangle-backed pelochrista moth	*Pelochrista dorsisignatana*
Figured tiger moth	*Apantesis figurata*	Tortricid moth	*Pelochrista matutina*
Tiger moth	*Apantesis f-pallida*	Morrison's borer moth	*Pelochrista morrisoni*
Arctiiine moth	*Apantesis incorrupta*	Spangled pelochrista	*Pelochrista scintillana*
Parthenice tiger moth	*Apantesis parthenice*	Poplar leafroller moth	*Pseudosciaphila duplex*
Williams' tiger moth	*Apantesis williamsii*	Rhyacionia moth	*Rhyacionia neomexicana*
Black witch	*Ascalapha odorata*	Pine pitch tip moth	*Rhyacionia salmonicolor*
Grote's bertholdia	*Bertholdia trigona*	Black-tipped rudenia moth	*Rudenia leguminana*
Bent-winged owlet	*Bleptina caradrinalis*	Sonia tortricid moth	*Sonia vovana*
Deduced graphic	*Bulia deducta*	Suleima tortricid moth	*Suleima baracana*
Clover looper moth	*Caenurgina crassiuscula*	Sunflower bud moth	*Suleima helianthana*
Forage looper moth	*Caenurgina erechtea*	Spruce needleminer moth	*Taniva albolineana*
Sweetheart underwing	*Catocala amatrix*	Ypsolopha moth	*Ypsolopha flavistrigella*
Hermia's underwing moth	*Catocala hermia*	Ypsolopha moth	*Ypsolopha unicipunctella*
Betrothed underwing	*Catocala innubens*	Agile ground mantis	*Litaneutria minor*
Joined underwing moth	*Catocala junctura*	Yersin's ground mantis	*Yersiniops solitarius*
Little underwing	*Catocala minuta*	European mantis	*Mantis religiosa*
Ophelia underwing	*Catocala ophelia*	Arizona mantis	*Stagmomantis limbata*
Semirelict underwing moth	*Catocala semirelicta*	Four-spotted green lacewing	*Chrysopa quadripunctata*
Barnes' lichen moth	*Cisthene barnesii*	Megalomus brown lacewing	*Megalomus moestus*
Thin-banded lichen moth	*Cisthene tenuifascia*	Brown lacewing	*Micromus variolosus*
Unexpected cycnia moth	*Cycnia collaris*	Barber's brown lacewing	*Sympherobius barberi*
Drasteria moth	*Drasteria howlandii*	Brown wasp mantidfly	*Climaciella brunnea*
Drasteria moth	*Drasteria mirifica*	Say's mantidfly	*Dicromantispa sayi*
Paler graphic	*Drasteria pallescens*	Common green darner	*Anax junius*

Common name	Scientific name	Common name	Scientific name
Salt marsh moth	*Estigmene acrea*	Blue-eyed darner	*Rhionaeschna multicolor*
Police car moth	*Gnophaela vermiculata*	American rubyspot	*Hetaerina americana*
Green cloverworm moth	*Hypena scabra*	Western red damsel	*Amphiagrion abbreviatum*
Many-spotted tiger moth	*Hypercompe permaculata*	Paiute dancer	*Argia alberta*
Cadaver lichen moth	*Hypoprepia cadaverosa*	Sooty dancer	*Argia lugens*
Common idia moth	*Idia aemula*	Powdered dancer	*Argia moesta*
American idia moth	*Idia americalis*	Aztec dancer	*Argia nahuana*
Glossy black idia moth	*Idia lubricalis*	Double-striped bluet	*Enallagma basidens*
Litter moth	*Idia occidentalis*	Tule bluet	*Enallagma carunculatum*
Tussock moth	*Lophocampa ingens*	Familiar bluet	*Enallagma civile*
Spotted tussock moth	*Lophocampa maculata*	Plains forktail	*Ischnura damula*
Black-and-yellow lichen moth	*Lycomorpha pholus*	Dot-winged baskettail	*Epitheca petechialis*
Lygephila moth	*Lygephila victoria*	Pale snaketail	*Ophiogomphus severus*
Bicolored moth	*Manulea bicolor*	Great spreadwing	*Archilestes grandis*
Indomitable graphic moth	*Melipotis indomita*	Spotted spreadwing	*Lestes congener*
Merry graphic moth	*Melipotis jucunda*	Calico pennant	*Celithemis elisa*
Douglas-fir tussock moth	*Orgyia pseudotsugata*	Halloween pennant	*Celithemis eponina*
Red-banded aemilia	*Pseudohemihyalea ambigua*	Checkered setwing	*Dythemis fugax*
Freckled glassy-wing	*Pseudohemihyalea labecula*	Western pondhawk	*Erythemis collocata*
Blue-green lichen moth	*Pygoctenucha terminalis*	Eastern pondhawk	*Erythemis simplicicollis*
Isabella tiger moth	*Pyrrharctia isabella*	Bleached skimmer	*Libellula composita*
Renia litter moth	*Renia rigida*	Widow skimmer	*Libellula luctuosa*
Alfalfa looper moth	*Tathorhynchus exsiccata*	Twelve-spotted skimmer	*Libellula pulchella*
Smoky tetanolita moth	*Tetanolita mynesalis*	Four-spotted skimmer	*Libellula quadrimaculata*
Orange virbia moth	*Virbia aurantiaca*	Flame skimmer	*Libellula saturata*
Holomelina moth	*Virbia fragilis*	Blue dasher	*Pachydiplax longipennis*
Zale moth	*Zale colorado*	Wandering glider	*Pantala flavescens*
Washed-out zale moth	*Zale metatoides*	Common whitetail	*Plathemis lydia*
Colorful zale moth	*Zale minerea*	Desert whitetail	*Plathemis subornata*
Dark marathyssa moth	*Marathyssa inficita*	Variegated meadowhawk	*Sympetrum corruptum*

Common name	Scientific name	Common name	Scientific name
Barrens paectes moth	*Paectes abrostolella*	Saffron-winged meadowhawk	*Sympetrum costiferum*
Agnippe moth	*Agnippe abdita*	White-faced meadowhawk	*Sympetrum obtrusum*
Anacampsis moth	*Anacampsis conclusella*	Striped meadowhawk	*Sympetrum pallipes*
Anacampsis moth	*Anacampsis fullonella*	Band-winged meadowhawk	*Sympetrum semicinctum*
Anacampsis moth	*Anacampsis paltodoriella*	Black saddlebags	*Tramea lacerata*
Twirler moth	*Aproaerema nigrella*	Green fool grasshopper	*Acrolophitus hirtipes*
Twirler moth	*Aristotelia devexella*	Thistle grasshopper	*Aeoloplides turnbulli*
Elegant aristotelia	*Aristotelia elegantella*	Speckle-winged rangeland grasshopper	*Arphia conspersa*
Twirler moth	*Aristotelia hexacopa*	Red-winged grasshopper	*Arphia pseudonietana*
Pink-washed aristotelia moth	*Aristotelia roseosuffusella*	White cross grasshopper	*Aulocara femoratum*
Gelechiid moth	*Aroga paulella*	Ebony grasshopper	*Boopedon nubilum*
Twirler moth	*Battaristis concinnusella*	Green-striped grasshopper	*Chortophaga viridifasciata*
Black-faced twirler moth	*Battaristis nigratomella*	Spotted wing grasshopper	*Cordillacris occipitalis*
Twirler moth	*Chionodes abella*	Rainbow grasshopper	*Dactylotum bicolor*
Twirler moth	*Chionodes pinguicula*	Carolina grasshopper	*Dissosteira carolina*
Spinach moth	*Chrysoesthia drurella*	High plains locust	*Dissosteira longipennis*
Orache leafminer moth	*Chrysoesthia sexguttella*	Velvet-striped grasshopper	*Eritettix simplex*
Conifer needleminer	*Coleotechnites coniferella*	Three-banded grasshopper	*Hadrotettix trifasciatus*
Small-spotted filatima moth	*Filatima biminimaculella*	Rufous grasshopper	*Heliaula rufa*
Hypatima moth	*Hypatima zesticopa*	Showy grasshopper	*Hesperotettix speciosus*
Twirler moth	*Isophrictis magnella*	Snakeweed grasshopper	*Hesperotettix viridis*
Gelechiid moth	*Nealyda bifidella*	Two-striped grasshopper	*Melanoplus bivittatus*
Gelechiid moth	*Ornativalva erubescens*	Differential grasshopper	*Melanoplus differentialis*
Gelechiid moth	*Prolita barnesiella*	Ponderous spur-throat grasshopper	*Melanoplus ponderosus*
Red-necked peanutworm moth	*Stegasta bosqueella*	Two-striped mermiria	*Mermiria bivittata*
Anavitrinella moth	*Anavitrinella addendaria*	Lively mermiria	*Mermiria picta*
Common gray	*Anavitrinella pampinaria*	Spotted-winged grasshopper	*Orphulella pelidna*

Common name	Scientific name	Common name	Scientific name
New Mexico carpet moth	*Archirhoe neomexicana*	Four-spotted grasshopper	*Phlibostroma quadrimaculatum*
Peppered moth	*Biston betularia*	Marsh meadow grasshopper	*Pseudochorthippus curtipennis*
Blackberry looper moth	*Chlorochlamys chloroleucaria*	Spotted bird grasshopper	*Schistocerca lineata*
Bent-lined carpet	*Costaconvexa centrostrigaria*	Mottled sand grasshopper	*Spharagemon collare*
Dwarf tawny wave	*Cyclophora nanaria*	Say's grasshopper	*Spharagemon equale*
Broad-lined angle	*Digrammia atrofasciata*	Admirable grasshopper	*Syrbula admirabilis*
Creosote moth	*Digrammia colorata*	Pallid-winged grasshopper	*Trimerotropis pallidipennis*
Curved-lined angle	*Digrammia continuata*	Great crested grasshopper	*Tropidolophus formosus*
Pale-lined angle	*Digrammia irrorata*	Red-shanked grasshopper	*Xanthippus corallipes*
Geometrid moth	*Digrammia muscariata*	Plains lubber grasshopper	*Brachystola magna*
Dark-bordered granite	*Digrammia neptaria*	Elegant bush katydid	*Insara elegans*
Geometrid moth	*Digrammia nubiculata*	Greater anglewing	*Microcentrum rhombifolium*
Vermilion granite moth	*Digrammia subminiata*	Fork-tailed bush katydid	*Scudderia furcata*
Geometrid moth	*Drepanulatrix bifilata*	Dicosmoecus caddisfly	*Dicosmoecus atripes*
Johnson's euchlaena moth	*Euchlaena johnsonaria*	Common silverfish	*Lepisma saccharina*
Mottled euchlaena moth	*Euchlaena tigrinaria*		

Table A-6 iNaturalist Spider and Mite Species Research-Grade Records (23) in Pueblo, Colorado

Common name	Scientific name	Common Name	Scientific name
Cat-faced orbweaver	*Araneus gemmoides*	Jumping spider	*Phidippus asotus*
Yellow garden spider	*Argiope aurantia*	Bold jumping spider	*Phidippus audax*
Arabesque orbweaver	*Neoscona arabesca*	Zebra jumping spider	*Salticus scenicus*
Spotted orbweaver	*Neoscona crucifera*	Texas brown tarantula	*Aphonopelma hentzi*
Western spotted orbweaver	*Neoscona oaxacensis*	Grand Canyon black tarantula	*Aphonopelma marxi*
Woodlouse spider	*Dysdera crocata*	Western black widow	*Latrodectus hesperus*
Wolf spider	*Hogna antelucana*	Triangulate combfoot	*Steatoda triangulosa*
Long-bodied cellar spider	*Pholcus phalangioides*	Goldenrod crab spider	*Misumena vatia*
White-lipped ornamental jumping spider	*Habronattus cognatus*	American dog tick	*Dermacentor variabilis*
Peppered jumping spider	*Pelegrina galathea*	European harvestman	*Phalangium opilio*
Apache jumping spider	*Phidippus apacheanus*	Striped bark scorpion	*Centruroides vittatus*
Desert red jumping spider	*Phidippus ardens*		

Table A-7 iNaturalist Reptile Species Research-Grade Records (30) in Pueblo, Colorado

Common name	Scientific name	Common Name	Scientific name
Kansas glossy snake	*Arizona elegans elegans*	Brown anole	*Anolis sagrei*
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*	Tropical house gecko	*Hemidactylus mabouia*
Plains hognose snake	*Heterodon nasicus*	Western earless lizard	*Holbrookia maculata*
Western milksnake	*Lampropeltis gentilis*	Prairie lizard	*Sceloporus consobrinus*
Coachwhip	*Masticophis flagellum*	Whiptail lizards	*Aspidoscelis*
Western coachwhip	*Masticophis flagellum testaceus*	Triploid checkered whiptail	*Aspidoscelis neotesselatus*
Great plains ratsnake	*Pantherophis emoryi*	Prairie racerunner	*Aspidoscelis sexlineatus viridis*
Gopher snake	*Pituophis catenifer*	Prairie rattlesnake	*Crotalus viridis*
Bullsnake	*Pituophis catenifer sayi*	Common snapping turtle	*Chelydra serpentina*
Plains black-headed snake	*Tantilla nigriceps*	Western painted turtle	*Chrysemys picta bellii*
Western black-necked gartersnake	*Thamnophis cyrtopsis cyrtopsis*	Ornate box turtle	*Terrapene ornata*
Western terrestrial garter snake	*Thamnophis elegans*	Plains box turtle	*Terrapene ornata ornata*
Wandering garter snake	*Thamnophis elegans vagrans*	Common slider	*Trachemys scripta*
Plains garter snake	*Thamnophis radix*	Red-eared slider	*Trachemys scripta elegans*
Eastern collared lizard	*Crotaphytus collaris*	Spiny softshell turtle	*Apalone spinifera*

Table A-8 iNaturalist Bird Species Research-Grade Records (340) in Pueblo, Colorado

Common name	Scientific name	Common Name	Scientific name
Cooper's hawk	*Accipiter cooperii*	Red-winged blackbird	*Agelaius phoeniceus*
Northern goshawk	*Accipiter gentilis*	Brewer's blackbird	*Euphagus cyanocephalus*
Sharp-shinned hawk	*Accipiter striatus*	Bullock's oriole	*Icterus bullockii*
Golden eagle	*Aquila chrysaetos*	Orchard oriole	*Icterus spurius*
Red-tailed hawk	*Buteo jamaicensis*	Brown-headed cowbird	*Molothrus ater*
Harlan's hawk	*Buteo jamaicensis harlani*	Great-tailed grackle	*Quiscalus mexicanus*
Rough-legged hawk	*Buteo lagopus*	Common grackle	*Quiscalus quiscula*
Broad-winged hawk	*Buteo platypterus*	Western meadowlark	*Sturnella neglecta*
Ferruginous hawk	*Buteo regalis*	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Swainson's hawk	*Buteo swainsoni*	Yellow-breasted chat	*Icteria virens*
Northern harrier	*Circus hudsonius*	Northern shrike	*Lanius borealis*
Bald eagle	*Haliaeetus leucocephalus*	Loggerhead shrike	*Lanius ludovicianus*
Mississippi kite	*Ictinia mississippiensis*	Gray catbird	*Dumetella carolinensis*
Osprey	*Pandion haliaetus*	Northern mockingbird	*Mimus polyglottos*
Wood duck	*Aix sponsa*	Sage thrasher	*Oreoscoptes montanus*
Northern pintail	*Anas acuta*	Curve-billed thrasher	*Toxostoma curvirostre*
Green-winged teal	*Anas crecca*	Brown thrasher	*Toxostoma rufum*
Mexican duck	*Anas diazi*	American pipit	*Anthus rubescens*
Mallard	*Anas platyrhynchos*	Juniper titmouse	*Baeolophus ridgwayi*
Domestic mallard	*Anas platyrhynchos domesticus*	Black-capped chickadee	*Poecile atricapillus*
Northern mallard	*Anas platyrhynchos platyrhynchos*	Mountain chickadee	*Poecile gambeli*
Greater white-fronted goose	*Anser albifrons*	Canada warbler	*Cardellina canadensis*
Greylag goose	*Anser anser*	Wilson's warbler	*Cardellina pusilla*
Snow goose	*Anser caerulescens*	Kentucky warbler	*Geothlypis formosa*
Domestic swan goose	*Anser cygnoides domesticus*	Mourning warbler	*Geothlypis philadelphia*
Ross's goose	*Anser rossii*	MacGillivray's warbler	*Geothlypis tolmiei*
Lesser scaup	*Aythya affinis*	Common yellowthroat	*Geothlypis trichas*
Redhead	*Aythya americana*	Worm-eating warbler	*Helmitheros vermivorum*
Ring-necked duck	*Aythya collaris*	Orange-crowned warbler	*Leiothlypis celata*

