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September 24, 2014

Victor Ketellapper, Site Assessment Team Leader
U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Preliminary Assessment Report regarding the Darrow/Freezeout/Triangle Uranium Mine Site near Edgemont, South Dakota
EPA ID: SDN000803095
EPA Region 8 START 8(a) Carve-Out Contract EP-S8-11-05, Task Order 0014
Task Monitor: Victor Ketellapper, Site Assessment Team Leader

Dear Mr. Ketellapper:

Seagull Environmental Technologies, Inc. (Seagull) is pleased to submit the attached Preliminary Assessment report regarding the Darrow/Freezeout/Triangle Uranium Mine site near Edgemont, South Dakota. Please contact the Project Manager via email at rlunt@seagullenvirotech.com or by phone at (720) 459-7874 if you have any questions.

Sincerely,

Ryan M. Lunt

Ryan M. Lunt
Task Order Project Manager

Hieu Q. Vu, PE
EPA Region 8 START 8(a) Program Manager

Enclosures

PRELIMINARY ASSESSMENT REPORT

Regarding the

DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE

NEAR EDGEMONT, SOUTH DAKOTA

EPA ID: SDN000803095

Contract No.: EP-S8-11-05
Task Order No.: 0014

Prepared By:

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CONTENTS

1.0 INTRODUCTION 1
2.0 OBJECTIVES 1
3.0 SITE LOCATION AND DESCRIPTION 1
3.1 SITE HISTORY 2
3.2 CURRENT SITE CONDITIONS 3
4.0 SITE CHARACTERISTICS 3
4.1 GEOLOGY AND HYDROGEOLOGY 3
4.2 HYDROLOGY 5
4.3 METEOROLOGY 5
5.0 PREVIOUS ANALYTICAL DATA 5
5.1 GROUNDWATER 5
5.1.1 GROUNDWATER SAMPLING 6
5.1.2 GROUNDWATER ANALYTICAL RESULTS SUMMARY 6
5.2 SURFACE WATER AND SEDIMENT 12
5.2.1 SURFACE WATER SAMPLING 13
5.2.2 SURFACE WATER ANALYTICAL RESULTS SUMMARY 13
5.2.3 SEDIMENT SAMPLING 16
5.2.4 SEDIMENT ANALYTICAL RESULT SUMMARY 17
5.3 SOIL 20
5.3.1 SOIL SAMPLING 20
5.3.2 SOIL ANALYTICAL RESULTS SUMMARY 20
5.4 AIR 22
5.4.1 AIR SAMPLING 22
5.4.2 AIR SAMPLING RESULTS SUMMARY 23
6.0 SOURCES OF CONTAMINATION AND WASTE CHARACTERISTICS 23
7.0 PATHWAY ANALYSIS 24
7.1 GROUNDWATER PATHWAY AND TARGETS 24
7.2 SURFACE WATER PATHWAY AND TARGETS 25
7.3 SOIL EXPOSURE AND AIR PATHWAYS AND TARGETS 28
8.0 DATA GAPS 29
9.0 SUMMARY 29
9.1 EMERGENCY RESPONSE AND REMOVAL ACITON CONSIDERATIONS 31
10.0 REFERENCES 32

TABLES

Table **Page**

1 GROUNDWATER DATA SUMMARY – DEWEY-BURDOCK IN-SITU RECOVERY PROJECT (2007-2009) 9

2 MONITORING WELL DATA SUMMARY – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2012-2013) 12

3 RADIOLOGICAL DATA FROM SURFACE WATER SAMPLES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2007-2008) 15

4 RADIOLOGICAL DATA FROM SURFACE WATER IMPOUNDMENT SAMPLES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2007-2008) 16

5 RADIOLOGICAL DATA FROM STREAM SEDIMENT SAMPLES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2008) 18

6 RADIOLOGICAL DATA FROM IMPOUNDMENT SEDIMENT SAMPLES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2008) 19

7 RADIOLOGICAL DATA FROM SURFACE SOIL SAMPLES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2012) 21

8 EXTERNAL GAMMA EXPOSURE RATES IN SURFACE SOIL IN MINE AREA – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE (2007-2008) 22

9 DRINKING WATER TARGET POPULATION – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE 25

10 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES – DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE 27

FIGURES

Figure

1 SITE LOCATION MAP
2 SITE LAYOUT MAP
3 4-MILE RADIUS WELL LOCATIONS
4 GROUNDWATER SAMPLE LOCATION MAP
5 ALLUVIAL MONITORING WELL LOCATIONS
6 SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS (POWERTECH 2008)
7 APPROXIMATE SURFACE SOIL SAMPLE LOCATIONS
8 APPROXIMATE SOURCE AREA BOUNDARIES
9 15-MILE TARGET DISTANCE LIMIT AND SURFACE WATER SAMPLE LOCATIONS

APPENDICES

Appendix

A SITE RECONNAISSANCE REPORT
B DIAGRAM OF HYDROGEOLOGY OF BLACK HILLS AREA
C CERCLA ELIGIBILITY CHECKLIST
D POTENTIAL HAZARDOUS WASTE PRELIMINARY ASSESSMENT FORM
E CONCEPTUAL SITE MODEL

1.0 INTRODUCTION

Under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team (START) Carve-Out 8(a) Contract (No. EP-S8-11-05), Task Order No. 0014, Seagull Environmental Technologies, Inc. (Seagull) has been tasked to conduct a Preliminary Assessment (PA) of the Darrow/Freezeout/Triangle Uranium Mine site (the Site) near Edgemont, Custer and Fall River Counties, South Dakota. This PA is to determine whether the site poses a threat to human health and the environment and if further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted.

This PA was conducted in accordance with *Guidance for Performing Preliminary Assessments Under CERCLA* (EPA 1994). The Site is listed in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database as EPA ID SDN000803095. The CERCLIS non-National Priorities List (NPL) status of the site as of February 7, 2014, was "Ongoing Preliminary Assessment" (EPA 2014a).

2.0 OBJECTIVES

Objectives of this PA were to:

- Evaluate existing information and analytical data.
- Assess presence, quantity, or absence of uranium-mine-related contaminants at the Site.
- Document any releases to the environment from the Site.
- Acquire information regarding exposure pathways, surrounding population density, and other target data, including environmentally sensitive receptors (wetlands, fisheries, and threatened or endangered species).
- Assess whether the Site warrants further investigation under CERCLA.
- Identify data gaps or limitations of existing data reviewed in this PA.

3.0 SITE LOCATION AND DESCRIPTION

The Site is near Edgemont, in Custer and Fall River Counties, South Dakota. Geographic coordinates at the approximate center of the site are 43.478486 degrees north latitude and 103.962746 degrees west longitude. Currently used primarily for cattle grazing, the Site encompasses approximately 1,426 acres at the southwest edge of the Black Hills uplift approximately 13 miles northwest of Edgemont, South Dakota (see Figures 1 and 2).