Common name	Scientific name	Common Name	Scientific name
Greater scaup	*Aythya marila*	Virginia's warbler	*Leiothlypis virginiae*
Canvasback	*Aythya valisineria*	Black-and-white warbler	*Mniotilta varia*
Canada goose	*Branta canadensis*	Northern waterthrush	*Parkesia noveboracensis*
Cackling goose	*Branta hutchinsii*	Ovenbird	*Seiurus aurocapilla*
Bufflehead	*Bucephala albeola*	Northern parula	*Setophaga americana*
Common goldeneye	*Bucephala clangula*	Black-throated blue warbler	*Setophaga caerulescens*
Barrow's goldeneye	*Bucephala islandica*	Bay-breasted warbler	*Setophaga castanea*
Long-tailed duck	*Clangula hyemalis*	Hooded warbler	*Setophaga citrina*
Trumpeter swan	*Cygnus buccinator*	Yellow-rumped warbler	*Setophaga coronata*
Hooded merganser	*Lophodytes cucullatus*	Audubon's warbler	*Setophaga coronata auduboni*
American wigeon	*Mareca americana*	Myrtle warbler	*Setophaga coronata coronata*
Eurasian wigeon	*Mareca penelope*	Prairie warbler	*Setophaga discolor*
Gadwall	*Mareca strepera*	Yellow-throated warbler	*Setophaga dominica*
Black scoter	*Melanitta americana*	Blackburnian warbler	*Setophaga fusca*
Common merganser	*Mergus merganser*	Grace's warbler	*Setophaga graciae*
Red-breasted merganser	*Mergus serrator*	Magnolia warbler	*Setophaga magnolia*
Ruddy duck	*Oxyura jamaicensis*	Black-throated gray warbler	*Setophaga nigrescens*
Northern shoveler	*Spatula clypeata*	Western palm warbler	*Setophaga palmarum palmarum*
Cinnamon teal	*Spatula cyanoptera*	Chestnut-sided warbler	*Setophaga pensylvanica*
Blue-winged teal	*Spatula discors*	Yellow warbler	*Setophaga petechia*
White-throated swift	*Aeronautes saxatalis*	American redstart	*Setophaga ruticilla*
Chimney swift	*Chaetura pelagica*	Blackpoll warbler	*Setophaga striata*
Common nighthawk	*Chordeiles minor*	Cape May warbler	*Setophaga tigrina*
Common poorwill	*Phalaenoptilus nuttallii*	Townsend's warbler	*Setophaga townsendi*
Black-chinned hummingbird	*Archilochus alexandri*	Golden-winged warbler	*Vermivora chrysoptera*
Calliope hummingbird	*Selasphorus calliope*	Lark bunting	*Calamospiza melanocorys*
Broad-tailed hummingbird	*Selasphorus platycercus*	Lark sparrow	*Chondestes grammacus*
Rufous hummingbird	*Selasphorus rufus*	Dark-eyed junco	*Junco hyemalis*
Turkey vulture	*Cathartes aura*	White-winged junco	*Junco hyemalis aikeni*

Common name	Scientific name	Common Name	Scientific name
Mountain plover	*Charadrius montanus*	Gray-headed junco	*Junco hyemalis caniceps*
Semipalmated plover	*Charadrius semipalmatus*	Pink-sided junco	*Junco hyemalis mearnsi*
Killdeer	*Charadrius vociferus*	Swamp sparrow	*Melospiza georgiana*
Black-bellied plover	*Pluvialis squatarola*	Lincoln's sparrow	*Melospiza lincolnii*
Black tern	*Chlidonias niger*	Song sparrow	*Melospiza melodia*
Bonaparte's gull	*Chroicocephalus philadelphia*	Canyon towhee	*Melozone fusca*
Caspian tern	*Hydroprogne caspia*	Savannah sparrow	*Passerculus sandwichensis*
Herring gull	*Larus argentatus*	Cassin's sparrow	*Peucaea cassinii*
American herring gull	*Larus argentatus smithsonianus*	Green-tailed towhee	*Pipilo chlorurus*
California gull	*Larus californicus*	Spotted towhee	*Pipilo maculatus*
Mew gull	*Larus canus*	Vesper sparrow	*Pooecetes gramineus*
Ring-billed gull	*Larus delawarensis*	Brewer's sparrow	*Spizella breweri*
Lesser black-backed gull	*Larus fuscus*	Clay-colored sparrow	*Spizella pallida*
Glaucous-winged gull	*Larus glaucescens*	Chipping sparrow	*Spizella passerina*
Iceland gull	*Larus glaucoides*	Field sparrow	*Spizella pusilla*
Kumlien's gull	*Larus glaucoides kumlieni*	American tree sparrow	*Spizelloides arborea*
Thayer's gull	*Larus glaucoides thayeri*	White-throated sparrow	*Zonotrichia albicollis*
Great black-backed gull	*Larus marinus*	Golden-crowned sparrow	*Zonotrichia atricapilla*
Laughing gull	*Leucophaeus atricilla*	White-crowned sparrow	*Zonotrichia leucophrys*
Franklin's gull	*Leucophaeus pipixcan*	Gambel's white-crowned sparrow	*Zonotrichia leucophrys gambelii*
Black-legged kittiwake	*Rissa tridactyla*	Mountain white-crowned sparrow	*Zonotrichia leucophrys oriantha*
Common tern	*Sterna hirundo*	Harris's sparrow	*Zonotrichia querula*
Sabine's gull	*Xema sabini*	House sparrow	*Passer domesticus*
Black-necked stilt	*Himantopus mexicanus*	Blue-gray gnatcatcher	*Polioptila caerulea*
American avocet	*Recurvirostra americana*	Ruby-crowned kinglet	*Regulus calendula*
Spotted sandpiper	*Actitis macularius*	Red-breasted nuthatch	*Sitta canadensis*
Sanderling	*Calidris alba*	White-breasted nuthatch	*Sitta carolinensis*
Dunlin	*Calidris alpina*	Cordilleran white-breasted nuthatch	*Sitta carolinensis nelsoni*
Baird's sandpiper	*Calidris bairdii*	Pygmy nuthatch	*Sitta pygmaea*

Common name	Scientific name	Common Name	Scientific name
Stilt sandpiper	*Calidris himantopus*	European starling	*Sturnus vulgaris*
Pectoral sandpiper	*Calidris melanotos*	Marsh wren	*Cistothorus palustris*
Least sandpiper	*Calidris minutilla*	Rock wren	*Salpinctes obsoletus*
Semipalmated sandpiper	*Calidris pusilla*	Bewick's wren	*Thryomanes bewickii*
Wilson's snipe	*Gallinago delicata*	Carolina wren	*Thryothorus ludovicianus*
Long-billed dowitcher	*Limnodromus scolopaceus*	House wren	*Troglodytes aedon*
Marbled godwit	*Limosa fedoa*	Northern house wren	*Troglodytes aedon parkmanii*
Long-billed curlew	*Numenius americanus*	Winter wren	*Troglodytes hiemalis*
Whimbrel	*Numenius phaeopus*	Veery	*Catharus fuscescens*
Red-necked phalarope	*Phalaropus lobatus*	Hermit thrush	*Catharus guttatus*
Wilson's phalarope	*Phalaropus tricolor*	Gray-cheeked thrush	*Catharus minimus*
Lesser yellowlegs	*Tringa flavipes*	Swainson's thrush	*Catharus ustulatus*
Greater yellowlegs	*Tringa melanoleuca*	Wood thrush	*Hylocichla mustelina*
Willet	*Tringa semipalmata*	Townsend's solitaire	*Myadestes townsendi*
Solitary sandpiper	*Tringa solitaria*	Mountain bluebird	*Sialia currucoides*
Parasitic jaeger	*Stercorarius parasiticus*	Western bluebird	*Sialia mexicana*
Rock pigeon	*Columba livia*	Eastern bluebird	*Sialia sialis*
Feral pigeon	*Columba livia domestica*	American robin	*Turdus migratorius*
Inca dove	*Columbina inca*	Olive-sided flycatcher	*Contopus cooperi*
Band-tailed pigeon	*Patagioenas fasciata*	Western wood-pewee	*Contopus sordidulus*
Eurasian collared-dove	*Streptopelia decaocto*	Hammond's flycatcher	*Empidonax hammondii*
White-winged dove	*Zenaida asiatica*	Least flycatcher	*Empidonax minimus*
Mourning dove	*Zenaida macroura*	Dusky flycatcher	*Empidonax oberholseri*
Belted kingfisher	*Megaceryle alcyon*	Cordilleran flycatcher	*Empidonax occidentalis*
Yellow-billed cuckoo	*Coccyzus americanus*	Willow flycatcher	*Empidonax traillii*
Greater roadrunner	*Geococcyx californianus*	Gray flycatcher	*Empidonax wrightii*
Merlin	*Falco columbarius*	Ash-throated flycatcher	*Myiarchus cinerascens*
Prairie falcon	*Falco mexicanus*	Vermilion flycatcher	*Pyrocephalus rubinus*
Peregrine falcon	*Falco peregrinus*	Black phoebe	*Sayornis nigricans*
American kestrel	*Falco sparverius*	Eastern phoebe	*Sayornis phoebe*
Scaled quail	*Callipepla squamata*	Say's phoebe	*Sayornis saya*
Northern bobwhite	*Colinus virginianus*	Scissor-tailed flycatcher	*Tyrannus forficatus*

Common name	Scientific name	Common Name	Scientific name
Chukar	*Alectoris chukar*	Eastern kingbird	*Tyrannus tyrannus*
Dusky grouse	*Dendragapus obscurus*	Western kingbird	*Tyrannus verticalis*
Wild turkey	*Meleagris gallopavo*	Cassin's kingbird	*Tyrannus vociferans*
Yellow-billed loon	*Gavia adamsii*	Bell's vireo	*Vireo bellii*
Common loon	*Gavia immer*	Cassin's vireo	*Vireo cassinii*
Pacific loon	*Gavia pacifica*	Warbling vireo	*Vireo gilvus*
Red-throated loon	*Gavia stellata*	White-eyed vireo	*Vireo griseus*
Sandhill crane	*Antigone canadensis*	Red-eyed vireo	*Vireo olivaceus*
American Coot	*Fulica americana*	Plumbeous vireo	*Vireo plumbeus*
Sora	*Porzana carolina*	Blue-headed vireo	*Vireo solitarius*
King rail	*Rallus elegans*	Great egret	*Ardea alba*
Virginia rail	*Rallus limicola*	Great blue heron	*Ardea herodias*
Bushtit	*Psaltriparus minimus*	Cattle egret	*Bubulcus ibis*
Horned lark	*Eremophila alpestris*	Green heron	*Butorides virescens*
Cedar waxwing	*Bombycilla cedrorum*	Snowy egret	*Egretta thula*
Lapland longspur	*Calcarius lapponicus*	Yellow-crowned night-heron	*Nyctanassa violacea*
Snow bunting	*Plectrophenax nivalis*	Black-crowned night-heron	*Nycticorax nycticorax*
Lazuli bunting	*Passerina amoena*	American white pelican	*Pelecanus erythrorhynchos*
Blue grosbeak	*Passerina caerulea*	Brown pelican	*Pelecanus occidentalis*
Indigo bunting	*Passerina cyanea*	White-faced Ibis	*Plegadis chihi*
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Glossy ibis	*Plegadis falcinellus*
Black-headed grosbeak	*Pheucticus melanocephalus*	Northern flicker	*Colaptes auratus*
Western tanager	*Piranga ludoviciana*	Northern red-shafted flicker	*Colaptes auratus cafer*
Scarlet tanager	*Piranga olivacea*	Northern yellow-shafted flicker	*Colaptes auratus luteus*
Summer tanager	*Piranga rubra*	Downy woodpecker	*Dryobates pubescens*
Dickcissel	*Spiza americana*	Ladder-backed woodpecker	*Dryobates scalaris*
Brown creeper	*Certhia americana*	Hairy woodpecker	*Dryobates villosus*
American dipper	*Cinclus mexicanus*	Red-bellied woodpecker	*Melanerpes carolinus*
Woodhouse's scrub-jay	*Aphelocoma woodhouseii*	Red-headed woodpecker	*Melanerpes erythrocephalus*
American crow	*Corvus brachyrhynchos*	Acorn woodpecker	*Melanerpes formicivorus*

Common name	Scientific name	Common Name	Scientific name
Common raven	*Corvus corax*	Lewis's woodpecker	*Melanerpes lewis*
Common raven	*Corvus corax*	American three-toed woodpecker	*Picoides dorsalis*
Chihuahuan raven	*Corvus cryptoleucus*	Red-naped sapsucker	*Sphyrapicus nuchalis*
Blue jay	*Cyanocitta cristata*	Williamson's sapsucker	*Sphyrapicus thyroideus*
Steller's jay	*Cyanocitta stelleri*	Yellow-bellied sapsucker	*Sphyrapicus varius*
Clark's nutcracker	*Nucifraga columbiana*	Clark's grebe	*Aechmophorus clarkii*
Black-billed magpie	*Pica hudsonia*	Western grebe	*Aechmophorus occidentalis*
Evening grosbeak	*Coccothraustes vespertinus*	Horned grebe	*Podiceps auritus*
Cassin's finch	*Haemorhous cassinii*	Red-necked grebe	*Podiceps grisegena*
House finch	*Haemorhous mexicanus*	Eared grebe	*Podiceps nigricollis*
Red crossbill	*Loxia curvirostra*	Pied-billed grebe	*Podilymbus podiceps*
White-winged crossbill	*Loxia leucoptera*	Northern saw-whet owl	*Aegolius acadicus*
Pine siskin	*Spinus pinus*	Long-eared owl	*Asio otus*
Lesser goldfinch	*Spinus psaltria*	Burrowing owl	*Athene cunicularia*
American goldfinch	*Spinus tristis*	Snowy owl	*Bubo scandiacus*
Barn swallow	*Hirundo rustica*	Great horned owl	*Bubo virginianus*
Cliff swallow	*Petrochelidon pyrrhonota*	Northern pygmy-owl	*Glaucidium gnoma*
Bank swallow	*Riparia riparia*	Western screech-owl	*Megascops kennicottii*
Northern rough-winged swallow	*Stelgidopteryx serripennis*	Barn owl	*Tyto alba*
Tree swallow	*Tachycineta bicolor*	Double-crested cormorant	*Phalacrocorax auritus*
Violet-green swallow	*Tachycineta thalassina*	Neotropic cormorant	*Phalacrocorax brasilianus*

Table A-9 iNaturalist Mammal Species Research-Grade Records (40) in Pueblo, Colorado

Common name	Scientific name	Common name	Scientific name
Pronghorn	*Antilocapra americana*	Big brown bat	*Eptesicus fuscus*
Domestic cattle	*Bos taurus*	Silver-haired bat	*Lasionycteris noctivagans*
Elk	*Cervus canadensis*	Black-tailed jackrabbit	*Lepus californicus*
Mule deer	*Odocoileus hemionus*	Desert cottontail	*Sylvilagus audubonii*
Rocky Mountain mule deer	*Odocoileus hemionus hemionus*	Domestic horse	*Equus caballus*
White-tailed deer	*Odocoileus virginianus*	American beaver	*Castor canadensis*
Domestic dog	*Canis familiaris*	Deer mouse	*Peromyscus maniculatus*
Coyote	*Canis latrans*	Hispid cotton rat	*Sigmodon hispidus*
Gray fox	*Urocyon cinereoargenteus*	North American porcupine	*Erethizon dorsatum*
Swift fox	*Vulpes velox*	Northern pocket gopher	*Thomomys talpoides*
Red fox	*Vulpes vulpes*	Golden-mantled ground squirrel	*Callospermophilus lateralis*
Eastern American red fox	*Vulpes vulpes fulvus*	Black-tailed prairie dog	*Cynomys ludovicianus*
Domestic cat	*Felis catus*	Yellow-bellied marmot	*Marmota flaviventris*
Bobcat	*Lynx rufus*	Least chipmunk	*Neotamias minimus*
Mountain lion	*Puma concolor*	Colorado chipmunk	*Neotamias quadrivittatus*
Striped skunk	*Mephitis mephitis*	Rock squirrel	*Otospermophilus variegatus*
American badger	*Taxidea taxus*	Abert's squirrel	*Sciurus aberti*
Common raccoon	*Procyon lotor*	Fox squirrel	*Sciurus niger*
American black bear	*Ursus americanus*	American red Squirrel	*Tamiasciurus hudsonicus*
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*	Spotted ground squirrel	*Xerospermophilus spilosoma*

Table A-10 ECOS and IPaC Species Records in Pueblo, Colorado

Group	Common name	Scientific name	Group	Common name	Scientific name
Bird	Lewis's woodpecker (IPaC-M)	*Melanerpes lewis*	Insect	Monarch butterfly (ECOS; IPaC-C)	*Danaus plexippus*
Bird	Red-headed woodpecker (IPaC-M)	*Melanerpes erythrocephalus*	Reptile	Texas horned lizard (ECOS)	*Phrynosoma cornutum*
Bird	Eastern black rail (ECOS; IPaC-T)	*Laterallus jamaicensis*	Reptile	Desert massasauga (ECOS)	*Sistrurus catenatus ssp. edwardsii*
Bird	Mountain plover (ECOS)	*Charadrius montanus*	Reptile	Eastern short-horned lizard (ECOS)	*Phrynosoma douglassii brevirostra*
Bird	Mexican spotted owl (ECOS)	*Strix occidentalis lucida*	Mammal	Preble's meadow jumping mouse (ECOS)	*Zapus hudsonius preblei*
Bird	White-faced ibis (ECOS)	*Plegadis chihi*	Mammal	Black-tailed prairie dog (ECOS)	*Cynomys ludovicianus*
Bird	Western burrowing owl (ECOS)	*Athene cunicularia ssp. hypugaea*	Mammal	Long-legged myotis (ECOS)	*Myotis volans*
Bird	Pinyon jay (IPaC-M)	*Gymnorhinus cyanocephalus*	Mammal	Canada Lynx (ECOS)	*Lynx canadensis*
Bird	Clark's grebe (IPaC-M)	*Aechmophorus clarkii*	Mammal	Black-footed ferret (ECOS)	*Mustela nigripes*
Bird	Lesser yellowlegs (IPaC-M)	*Tringa flavipes*	Mammal	American pika (ECOS)	*Ochotona princeps*
Bird	Chimney Swift (IPaC-M)	*Chaetura pelagica*	Mammal	Long-eared myotis (ECOS)	*Myotis evotis*
Bird	Peregrine falcon (ECOS)	*Falco peregrinus anatum*	Mammal	Little brown bat (ECOS)	*Myotis lucifugus*
Bird	Bald eagle (ECOS; IPaC-M)	*Haliaeetus leucocephalus*	Mammal	Swift fox (ECOS)	*Vulpes velox*
Bird	Golden Eagle (IPaC-M)	*Aquila chrysaetos*	Mammals	Tricolored bat (ECOS)	*Perimyotis subflavus*
Bird	Ferruginous hawk (ECOS; IPaC-M)	*Buteo regalis*	Fish	Greenback Cutthroat trout (ECOS; IPaC - T)	*Oncorhynchus clarkii stomias*
Bird	Swainson's hawk (ECOS)	*Buteo swainsoni*	Amphibian	Northern leopard frog (ECOS)	*Rana pipiens*

NOTES:

ECOS: Environmental Conservation Online System
IPaC: Information for Planning and Consultation system
IPaC-E: Endangered
IPaC-M: Protected under the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act
IPaC-T: Threatened

APPENDIX B
SUPPORTING DATA TABLES

Table B-1. Surficial Soil Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (mg/kg)	Standard Deviation (mg/kg)	Sample_No of Max	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
Metals	Antimony	7440-36-0	568	533	94%	2.770	3.381	S0016-DU-1824-31	19.500	0.061
Metals	Arsenic	7440-38-2	568	568	100%	68.351	182.902	S0030-DU-1824-31	1,180.000	0.059
Metals	Barium	7440-39-3	568	568	100%	233.574	204.304	S0017-DU-0612-31	1,540.000	0.255
Metals	Beryllium	7440-41-7	568	519	91%	0.663	0.386	S0019-DU-1824-31	3.300	0.040
Metals	Cadmium	7440-43-9	568	568	100%	6.075	8.662	S0023-DU-1218-31	69.800	0.058
Metals	Chromium	7440-47-3	568	568	100%	24.141	44.291	S0100-DU-0001-31-ICP	390.000	0.086
Metals	Chromium, Hexavalent	18540-29-9	170	118	69%	0.380	0.732	S0001-DU-0001-31	3.270	0.012
Metals	Cobalt	7440-48-4	568	568	100%	6.565	1.767	S0053-DU-0001-31	15.000	0.032
Metals	Copper	7440-50-8	568	568	100%	162.828	315.981	S0013-DU-0106-31-ICP	2,130.000	0.127
Metals	Lead	7439-92-1	568	568	100%	776.512	1,478.102	S0013-DU-0106-31-ICP	9,290.000	0.211
Metals	Manganese	7439-96-5	568	567	100%	1,030.929	1,213.343	S0012-DU-0612-31	8,630.000	0.236
Metals	Mercury	7439-97-6	170	164	96%	1.103	2.322	S0035-DU-1824-31	11.500	0.018
Metals	Nickel	7440-02-0	568	567	100%	126.503	488.709	S0022-DU-1218-31	5,300.000	0.064
Metals	Selenium	7782-49-2	568	515	91%	2.833	2.408	S0005-DU-0001-31-ICP	11.300	0.356
Metals	Silver	7440-22-4	568	544	96%	3.814	7.651	S0025-DU-0612-31	36.700	0.033
Metals	Thallium	7440-28-0	568	506	89%	0.377	0.282	S0016-DU-1824-31	1.600	0.042
Metals	Vanadium	7440-62-2	568	567	100%	31.142	9.233	S0082-DU-1218-31	55.000	0.151
Metals	Zinc	7440-66-6	568	568	100%	1,273.056	2,082.928	S0013-DU-0106-31-ICP	11,900.000	0.631
SVOCs	Low Molecular Weight PAHs	PAH_Low	170	170	100%	0.157	0.240	S0023-DU-1218-31	1.060	0.003
SVOCs	Acenaphthene	83-32-9	170	167	98%	0.029	0.052	S0023-DU-0612-31	0.260	0.001
SVOCs	Anthracene	120-12-7	170	167	98%	0.049	0.069	S0023-DU-0612-31	0.300	0.001
SVOCs	Fluorene	86-73-7	170	144	85%	0.026	0.046	S0023-DU-0612-31	0.200	0.000
SVOCs	2-Methylnaphthalene	91-57-6	170	170	100%	0.033	0.068	S0034-DU-0106-31	0.410	0.001
SVOCs	Naphthalene	91-20-3	170	156	92%	0.026	0.037	S0023-DU-0612-31	0.160	0.001
SVOCs	High Molecular Weight PAHs	PAH_High	170	170	100%	2.464	3.037	S0023-DU-0106-31	13.843	0.020
SVOCs	Benzo(a)anthracene	56-55-3	170	170	100%	0.257	0.340	S0032-DU-1218-31	1.500	0.001
SVOCs	Benzo(a)pyrene	50-32-8	170	170	100%	0.267	0.313	S0023-DU-0001-31	1.400	0.002
SVOCs	Benzo(b)fluoranthene	205-99-2	170	170	100%	0.444	0.499	S0023-DU-0001-31	2.100	0.003
SVOCs	Benzo(k)fluoranthene	207-08-9	170	170	100%	0.158	0.178	S0023-DU-0001-31	0.800	0.002
SVOCs	Chrysene	218-01-9	170	170	100%	0.326	0.419	S0023-DU-0001-31 & S0032-DU-1218-31	1.800	0.002
SVOCs	Dibenzo(a,h)anthracene	53-70-3	170	2	1%	0.002	0.003	S0026-DU-1824-31	0.019	0.002
SVOCs	Fluoranthene	206-44-0	170	170	100%	0.437	0.587	S0023-DU-0001-31	2.700	0.002
SVOCs	Indeno(1,2,3-cd)pyrene	193-39-5	170	170	100%	0.157	0.169	S0023-DU-0001-31	0.840	0.004
SVOCs	Pyrene	129-00-0	170	170	100%	0.435	0.587	S0023-DU-0001-31	2.900	0.002
SVOCs	Acetophenone	98-86-2	170	0	0%	0.014	0.011	-	-	0.023
SVOCs	Atrazine	1912-24-9	170	0	0%	0.014	0.011	-	-	0.023
SVOCs	Benzaldehyde	100-52-7	170	4	2%	0.013	0.010	S0018-DU-0106-31	0.028	0.020
SVOCs	1,1'-Biphenyl	92-52-4	170	4	2%	0.030	0.072	S0034-DU-0106-31	0.450	0.030
SVOCs	bis(2-Chloroethoxy)methane	111-91-1	170	0	0%	0.016	0.013	-	-	0.026
SVOCs	Bis(2-Chloroethyl) ether	111-44-4	170	1	1%	0.014	0.011	S0025-DU-0001-31	0.019	0.024

Table B-1. Surficial Soil Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (mg/kg)	Standard Deviation (mg/kg)	Sample_No of Max	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
SVOCs	bis(2-Ethylhexyl)phthalate	117-81-7	170	89	52%	0.125	0.198	S0015-DU-0001-31	0.990	0.027
SVOCs	Butylbenzylphthalate	85-68-7	170	19	11%	0.025	0.019	S0130-DU-0001-31	0.072	0.026
SVOCs	Caprolactam	105-60-2	170	1	1%	0.018	0.015	S0002-DU-0001-31	0.041	0.028
SVOCs	4-Chloroaniline	106-47-8	170	0	0%	0.015	0.011	-	-	0.025
SVOCs	4-Chloro-3-methylphenol	59-50-7	170	0	0%	0.016	0.014	-	-	0.027
SVOCs	2-Chloronaphthalene	91-58-7	170	0	0%	0.017	0.014	-	-	0.029
SVOCs	2-Chlorophenol	95-57-8	170	0	0%	0.016	0.013	-	-	0.027
SVOCs	Dibenzofuran	132-64-9	170	16	9%	0.025	0.027	S0023-DU-0612-31	0.140	0.028
SVOCs	3,3'-Dichlorobenzidine	91-94-1	170	0	0%	0.018	0.014	-	-	0.029
SVOCs	2,4-Dichlorophenol	120-83-2	170	0	0%	0.017	0.014	-	-	0.029
SVOCs	Diethylphthalate	84-66-2	170	0	0%	0.014	0.012	-	-	0.023
SVOCs	2,4-Dimethylphenol	105-67-9	170	0	0%	0.019	0.014	-	-	0.032
SVOCs	Di-n-butylphthalate	84-74-2	170	3	2%	0.015	0.012	S0036-DU-0106-31	0.036	0.022
SVOCs	4,6-Dinitro-2-methylphenol	534-52-1	170	0	0%	0.023	0.020	-	-	0.038
SVOCs	2,4-Dinitrophenol	51-28-5	170	0	0%	0.014	0.011	-	-	0.023
SVOCs	2,4-Dinitrotoluene	121-14-2	170	0	0%	0.016	0.013	-	-	0.026
SVOCs	2,6-Dinitrotoluene	606-20-2	170	0	0%	0.015	0.013	-	-	0.024
SVOCs	Di-n-octylphthalate	117-84-0	170	1	1%	0.018	0.016	S0023-DU-0106-31	0.046	0.029
SVOCs	1,4-Dioxane	123-91-1	170	0	0%	0.007	0.007	-	-	0.012
SVOCs	Hexachlorobenzene	118-74-1	170	0	0%	0.015	0.013	-	-	0.026
SVOCs	Hexachlorobutadiene	87-68-3	170	0	0%	0.017	0.014	-	-	0.028
SVOCs	Hexachlorocyclo-pentadiene	77-47-4	170	0	0%	0.031	0.025	-	-	0.052
SVOCs	Hexachloroethane	67-72-1	170	0	0%	0.013	0.011	-	-	0.022
SVOCs	Isophorone	78-59-1	170	0	0%	0.014	0.011	-	-	0.024
SVOCs	2-Methylphenol	95-48-7	170	0	0%	0.016	0.014	-	-	0.027
SVOCs	3-Methylphenol + 4-Methylphenol	106-44-5	170	1	1%	0.016	0.013	S0026-DU-0001-31	0.018	0.026
SVOCs	2-Nitroaniline	88-74-4	170	0	0%	0.017	0.014	-	-	0.029
SVOCs	4-Nitroaniline	100-01-6	170	0	0%	0.013	0.010	-	-	0.023
SVOCs	Nitrobenzene	98-95-3	170	0	0%	0.015	0.013	-	-	0.025
SVOCs	N-Nitroso-di-n propylamine	621-64-7	170	0	0%	0.013	0.010	-	-	0.022
SVOCs	N-Nitrosodiphenylamine	86-30-6	170	3	2%	0.017	0.013	S0018-DU-0612-31	0.021	0.027
SVOCs	2,2'-Oxybis(1-chloropropane)	108-60-1	170	0	0%	0.015	0.013	-	-	0.025
SVOCs	Pentachlorophenol	87-86-5	170	61	36%	0.008	0.013	S0022-DU-0106-31	0.077	0.005
SVOCs	Phenol	108-95-2	170	0	0%	0.017	0.014	-	-	0.028
SVOCs	1,2,4,5-Tetrachlorobenzene	95-94-3	170	0	0%	0.018	0.015	-	-	0.030
SVOCs	2,3,4,6-Tetrachlorophenol	58-90-2	170	0	0%	0.015	0.013	-	-	0.026
SVOCs	2,4,5-Trichlorophenol	95-95-4	170	0	0%	0.016	0.014	-	-	0.026
SVOCs	2,4,6-Trichlorophenol	88-06-2	170	0	0%	0.019	0.016	-	-	0.031
VOCs	Acetone	67-64-1	171	72	42%	0.074	0.208	S0131-DU-1824-31-V	0.170	0.047
VOCs	Benzene	71-43-2	171	0	0%	0.009	0.049	-	-	0.007

Table B-1. Surficial Soil Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (mg/kg)	Standard Deviation (mg/kg)	Sample_No of Max	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
VOCs	Bromochloromethane	74-97-5	171	0	0%	0.006	0.034	-	-	0.006
VOCs	Bromodichloromethane	75-27-4	171	0	0%	0.006	0.028	-	-	0.005
VOCs	Bromoform	75-25-2	171	0	0%	0.004	0.021	-	-	0.005
VOCs	Bromomethane	74-83-9	171	0	0%	0.011	0.056	-	-	0.013
VOCs	2-Butanone	78-93-3	171	19	11%	0.032	0.137	S0018-DU-0001-31-V	0.091	0.031
VOCs	Carbon disulfide	75-15-0	171	5	3%	0.007	0.033	S0018-DU-0001-31-V	0.007	0.006
VOCs	Carbon tetrachloride	56-23-5	171	0	0%	0.006	0.028	-	-	0.007
VOCs	Chlorobenzene	108-90-7	171	0	0%	0.005	0.023	-	-	0.005
VOCs	Chloroethane	75-00-3	171	0	0%	0.006	0.027	-	-	0.009
VOCs	Chloroform	67-66-3	171	1	1%	0.008	0.043	S0008-DU-1218-31-V	0.006	0.007
VOCs	Chloromethane	74-87-3	171	0	0%	0.006	0.026	-	-	0.007
VOCs	Cyclohexane	110-82-7	171	0	0%	0.008	0.044	-	-	0.010
VOCs	Dibromochloromethane	124-48-1	171	0	0%	0.006	0.033	-	-	0.006
VOCs	1,2-Dibromo-3-chloropropane	96-12-8	171	0	0%	0.007	0.039	-	-	0.008
VOCs	1,2-Dibromoethane	106-93-4	171	0	0%	0.005	0.027	-	-	0.005
VOCs	1,2-Dichlorobenzene	95-50-1	171	0	0%	0.006	0.032	-	-	0.006
VOCs	1,4-Dichlorobenzene	106-46-7	171	0	0%	0.005	0.026	-	-	0.006
VOCs	Dichlorodifluoromethane	75-71-8	171	0	0%	0.012	0.060	-	-	0.010
VOCs	1,1-Dichloroethane	75-34-3	171	0	0%	0.007	0.037	-	-	0.006
VOCs	1,2-Dichloroethane	107-06-2	171	0	0%	0.006	0.027	-	-	0.006
VOCs	1,1-Dichloroethene	75-35-4	171	0	0%	0.010	0.053	-	-	0.008
VOCs	cis-1,2-Dichloroethene	156-59-2	171	1	1%	0.008	0.038	S0002-DU-1218-31-V	0.031	0.006
VOCs	trans-1,2-Dichloroethene	156-60-5	171	0	0%	0.006	0.032	-	-	0.007
VOCs	1,2-Dichloropropane	78-87-5	171	0	0%	0.006	0.031	-	-	0.006
VOCs	Ethylbenzene	100-41-4	171	2	1%	0.021	0.122	S0034-DU-0106-31-V	0.750	0.006
VOCs	2-Hexanone	591-78-6	171	23	13%	0.028	0.145	S0128-DU-0001-31-V	0.019	0.031
VOCs	Isopropylbenzene	98-82-8	171	2	1%	0.022	0.130	S0034-DU-0106-31-V	0.800	0.005
VOCs	Methyl acetate	79-20-9	171	14	8%	0.007	0.032	S0019-DU-0001-31-V	0.006	0.007
VOCs	Methyl tert-butyl ether	1634-04-4	171	0	0%	0.006	0.029	-	-	0.006
VOCs	Methylene chloride	75-09-2	171	53	31%	0.009	0.028	S0006-DU-0001-31-V	0.019	0.005
VOCs	4-Methyl-2-pentanone	108-10-1	171	0	0%	0.008	0.034	-	-	0.010
VOCs	Styrene	100-42-5	171	0	0%	0.006	0.029	-	-	0.005
VOCs	Tetrachloroethene	127-18-4	171	1	1%	0.005	0.023	S0130-DU-0001-31-V	0.010	0.006
VOCs	1,1,2,2-Tetrachloroethane	79-34-5	171	0	0%	0.007	0.033	-	-	0.006
VOCs	Toluene	108-88-3	171	14	8%	0.013	0.068	S0034-DU-0106-31-V	0.420	0.006
VOCs	1,1,1-Trichloroethane	71-55-6	171	0	0%	0.006	0.028	-	-	0.005
VOCs	1,1,2-Trichloroethane	79-00-5	171	0	0%	0.005	0.027	-	-	0.005
VOCs	1,2,3-Trichlorobenzene	87-61-6	171	0	0%	0.006	0.031	-	-	0.006
VOCs	1,2,4-Trichlorobenzene	120-82-1	171	0	0%	0.007	0.035	-	-	0.006
VOCs	Trichloroethene	79-01-6	171	0	0%	0.005	0.026	-	-	0.005