The Site lies within the proposed Dewey-Burdock in-situ uranium recovery (ISR) project area. ISR is a means of extracting uranium from underground ore bodies through a series of injection and production

wells, and pumping it to the surface for production of nuclear fuel (Powertech Uranium Corporation [Powertech] 2014). In 2009, Powertech submitted the Dewey-Burdock Project Application Technical Report in order to obtain a U.S. Nuclear Regulatory Commission (NRC) Uranium Recovery License for working within the Proposed Action Area (PAA) (Powertech 2009). The PAA boundary encompasses approximately 10,580 acres of mostly private land, including a series of sequentially developed well fields, a satellite ion exchange facility, a central processing plant, and associated facilities to recover and process the final uranium product. The NRC prepared a draft Supplemental Environmental Impact Statement (SEIS) to evaluate potential environmental impacts from proposed construction, operation, aquifer restoration, and decommission of an ISR uranium facility at the proposed site (NRC 2012). The Final Environmental Impact Statement (EIS) was completed in January 2014 (NRC 2014a). The technical report completed by Powertech included results of baseline sampling within the PAA. Sampling data from the area of the Site obtained during that effort were used for this PA to evaluate conditions at the Site. Mining waste remains in abundance at the Site, and is suspected to be a source of radionuclide contamination to nearby streams and groundwater (see Figure 2).

The site is within the Great Plains physiographic province, where vegetation is a mix of short grasses and shrubs typical of semi-arid steppe land, along with Ponderosa Pine forest toward the Black Hills. Most of the surrounding land is used for rangeland (Powertech 2009).

3.1 SITE HISTORY

The Site is an abandoned uranium mine. Uranium was discovered in the Edgemont area in 1952 (Powertech 2009). Early mining of the material was limited to surface deposits; however, later drilling revealed deeper deposits. In the mid-1970s, the Tennessee Valley Authority (TVA) purchased a major interest in the Edgemont area and hired Silver King Mines, Inc., to explore the property. However, in the mid-1980s, the operation was halted due to an economically unsustainable decline in uranium prices. In 1994, Energy Fuels Nuclear (EFN) acquired the property but relinquished it due to low uranium prices. Surface land rights and mineral rights in the site area belong to private owners and the U.S. government (Powertech 2012a, b).

A number of uranium mine sites have been investigated under Superfund authority, as these sites can present potential for (1) public exposure to radon and other radionuclides, (2) contamination of groundwater and surface water supplies (via acid drainage and mobilization of heavy metals), (3) natural habitat disturbance, (4) increased instability of the land via erosion and slope stability failure, and (5) other physical safety hazards. Therefore, these sites may pose a threat to nearby human health and the environment (EPA 2007).

3.2 CURRENT SITE CONDITIONS

During a site reconnaissance on November 5, 2013, Seagull team members and EPA traveled along public roads in the vicinity of the Site in an unsuccessful attempt to identify a vantage point from which to view the Site. Photos of the area of the Site—including drainage areas, historical points of interest, and current conditions of the surrounding area—were taken during this site reconnaissance (see Appendix A). START and EPA visited Edgemont City Hall to meet with local officials to discuss purposes of the PA and to obtain information for the report. Following the meeting with local officials, the City Engineer/Code Administrator of Edgemont accompanied START and EPA to visit areas of interest in and around Edgemont, including the nearby uranium mill tailings repository and location of the former mill. The visit also included travel to current City of Edgemont Public Water Supply (PWS) wells to confirm their locations.

4.0 SITE CHARACTERISTICS

The following sections discuss the geology and hydrogeology, hydrology, and meteorology of the site vicinity.

4.1 GEOLOGY AND HYDROGEOLOGY

The Site is within the Black Hills; soils within the Site's boundaries are generally clayey or silty, with patches of sandy loam on upland areas and clay in or near drainages. The level upland areas have deep soils, and shallow soils are on hills, ridges, and breaks (NRC 2012). Wide areas of unconsolidated alluvial and terrace deposits of Quaternary age overlie the sedimentary rocks of Cretaceous and Jurassic age. The sedimentary rocks include the Cretaceous-age Belle Fourche Shale, Granerous Group (Mowry Shale and Skull Creek Shale), and Inyan Kara Group (Fall River and Lakota Formations). The Fall River Formation consists of sandstone, siltstone, and interbedded sandstone and shale. The Lakota Formation consists of the Fuson Member (shale and siltstone with discontinuous sandstone) and Chilson Member (interbedded shale and sandstone, and a basal mudstone). The Chilson Member is also known as the Lakota Sandstone (Schnabel 1963, NRC 2012).

The Jurassic-age Morrison and Sundance Formations underlie the Inyan Kara Group. The Morrison Formation consists of shale and claystone interbedded with limestone. The Sundance Formation is composed of the Stockade Beaver Member (shale), Hulett Member (sandstone), Lak Member (sandstone, siltstone, and mudstone), and Redwater Member (shale) (Schnabel 1963).

Many occurrences of uranium minerals have been prospected within the Burdock quadrangle. Generally, the ore minerals occur as impregnations in sandstone, siltstone, and mudstone beds, but not consistently

in a carbonaceous environment. Uranium and vanadium minerals from these deposits have been identified as uraninite, carnotite, and tyuyamunite. Corvusite and rauvite are probably present in some of the deposits, although these have not been positively identified. The uranium minerals are restricted to the sandstone and sandy or silty facies in the Fall River Formation and the sandstone in the Chilson Member of the Lakota Formation (Schnabel 1963).

Major aquifers in the Black Hills area include (from top to bottom) the Inyan Kara Group, Minnekahta, Minnelusa, Madison, and Deadwood aquifers (see Appendix B). These aquifers are separated by confining layers with low permeability, except where they outcrop (NRC 2012). The Inyan Kara Group aquifer ranges from 250 to 500 feet thick and contains two subaquifers, the Fall River aquifer and Chilson aquifer, which are separated by the Fuson Shale. Aquifer pumping tests have provided data indicating a hydraulic connection between the Lakota and Fall River Formations through the intervening Fuson Shale in the Burdock area (NRC 2012). The Inyan Kara Group aquifer is separated from the Minnekahta aquifer by the Morrison Formation (60 to 140 feet thick), Sundance/Unkpapa aquifer (a minor aquifer), Gypsum Spring Formation, and the Spearfish Formation (320 feet thick). The Minnekahta aquifer ranges in thickness from 25 to 65 feet. Underlying the Minnekahta aquifer is the Opeche Shale (a confining layer) and the Minnelusa aquifer. The Minnelusa aquifer ranges in thickness from 375 to 1,175 feet. Confining layers are present at the base of the Minnelusa Formation; however, locally, these confining layers may be absent or provide ineffective confinement from the underlying Madison aquifer. The Madison aquifer is the most important aquifer in the region, supplying municipal water for numerous communities, including Rapid City and Edgemont, South Dakota. The Madison Formation is 200 to 1,000 feet thick and mainly consists of a dolomite unit characterized by fractures and karst features. The Madison aquifer is separated from the underlying Deadwood aquifer by the low-permeability Whitewood, Winnipeg, and Englewood Formations (NRC 2012). With the exception of Edgemont, which has two municipal wells in the Madison aquifer, the deeper aquifers are not used as a source of water in the area (Powertech 2009).

The hydrogeologic setting in the Black Hills area also involves minor aquifers, which include the Sundance/Unkpapa, Newcastle, and alluvial aquifers. These minor aquifers yield small volumes of water locally for domestic and stock uses. Alluvial aquifers with thicknesses of 0 to 50 feet are along Beaver Creek, Pass Creek, and the Cheyenne River. They are typically unconfined, but may be confined locally. Alluvial aquifers are separated from the underlying Fall River Formation by the low-permeability Graneros Group confining unit. An alluvial drilling program completed in 2012 did not indicate any areas of discharge to the alluvium along Beaver Creek and Pass Creek from the underlying Fall River aquifer (NRC 2012).