Table B-1. Surficial Soil Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (mg/kg)	Standard Deviation (mg/kg)	Sample_No of Max	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
VOCs	Trichlorofluoromethane	75-69-4	171	0	0%	0.009	0.044	-	-	0.008
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	171	0	0%	0.011	0.061	-	-	0.012
VOCs	Vinyl chloride	75-01-4	171	2	1%	0.008	0.031	S0002-DU-1218-31-V	0.039	0.008
VOCs	o-Xylene	95-47-6	171	3	2%	0.064	0.389	S0034-DU-0106-31-V	2.400	0.005

Table B-2. Surface Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
Metals	Aluminum	7429-90-5	D	92	7	8%	26.4	23.6	SW011-201912-01	90.3	49.40
Metals	Aluminum	7429-90-5	T	92	34	37%	88.6	186	SW020-201912-01	1,580	49.40
Metals	Antimony	7440-36-0	D	92	23	25%	1.28	1.1	SW021-201909-01	4.87	1.68
Metals	Antimony	7440-36-0	T	92	23	25%	1.28	1.1	SW021-201909-01	4.74	1.68
Metals	Arsenic	7440-38-2	D	92	52	57%	2.47	3.08	SW020-201912-01	11.1	1.18
Metals	Arsenic	7440-38-2	T	92	57	62%	2.54	3.02	SW020-201912-01	10.9	1.18
Metals	Barium	7440-39-3	D	92	91	99%	32.7	14.3	SW006-201912-01	67.2	1.97
Metals	Barium	7440-39-3	T	92	91	99%	34.3	15.6	SW008-20190308-01	78.9	1.97
Metals	Beryllium	7440-41-7	D	91	2	2%	0.924	0.904	SW001-201909-01	4.65	1.78
Metals	Beryllium	7440-41-7	T	92	1	1%	0.884	0.815	SW011-201912-01	0.254	1.76
Metals	Cadmium	7440-43-9	D	92	22	24%	0.513	0.407	SW020-201912-01	1.42	0.69
Metals	Cadmium	7440-43-9	T	92	23	25%	0.52	0.409	SW020-201912-01	1.57	0.69
Metals	Chromium	7440-47-3	D	92	10	11%	1.33	1.14	SW021-201912-01	2.18	2.47
Metals	Chromium	7440-47-3	T	94	11	12%	1.48	1.59	SW017-201912-01	9.41	2.52
Metals	Cobalt	7440-48-4	D	92	35	38%	0.624	0.414	SW021-201912-01	0.962	0.99
Metals	Cobalt	7440-48-4	T	92	32	35%	0.603	0.418	SW021-201912-01	0.953	0.97
Metals	Copper	7440-50-8	D	92	29	32%	7.17	15.3	SW021-201909-01	90.6	3.90
Metals	Copper	7440-50-8	T	92	40	43%	8.13	16	SW021-201912-01	94.5	3.90
Metals	Iron	7439-89-6	D	92	15	16%	649	2,930.00	SW021-201909-01	14,800	39.40
Metals	Iron	7439-89-6	T	92	52	57%	840.00	3,330.00	SW002-201909-01	17,600	39.00
Metals	Lead	7439-92-1	D	92	25	27%	4.2	15.2	SW011-201909-01	91.1	0.49
Metals	Lead	7439-92-1	T	92	59	64%	5.75	17.8	SW017-201912-01	95.8	0.49
Metals	Manganese	7439-96-5	D	92	78	85%	64	126	SW020-201912-01	511	2.07
Metals	Manganese	7439-96-5	T	94	85	90%	75.8	128	SW020-201912-01	511	2.12
Metals	Mercury	7439-97-6	D	92	84	91%	0.000926	0.000682	SW017-201912-01	0.00476	0.00
Metals	Mercury	7439-97-6	T	92	89	97%	0.00179	0.00291	SW001-20190305-01	0.0274	0.00
Metals	Nickel	7440-02-0	D	92	48	52%	3.99	3.58	SW021-201909-01	31.61	4.72
Metals	Nickel	7440-02-0	T	92	47	51%	4.04	3.55	SW021-201909-01	31.61	4.72
Metals	Selenium	7782-49-2	D	92	87	95%	42.2	33.7	SW008-201912-01	107	1.77
Metals	Selenium	7782-49-2	T	92	87	95%	42.2	34	SW008-201912-01	118	1.77
Metals	Silver	7440-22-4	D	93	0	0%	0.351	0.325	--	--	0.70
Metals	Silver	7440-22-4	T	92	0	0%	0.345	0.322	--	--	0.69
Metals	Thallium	7440-28-0	D	92	0	0%	0.641	0.597	--	--	1.28
Metals	Thallium	7440-28-0	T	92	0	0%	0.641	0.597	--	--	1.28
Metals	Vanadium	7440-62-2	D	92	33	36%	3.19	7.43	SW020-201912-01	44	2.36
Metals	Vanadium	7440-62-2	T	92	42	46%	3.53	7.68	SW020-201912-01	45.3	2.36
Metals	Zinc	7440-66-6	D	92	34	37%	156	269	SW011-201909-01	929	19.70
Metals	Zinc	7440-66-6	T	92	43	47%	161	268	SW011-201912-01	950.00	19.70
SVOCs	1,1'-Biphenyl	92-52-4	--	42	0	0%	0.426	0.136	--	--	0.85
SVOCs	1,1-Biphenyl	92-52-4	--	42	0	0%	0.461	0.0409	--	--	0.92

Table B-2. Surface Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	1,2,4,5-Tetrachlorobenzene	95-94-3	--	84	0	0%	0.442	0.123	--	--	0.88
SVOCs	1,4-Dioxane	123-91-1	--	84	0	0%	0.299	0.153	--	--	0.60
SVOCs	2,2'-Oxybis(1-Chloropropane)	108-60-1	--	42	0	0%	0.453	0.159	--	--	0.91
SVOCs	2,2-Oxybis(1-Chloropropane)	108-60-1	--	42	0	0%	0.457	0.0467	--	--	0.91
SVOCs	2,3,4,6-Tetrachlorophenol	58-90-2	--	84	0	0%	0.468	0.0888	--	--	0.94
SVOCs	2,4,5-Trichlorophenol	95-95-4	--	84	0	0%	0.435	0.126	--	--	0.87
SVOCs	2,4,6-Trichlorophenol	88-06-2	--	84	0	0%	0.43	0.138	--	--	0.86
SVOCs	2,4-Dichlorophenol	120-83-2	--	84	0	0%	0.464	0.124	--	--	0.93
SVOCs	2,4-Dimethylphenol	105-67-9	--	84	0	0%	0.36	0.0814	--	--	0.72
SVOCs	2,4-Dinitrophenol	51-28-5	--	84	0	0%	0.41	0.124	--	--	0.82
SVOCs	2,4-Dinitrotoluene	121-14-2	--	84	0	0%	0.472	0.095	--	--	0.94
SVOCs	2,6-Dinitrotoluene	606-20-2	--	84	0	0%	0.422	0.0867	--	--	0.85
SVOCs	2-Chloronaphthalene	91-58-7	--	84	0	0%	0.448	0.119	--	--	0.90
SVOCs	2-Chlorophenol	95-57-8	--	84	0	0%	0.44	0.144	--	--	0.88
SVOCs	2-Methylnaphthalene	91-57-6	--	184	1	1%	0.22	0.223	SW003-201909-01	0.04	0.44
SVOCs	2-Methylphenol	95-48-7	--	84	0	0%	0.41	0.0991	--	--	0.82
SVOCs	2-Nitroaniline	88-74-4	--	84	0	0%	0.444	0.118	--	--	0.89
SVOCs	2-Nitrophenol	88-75-5	--	84	0	0%	0.452	0.106	--	--	0.91
SVOCs	3,3'-Dichlorobenzidine	91-94-1	--	42	0	0%	0.571	0.141	--	--	1.14
SVOCs	3,3-Dichlorobenzidine	91-94-1	--	42	0	0%	0.367	0.0376	--	--	0.73
SVOCs	3-Methylphenol + 4-Methylphenol	106-44-5	--	11	0	0%	0.307	0.00783	--	--	0.61
SVOCs	3-Nitroaniline	99-09-2	--	84	0	0%	0.379	0.0513	--	--	0.76
SVOCs	4,6-Dinitro-2-Methylphenol	534-52-1	--	84	0	0%	0.447	0.131	--	--	0.90
SVOCs	4-Bromophenyl-Phenylether	101-55-3	--	84	0	0%	0.453	0.124	--	--	0.91
SVOCs	4-Chloro-3-Methylphenol	59-50-7	--	84	0	0%	0.42	0.0917	--	--	0.84
SVOCs	4-Chloroaniline	106-47-8	--	84	0	0%	0.436	0.0992	--	--	0.87
SVOCs	4-Chlorophenyl-Phenyl Ether	7005-72-3	--	42	0	0%	0.521	0.187	--	--	1.04
SVOCs	4-Chlorophenyl-Phenylether	7005-72-3	--	42	0	0%	0.422	0.0381	--	--	0.85
SVOCs	4-Methylphenol	106-44-5	--	73	1	1%	0.521	0.743	SW007-201906-01	6.75	0.87
SVOCs	4-Nitroaniline	100-01-6	--	84	0	0%	0.421	0.141	--	--	0.84
SVOCs	4-Nitrophenol	100-02-7	--	84	0	0%	0.512	0.118	--	--	1.02
SVOCs	Acenaphthene	83-32-9	--	184	3	2%	0.223	0.224	SW011-20190325-01-SV	0.031	0.45
SVOCs	Acenaphthylene	208-96-8	--	184	1	1%	0.237	0.244	SW008-20190322-01-SV	0.015	0.47
SVOCs	Acetophenone	98-86-2	--	84	0	0%	0.464	0.109	--	--	0.93
SVOCs	Anthracene	120-12-7	--	184	1	1%	0.229	0.232	SW006-201912-01	0.02	0.46
SVOCs	Atrazine	1912-24-9	--	84	5	6%	1.03	2.37	SW005-201909-01	11	0.86
SVOCs	Benzaldehyde	100-52-7	--	84	0	0%	0.431	0.193	--	--	0.86
SVOCs	Benzo(A)Anthracene	56-55-3	--	184	5	3%	0.223	0.221	SW006-201912-01	0.13	0.44
SVOCs	Benzo(A)Pyrene	50-32-8	--	184	6	3%	0.258	0.409	SW006-201912-01	4.8	0.47

Table B-2. Surface Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	Benzo(B)Fluoranthene	205-99-2	--	184	13	7%	0.28	0.536	SW006-201912-01	5.05	0.45
SVOCs	Benzo(G,H,I)Perylene	191-24-2	--	184	5	3%	0.25	0.403	SW006-201912-01	4.8	0.45
SVOCs	Benzo(K)Fluoranthene	207-08-9	--	184	4	2%	0.254	0.403	SW006-201912-01	4.8	0.46
SVOCs	Bis(2-Chloroethoxy)Methane	111-91-1	--	84	0	0%	0.437	0.132	--	--	0.87
SVOCs	Bis(2-Chloroethyl) Ether	111-44-4	--	42	0	0%	0.467	0.195	--	--	0.94
SVOCs	Bis(2-Chloroethyl)Ether	111-44-4	--	42	0	0%	0.45	0.0299	--	--	0.90
SVOCs	Bis(2-Ethylhexyl)Phthalate	117-81-7	--	84	0	0%	0.413	0.0737	--	--	0.83
SVOCs	Butylbenzylphthalate	85-68-7	--	84	0	0%	0.413	0.0906	--	--	0.83
SVOCs	Caprolactam	105-60-2	--	84	0	0%	0.457	0.194	--	--	0.91
SVOCs	Carbazole	86-74-8	--	84	0	0%	0.424	0.112	--	--	0.85
SVOCs	Chrysene	218-01-9	--	184	4	2%	0.223	0.222	SW006-201912-01	0.18	0.44
SVOCs	Di-N-Butylphthalate	84-74-2	--	84	0	0%	0.448	0.134	--	--	0.90
SVOCs	Di-N-Octyl Phthalate	117-84-0	--	42	0	0%	0.372	0.0492	--	--	0.75
SVOCs	Di-N-Octylphthalate	117-84-0	--	42	0	0%	0.419	0.0173	--	--	0.84
SVOCs	Dibenzo(A,H)Anthracene	53-70-3	--	184	3	2%	0.248	0.401	SW006-201912-01	4.8	0.45
SVOCs	Dibenzofuran	132-64-9	--	84	0	0%	0.431	0.106	--	--	0.86
SVOCs	Diethylphthalate	84-66-2	--	84	0	0%	0.446	0.106	--	--	0.89
SVOCs	Dimethylphthalate	131-11-3	--	84	32	38%	1.18	1.15	SW004-201912-01	5.5	0.93
SVOCs	Fluoranthene	206-44-0	--	184	5	3%	0.219	0.22	SW006-201912-01	0.22	0.43
SVOCs	Fluorene	86-73-7	--	184	0	0%	0.223	0.233	--	--	0.45
SVOCs	Hexachlorobenzene	118-74-1	--	84	0	0%	0.437	0.143	--	--	0.87
SVOCs	Hexachlorobutadiene	87-68-3	--	84	0	0%	0.41	0.105	--	--	0.82
SVOCs	Hexachlorocyclo-Pentadiene	77-47-4	--	42	0	0%	1.02	0.468	--	--	2.04
SVOCs	Hexachlorocyclopentadiene	77-47-4	--	42	0	0%	0.382	0.0194	--	--	0.76
SVOCs	Hexachloroethane	67-72-1	--	84	0	0%	0.434	0.0867	--	--	0.87
SVOCs	Indeno(1,2,3-Cd)Pyrene	193-39-5	--	184	4	2%	0.25	0.402	SW006-201912-01	4.8	0.46
SVOCs	Isophorone	78-59-1	--	84	0	0%	0.444	0.12	--	--	0.89
SVOCs	N-Nitroso-Di-N Propylamine	621-64-7	--	42	0	0%	0.477	0.135	--	--	0.96
SVOCs	N-Nitroso-Di-N-Propylamine	621-64-7	--	42	0	0%	0.474	0.0268	--	--	0.95
SVOCs	N-Nitrosodiphenylamine	86-30-6	--	84	0	0%	0.437	0.0998	--	--	0.88
SVOCs	Naphthalene	91-20-3	--	184	4	2%	0.219	0.218	SW014-201909-01	0.16	0.44
SVOCs	Nitrobenzene	98-95-3	--	84	0	0%	0.45	0.142	--	--	0.90
SVOCs	Pentachlorophenol	87-86-5	--	184	2	1%	0.204	0.181	SW006-201912-01	0.06	0.41
SVOCs	Phenanthrene	85-01-8	--	184	2	1%	0.213	0.216	SW006-201912-01	0.1	0.43
SVOCs	Phenol	108-95-2	--	84	8	10%	0.523	0.309	SW019-201912-01	1.8	0.88
SVOCs	Pyrene	129-00-0	--	184	7	4%	0.284	0.434	SW002-20190304-01	5.05	0.51
VOCs	1,1,1-Trichloroethane	71-55-6	--	84	0	0%	0.0333	0.00848	--	--	0.07
VOCs	1,1,2,2-Tetrachloroethane	79-34-5	--	84	0	0%	0.0542	0.02	--	--	0.11
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	--	84	0	0%	0.039	0.01	--	--	0.08

Table B-2. Surface Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
VOCs	1,1,2-Trichloroethane	79-00-5	--	84	0	0%	0.0414	0.0103	--	--	0.08
VOCs	1,1-Dichloroethane	75-34-3	--	84	0	0%	0.0322	0.00926	--	--	0.06
VOCs	1,1-Dichloroethene	75-35-4	--	84	0	0%	0.043	0.0126	--	--	0.09
VOCs	1,2,3-Trichlorobenzene	87-61-6	--	84	0	0%	0.0397	0.0118	--	--	0.08
VOCs	1,2,4-Trichlorobenzene	120-82-1	--	84	0	0%	0.0306	0.0119	--	--	0.06
VOCs	1,2-Dibromo-3-Chloropropane	96-12-8	--	84	0	0%	0.122	0.0316	--	--	0.24
VOCs	1,2-Dibromoethane	106-93-4	--	84	0	0%	0.0362	0.0123	--	--	0.07
VOCs	1,2-Dichlorobenzene	95-50-1	--	84	0	0%	0.0364	0.0109	--	--	0.07
VOCs	1,2-Dichloroethane	107-06-2	--	84	4	5%	0.0456	0.0537	SW008-201909-01	0.32	0.07
VOCs	1,2-Dichloropropane	78-87-5	--	84	0	0%	0.0385	0.0132	--	--	0.08
VOCs	1,3-Dichlorobenzene	541-73-1	--	84	1	1%	0.0389	0.0418	SW015-20190327-01	0.41	0.07
VOCs	1,4-Dichlorobenzene	106-46-7	--	84	0	0%	0.0294	0.0117	--	--	0.06
VOCs	2-Butanone	78-93-3	--	84	0	0%	0.537	0.16	--	--	1.07
VOCs	2-Hexanone	591-78-6	--	84	0	0%	0.253	0.102	--	--	0.51
VOCs	4-Methyl-2-Pentanone	108-10-1	--	84	0	0%	0.328	0.0914	--	--	0.66
VOCs	Acetone	67-64-1	--	84	3	4%	0.654	0.578	SW013-201909-01	5.6	1.14
VOCs	Benzene	71-43-2	--	84	0	0%	0.0316	0.00748	--	--	0.06
VOCs	Bromochloromethane	74-97-5	--	84	0	0%	0.0485	0.00976	--	--	0.10
VOCs	Bromodichloromethane	75-27-4	--	84	0	0%	0.0268	0.00618	--	--	0.05
VOCs	Bromoform	75-25-2	--	84	0	0%	0.0418	0.0127	--	--	0.08
VOCs	Bromomethane	74-83-9	--	84	0	0%	0.0559	0.0272	--	--	0.11
VOCs	Carbon Disulfide	75-15-0	--	84	4	5%	0.0695	0.252	SW001-201912-01	2.3	0.06
VOCs	Carbon Tetrachloride	56-23-5	--	84	0	0%	0.0372	0.013	--	--	0.07
VOCs	Chlorobenzene	108-90-7	--	84	0	0%	0.0243	0.00812	--	--	0.05
VOCs	Chloroethane	75-00-3	--	84	0	0%	0.0497	0.0205	--	--	0.10
VOCs	Chloroform	67-66-3	--	84	9	11%	0.114	0.285	SW019-201906-01	2.1	0.09
VOCs	Chloromethane	74-87-3	--	84	0	0%	0.0386	0.00994	--	--	0.08
VOCs	Cis-1,2-Dichloroethene	156-59-2	--	84	0	0%	0.033	0.00838	--	--	0.07
VOCs	Cis-1,3-Dichloropropene	10061-01-5	--	84	0	0%	0.0421	0.0143	--	--	0.08
VOCs	Cyclohexane	110-82-7	--	84	0	0%	0.0415	0.00572	--	--	0.08
VOCs	Dibromochloromethane	124-48-1	--	84	0	0%	0.0357	0.00933	--	--	0.07
VOCs	Dichlorodifluoromethane	75-71-8	--	84	0	0%	0.0385	0.00584	--	--	0.08
VOCs	Ethylbenzene	100-41-4	--	84	0	0%	0.0276	0.00918	--	--	0.06
VOCs	Isopropylbenzene	98-82-8	--	84	0	0%	0.0279	0.00575	--	--	0.06
VOCs	M, P-Xylene	179601-23-1	--	10	0	0%	0.0215	0	--	--	0.04
VOCs	M,P-Xylene	179601-23-1	--	74	0	0%	0.0315	0.00847	--	--	0.06
VOCs	Methyl Acetate	79-20-9	--	84	0	0%	0.0971	0.0225	--	--	0.19
VOCs	Methyl Tert-Butyl Ether	1634-04-4	--	84	4	5%	0.0979	0.313	SW008-201909-01	1.7	0.06
VOCs	Methylcyclohexane	108-87-2	--	84	0	0%	0.0326	0.00707	--	--	0.07
VOCs	Methylene Chloride	75-09-2	--	84	0	0%	0.0444	0.00883	--	--	0.09

Table B-2. Surface Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
VOCs	O-Xylene	95-47-6	--	84	0	0%	0.0336	0.00962	--	--	0.07
VOCs	Styrene	100-42-5	--	84	0	0%	0.0256	0.00647	--	--	0.05
VOCs	Tetrachloroethene	127-18-4	--	84	1	1%	0.0321	0.0143	SW019-20190318-01	0.046	0.06
VOCs	Toluene	108-88-3	--	84	3	4%	0.0312	0.0243	SW001-20190305-01	0.22	0.06
VOCs	Trans-1,2-Dichloroethene	156-60-5	--	84	0	0%	0.0408	0.012	--	--	0.08
VOCs	Trans-1,3-Dichloropropene	10061-02-6	--	84	0	0%	0.0261	0.00928	--	--	0.05
VOCs	Trichloroethene	79-01-6	--	84	0	0%	0.0379	0.0153	--	--	0.08
VOCs	Trichlorofluoromethane	75-69-4	--	84	0	0%	0.0359	0.00835	--	--	0.07
VOCs	Vinyl Chloride	75-01-4	--	84	0	0%	0.0408	0.00953	--	--	0.08

Table B-3. Sediment Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
Metals	Antimony	7440-36-0	32	28	88%	4.16	11.26	SED009-201903-0612-01	59.6	0.36
Metals	Arsenic	7440-38-2	32	32	100%	38.49	134.67	SED010-201904-0006-01	772.00	0.22
Metals	Barium	7440-39-3	32	32	100%	282.37	437.81	SED021-201904-0006-01	2510	1.73
Metals	Beryllium	7440-41-7	32	25	78%	0.29	0.15	SED011-201904-0006-01	0.81	0.21
Metals	Cadmium	7440-43-9	32	30	94%	3.71	3.76	SED009-201903-0612-01	14	0.17
Metals	Chromium	7440-47-3	32	32	100%	12.04	8.87	SED021-201904-0006-01	37.1	0.42
Metals	Cobalt	7440-48-4	32	32	100%	4.83	2.62	SED010-201904-0006-01	11.1	0.19
Metals	Copper	7440-50-8	32	32	100%	167.85	612.76	SED021-201904-0006-01	3510	0.36
Metals	Lead	7439-92-1	32	32	100%	587.62	2024.35	SED021-201904-0006-01	11500	0.21
Metals	Manganese	7439-96-5	32	32	100%	1237.39	1903.2	SED009-201903-0612-01	7700	0.39
Metals	Mercury	7439-97-6	32	27	84%	0.11	0.13	SED017-201903-0006-01	0.58	0.01
Metals	Nickel	7440-02-0	32	32	100%	19.41	12.89	SED009-201903-0612-01	53.9	0.28
Metals	Selenium	7782-49-2	32	31	97%	13.36	16.66	SED008-201903-0003-01	72.8	1.05
Metals	Silver	7440-22-4	32	26	81%	2.41	9.4	SED001-201904-0006-01	53.7	0.14
Metals	Thallium	7440-28-0	32	23	72%	0.37	0.31	SED008-201903-0003-01	1.2	0.14
Metals	Vanadium	7440-62-2	32	32	100%	32.55	24.36	SED008-201903-0003-01	114	0.58
Metals	Zinc	7440-66-6	32	32	100%	1332.03	3296.72	SED021-201904-0006-01	17700	0.56
SVOCs	1,1'-Biphenyl	92-52-4	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	1,2,4,5-Tetrachlorobenzene	95-94-3	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	1,4-Dioxane	123-91-1	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2,2'-Oxybis(1-chloropropane)	108-60-1	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2,3,4,6-Tetrachlorophenol	58-90-2	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	2,4,5-Trichlorophenol	95-95-4	32	0	0%	0.01	0	--	--	0.02
SVOCs	2,4,6-Trichlorophenol	88-06-2	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	2,4-Dichlorophenol	120-83-2	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	2,4-Dimethylphenol	105-67-9	32	0	0%	0.02	0.01	--	--	0.04
SVOCs	2,4-Dinitrophenol	51-28-5	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	2,4-Dinitrotoluene	121-14-2	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	2,6-Dinitrotoluene	606-20-2	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2-Chloronaphthalene	91-58-7	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2-Chlorophenol	95-57-8	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2-Methylnaphthalene	91-57-6	68	28	41%	0.02	0.04	SED017-201903-0006-01	0.285	0.01
SVOCs	2-Methylphenol	95-48-7	32	1	3%	0.01	0.01	SED006-201904-0612-01	0.074	0.02
SVOCs	2-Nitroaniline	88-74-4	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	2-Nitrophenol	88-75-5	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	3,3'-Dichlorobenzidine	91-94-1	32	0	0%	0.05	0.02	--	--	0.09
SVOCs	3-Methylphenol + 4-Methylphenol	106-44-5	32	2	6%	0.03	0.07	SED006-201904-0612-01	0.38	0.02
SVOCs	3-Nitroaniline	99-09-2	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	4,6-Dinitro-2-methylphenol	534-52-1	32	0	0%	0.02	0.01	--	--	0.04
SVOCs	4-Bromophenyl-phenylether	101-55-3	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	4-Chloro-3-methylphenol	59-50-7	32	0	0%	0.01	0.01	--	--	0.03

Table B-3. Sediment Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	4-Chloroaniline	106-47-8	32	0	0%	0.02	0.01	--	--	0.04
SVOCs	4-Chlorophenyl-phenyl ether	7005-72-3	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	4-Nitroaniline	100-01-6	32	0	0%	0.02	0.01	--	--	0.04
SVOCs	4-Nitrophenol	100-02-7	32	0	0%	0.02	0.01	--	--	0.04
SVOCs	Acenaphthene	83-32-9	68	30	44%	0.02	0.04	SED017-201903-0006-01	0.285	0.01
SVOCs	Acenaphthylene	208-96-8	68	33	49%	0.02	0.04	SED021-201904-0006-01	0.285	0.01
SVOCs	Acetophenone	98-86-2	32	1	3%	0.02	0.05	SED014-201903-0006-01	0.27	0.03
SVOCs	Anthracene	120-12-7	68	38	56%	0.03	0.04	SED016-201904-0006-01	0.19	0.01
SVOCs	Atrazine	1912-24-9	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	Benzaldehyde	100-52-7	32	2	6%	0.02	0.03	SED014-201903-0612-01	0.16	0.03
SVOCs	Benzo(a)anthracene	56-55-3	68	55	81%	0.1	0.11	SED021-201904-0006-01	0.58	0.01
SVOCs	Benzo(a)pyrene	50-32-8	68	57	84%	0.11	0.12	SED021-201904-0006-01	0.68	0.01
SVOCs	Benzo(b)fluoranthene	205-99-2	68	60	88%	0.16	0.16	SED016-201904-0612-01	0.85	0.02
SVOCs	Benzo(g,h,i)perylene	191-24-2	68	56	82%	0.08	0.09	SED021-201904-0006-01	0.54	0.01
SVOCs	Benzo(k)fluoranthene	207-08-9	68	52	76%	0.06	0.07	SED016-201904-0006-01	0.36	0.01
SVOCs	Bis(2-Chloroethyl) ether	111-44-4	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	Butylbenzylphthalate	85-68-7	32	4	12%	0.02	0.01	SED006-201904-0612-01	0.0535	0.03
SVOCs	Caprolactam	105-60-2	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	Carbazole	86-74-8	32	3	9%	0.02	0.02	SED003-201903-0006-01	0.11	0.03
SVOCs	Chrysene	218-01-9	68	58	85%	0.12	0.13	SED016-201904-0612-01	0.67	0.01
SVOCs	Di-n-butylphthalate	84-74-2	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	Di-n-octylphthalate	117-84-0	32	0	0%	0.06	0.03	--	--	0.13
SVOCs	Dibenzo(a,h)anthracene	53-70-3	68	0	0%	0.01	0.01	--	--	0.01
SVOCs	Dibenzofuran	132-64-9	32	2	6%	0.01	0.01	SED003-201903-0612-01	0.053	0.02
SVOCs	Diethylphthalate	84-66-2	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	Dimethylphthalate	131-11-3	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	Fluoranthene	206-44-0	68	58	85%	0.2	0.27	SED021-201904-0006-01	1.5	0.02
SVOCs	Fluorene	86-73-7	68	23	34%	0.02	0.04	SED017-201903-0006-01	0.285	0.01
SVOCs	Hexachlorobenzene	118-74-1	32	0	0%	0.01	0	--	--	0.02
SVOCs	Hexachlorobutadiene	87-68-3	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	Hexachlorocyclo-pentadiene	77-47-4	32	0	0%	0.02	0.02	--	--	0.03
SVOCs	Hexachloroethane	67-72-1	32	0	0%	0.01	0	--	--	0.02
SVOCs	Indeno(1,2,3-cd)pyrene	193-39-5	68	56	82%	0.07	0.08	SED021-201904-0006-01	0.45	0.02
SVOCs	Isophorone	78-59-1	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	N-Nitroso-di-n propylamine	621-64-7	32	1	3%	0.02	0.01	SED014-201903-0612-01	0.037	0.03
SVOCs	N-Nitrosodiphenylamine	86-30-6	32	0	0%	0.01	0.01	--	--	0.02
SVOCs	Naphthalene	91-20-3	68	25	37%	0.02	0.05	SED021-201904-0006-01	0.285	0.01
SVOCs	Nitrobenzene	98-95-3	32	0	0%	0.01	0.01	--	--	0.03
SVOCs	Pentachlorophenol	87-86-5	68	15	22%	0.01	0.01	SED003-201903-0612-01	0.036	0.01
SVOCs	Phenanthrene	85-01-8	68	54	79%	0.12	0.18	SED016-201904-0006-01	0.79	0.02
SVOCs	Phenol	108-95-2	32	3	9%	0.02	0.02	SED006-201904-0006-01	0.092	0.03