Groundwater in the Fall River and Chilson aquifers flows from northeast to southwest. Regionally, groundwater flows radially outward from the Black Hills toward the surrounding plains (NRC 2012).

Groundwater Levels

Regionally, groundwater levels in alluvial aquifers range from 14.4 to 22.5 feet below ground surface (bgs). Groundwater levels in the Fall River aquifer range from 80 to 680 feet bgs. Groundwater levels in the Chilson aquifer range from 196 to 1,000 feet bgs (Powertech 2009).

4.2 HYDROLOGY

The site lies within the Pass Creek sub-watershed, which comprises most of the east-southeast portion of the larger Beaver Creek watershed. The site is drained by Pass Creek and its tributaries. Located adjacent and east of the site, Pass Creek is an intermittent creek with periods of high runoff following major storm events. No permanent stream flow gages are stationed along Pass Creek (Powertech 2009). Pass Creek flows southwest from the northwest boundary of the Site approximately 6 stream miles to Beaver Creek. Approximately 5.5 stream miles southeast of the confluence of Pass and Beaver Creeks, Beaver Creek flows into the Cheyenne River (Google Earth 2013). In 2013, the mean annual discharge from the Cheyenne River was 38.2 cubic feet per second (cfs), according to a gaging station in Edgemont, downstream of its confluence with Beaver Creek (U.S. Geological Survey [USGS] 2014).

4.3 METEOROLOGY

According to the High Plains Regional Climate Center's (HPRCC) station in Edgemont, the average maximum and minimum annual temperatures in the site area are 61.2 and 33.1 degrees Fahrenheit (°F), respectively. The annual average precipitation is 15.79 inches (HPRCC 2014).

5.0 PREVIOUS ANALYTICAL DATA

Analytical data from groundwater, surface water, sediment, soil, and air were collected within the study area by Powertech and were included in the Dewey-Burdock Project Application for NRC Uranium Recovery License Technical Report (Powertech 2009). These data were referenced in the Environmental Impact Statement (EIS) completed by the NRC.

5.1 GROUNDWATER

The following sections address groundwater sampling and results of that sampling.

5.1.1 Groundwater Sampling

According to a well inventory conducted by Powertech, the following wells are within a 4-mile radius of the Site boundary: one domestic well and five stock wells are within the Site boundary; one domestic well is within 0.25 mile of the Site; one domestic well and four stock wells are between 0.25 and 0.50 mile of the Site; one domestic well and six stock wells are within 0.50 and 1 mile of the Site; 12 stock wells are between 1 and 2 miles of the Site; eight domestic wells, 10 stock wells, and one irrigation well are between 2 and 3 miles of the Site; and six domestic and 10 stock wells are between 3 and 4 miles of the Site (Figure 3).

Powertech conducted groundwater sampling of wells at the proposed Dewey-Burdock ISR project area from October 2006 through February 2009 (see Figure 4). Groundwater samples were collected from domestic, stock, irrigation, monitoring, and temporary wells, the majority of which were downgradient of the Site. Groundwater samples were collected from wells in various aquifers: 17 wells were in the Fall River Formation, 19 wells were in the Lakota Formation (Chilson Member), two wells were in the Inyan Kara Group, three wells were in the Unkpapa Formation, two wells were in unknown aquifers, one well was in the Sundance Formation, and five wells were in alluvium. Generally, groundwater samples were collected for analysis for water quality parameters: major ions; metals, including mercury (total, suspended, and dissolved); and radionuclides (total, suspended, and dissolved).

USGS also conducted groundwater sampling in the Dewey-Burdock area during June 2011. USGS collected 28 groundwater samples from monitoring wells in and around the Dewey-Burdock site that were screened in multiple aquifers.

During July 2012, American Engineering and Testing, Inc. installed additional alluvial groundwater monitoring wells in the area of the Site to supplement the groundwater monitoring results included in the initial application submitted to NRC by Powertech. The additional wells were compliance point wells within the alluvial aquifers along Beaver Creek and Pass Creek (see Figure 5). The wells were sampled monthly by Powertech from July 2012 to June 2013. Most of the samples were analyzed for water quality measurements, metals (including mercury), and dissolved radionuclides.

5.1.2 Groundwater Analytical Results Summary

Groundwater sampling results indicated that in 36 of 49 samples, at least one analyte exceeded the Maximum Contaminant Level (MCL). Of 38 groundwater samples collected from the proposed ore-bearing aquifer, 28 contained analyte concentrations exceeding at least one MCL for drinking water (NRC 2012). The designated crossgradient background well (Well 650) contained concentrations of the

contaminants of concern, including total and dissolved radium-226 (Ra-226) (3.2/2.7 picocuries per liter [pCi/L]), total and dissolved uranium (0.4/1.9 micrograms per liter [µg/L]), and dissolved gross alpha (13.1 pCi/L). None of these background concentrations exceeded its MCL.

Samples collected from Wells 615, 684, and 3026, which were screened within the Chilson aquifer, exceeded the MCL for arsenic (0.01 milligram per liter [mg/L]); Wells 650 and 689, also within the Chilson aquifer, exceeded the EPA action level for lead (0.015 mg/L). Samples from Well 622 in the Fall River aquifer and from Wells 676 and 679 in alluvial aquifers along Pass Creek exceeded the MCL for arsenic and EPA action level for lead. Samples from Wells 681 and 688 in the Fall River aquifer exceeded the MCL for arsenic. The MCL for uranium (30 µg/L) was exceeded in samples collected from four of five wells sampled in the alluvial aquifers. Samples from Wells 42, 680, 684, and 3026 in the Chilson aquifer and Well 698 in the Fall River aquifer also exceeded the MCL for uranium. No MCLs for other metals were exceeded in any of the groundwater samples (NRC 2012).

Approximately 50 percent of the samples collected from the Fall River and Chilson aquifers for analysis for dissolved Ra-226 exceeded the MCL of 5 pCi/L. Dissolved Ra-226 levels exceeding the MCL ranged between 5.2 and 1,440 pCi/L. Approximately 75 percent of the samples collected from wells in the Fall River, Chilson, and alluvial aquifers for analysis for dissolved gross alpha exceeded the MCL of 15 pCi/L. Gross alpha levels exceeding the MCL in alluvial wells ranged between 18.3 and 129 pCi/L; however, gross alpha levels exceeding the MCL in the Fall River and Chilson aquifers were higher, ranging from 15.1 to 6,730 pCi/L. Samples from wells 16, 619, 680, 688, and 692 contained dissolved Ra-226 ranging from 6.4 to 1,440 pCi/L, and dissolved gross alpha concentrations ranging from 17.3 to 6,730 pCi/L exceeding their respective MCLs; these wells are within a 1-mile radius of the Site boundary, and are crossgradient or downgradient of the Site.

A primary drinking water standard for radon-222 (Rn-222) has not been established; however, EPA has proposed a limit of 300 pCi/L (EPA 2000). Of samples from all the wells tested during baseline groundwater sampling, only the sample from Well 650 (background) did not exceed the proposed EPA limit; Well 650 is screened in the Chilson aquifer, and is crossgradient of the Site (NRC 2012). Concentrations of Rn-222 found to exceed the EPA's proposed limit for Rn-222 ranged from 11,247 to 17,092,120 Becquerels per cubic meter (Bq/m^3) (304 to 462,000 pCi/L). Wells 680 and 42 in the mapped ore bodies in the Chilson aquifer, and Well 681 in the Fall River aquifer, contained the highest concentrations of Rn-222. Well 42 provides water for domestic use and stock water (NRC 2012).

Groundwater samples collected from all domestic wells except Well 8 contained concentrations of at least one analyte that exceeded its MCL. Groundwater samples exceeding MCLs for uranium (total and

dissolved), Ra-226 (total and dissolved), dissolved gross alpha, and arsenic, and the EPA action level for lead, are listed in Table 1.

TABLE 1

GROUNDWATER DATA SUMMARY
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
JULY 2007 THROUGH FEBRUARY 2009

Well ID	Aquifer	Well Description	Ra-226 (Total) (pCi/L)	Ra-226 (Dissolved) (pCi/L)	Uranium (Total) (µg/L)	Uranium (Dissolved) (µg/L)	Gross Alpha (Dissolved) (pCi/L)	Arsenic (mg/L)	Lead (mg/L)
2	Chilson	Domestic/Stock	--	--	--	--	--	--	--
4	Unknown	Stock	--	--	--	--	--	--	--
5	Fall River	Stock	--	--	--	--	--	--	--
7	Fall River	Domestic	--	--	--	--	15.5 – 17.0	--	--
8	Fall River	Domestic	--	--	--	--	--	--	--
13	Chilson	Domestic	--	--	--	--	19.5	--	--
16	Chilson	Domestic	17.4	6.4 – 33.6	--	--	28.3 – 110	--	--
18	Fall River	Domestic	--	5.8	--	--	15.7 – 37.0	--	--
41	Unknown	Stock	--	16.5	--	--	88	--	
42	Chilson	Domestic	79.7	87.6 – 102	--	32.4 – 40	371 – 560	--	--
49	Fall River	Stock	--	--	--	--	--	--	--
615	Chilson	Monitoring	--	7.2	--	--	15.1 – 38.3	0.021 – 0.024	--
619	Chilson	Stock	120	99.7 – 120	--	--	341 – 438	--	--
622	Fall River	Monitoring	--	7.9	--	--	22.6 – 1,470	0.027	0.023 – 0.03
628	Inyan Kara	Stock	6.8	6.1 – 20.7	--	--	29.9 – 83.9	--	--
631	Fall River	Stock	15.2	9.5 – 22.1	--	--	46.5 – 162	--	--
635	Sundance	Stock	--	--	--	--	--	--	--
650	Chilson	Stock (background)	--	--	--	--	--	--	0.05
675	Alluvial	Alluvial	--	--	38.7 – 50.2	30.7 – 49.3	18.3 – 55.2	--	--
676	Alluvial	Alluvial	--	--	59.1 – 68.7	49.4 – 58.6	31.9 – 95.5	0.021	0.06
677	Alluvial	Alluvial	--	--	41.4 – 47.1	40.2 – 45.0	38.7 – 129	--	--
678	Alluvial	Alluvial	--	--	37.9 – 38.7	34.9 – 36.8	18.9 – 54.7	--	--
679	Alluvial	Alluvial (background)	--	--	--	--	18.4 – 22.4	0.011	0.015 – 0.022

TABLE 1 (Continued)

GROUNDWATER DATA SUMMARY
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
JULY 2007 THROUGH FEBRUARY 2009

Well ID	Aquifer	Well Description	Ra-226 (Total) (pCi/L)	Ra-226 (Dissolved) (pCi/L)	Uranium (Total) (µg/L)	Uranium (Dissolved) (µg/L)	Gross Alpha (Dissolved) (pCi/L)	Arsenic (mg/L)	Lead (mg/L)
680	Chilson	Test Well	--	1,110 – 1,440	54.1	30.3 – 172	4,090 – 6,730	--	--
681	Fall River	Test Well	--	258 – 445	--	--	656 – 2,220	0.024	--
682	Chilson	Monitoring	--	--	--	--	50.3	--	--
683	Fall River	Monitoring	--	--	--	--	--	--	--
684	Chilson	Monitoring	--	543	336	66.7	1890	0.04	--
685	Fall River	Monitoring	--	--	--	--	23.8	--	--
686	Chilson	Monitoring	--	--	--	--	--	--	--
687	Fall River	Monitoring	--	25.7	--	--	114	--	--
688	Fall River	Test Well		6.7 – 7.9	--	--	17.3 – 29.8	0.015	--
689	Chilson	Test Well	--	5.4 – 7.9	--	--	23.9 – 64.3	--	0.017
690	Unkpapa	Monitoring	--	--	--	--	--	--	--
691	Fall River	Monitoring	--	--	--	--	--	--	--
692	Chilson	Monitoring	--	484	--	--	1450	--	--
693	Unkpapa	Monitoring	--	--	--	--	--	--	--
694	Fall River	Domestic	--	--	--	--	20.2 – 23.9	--	--
695	Fall River	Stock	--	5.2–6.3	--	--	15.9 – 52.2	--	--
696	Chilson	Domestic	--	--	--	--	15.1 – 25.9	--	--
697	Chilson	Stock	--	5.6	--	--	18.2 – 21.7	--	--
698	Fall River	Weather Station	--	347 – 429	101 – 132	99.8 – 119	36.3 – 2,110	--	--
703	Unkpapa	Domestic	--	--	--	--	42.6	--	--
704	Chilson	Monitoring	--	--	--	--	--	--	--
705	Chilson	Monitoring	--	--	--	--	--	--	--

TABLE 1 (Continued)

GROUNDWATER DATA SUMMARY
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
JULY 2007 THROUGH FEBRUARY 2009

Well ID	Aquifer	Well Description	Ra-226 (Total) (pCi/L)	Ra-226 (Dissolved) (pCi/L)	Uranium (Total) (µg/L)	Uranium (Dissolved) (µg/L)	Gross Alpha (Dissolved) (pCi/L)	Arsenic (mg/L)	Lead (mg/L)
706	Fall River	Monitoring	--	--	--	--	20.5 – 56.3	--	--
3026	Chilson	Stock	--	9.5 – 10.4	32.2	--	15.4 – 116	0.022–0.044	--
4002	Inyan Kara	Stock	62.7	52.3 – 63.6	--	--	120 – 314	--	--
7002	Chilson	Stock	6.3	8.0 – 8.8	--	--	29.5 – 91.4	--	--
MCL			**5**	**5**	**30**	**30**	**15**	**0.01**	**0.015[a]**

Source: Powertech 2012c

Notes:

[a] EPA action level
-- Below the MCL or not analyzed
ID Identification
MCL Maximum Contaminant Level
mg/L Milligrams per liter
pCi/L Picocuries per liter
Ra-226 Radium-226
µg/L Micrograms per liter

Samples collected by USGS from Wells 676 and 678 (also sampled by Powertech), which were screened in the alluvial aquifer along Pass Creek, exceeded the MCL for uranium. Additionally, a sample collected from Well 698 (also sampled by Powertech), screened in the Fall River aquifer and immediately downstream of runoff from the Site, also exceeded the MCL for uranium (Johnson 2012).