Table B-3. Sediment Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	Pyrene	129-00-0	68	58	85%	0.18	0.21	SED021-201904-0006-01	1.1	0.02
SVOCs	bis(2-Chloroethoxy)methane	111-91-1	32	0	0%	0.02	0.01	--	--	0.03
SVOCs	bis(2-Ethylhexyl)phthalate	117-81-7	32	14	44%	0.06	0.08	SED009-201903-0006-01	0.28	0.02
VOCs	1,1,1-Trichloroethane	71-55-6	32	0	0%	0	0	--	--	0
VOCs	1,1,2,2-Tetrachloroethane	79-34-5	32	0	0%	0	0	--	--	0
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	32	0	0%	0	0	--	--	0.01
VOCs	1,1,2-Trichloroethane	79-00-5	32	0	0%	0	0	--	--	0
VOCs	1,1-Dichloroethane	75-34-3	32	0	0%	0	0	--	--	0
VOCs	1,1-Dichloroethene	75-35-4	32	0	0%	0	0	--	--	0
VOCs	1,2,3-Trichlorobenzene	87-61-6	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	1,2,4-Trichlorobenzene	120-82-1	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	1,2-Dibromo-3-chloropropane	96-12-8	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	1,2-Dibromoethane	106-93-4	32	0	0%	0	0	--	--	0
VOCs	1,2-Dichlorobenzene	95-50-1	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	1,2-Dichloroethane	107-06-2	32	0	0%	0	0	--	--	0
VOCs	1,2-Dichloropropane	78-87-5	32	0	0%	0	0	--	--	0
VOCs	1,3-Dichlorobenzene	541-73-1	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	1,4-Dichlorobenzene	106-46-7	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	2-Butanone	78-93-3	32	15	47%	0.01	0.02	SED001-201904-0006-01	0.054	0.01
VOCs	2-Hexanone	591-78-6	32	4	12%	0	0.01	SED006-201904-0006-01	0.019	0.01
VOCs	4-Methyl-2-pentanone	108-10-1	32	0	0%	0	0	--	--	0
VOCs	Acetone	67-64-1	32	19	59%	0.02	0.03	SED003-201903-0612-01	0.11	0.01
VOCs	Benzene	71-43-2	32	0	0%	0	0	--	--	0
VOCs	Bromochloromethane	74-97-5	32	0	0%	0	0	--	--	0
VOCs	Bromodichloromethane	75-27-4	32	0	0%	0	0	--	--	0
VOCs	Bromoform	75-25-2	32	1	3%	0	0	SED020-201904-0612-01	0.0062	0
VOCs	Bromomethane	74-83-9	32	0	0%	0	0	--	--	0
VOCs	Carbon disulfide	75-15-0	32	3	9%	0	0	SED005-201904-0006-01	0.0078	0
VOCs	Carbon tetrachloride	56-23-5	32	0	0%	0	0	--	--	0
VOCs	Chlorobenzene	108-90-7	32	0	0%	0	0	--	--	0
VOCs	Chloroethane	75-00-3	32	0	0%	0	0	--	--	0
VOCs	Chloroform	67-66-3	32	2	6%	0	0	SED001-201904-0612-01	0.0038	0
VOCs	Chloromethane	74-87-3	32	0	0%	0	0	--	--	0
VOCs	Cyclohexane	110-82-7	32	0	0%	0	0	--	--	0
VOCs	Dibromochloromethane	124-48-1	32	0	0%	0	0	--	--	0
VOCs	Dichlorodifluoromethane	75-71-8	32	0	0%	0	0	--	--	0.01
VOCs	Ethylbenzene	100-41-4	32	0	0%	0	0	--	--	0
VOCs	Isopropylbenzene	98-82-8	32	0	0%	0	0	--	--	0
VOCs	Methyl acetate	79-20-9	32	1	3%	0	0	SED010-201904-0006-01-V	0.0023	0
VOCs	Methyl tert-butyl ether	1634-04-4	32	0	0%	0	0	--	--	0

Table B-3. Sediment Summary – Analytes

Chemical Group	Analyte	CAS Number	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
VOCs	Methylcyclohexane	108-87-2	32	0	0%	0	0	--	--	0
VOCs	Methylene chloride	75-09-2	32	2	6%	0	0	SED020-201904-0612-01	0.0049	0
VOCs	Styrene	100-42-5	32	0	0%	0	0	--	--	0
VOCs	Tetrachloroethene	127-18-4	32	0	0%	0	0	--	--	0
VOCs	Toluene	108-88-3	32	8	25%	0	0.01	SED009-201903-0612-01	0.026	0
VOCs	Trichloroethene	79-01-6	32	0	0%	0	0	--	--	0
VOCs	Trichlorofluoromethane	75-69-4	32	0	0%	0	0	--	--	0
VOCs	Vinyl chloride	75-01-4	32	0	0%	0	0	--	--	0
VOCs	cis-1,2-Dichloroethene	156-59-2	32	0	0%	0	0	--	--	0
VOCs	cis-1,3-Dichloropropene	10061-01-5	32	0	0%	0	0	--	--	0
VOCs	m, p-Xylene	179601-23-1	29	0	0%	0	0	--	--	0
VOCs	m,p-Xylene	179601-23-1	3	0	0%	0	0	--	--	0.01
VOCs	o-Xylene	95-47-6	32	0	0%	0	0	--	--	0
VOCs	trans-1,2-Dichloroethene	156-60-5	32	0	0%	0	0	--	--	0
VOCs	trans-1,3-Dichloropropene	10061-02-6	32	0	0%	0	0	--	--	0
VOCs	Trichlorofluoromethane	75-69-4	32	0	0%	0	0	--	--	0
VOCs	Vinyl chloride	75-01-4	32	0	0%	0	0	--	--	0

Table B-4. Pore Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
Metals	Aluminum	7429-90-5	D	13	0	0%	64	0	--	--	128
Metals	Aluminum	7429-90-5	T	13	2	15%	115	124	PW007-20190314-01	406.00	126
Metals	Antimony	7440-36-0	D	13	1	8%	3.67	5.42	PW004-20190305-01	21.7	4.34
Metals	Antimony	7440-36-0	T	13	0	0%	2.17	0	--	--	4.34
Metals	Arsenic	7440-38-2	D	13	3	23%	3.98	5.96	PW007-20190314-01	22.4	3.06
Metals	Arsenic	7440-38-2	T	13	4	31%	4.57	6.65	PW004-20190305-01	24.7	3.06
Metals	Barium	7440-39-3	D	13	13	100%	44.8	21.2	PW006-20190318-01	78.7	5.1
Metals	Barium	7440-39-3	T	13	13	100%	47.8	21.3	PW006-20190318-01	84.3	5.1
Metals	Beryllium	7440-41-7	D	13	0	0%	2.3	0	--	--	4.59
Metals	Beryllium	7440-41-7	T	13	0	0%	2.3	0	--	--	4.59
Metals	Cadmium	7440-43-9	D	13	0	0%	0.895	0	--	--	1.79
Metals	Cadmium	7440-43-9	T	13	0	0%	0.895	0	--	--	1.79
Metals	Chromium	7440-47-3	D	13	0	0%	3.09	0.24	--	--	6.18
Metals	Chromium	7440-47-3	T	13	0	0%	3.14	0.178	--	--	6.28
Metals	Cobalt	7440-48-4	D	13	1	8%	1.4	0.525	PW004-20190305-01	3.13	2.47
Metals	Cobalt	7440-48-4	T	13	0	0%	1.26	0.0707	--	--	2.51
Metals	Copper	7440-50-8	D	13	2	15%	11.2	20.9	PW010-20190311-01	80.7	9.89
Metals	Copper	7440-50-8	T	13	3	23%	12.1	22	PW007-20190314-01	85	10
Metals	Iron	7439-89-6	D	13	3	23%	2310	7,870.00	PW007-20190314-01	28,500.00	98.9
Metals	Iron	7439-89-6	T	13	6	46%	2,550.00	8,080.00	PW010-20190311-01	29,400.00	100
Metals	Lead	7439-92-1	D	13	2	15%	6.88	18.5	PW010-20190311-01	67.1	1.28
Metals	Lead	7439-92-1	T	13	7	54%	11.2	21.6	PW009-20190308-01	74.9	1.28
Metals	Manganese	7439-96-5	D	13	11	85%	435	922	PW010-20190311-01	3340	5.28
Metals	Manganese	7439-96-5	T	13	11	85%	458	932	PW001-20190305-01	3390	5.28
Metals	Mercury	7439-97-6	D	13	11	85%	0.000827	0.000692	PW009-20190308-01	0.00231	0.00013
Metals	Mercury	7439-97-6	T	13	13	100%	0.00172	0.0011	PW017-20190307-01	0.00369	0.00013
Metals	Nickel	7440-02-0	D	13	0	0%	5.92	0.451	--	--	11.8
Metals	Nickel	7440-02-0	T	13	2	15%	7.08	2.7	PW001-20190305-01	13.95	12
Metals	Selenium	7782-49-2	D	13	10	77%	31.9	34.3	PW014-20190307-01	93	4.59
Metals	Selenium	7782-49-2	T	13	9	69%	31.1	33.7	PW014-20190307-01	89.1	4.59
Metals	Silver	7440-22-4	D	13	0	0%	0.895	0	--	--	1.79
Metals	Silver	7440-22-4	T	13	0	0%	0.895	0	--	--	1.79
Metals	Thallium	7440-28-0	D	13	0	0%	1.66	0	--	--	3.32
Metals	Thallium	7440-28-0	T	13	0	0%	1.66	0	--	--	3.32
Metals	Vanadium	7440-62-2	D	13	0	0%	3.06	0	--	--	6.12
Metals	Vanadium	7440-62-2	T	13	3	23%	4.35	3.01	PW001-20190305-01	13.6	6.12
Metals	Zinc	7440-66-6	D	13	2	15%	101	193	PW007-20190314-01	662	51
Metals	Zinc	7440-66-6	T	13	3	23%	111	198	PW004-20190305-01	634.00	51
SVOCs	1,1'-Biphenyl	92-52-4	--	12	0	0%	0.291	0.00515	--	--	0.582
SVOCs	1,2,4,5-Tetrachlorobenzene	95-94-3	--	12	0	0%	0.261	0.00515	--	--	0.522

Table B-4. Pore Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	1,4-Dioxane	123-91-1	--	12	0	0%	0.241	0.00515	--	--	0.482
SVOCs	2-Chloronaphthalene	91-58-7	--	12	0	0%	0.276	0.00515	--	--	0.552
SVOCs	2-Chlorophenol	95-57-8	--	12	0	0%	0.251	0.00515	--	--	0.502
SVOCs	2-Methylnaphthalene	91-57-6	--	26	0	0%	0.132	0.126	--	--	0.263
SVOCs	2-Methylphenol	95-48-7	--	12	0	0%	0.276	0.00515	--	--	0.552
SVOCs	2-Nitroaniline	88-74-4	--	12	0	0%	0.256	0.00515	--	--	0.512
SVOCs	2-Nitrophenol	88-75-5	--	12	0	0%	0.329	0.00772	--	--	0.658
SVOCs	2,2'-Oxybis(1-chloropropane)	108-60-1	--	12	0	0%	0.296	0.00515	--	--	0.592
SVOCs	2,3,4,6-Tetrachlorophenol	58-90-2	--	12	0	0%	0.389	0.00772	--	--	0.778
SVOCs	2,4-Dichlorophenol	120-83-2	--	12	0	0%	0.326	0.00515	--	--	0.652
SVOCs	2,4-Dimethylphenol	105-67-9	--	12	0	0%	0.296	0.00515	--	--	0.592
SVOCs	2,4-Dinitrophenol	51-28-5	--	12	0	0%	0.246	0.00515	--	--	0.492
SVOCs	2,4-Dinitrotoluene	121-14-2	--	12	0	0%	0.356	0.00515	--	--	0.712
SVOCs	2,4,5-Trichlorophenol	95-95-4	--	12	0	0%	0.246	0.00515	--	--	0.492
SVOCs	2,4,6-Trichlorophenol	88-06-2	--	12	0	0%	0.286	0.00515	--	--	0.572
SVOCs	2,6-Dinitrotoluene	606-20-2	--	12	0	0%	0.286	0.00515	--	--	0.572
SVOCs	3-Methylphenol + 4-Methylphenol	106-44-5	--	7	0	0%	0.304	0.00732	--	--	0.609
SVOCs	3-Nitroaniline	99-09-2	--	12	0	0%	0.334	0.00772	--	--	0.668
SVOCs	3,3'-Dichlorobenzidine	91-94-1	--	12	0	0%	0.432	0.0103	--	--	0.863
SVOCs	4-Bromophenyl-phenylether	101-55-3	--	12	0	0%	0.316	0.00515	--	--	0.632
SVOCs	4-Chloro-3-methylphenol	59-50-7	--	12	0	0%	0.281	0.00515	--	--	0.562
SVOCs	4-Chloroaniline	106-47-8	--	12	0	0%	0.281	0.00515	--	--	0.562
SVOCs	4-Chlorophenyl-phenyl ether	7005-72-3	--	12	0	0%	0.336	0.00515	--	--	0.672
SVOCs	4-Methylphenol	106-44-5	--	5	0	0%	0.315	0	--	--	0.63
SVOCs	4-Nitroaniline	100-01-6	--	12	0	0%	0.319	0.00772	--	--	0.638
SVOCs	4-Nitrophenol	100-02-7	--	12	0	0%	0.409	0.00772	--	--	0.818
SVOCs	4,6-Dinitro-2-methylphenol	534-52-1	--	12	0	0%	0.329	0.00772	--	--	0.658
SVOCs	Acenaphthene	83-32-9	--	26	0	0%	0.14	0.138	--	--	0.279
SVOCs	Acenaphthylene	208-96-8	--	26	0	0%	0.151	0.15	--	--	0.303
SVOCs	Acetophenone	98-86-2	--	12	0	0%	0.321	0.00515	--	--	0.642
SVOCs	Anthracene	120-12-7	--	26	0	0%	0.162	0.161	--	--	0.324
SVOCs	Atrazine	1912-24-9	--	12	0	0%	0.369	0.00772	--	--	0.738
SVOCs	Benzaldehyde	100-52-7	--	12	0	0%	0.324	0.00772	--	--	0.648
SVOCs	Benzo(a)anthracene	56-55-3	--	26	0	0%	0.155	0.149	--	--	0.309
SVOCs	Benzo(a)pyrene	50-32-8	--	26	0	0%	0.197	0.195	--	--	0.395
SVOCs	Benzo(b)fluoranthene	205-99-2	--	26	0	0%	0.213	0.21	--	--	0.425
SVOCs	Benzo(g,h,i)perylene	191-24-2	--	26	0	0%	0.205	0.197	--	--	0.409
SVOCs	Benzo(k)fluoranthene	207-08-9	--	26	0	0%	0.203	0.199	--	--	0.406
SVOCs	bis(2-Chloroethoxy)methane	111-91-1	--	12	0	0%	0.256	0.00515	--	--	0.512

Table B-4. Pore Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
SVOCs	Bis(2-Chloroethyl) ether	111-44-4	--	12	0	0%	0.274	0.00772	--	--	0.548
SVOCs	bis(2-Ethylhexyl)phthalate	117-81-7	--	12	0	0%	0.339	0.00772	--	--	0.678
SVOCs	Butylbenzylphthalate	85-68-7	--	12	0	0%	0.349	0.00772	--	--	0.698
SVOCs	Caprolactam	105-60-2	--	12	0	0%	0.779	0.0257	--	--	1.56
SVOCs	Carbazole	86-74-8	--	12	0	0%	0.256	0.00515	--	--	0.512
SVOCs	Chrysene	218-01-9	--	26	0	0%	0.153	0.148	--	--	0.306
SVOCs	Di-n-butylphthalate	84-74-2	--	12	0	0%	0.314	0.00772	--	--	0.628
SVOCs	Di-n-octylphthalate	117-84-0	--	12	0	0%	0.432	0.0103	--	--	0.863
SVOCs	Dibenzo(a,h)anthracene	53-70-3	--	26	0	0%	0.196	0.185	--	--	0.393
SVOCs	Dibenzofuran	132-64-9	--	12	0	0%	0.276	0.00515	--	--	0.552
SVOCs	Diethylphthalate	84-66-2	--	12	0	0%	0.331	0.00515	--	--	0.662
SVOCs	Dimethylphthalate	131-11-3	--	12	0	0%	0.379	0.00772	--	--	0.758
SVOCs	Fluoranthene	206-44-0	--	26	0	0%	0.133	0.13	--	--	0.267
SVOCs	Fluorene	86-73-7	--	26	0	0%	0.125	0.123	--	--	0.25
SVOCs	Hexachlorobenzene	118-74-1	--	12	0	0%	0.266	0.00515	--	--	0.532
SVOCs	Hexachlorobutadiene	87-68-3	--	12	0	0%	0.261	0.00515	--	--	0.522
SVOCs	Hexachlorocyclo-pentadiene	77-47-4	--	12	0	0%	1.48	0.0257	--	--	2.96
SVOCs	Hexachloroethane	67-72-1	--	12	0	0%	0.329	0.00772	--	--	0.658
SVOCs	Indeno(1,2,3-cd)pyrene	193-39-5	--	26	0	0%	0.2	0.192	--	--	0.4
SVOCs	Isophorone	78-59-1	--	12	0	0%	0.281	0.00515	--	--	0.562
SVOCs	N-Nitroso-di-n propylamine	621-64-7	--	12	0	0%	0.344	0.00772	--	--	0.688
SVOCs	N-Nitrosodiphenylamine	86-30-6	--	12	0	0%	0.291	0.00515	--	--	0.582
SVOCs	Naphthalene	91-20-3	--	26	0	0%	0.143	0.13	--	--	0.286
SVOCs	Nitrobenzene	98-95-3	--	12	0	0%	0.256	0.00515	--	--	0.512
SVOCs	Pentachlorophenol	87-86-5	--	26	1	4%	0.231	0.182	PW002-20190304-01	0.82	0.403
SVOCs	Phenanthrene	85-01-8	--	26	0	0%	0.132	0.126	--	--	0.263
SVOCs	Phenol	108-95-2	--	12	1	8%	1.22	3.39	PW001-20190305-01	12	0.482
SVOCs	Pyrene	129-00-0	--	26	0	0%	0.215	0.212	--	--	0.431
VOCs	1,1-Dichloroethane	75-34-3	--	12	0	0%	0.035	0	--	--	0.07
VOCs	1,1-Dichloroethene	75-35-4	--	12	0	0%	0.0425	0	--	--	0.085
VOCs	1,1,1-Trichloroethane	71-55-6	--	12	0	0%	0.0305	0	--	--	0.061
VOCs	1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	--	12	0	0%	0.0325	0	--	--	0.065
VOCs	1,1,2-Trichloroethane	79-00-5	--	12	0	0%	0.047	0	--	--	0.094
VOCs	1,1,2,2-Tetrachloroethane	79-34-5	--	12	0	0%	0.085	0	--	--	0.17
VOCs	1,2-Dibromo-3-chloropropane	96-12-8	--	12	0	0%	0.135	0	--	--	0.27
VOCs	1,2-Dibromoethane	106-93-4	--	12	0	0%	0.0285	0	--	--	0.057
VOCs	1,2-Dichlorobenzene	95-50-1	--	12	0	0%	0.036	0	--	--	0.072
VOCs	1,2-Dichloroethane	107-06-2	--	12	0	0%	0.0415	0	--	--	0.083
VOCs	1,2-Dichloropropane	78-87-5	--	12	0	0%	0.0465	0	--	--	0.093