Samples collected by Powertech from monitoring wells in 2012 and 2013 contained concentrations of gross alpha that exceeded its MCL (15 pCi/L). Well BC1, downgradient of the Site, was the only well that contained a concentration of uranium above its MCL. As previously mentioned, a primary drinking water standard for Rn-222 has not been established; however, EPA has proposed a limit of 300 pCi/L (EPA 2000). All groundwater samples collected from the alluvial monitoring wells contained concentrations of Rn-222 that exceeded 300 pCi/L. A summary of groundwater results from the alluvial monitoring wells in the area of the Site is in Table 2 below.

TABLE 2

MONITORING WELL SUMMARY DATA
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2012-2013

Well ID	Sample Location	Ra-226 (pCi/L)	Uranium (pCi/L)	Gross Alpha (pCi/L)
BC1	Pass Creek watershed	--	75.7 – 111	50.1 – 108
BC2	Pass Creek watershed	--	--	20.0 – 38.9
BC3	Pass Creek watershed	--	--	19.3 – 43.5
DC1	Beaver Creek watershed	--	--	15.9 – 88.7
DC2	Beaver Creek watershed	--	--	20.7 – 41.7
DC3	Beaver Creek watershed	--	--	--
DC4	Beaver Creek watershed	--	--	16.5 – 29.6
MCL		**5**	**30**	**15**

Source: Powertech 2013

Notes:
-- Below the MCL or not analyzed
ID Identification
MCL Maximum Contaminant Level
pCi/L Picocuries per liter
Ra-226 Radium-226

5.2 SURFACE WATER AND SEDIMENT

The following sections address analytical data from surface water and sediment samples collected at the study area. Sample locations are shown on Figure 6.

5.2.1 Surface Water Sampling

Surface water samples were collected monthly between July 2007 and June 2008 from perennial and ephemeral streams near the area of the Site. The perennial streams, Beaver Creek and the Cheyenne River, were each sampled at two locations. The ephemeral streams included Pass Creek, Bennett Canyon, and an unnamed tributary (see Figure 6). Passive samplers were installed at the ephemeral stream locations to collect samples during flow events. Two sample locations were on Pass Creek, while samples were to be collected at one location each at Bennet Canyon and the unnamed tributary (Powertech 2009). The Bennet Canyon sample location was absent of water during both sampling periods.

Surface water samples were also collected at impoundment locations in the area of the Site during 2007-2008. In all, 48 impoundments had been identified on aerial photographs and topographic maps prior to field activities and were subsequently field-verified. A subset of 11 impoundments were chosen from the total of 48, based on presence of water during sampling activities and spatial distribution of the impoundments. The locations included the Darrow Pit, Triangle Pit, and nine other impoundments (see Figure 6). Some of the impoundments on the site meet the definition of "surface impoundment" described in Hazard Ranking System (HRS) Table 2-5, indicating they could also be evaluated as potential sources of contamination for HRS scoring purposes (EPA 2011).

5.2.2 Surface Water Analytical Results Summary

Total gross alpha concentrations were detected at all seven sample locations and ranged from 1.9 to 65.8 pCi/L. The highest concentration was detected in a sample collected at the downstream Beaver Creek location. Total and dissolved uranium were detected in every sample except the one collected from the unnamed tributary. The highest concentrations of total uranium (37.8 µg/L) and dissolved uranium (36.8 µg/L) were in a sample collected at the downstream Cheyenne River location. Total and dissolved Ra-226 were detected at concentrations ranging from 0.2 to 5.1 pCi/L. The highest detections occurred in samples collected at the downstream sample locations on Beaver Creek and the Cheyenne River. Total and dissolved Pb-210 were detected at concentrations up to 35 pCi/L. The highest concentration was detected at the upstream sample location on Beaver Creek.

Samples collected at downstream locations on Beaver Creek and Pass Creek met observed release criteria by containing analytes that exceeded three times background concentrations. The sample collected downstream on Pass Creek contained elevated concentrations of gross alpha (8.8 pCi/L), and total and dissolved uranium (25.2/5.0 µg/L), meeting observed release criteria. The sample collected downstream on Beaver Creek contained elevated concentrations of gross alpha (65.8 pCi/L); however, the

concentration did not meet observed release criteria. Additionally, a sample collected at the downstream location on the Cheyenne River contained an elevated concentration of Pb-210 (22.0 pCi/L) that met observed release criteria. However, that downstream sampling location on the Cheyenne River was beyond the 15-mile Target Distance Limit (TDL).

Analytical results from surface water samples are listed in Table 3 (Powertech 2012). To summarize the surface water data, the highest downstream detections of each analyte are listed with the corresponding upstream sample results from the same sampling event. For example, the highest concentration of total gross alpha at the downstream Beaver Creek location was detected in a sample collected on November 19, 2007 (65.8 pCi/L at BVC01). Therefore, the total gross alpha concentration detected in the upstream Beaver Creek sample collected on November 19, 2007 (34.7 pCi/L at BVC04), is also listed in the table. The date on which concentrations of Pb-210 were detected at the Cheyenne River downstream location had no counterpart date of Pb-210 data acquisition at the upstream location; thus data obtained on the date of upstream data acquisition closest to the date of data acquisition at the downstream location were used for the comparison. No Superfund Chemical Data Matrix (SCDM) benchmarks have been established for radionuclides in surface water.

TABLE 3

**RADIOLOGICAL DATA FOR SURFACE WATER SAMPLES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2007-2008**

Sample Location	Sample Description	Gross Alpha Total (pCi/L)	Uranium (µg/L)		Ra-226 (pCi/L)		Pb-210 (pCi/L)	
			Total	Dissolved	Total	Dissolved	Total	Dissolved
BVC04	Beaver Creek–upstream	34.7	6.1	5.6	2.2j	-0.06j	35	26
BVC01	Beaver Creek–downstream	65.8	26.2	26.9	5.1	2.0	14.0	11.0
CHR01	Cheyenne River–upstream	35.3	32.0	30.8	4.1	0.06j	<1	<1
CHR05	Cheyenne River–downstream	29.9	37.8	36.8	5.1	1.4	22.0	<1
PSC02	Pass Creek–upstream	1.9	5.7	0.7	<0.2	NM	0.0j	1.7j
PSC01	Pass Creek–downstream	8.8	25.2	5.0	0.7	NM	3.0j	2.2j
UNT01	Unnamed Tributary	6.1	0.9	ND	0.3	0.2	NA	NA

Source: Powertech 2012d

Notes:

Shaded result indicates the value exceeds three times the background (upstream) level (or above the detection limit if non-detect in the background sample).

<	Less than
ID	Identification
j	Not detected above minimum detectable concentration
NA	Not analyzed
ND	Non detect
NM	Not measured in field/not requested for analysis from laboratory
Pb-210	Lead-210
pCi/L	Picocuries per liter
Ra-226	Radium-226
µg/L	Micrograms per liter

Samples collected from the Darrow Pit (Sub06) and the Triangle Mine Pit (Sub02) contained the highest radionuclide concentrations of the 11 impoundment samples. Total gross alpha was detected at 8,750 pCi/L at location Sub06 and 199 pCi/L at location Sub02. Total and dissolved uranium were detected at 7,380 and 7,840 pCi/L, respectively, at location Sub06, and at 190 and 177 pCi/L, respectively, at location Sub02. In addition, samples collected at Sub01, Sub03, Sub04, Sub09, and Sub10 contained concentrations of total gross alpha ranging from 15.9 to 19.9 pCi/L. Samples collected from Sub01, Sub06, and Sub08 through Sub11 contained concentrations of total Pb-210 ranging from 1.1 to 8.2 pCi/L. Samples collected from Sub02, Sub08, and Sub11 contained concentrations of dissolved

Pb-210 ranging from 1.5 to 4.6 pCi/L. Maximum results for each surface water impoundment in the area of the Site are listed in Table 4.

TABLE 4

**RADIOLOGICAL DATA FOR SURFACE WATER IMPOUNDMENT SAMPLES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2007-2008**

Sample Location	Sample Description	Gross Alpha Total (pCi/L)	Uranium (µg/L)		Ra-226 (pCi/L)		Pb-210 (pCi/L)	
			Total	Dissolved	Total	Dissolved	Total	Dissolved
Sub01	Stock pond	16.2	2.0	0.3	1.2	0.5	-1.4 j	0.7
Sub02	Triangle Mine Pit	199	190	177	0.6	0.7	0.5	0j
Sub03	Mine dam	19.9	3.1	2.3	4.0	4.5	-3.8j	-3.0j
Sub04	Stock pond	13.6	2.4	2.1	3.5	3.4	-3.0j	-2.1j
Sub05	Mine dam	NS	NS	NS	NS	NS	NS	NS
Sub06	Darrow Mine Pit - Northwest	8,750	7,380d	7,840	2.0	4.3	3.1	-0.6j
Sub07	Stock dam	5.8	1.3	2.4	0.8	0.8	-0.8j	-1.4j
Sub08	Stock pond	14.1	2.3	2.8	0.5	0.5	5.3	4.6
Sub09	Stock pond	15.9	2.3	5.6	0.5	0.1	3.6	-0.9j
Sub10	Stock pond	16.3	3.3	2.7	1.2	0.2	5.3j	0.1
Sub11	Stock pond	9.4	1.6	33.6d	0.9	0.7	8.2	3.2

Source: Powertech 2012d

Notes:

<	Less than
d	Reporting limit increased due to sample matrix interference
ID	Identification
j	Not detected above minimum detectable concentration
NS	Not sampled because no water present
Pb-210	Lead-210
pCi/L	Picocuries per liter
Ra-226	Radium-226

5.2.3 Sediment Sampling

Sediment samples were collected by Powertech at collocated surface water sample locations previously cited in Section 5.2.1 (see Figure 6). At each location, four sample aliquots were collected by use of a plastic hand trowel to a depth of 5 centimeters (cm), along a transect spanning the width of the channel in areas where sediment had been deposited. The aliquots were then composited into a single sample to represent the average radionuclide concentration across the channel (Powertech 2009).

Additional sediment samples were collected in the area of the Site from on-site impoundments described in Section 5.2.1. At each location, a single sample was collected by use of a trowel to a depth of 5 cm. Samples were collected near the edge of the water at locations appearing relatively undisturbed. At dry impoundments, sediment samples were collected within areas determined likely to be submerged if water would be present (Powertech 2009). The sediment samples were analyzed for natural uranium, Ra-226, thorium-230 (Th-230), and Pb-210 (Powertech 2009).

5.2.4 Sediment Analytical Results Summary

Samples collected at the downstream Pass Creek location (PSC01) exceeded three times background concentrations for all analytes, thereby meeting observed release criteria. Additionally, a sample collected at the downstream Cheyenne River location (CHR05) exceeded three times the background level for uranium, thereby meeting observed release criteria. Table 5 summarizes analytical results from sediment samples collected at locations on Pass Creek, Beaver Creek, the Cheyenne River, Bennet Canyon, and an unnamed tributary.

TABLE 5
RADIOLOGICAL DATA FROM STREAM SEDIMENT SAMPLES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2008

Sample Location	Sample Description	Sample Date	U-nat Total (mg/kg-dry)	Ra-226 Total (pCi/g-dry)	Pb-210 Total (pCi/g-dry)	Th-230 Total (pCi/g-dry)
BEN01	Bennet Canyon	6/23/2008	1.8	0.6	2.3U	0.6
		8/21/2008	2.4	0.6	2.0	0.5
BVC04	Beaver Creek-upstream	6/17/2008	2.0	1.5	1.9U	0.7
		8/21/2008	2.0	1.0	1.8	1.0
BVC01	Beaver Creek-downstream	6/17/2008	2.0	1.3	0.5U	0.8
		8/21/2008	2.0	0.6	2.6	1.2
CHR01	Cheyenne River-upstream	6/17/2008	1.7	1.0	0.2U	0.6
		8/21/2008	2.7	0.9	1.7	1.4
CHR05	Cheyenne River-downstream	6/17/2008	6.2	2.1	1.7U	1.9
		8/21/2008	1.2	0.6	1.3	0.5
PSC02	Pass Creek-upstream	6/17/2008	1.1	0.6	1.2U	0.4
		8/21/2008	1.0	0.4	0.4U	0.4
PSC01	Pass Creek-downstream	6/17/2008	3.9	2.9	4.7	2.0
		8/21/2008	6.5	1.8	4.0	4.1
UNT01	Unnamed Tributary	6/23/2008	2.0	0.8	2.2U	0.5
		8/21/2008	2.5	0.7	1.7	1.0

Source: Powertech 2009

Notes:

Shaded result indicates the value exceeds three times the background (upstream) level (or above the detection limit if non-detect in the background sample).

ID Identification
mg/kg Milligrams per kilogram
NE Not established
Pb-210 Lead-210
pCi/g Picocuries per gram
Ra-226 Radium-226
Th-230 Throium-230
U Analyte not detected at or above the reporting limit
U-nat Natural uranium

Uranium concentrations in samples from the Darrow Mine Pit – Northwest (Sub06) and Triangle Mine Pit (Sub02) ranged from 18 to 37 mg/kg. Samples from two mine dams (Sub03 and Sub05) and one stock pond (Sub04) contained concentrations of uranium ranging from 4.2 to 8.5 mg/kg. Samples collected from Sub02, Sub05, and Sub06 contained concentrations that exceeded three times background concentrations of uranium, Ra-226 and Th-230, meeting observed release criteria. The sample collected at location Sub03 also contained a concentration of Ra-226 that exceeded three times background, meeting observed release criteria. The sample quantitation limit (SQL) for Pb-210 could not be confirmed through laboratory data information, and therefore the data could not be used to establish an

observed release. Table 6 summarizes analytical results from sediment samples collected at impoundment locations throughout the area of the Site.