Table B-4. Pore Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
VOCs	1,2,3-Trichlorobenzene	87-61-6	--	12	0	0%	0.0355	0	--	--	0.071
VOCs	1,2,4-Trichlorobenzene	120-82-1	--	12	0	0%	0.026	0	--	--	0.052
VOCs	1,3-Dichlorobenzene	541-73-1	--	12	1	8%	0.0433	0.0462	PW001-20190305-01	0.19	0.06
VOCs	1,4-Dichlorobenzene	106-46-7	--	12	0	0%	0.025	0	--	--	0.05
VOCs	2-Butanone	78-93-3	--	12	0	0%	0.8	0	--	--	1.6
VOCs	2-Hexanone	591-78-6	--	12	0	0%	0.2	0	--	--	0.4
VOCs	4-Methyl-2-pentanone	108-10-1	--	12	0	0%	0.25	0	--	--	0.5
VOCs	Acetone	67-64-1	--	12	3	25%	4.29	10.1	PW014-20190307-01	36	1.4
VOCs	Benzene	71-43-2	--	12	0	0%	0.0255	0	--	--	0.051
VOCs	Bromochloromethane	74-97-5	--	12	0	0%	0.05	0	--	--	0.1
VOCs	Bromodichloromethane	75-27-4	--	12	0	0%	0.0335	0	--	--	0.067
VOCs	Bromoform	75-25-2	--	12	0	0%	0.044	0	--	--	0.088
VOCs	Bromomethane	74-83-9	--	12	0	0%	0.05	0	--	--	0.1
VOCs	Carbon disulfide	75-15-0	--	12	1	8%	0.0502	0.0424	PW001-20190305-01	0.185	0.076
VOCs	Carbon tetrachloride	56-23-5	--	12	0	0%	0.0175	0	--	--	0.035
VOCs	Chlorobenzene	108-90-7	--	12	0	0%	0.015	0	--	--	0.03
VOCs	Chloroethane	75-00-3	--	12	0	0%	0.05	0	--	--	0.1
VOCs	Chloroform	67-66-3	--	12	0	0%	0.018	0	--	--	0.036
VOCs	Chloromethane	74-87-3	--	12	0	0%	0.046	0	--	--	0.092
VOCs	cis-1,2-Dichloroethene	156-59-2	--	12	0	0%	0.0375	0	--	--	0.075
VOCs	cis-1,3-Dichloropropene	10061-01-5	--	12	0	0%	0.03	0	--	--	0.06
VOCs	Cyclohexane	110-82-7	--	12	0	0%	0.05	0	--	--	0.1
VOCs	Dibromochloromethane	124-48-1	--	12	0	0%	0.0265	0	--	--	0.053
VOCs	Dichlorodifluoromethane	75-71-8	--	12	0	0%	0.035	0	--	--	0.07
VOCs	Ethylbenzene	100-41-4	--	12	0	0%	0.0205	0	--	--	0.041
VOCs	Isopropylbenzene	98-82-8	--	12	0	0%	0.0265	0	--	--	0.053
VOCs	m, p-Xylene	179601-23-1	--	7	0	0%	0.0215	0	--	--	0.043
VOCs	m,p-Xylene	179601-23-1	--	5	0	0%	0.0215	0	--	--	0.043
VOCs	Methyl acetate	79-20-9	--	12	0	0%	0.1	0	--	--	0.2
VOCs	Methyl tert-butyl ether	1634-04-4	--	12	0	0%	0.024	0	--	--	0.048
VOCs	Methylcyclohexane	108-87-2	--	12	0	0%	0.0255	0	--	--	0.051
VOCs	Methylene chloride	75-09-2	--	12	0	0%	0.0345	0	--	--	0.069
VOCs	o-Xylene	95-47-6	--	12	0	0%	0.0225	0	--	--	0.045
VOCs	Styrene	100-42-5	--	12	0	0%	0.0175	0	--	--	0.035
VOCs	Tetrachloroethene	127-18-4	--	12	0	0%	0.017	0	--	--	0.034
VOCs	Toluene	108-88-3	--	12	2	17%	0.0619	0.148	PW004-20190305-01	0.53	0.034
VOCs	trans-1,2-Dichloroethene	156-60-5	--	12	0	0%	0.028	0	--	--	0.056
VOCs	trans-1,3-Dichloropropene	10061-02-6	--	12	0	0%	0.022	0	--	--	0.044

Table B-4. Pore Water Summary – Analytes

Chemical Group	Analyte	CAS Number	Total (T) or Dissolved (D)	Total Sample Number	Detect	Detection Frequency	Average Concentration (µg/L)	Standard Deviation (µg/L)	Sample_No of Max	Maximum Detected Concentration (µg/L)	Average MDL (µg/L)
VOCs	Trichloroethene	79-01-6	--	12	0	0%	0.0215	0	--	--	0.043
VOCs	Trichlorofluoromethane	75-69-4	--	12	0	0%	0.0255	0	--	--	0.051
VOCs	Vinyl chloride	75-01-4	--	12	0	0%	0.0485	0	--	--	0.097

APPENDIX C
TOXICITY BENCHMARKS FOR ECOLOGICAL RECEPTORS

Overview

The purpose of the SLERA is to identify COPECs based on comparison of Site-related concentrations to appropriate benchmarks of toxicity. The benchmarks identified for this SLERA are concentration-based (e.g., the concentration in soil, sediment, or surface water). Each benchmark is contaminant-specific, receptor-specific (e.g., freshwater water column, benthic invertebrate, soil invertebrate, plant community, birds, and mammals) and medium specific.

For this SLERA, all toxicity benchmarks are based on values developed by various regulatory agencies and published in the literature; values were chosen to be consistent with other recent and/or ongoing regional ecological risk assessments. This appendix describes the various sources of benchmark values reviewed for this SLERA, and identifies the hierarchy used to prioritize values when more than one value was available.

This appendix is organized into the following sections:

Aquatic Receptors

C-1 Benchmarks for Direct Contact with Surface Water

C-2 Benchmarks for Direct Contact with Sediment

Terrestrial Receptors

C-3 Benchmarks for Direct Contact with Soil

References cited in this appendix are listed in corresponding reference sections for C-1, C-2, and C-3.

Aquatic Receptors (Fish and Benthic Macroinvertebrates)

C-1 Benchmarks for Direct Contact with Surface Water

Toxicity values for the protection of aquatic life from contaminants in surface water are available from several sources. Each of these sources is described briefly below.

Code of Colorado Regulations (CCR) 5 CCR 1002-31 - *Basic Standards and Methodologies for Surface Water (2023)*

The CDPHE along with the Colorado Water Quality Control Commission have published regulations regarding the standards for classifying surface waters throughout the state of Colorado. Section 31 of the Colorado Code of Regulations presents tables containing "basic standards" (Namely 31.11 Table B, 31.16 Table III, and 31.16 Table IV) protective of aquatic life based on acute and chronic exposure durations. The "basic standards" generated for the protections of aquatic life based on chronic exposure were used as benchmark ecotoxicity values in this SLERA.

National Recommended Water Quality Criteria – Aquatic Life (2023)

The EPA has established acute and chronic National Recommended Water Quality Criteria (NRWQC) values for surface waters for the protection of aquatic communities (EPA, 2023a). The chronic ambient water quality criteria value for the protection of aquatic life, (i.e., the Criterion Continuous Concentration [CCC]) is used as the screening value for surface water. The CCC is an estimate of the highest concentration of a chemical in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect on growth, reproduction, or survival (EPA, 2018). The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The NRWQC values are not species-specific but are designed to protect 95% of the aquatic species for which toxicity data are available (EPA, 1985).

Aquatic Life Benchmarks and Ecological Risk Assessments for Registered Pesticides (2023)

The EPA's Aquatic Life Benchmarks for Registered Pesticides are estimates of the concentrations below which pesticides are not expected to represent a risk of concern for aquatic life. The benchmarks are based on toxicity values from scientific studies that the EPA reviewed and used to estimate risk to freshwater organisms from exposure to pesticides and their degradants in their most recent publicly available ecological risk assessments and preliminary Problem Formulations written in support of pesticide registration or registration review. The toxicity data used to develop Aquatic Life Benchmarks are extracted from the most recent publicly available EPA Office of Pesticide Programs risk assessment for the individual pesticide and are typically based on the most sensitive value for each taxon.

EPA Region 4 Ecological Risk Assessment Supplemental Guidance- Surface Water Screening Values for Hazardous Waste Sites (2018)

EPA Region 4 has developed ecological screening values (ESVs) based on chemical concentrations associated with a low probability of unacceptable risks to ecological receptors. These ESVs are based on conservative endpoints and sensitive ecological effects data. They represent a preliminary screening of site chemical concentrations to determine the need to conduct further investigations at the site and are not recommended for use as remediation levels. (EPA, 2018) The hierarchy for Region 4 ESVs includes:

- National Recommended Surface Water Criteria
- Tier 2 values or equivalent

- Canadian Water Quality Values
- Minimum value from either the Target Lipid Model or Ecological Structure Activity Relationships model
- Office of Pesticide Programs Aquatic Life Benchmarks
- Minimum of chronic toxicity observed as recorded in ECOTOX database.

EPA Region 5 Ecological Screening Levels (2003)

EPA Region 5 has derived ecological screening levels (ESLs) for Resource Conservation and Recovery Act (RCRA) Appendix IX Hazardous Constituents in soil, surface water, sediment, and air. The surface water ESL is based on either an aquatic benchmark, which is protective of direct contact exposures, or a wildlife receptor-specific benchmark, which is protective of ingestion exposures in the mink and belted kingfisher.

Selection of Water Toxicity Benchmarks

Selection of the surface water toxicity benchmarks for aquatic receptors is based on the following hierarchy:

1. Colorado Code of Regulations, Regulation Number 31 (2023)
2. EPA National Ambient Water Quality Criteria (2023)
3. EPA Aquatic Life Benchmarks for Registered Pesticides (2023)
4. EPA Region 4 Ecological Screening Values (2018)
5. EPA Region 5 Ecological Screening Levels (2003)

The "basic standards" published in the CCR, Regulation Number 31 are given the highest priority over all other sources of benchmark values considering the location of the site. The EPA's NRWQCs are selected next because these surface water quality criteria are derived using a well-documented derivation approach which incorporates toxicity data from multiple studies, receptors, and endpoints that has undergone extensive review and approval by EPA. EPA's Aquatic Life Benchmarks for Registered Pesticides are placed next in the hierarchy because the benchmarks are based on toxicity values from the most recent publicly available ecological risk assessments and are reviewed by EPA. All three benchmark sources were updated in 2023.

The EPA Region 4 screening values are next in the hierarchy because they are often based on extremely limited data sets (i.e., only 1 or 2 studies), and these toxicity benchmarks tend to incorporate safety factor adjustments to account for limitations in the underlying data sets.

EPA Region 5 screening values are placed lowest on the hierarchy because of the same reasons noted for the EPA Region 4 values along with the age of the data relative to the other benchmarks.

The surface water benchmark values from these sources are shown in Table C-1, along with the values selected for use in the SLERA:

Table C-1 Summary of Surface Water Benchmark Screening Levels

Common Chemical Name - Detected Chemicals in Surface Water	Surface Water Benchmark (µg/L)	Total or Dissolved (Metals)[E]	Colorado WQCC 31 (CCR 2023) [B]	NRWQC (EPA 2023a)[A]	EPA Registered Pesticides Benchmarks (EPA 2023b)	EPA Region 4 Surface Water Screening Values (EPA 2018) [c]	EPA Region 5 RCRA ESLs (EPA 2003) [c]
Aluminum	87	T	87	--	--	87	87
Antimony	190	D	--	--	--	190	80
Arsenic	150	D	150	150	--	150	148
Barium	220	D	--	--	--	220	220
Beryllium	3.6	T	--	--	--	11	3.6
Cadmium*	0.77	D	0.77	Vacated by court order, (updated value is 0.27 using 109 mg/L hardness)	--	0.45	0.15
Chromium* [D]	11	D	11	11	--	11	42
Cobalt	19	D	--	--	--	19	24
Copper	9.64	D	9.64	--	--	4.95	1.58
Iron	1,000	T	1,000	1,000	--	1,000	--
Lead*	2.76	D	2.76	2.5	--	1	1.17
Manganese	1,698	D	1,698	--	--	93	--
Mercury	0.01	T	0.01	0.77	--	1	0.0013
Nickel*	55.49	D	55.49	52	--	29	28.9
Selenium	4.6	D	4.6	1.5 lentic, 3.1 lotic	--	5	5
Vanadium	27	D	--	--	--	27	12
Zinc*	131	D	131	120	--	66	65.7
2-Methylnaphthalene	4.7	--	--	--	--	4.7	330
4-Methylphenol	53	--	--	--	--	53	--
Acenaphthene	520	--	520	--	--	15	38
Acenaphthylene	13	--	--	--	--	13	4,840
Anthracene	0.02	--	--	--	--	0.02	0.035
Atrazine	5	--	--	--	5	0.03	--
Benzo(a)Anthracene	4.7	--	--	--	--	4.7	0.025
Benzo(a)Pyrene	0.06	--	--	--	--	0.06	0.014
Benzo(b)Fluoranthene	2.6	--	--	--	--	2.6	9.07
Benzo(g,h,i)Perylene	0.012	--	--	--	--	0.012	7.64
Benzo(k)Fluoranthene	0.06	--	--	--	--	0.06	--
Chrysene	4.7	--	--	--	--	4.7	--

Common Chemical Name - Detected Chemicals in Surface Water	Surface Water Benchmark (µg/L)	Total or Dissolved (Metals)[E]	Colorado WQCC 31 (CCR 2023) [B]	NRWQC (EPA 2023a)[A]	EPA Registered Pesticides Benchmarks (EPA 2023b)	EPA Region 4 Surface Water Screening Values (EPA 2018) [c]	EPA Region 5 RCRA ESLs (EPA 2003) [c]
Dibenzo(a,h)Anthracene	0.012	--	--	--	--	0.012	--
Dimethylphthalate	1,100	--	--	--	--	1,100	--
Fluoranthene	0.8	--	3,980 (acute)	--	--	0.8	1.90
Indeno(1,2,3-cd)Pyrene	0.012	--	--	--	--	0.012	4.31
Naphthalene	620	--	620	--	--	21	13
Pentachlorophenol	15	--	15	15	11	15	4
Phenanthrene	2.3	--	--	--	--	2.3	3.6
Phenol	2,560	--	2,560	--	--	160	180
Pyrene	4.6	--	--	--	--	4.6	0.3
1,2-Dichloroethane	20,000	--	20,000	--	--	2,000	910
1,3-Dichlorobenzene	22	--	--	--	--	22	38
Acetone	1,700	--	--	--	--	1,700	1,700
Carbon Disulfide	15	--	--	--	--	15	15
Chloroform	1,240	--	1,240	--	--	140	140
Methyl Tert-Butyl Ether	730	--	--	--	--	730	--
Tetrachloroethene	840	--	840	--	--	53	45
Toluene	62	--	17,500 (acute)	--	--	62	253

NOTES:

*: Benchmark values are hardness dependent

A: 100 mg/L hardness used to determine benchmark value

B: 109 mg/L hardness used to determine benchmark value

C: 50 mg/L hardness used to determine benchmark value

D: Assuming 100% of detected chromium is chromium VI

E: Total (T) or dissolved (D) is based on if the standard is a Colorado WQCC 31 (CCR 2023) and the fraction is specified as total. If not specified, dissolved is assumed.

Benchmarks for all hardness-dependent metals were established by using the source hierarchy list to obtain the relevant equation(s) from the highest rated source for each analyte. The minimum hardness result obtained from the 2019 surface water dataset (109 mg/L) was then applied to the appropriate equation published in the selected source. The equation output yields a site-specific benchmark value.