TABLE 6

**RADIOLOGICAL DATA FOR IMPOUNDMENT SEDIMENT SAMPLES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2008**

Sample Location	Location Description	Sample Date	U-nat Total (mg/kg-dry)	Ra-226 Total (pCi/g-dry)	Pb-210 Total (pCi/g-dry)	Th-230 Total (pCi/g-dry)
Sub01 (background)	Stock pond	6/18/2008	2.2	1.2	0.5U	0.7
		8/21/2008	3.3	1.1	1.0U	1.0
Sub02	Triangle Mine Pit	6/18/2008	18	3.9	2.8U	2.9
		8/21/2008	19	1.3	3.1	6.8
Sub03	Mine dam	6/18/2008	7.2	4.1	3.9	2.1
		8/21/2008	4.2	1.1	3.2	1.9
Sub04	Stock pond	6/17/2008	6.5	2.5	1.2U	0.9
		8/21/2008	5.1	0.7	2.1	1.8
Sub05	Mine dam	6/18/2008	8.5	4.2	4.2	2.4
		8/21/2008	6.0	3.0	2.8	2.3
Sub06	Darrow Mine Pit – Northwest	6/23/2008	37	8.6	9.6	7.8
		8/21/2008	32	5.2	4.0	5.9
Sub07	Stock dam	6/23/2008	1.7	0.7	0.6U	0.5
		8/21/2008	2.2	0.4	1.9	0.9
Sub08	Stock pond	6/23/2008	1.2	0.6	0.6U	0.4
		8/21/2008	1.9	0.4	1.7	0.8
Sub09	Stock pond	6/23/2008	2.4	1.0	1.5U	0.7
		8/21/2008	2.3	0.6	1.7	0.9
Sub10	Stock pond	6/23/2008	1.5	0.8	1.5U	0.7
		8/21/2008	2.1	0.6	0.9U	0.7
Sub11	Stock pond	6/23/2008	2.7	0.8	2.1U	0.5
		8/21/2008	1.8	0.6	1.5	0.8

Source: Powertech 2009
Notes:

Shaded result indicates a concentration that exceeds three times the background level (sample results from June 18, 2008)

ID Identification
mg/kg Milligrams per kilogram
Pb-210 Lead-210
pCi/g Picocuries per gram
Ra-226 Radium-226
Th-230 Thorium-230
U Analyte not detected at or above the reporting limit
U-nat Natural uranium

5.3 SOIL

The following sections address soil sampling and analytical results from soil sampling.

5.3.1 Soil Sampling

Powertech conducted soil sampling within the proposed Dewey-Burdock permit area, which included the area of the Site. Surface soil samples were collected from the top 15 cm by use of a hand shovel. All of the soil samples were analyzed for Ra-226. In all, 25 samples were collected at the area of the Site (Powertech 2009).

5.3.2 Soil Analytical Results Summary

Samples SMA-B01 through SMA-B29 (not consecutive) were collected at the area of the Site (see Figure 7). Sample SMA-B01 was the designated background sample. The sample results were compared to SCDM cancer risk (CR) screening levels for ingestion of soil, and the health-based standard of 5.0 pCi/g for Ra-226 in surface soil (15 pCi/g for subsurface soil) based on the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. That standard was developed for cleanup of radiation-contaminated soil, specifically uranium mill tailings sites. An EPA memorandum dated February 12, 1998, clarifies use of the UMTRCA soil cleanup standard for CERCLA sites (EPA 1998). The purpose of the standard was to limit risk from inhalation of radon decay products in houses built on mine tailings, and to limit gamma radiation exposure to people using contaminated land. The standard was developed to control the hazard from gamma radiation; therefore, this standard may be appropriate and relevant to CERCLA sites (EPA 1998).

Samples SMA-B03, -B07, -B09, -B10, -B11, -B13, -B14, -B15, -B19, -B21, and -B23 through -B30 contained concentrations of Ra-226 that exceeded the SCDM CR screening level of 1.0 pCi/g. Samples SMA-B26 through -B30, collected near the Triangle Mine Pit area and the Darrow Mine Pit, contained concentrations exceeding both the SCDM CR benchmark for Ra-226 and the UMTRCA standard for surface soil for Ra-226 of 5.0 pCi/g. Samples SMA-B07, -B23, -B26, -B28, and -B30 contained concentrations of Ra-226 at or above three times background (0.9 pCi/g), meeting observed release criteria. The exact location of sample SMA-B28 could not be confirmed from the source map produced by Powertech. In addition, samples SMA-B27 and -B29 contained concentrations of natural uranium (U-nat), Pb-210, and Th-230 at concentrations exceeding three times background, also meeting observed release criteria. Table 7 summarizes the surface soil sample analytical results.

TABLE 7

**RADIOLOGICAL DATA FROM SURFACE SOIL SAMPLES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
2012**

Sample ID	Sample Date	Ra-226 (pCi/g)	U-nat (pCi/g)	Pb-210 (pCi/g)	Th-230 (pCi/g)
SMA-B01(background)	9/24/2007	0.9	1.2	0.6	0.5
SMA-B03	9/24/2007	**1.5**	-	-	-
SMA-B04	9/24/2007	1.0	-	-	-
SMA-B07	9/24/2007	**3.2**	-	-	-
SMA-B09	9/24/2007	**1.2**	-	-	-
SMA-B10	9/25/2007	**1.4**	-	-	-
SMA-B11	9/24/2007	**2.3**	-	-	-
SMA-B13	9/25/2007	**1.7**	-	-	-
SMA-B14	9/24/2007	**1.4**	-	-	-
SMA-B15	9/24/2007	**1.6**	-	-	-
SMA-B16	9/24/2007	0.8	-	-	-
SMA-B17	9/24/2007	0.9	-	-	-
SMA-B18	9/25/2007	0.5	-	-	-
SMA-B19	9/24/2007	**1.2**	-	-	-
SMA-B20	9/27/2007	0.9	-	-	-
SMA-B21	9/24/2007	**1.4**	-	-	-
SMA-B22	9/24/2007	0.8	-	-	-
SMA-B23	9/24/2007	**2.7**	-	-	-
SMA-B24	9/24/2007	**1.3**	-	-	-
SMA-B25	9/24/2007	**1.1**	-	-	-
SMA-B26	9/28/2007	**11**	-	-	-
SMA-B27	9/28/2007	**40**	**67**	30	**30**
SMA-B28	9/29/2007	**6.4**	-	-	-
SMA-B29	9/28/2007	**29**	**16**	20	**20**
SMA-B30	9/28/2007	**34**	-	-	-
SCDM Cancer Risk (ingestion)		**1.0**	**3.7***	**NE**	**3.0**
UMTRCA Standard for Surface Soil		**5.0**	**30***	**NE**	**NE**

Source: Powertech 2009

Notes:

Bold result indicates a concentration that exceeds the SCDM or UMTRCA benchmark.
Shaded result indicates a concentration that exceeds three times the background level.

*	Uranium-238 concentration
-	Not analyzed
ID	Identification
NA	Not applicable
NE	Not established
Pb-210	Lead-210
pCi/g	Picocuries per gram
Ra-226	Radium-226
SCDM	Superfund Chemical Data Matrix
Th-230	Thorium-230
UMTRCA	Uranium Mill Tailings Radiation Control Act
U-nat	Natural uranium

Powertech conducted baseline radiological surveys and sampling in the area of the Site between August 2007 and July 2008 to characterize and quantify radiation levels and radionuclide concentrations in soils. Within the surface mine area, external gamma exposure rates ranged from 5.9 to 324 microroentgens per hour (µR/hr). Elevated readings were associated with the abandoned open pit mines, waste rock, and drainages in the surface mine area (Powertech 2009). Background external gamma exposure rates near the Site were approximately 5.0 µR/hr (USGS 1993). Gamma exposure rates within the area of the Site exceeded three times the background, meeting observed release criteria. Table 8 summarizes gamma exposure rates in surface soil in the mine area.