Footnote 9 of Table III in 5 CCR 1002-31 states that selenium is subject to a range of toxicity values depending on site-specific variables due to its bioaccumulative nature. Consequently, the benchmark value of 4.6 µg/L likely introduces uncertainty to this SLERA. Alternative methods to determine a site-specific selenium benchmark may be necessary.

All benchmarks listed in the table above are established for a chronic exposure scenario except where noted. The benchmarks selected for fluoranthene and toluene are from EPA Region 4 because the Colorado values are based on acute exposure.

C-1 References

Code of Colorado Regulations (CCR 2023). 5 CCR 1002-31 - *Basic Standards and Methodologies for Surface Water.* Found online at: https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=10835&fileName=5%20CCR%201002-31

US Environmental Protection Agency (EPA). 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. NTIS Document Number PB85-227049.US Environmental Protection Agency, Office of Research and Development.

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C-2 Benchmarks for Direct Contact with Sediment

Toxicity values for the protection of benthic macroinvertebrates from contaminants in freshwater sediment are available from several sources. Each of these sources is described briefly below.

Consensus-Based Sediment Quality Guidelines (2000)

MacDonald et al. (2000) issued consensus-based sediment quality guidelines (SQGs) for 28 chemicals of concern, in an effort to focus on agreement among the various sediment quality guidelines. For each chemical of concern, a threshold effect concentration (TEC) and a probable effect concentration (PEC) were identified based on available sediment toxicity literature. The consensus-based TECs were calculated by determining the geometric mean of all threshold effect values from the literature. The consensus-based PECs were calculated by determining the geometric mean of all probable effect values from the literature. A summary of the types of sediment effect concentrations included in the TEC and PEC calculations is provided in MacDonald et al. (2000).

EPA Region 4 Screening Levels (2018)

Numerous efforts to develop suitable sediment quality benchmarks for classifying sediment as toxic or non-toxic have been published in the scientific literature. In order to best protect aquatic resources, many of the EPA Region 4 sediment ESVs are derived from statistical interpretation of effects databases from the literature, as reported in publications from states such as Florida and Washington, and from other agencies. These benchmarks are generally based on observations of direct toxicity to benthic organisms. The hierarchy for ESV values includes:

- Threshold effect levels (TELs) or TECs such as those provided in MacDonald et al (2003),
- Modeled equilibrium partitioning values for organic chemicals from surface water benchmarks,
- Other effect ranges such as effects range-low values and Washington State sediment quality objectives.

U.S. EPA Region 3 Biological Technical Assistance Group (BTAG) Screening Benchmarks (2006)

The Region 3 BTAG screening benchmarks were derived based on the following hierarchy:

- Preference was given to benchmarks based on chronic, direct exposure, non-lethal endpoint studies designed to be protective of sensitive species.
- Values derived by statistical or consensus-based evaluation of multiple studies were given first priority.
- Equilibrium partitioning values were selected for contaminants with $2.0 < \log K_{ow} < 6.0$ if empirical values based on multiple studies were not available.
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected.

In addition to the compilations from EPA Regions 3 and 4 and the McDonald et al (2000) consensus values, Thompson et al. (2005) provides screening values for selenium and vanadium. A summary of all selected sediment toxicity benchmarks is shown in Table C-2.

Table C-2 Summary of Sediment Benchmark Screening Levels

Common Chemical Name - Detected Chemicals in Sediment	Sediment Benchmark (mg/kg)	Consensus Based (McDonald, 2000)	EPA Region 4 ESVs (2018)	EPA Region 3 BTAG (2006)	Thompson et al., 2005
Aluminum	25,000	--	25,000	--	--
Antimony	2	--	2	2	--
Arsenic	9.79	9.79	9.8	9.8	--
Barium	20	--	20	--	--
Beryllium	--	--	--	--	--
Cadmium	0.99	0.99	1	0.99	--
Chromium	43.4	43.4	43.4	43.4	--
Cobalt	50	--	50	50	--
Copper	31.6	31.6	31.6	31.6	--
Iron	20,000	--	20,000	20,000	--
Lead	35.8	35.8	35.8	35.8	--
Manganese	460	--	460	460	--
Mercury	0.18	0.18	0.18	0.18	--
Nickel	20	22.7	22.7	22.7	--
Selenium	0.72	--	0.72	2	0.9
Silver	1	--	1	1	--
Thallium	--	--	--	--	--
Vanadium	27.3	--	--	--	27.3
Zinc	121	121	121	121	--
High Molecular Weight PAHs	0.19	--	--	0.19	--
Low Molecular Weight PAHs	0.076	--	--	0.076	--
Total PAHs	1.61	1.61	--		--
2-Methylnaphthalene	--	--	--	--	--
2-Methylphenol	--	--	--	--	--
3-Methylphenol + 4-Methylphenol	--	--	--	--	--
Acenaphthene	0.0067	--	--	0.0067	--
Acenaphthylene	0.0059	--	--	0.0059	--
Acetophenone	--	--	--	--	--
Anthracene	0.0572	--	--	0.0572	--
Benzaldehyde	--	--	--	--	--
Benzo(a)anthracene	0.108	0.108	--	0.108	--
Benzo(a)pyrene	0.15	0.15	--	0.15	--
Benzo(b)fluoranthene	--	--	--	--	--
Benzo(g,h,i)perylene	0.17	--	--	0.17	--
Benzo(k)fluoranthene	0.24	--	--	0.24	--
bis(2-Ethylhexyl)phthalate	0.18	--	--	0.18	--
Butylbenzylphthalate	10.9	--	--	10.9	--
Carbazole	--	--	--	--	--
Chrysene	0.166	0.166	--	0.166	--

Common Chemical Name - Detected Chemicals in Sediment	Sediment Benchmark (mg/kg)	Consensus Based (McDonald, 2000)	EPA Region 4 ESVs (2018)	EPA Region 3 BTAG (2006)	Thompson et al., 2005
Dibenzofuran	0.415	--	--	0.415	--
Fluoranthene	0.423	0.423	--	0.423	--
Fluorene	0.0774	0.0774	--	0.0774	--
Indeno(1,2,3-cd)pyrene	0.017	--	--	0.017	--
N-Nitroso-di-n propylamine	--	--	--	--	--
Naphthalene	0.176	0.176	--	0.176	--
Pentachlorophenol	0.504	--	--	0.504	--
Phenanthrene	0.204	0.204	--	0.204	--
Phenol	0.42	--	--	0.42	--
Pyrene	0.195	--	--	0.195	--
1,2-Dibromo-3-chloropropane	--	--	--	--	--
1,2-Dichlorobenzene	0.0165	--	--	0.0165	--
1,2,3-Trichlorobenzene	0.858	--	--	0.858	--
1,2,4-Trichlorobenzene	2.1	--	--	2.1	--
1,3-Dichlorobenzene	4.43	--	--	4.43	--
1,4-Dichlorobenzene	0.599	--	--	0.599	--
2-Butanone	--	--	--	--	--
2-Hexanone	--	--	--	--	--
Acetone	--	--	--	--	--
Bromoform	--	--	--	--	--
Carbon disulfide	0.000851	--	--	0.000851	--
Chloroform	--	--	--	--	--
Methyl acetate	--	--	--	--	--
Methylene chloride	--	--	--	--	--
Toluene	--	--	--	--	--

C-2 References:

MacDonald, DD, CG Ingersoll and TA Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39:20-31.

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Terrestrial Receptors

C-3 Benchmarks for Direct Contact with Soil

Toxicity values for the protection of terrestrial plants, soil invertebrates and wildlife from contaminants in surface soils are available from several sources. Each of these sources is described briefly below. Table C-3 summarizes the benchmarks used in this SLERA.

Ecological Soil Screening Levels (Eco-SSLs). Eco-SSLs (EPA, 2003-2008) are concentrations of contaminants in soils that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. The Eco-SSLs are screening values that can be used routinely to identify those COPCs in soils requiring further evaluation in a BERA. Eco-SSLs are derived separately for four groups of ecological receptors, plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. The lower of the values for all the receptor groups was used as the soil screening benchmark.

Los Alamos National Laboratory. The Los Alamos National Laboratory (LANL) ECORISK database was created in 1998 to document and archive information for the ESLs and associated exposure parameters, including toxicity reference values (TRVs). The latest version of the ECORISK database is version 4.3, dated September 2022. The ECORISK database provides detailed documentation justifying the type of information collected and used and illustrates how values are calculated (LANL, 2022). Most of the benchmarks listed in Table C-3 are based on the Montane shrew as an insectivorous mammal.

Oak Ridge National Laboratory Soil Invertebrates. Oak Ridge National Laboratory (ORNL) reviewed data on the toxicity of contaminants on soil invertebrates and determined the lowest observed effect concentration (LOEC) (Efroymson et al, 1997). The LOEC is defined as the lowest applied concentration of the chemical causing a greater than 20% reduction in the measured response. In some cases, the LOEC is the lowest concentration tested or the only concentration reported (EC50 or ED50 data). The benchmark values are then rounded to one significant figure. In this SLERA only the chromium plant benchmark value is taken from the ORNL document.

EPA Region 4 Ecological Screening Levels. The EPA Region 4 compiled soil toxicity screening benchmarks in support of these ecological risk assessment guidance (March 2018 Update). The EPA Region 4 soil screening levels typically address toxicity through direct exposure (e.g., toxicity to soil invertebrates such as earthworm and plants). For those chemicals that biomagnify, screening values may have been back calculated to derive screening values for avian or mammalian wildlife by considering trophic transfers from the abiotic medium to prey items. For those organic compounds that don't have conventional screening benchmarks, values for invertebrates are based on the equilibrium partitioning (EqP) theory similar to the sediment model. For screening purposes, the silty clay loam soil texture classification was used.

Texas Commission on Environmental Quality (TCEQ) Protective Concentration Levels. The TCEQ has developed a database to develop soil protective concentrations based on a variety of birds and mammals. The soil screening level based on the No Observed Adverse Effect Level (NOAEL) is listed in Table C-3 for several organic compounds.

The soil benchmark values from these sources are shown in Table C-3, along with the values selected for use in the risk assessment. The hierarchy for soil benchmark selection was as follows:

- Eco-SSLs

- ORNL benchmarks
- EPA Region 4 screening levels
- TCEQ Protective Concentration Level Database

Table C-3 Summary of Soil Benchmark Screening Levels

Common Chemical Name	Benchmark (mg/kg)	Plant Community (mg/kg)		Soil Invertebrate (mg/kg)		Birds (mg/kg)		Mammal (mg/kg)	
Metals/Inorganics									
Antimony	0.27	11	b	78	a	--	--	0.27	a
Arsenic	6.8	18	a	6.8	b	43	a	46	a
Barium	110	110	b	330	a	820	b	2000	a
Beryllium	2.5	2.5	b	40	a	-		21	a
Cadmium	0.36	32	a	140	a	0.77	a	0.36	a
Chromium	0.4	-		0.4	c	26	a	34	a
Chromium VI	0.34	0.35	b	0.34	b	140	b	130	a
Cobalt	13	13	a	--	--	120	a	230	a
Copper	28	70	a	80	a	28	a	49	a
Lead	11	120	a	1700	a	11	a	56	a
Manganese	220	220	a	450	a	4300	a	4000	a
Mercury	0.013	34	b	0.05	b	0.013	b	1.7	b
Nickel	38	38	a	280	a	210	a	130	a
Selenium	0.52	0.52	a	4.1	a	1.2	a	0.63	a
Silver	4.2	560	b	--	--	4.2	a	14	a
Thallium	0.05	0.05	b	--	--	4.5	b	0.42	b
Vanadium	7.8	60	b	--	--	7.8	a	280	a
Zinc	46	160	a	120	a	46	a	79	a
PAHs									
Low Molecular Weight PAHs	29	--	--	29	a	--	--	100	a
High Molecular Weight PAHs	1.1	--	--	18	a	--	--	1.1	a
BTEX									
Benzene	0.12	--	--	0.12	d	--	--	24	b
Toluene	0.15	200	b	0.15	d	--	--	23	b
Ethylbenzene	0.27	--	--	0.27	d	--	--	5.16	d
o-Xylene	0.1	100	b	0.1	d	41	b	1.4	b

Common Chemical Name	Benchmark (mg/kg)	Plant Community (mg/kg)		Soil Invertebrate (mg/kg)		Birds (mg/kg)		Mammal (mg/kg)	
Phthalates									
bis(2-Ethylhexyl)phthalate	0.02	--	--	8.4	d	0.02	b	0.6	b
Butylbenzylphthalate	0.59	--	--	0.59	d	--	--	90	b
Di-n-butylphthalate	0.011	160	b	0.22	d	0.011	b	180	b
Di-n-octylphthalate	0.91	--	--	303	d	--	--	0.91	b
Other Organics									
1,1,1-Trichloroethane	0.04	--	--	0.04	d	--	--	260	b
1,1,2,2-Tetrachloroethane	0.127	--	--	0.19	d	--	--	0.127	d
1,1,2-Trichloro-1,2,2-Trifluoroethane	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	0.32	--	--	0.32	d	--	--	28.6	d
1,1'-Biphenyl	0.2	60	d	0.2	d	--	--	1825	e
1,1-Dichloroethane	0.14	--	--	0.14	d	--	--	210	b
1,1-Dichloroethene	0.04	--	--	0.04	d	--	--	11	b
1,2,3-Trichlorobenzene	20	--	--	20	d	--	--	--	--
1,2,4-Trichlorobenzene	0.27	--	--	1.2	d	--	--	0.27	b
1,2-Dibromo-3-chloropropane	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	0.09	--	--	0.09	d	--	--	0.92	b
1,2-Dichloroethane	0.4	--	--	0.4	d	0.85	b	27	b
1,2-Dichloropropane	0.28	--	--	0.28	d	--	--	32.7	d
1,4-Dichlorobenzene	0.89	--	--	1.2	b	--	--	0.89	b
2-Butanone	1	--	--	1	d	--	--	350	b
2-Hexanone	0.36	--	--	2.5	d	0.36	b	5.4	b
3-Methylphenol + 4-Methylphenol	0.69	0.69	b	--	--	1.4	e	580	b
4-Methyl-2-pentanone	9.7	--	--	--	--	--	--	9.7	b
Acetone	0.04	--	--	0.04	d	7.5	b	1.2	b
Benzaldehyde	--	--	--	--	--	--	--	--	--
Bis(2-Chloroethyl) ether	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	--	--	--	--	--	--	--
Bromoform	0.07	--	--	0.07	d	--	--	15.9	d

Common Chemical Name	Benchmark (mg/kg)	Plant Community (mg/kg)		Soil Invertebrate (mg/kg)		Birds (mg/kg)		Mammal (mg/kg)	
Bromomethane	0.002	--	--	0.002	d	--	--	0.24	d
Caprolactam	--	--	--	--	--	--	--	--	--
Carbon disulfide	0.005	--	--	0.005	d	--	--	0.81	b
Carbon tetrachloride	0.05	--	--	0.05	d	--	--	2.98	d
Chlorobenzene	2.4	--	--	2.4	b	--	--	43	b
Chloroethane	--	--	--	--	--	--	--	--	--
Chloroform	0.05	--	--	0.05	d	--	--	8	b
Chloromethane	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	0.04	--	--	0.04	d	--	--	24	b
Cyclohexane	--	--	--	--	--	--	--	--	--
Dibenzofuran	0.15	6.1	b	0.15	d	2.24	e	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	--	--	--	--	--	--	--	--	--
Isopropylbenzene	--	--	--	--	--	--	--	--	--
Methyl acetate	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	--	--	--	--	--	--	--	--	--
Methylene chloride	2.6	1600	b	--	--	--	--	2.6	b
N-Nitrosodiphenylamine	0.545	--	--	20	d	--	--	0.545	d
Pentachlorophenol	2.1	5	a	31	a	2.1	a	2.8	a
Styrene	1.2	3.2	b	1.2	b	--	--	53	e
Tetrachloroethene	0.06	10	b	0.06	d	--	--	0.35	b
trans-1,2-Dichloroethene	0.04	--	--	0.04	d	--	--	24	b
Trichloroethene	0.06	--	--	0.06	d	--	--	42	b
Trichlorofluoromethane	52	--	--	--	--	--	--	52	b
Vinyl chloride	0.03	--	--	0.03	d	--	--	0.12	b

SOURCES:

a – EPA Eco SSLs

b - LANL

c - ORNL

d - EPA Region 4

e – TCEQ PCL Database

C-3 References:

Efroymson, R.A., M.E. Will and G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Prepared for the U.S. Department of Energy, Office of Environmental Management by Lockheed Martin Energy Systems, Inc. managing the Oak Ridge National Laboratory (ORNL). ORNL publication. ES/ER/TM-126/R2, November 1997.

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