TABLE 8

EXTERNAL GAMMA EXPOSURE RATES IN SURFACE SOIL IN MINE AREA DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE

2007-2008

Parameter	Gamma-Ray Count Rate (µR/hr)
Mean	13.8
Standard Deviation	18.4
Median	10.9
Minimum	5.9
Maximum	324.1
Background	**5.0***

Sources: Powertech 2009, USGS 1993

Notes:

* Approximate
µR/hr Microroentgens per hour

5.4 AIR

The following sections address air sampling and analytical results from air sampling.

5.4.1 Air Sampling

Powertech conducted air monitoring and sampling within the area of the Site during three monitoring periods: August 18, 2007 to February 4, 2008; February 4 to May 17, 2008; and May 17 to July 17, 2008. Ambient exposure rates were measured by use of thermo luminescent dosimeters (TLD) placed at eight locations throughout the Dewey-Burdock site; however, five of the TLDs deployed were lost due to suspected disturbance by livestock in the area.

In addition, Radtrak passive track etch detectors were placed at each of those air monitoring locations, and at an additional eight biased locations to measure radon-222 (Rn-222) concentrations in air. The measurement events were separated into four quarterly periods as follows: August 14 to September 27, 2007; September 27, 2007, to February 1 through 12, 2008; February 1 through 12, 2008, to May 17, 2008; and May 17 to July 17, 2008 (Powertech 2009).

5.4.2 Air Sampling Results Summary

The associated annualized dose rates ranged from 114 to 323 mrem/yr. Typical ranges of average worldwide exposures are 60 to 160 mrem/yr (Powertech 2009).

Ambient radon monitoring results were as follows: Period 1 concentrations ranged from 1.0 to 9.8 pCi/L, with an average of 2.4 pCi/L; Period 2 concentrations ranged from 0.4 to 1.8 pCi/L, with an average of 1.2 pCi/L; Period 3 concentrations ranged from 0.4 to 3.3 pCi/L, with an average of 1.8 pCi/L; Period 4 concentrations ranged from 0.5 to 0.8 pCi/L, with an average of 0.5 pCi/L. In terms of effluent limits, the measured values exceeded the 10 *Code of Federal Regulations* (CFR) Part 20 limit of 0.1 pCi/L for Rn-222 with daughters present (Powertech 2009).

6.0 SOURCES OF CONTAMINATION AND WASTE CHARACTERISTICS

The source areas at the Site were geo-referenced to establish an approximate boundary and area of the four mine waste piles within the site boundary (see Figure 8). Waste Pile #1 (approximately 941,651.45 ft^2) is near the Triangle Mine Pit in the northwest portion of the site. Waste Pile #2 (approximately 11,037.49 ft^2) is 0.25 mile east of Pile #1. Waste Pile #3 (approximately 1,372,012.21 ft^2) is in the north central portion of the site. Waste Pile #4 (approximately 8,552,514.66 ft^2) is near the Darrow Mine Pit in the southeast portion of the site. The combined area of the waste piles is approximately10,877,215 ft^2 (see Figure 8). Radionuclides are the contaminants of concern, including natural uranium, Ra-226, Th-230, and Pb-210. Natural uranium is uranium containing the following relative concentrations of isotopes found in nature: uranium-235 (0.7 %), uranium-238 (99.3 %), and uranium-234 (trace amounts) (NRC 2014b). These radionuclides are present across the area of the Site, and migration of these off site into nearby surface water bodies has been documented. Surface soil samples near the open pits and mine waste piles have contained significantly elevated concentrations of radionuclides, exceeding UMTRCA standards and three times background concentrations.

Uranium, radium, and radon are naturally occurring. Chronic (long-term) inhalation exposure to uranium and radon in humans has been linked to respiratory effects such as chronic lung disease, while radium exposure has resulted in acute leukopenia, anemia, necrosis of the jaw, and other effects. Cancer is the

major effect of concern from exposure to radium via oral exposure, which is known to cause bone, head, and nasal passage tumors in humans. Uranium may cause lung cancer and tumors in lymphatic and hematopoietic tissues (EPA 2000).

7.0 PATHWAY ANALYSIS

This section discusses contaminant migration pathways evaluated under the HRS. A CERCLA Eligibility Checklist (Appendix B) and a Potential Hazardous Waste Preliminary Assessment Form (Appendix C) have been completed for the PA. Additionally, site risks and pathways of concern have been presented in a Conceptual Site Model (Appendix D).

7.1 GROUNDWATER PATHWAY AND TARGETS

Radiological results from samples indicate that groundwater in the area of the Site contains concentrations of radionuclides that exceed MCLs for uranium, Ra-226, and gross alpha. In addition, some wells contain concentrations of lead and arsenic that exceed the EPA action level for lead and MCL for arsenic. The majority of the samples exceeding these standards were collected from the Inyan Kara Group aquifer. This aquifer ranges from 250 to 500 feet thick and contains two subaquifers—the Fall River aquifer and Chilson aquifer—which are separated by the Fuson Shale. Data from aquifer pumping tests indicate a hydraulic connection between the Lakota and Fall River Formations through the intervening Fuson Shale in the Burdock area (NRC 2012). Samples collected from the alluvial aquifer in the area of the Site have also contained elevated concentrations of radionuclides. Minor aquifers also occur within the Black Hills, including the Sundance/Unkpapa, Newcastle, and alluvial aquifers. These minor aquifers yield small volumes of water locally for domestic and stock uses. Alluvial aquifers with thicknesses of 0 to 50 feet are along Beaver Creek, Pass Creek, and the Cheyenne River. They are typically unconfined, but may be confined locally. Alluvial aquifers are separated from the underlying Fall River Formation by the low-permeability Graneros Group confining unit. An alluvial drilling program completed in 2012 did not indicate any areas of discharge to the alluvium along Beaver Creek and Pass Creek from the underlying Fall River aquifer (NRC 2012).

Groundwater in the Fall River and Chilson aquifers flows from northeast to southwest. Regionally, groundwater flows radially outward from the Black Hills toward the surrounding plains (NRC 2012). The Site is not within a wellhead protection area (South Dakota Department of Environment and Natural Resources [SDDENR] 2013).

According to a well inventory of the area of the Site conducted by Powertech, the following water wells are within a 4-mile TDL of the Site boundary (see Figure 9): one domestic well and five stock wells are

within the Site boundary; one domestic well is within 0.25 mile of the Site; one domestic well and four stock wells are within 0.25 and 0.50 mile of the Site; one domestic well and six stock wells are within 0.50 and 1 mile of the Site; 12 Stock wells are within 1 to 2 miles of the Site; eight domestic wells, 10 Stock wells, and one irrigation well are within 2 to 3 miles of the Site; and six domestic and 10 stock wells are within 3 to 4 miles of the Site. The Site is on the border of Custer and Fall River Counties; the average persons per household in Custer County is 2.17, and the average persons per household in Fall River County is 2.12. Based on the number of domestic wells and the average number of persons per household, approximately 15 people could obtain their water from private wells in Custer County within the 4-mile TDL. Approximately 23 people could obtain their water from private wells in Fall River County within the 4-mile TDL. Table 9 summarizes the drinking water target population in the area of the Site. This estimated population differs slightly from the data obtained for the 2010 census, which indicated fewer (approximately 29) people live within 4 miles of the approximate center of the Site (Mable/Geocorr12: Geographic Correspondence Engine with Census 2010 Geography [Mable/Geocorr] 2014).

TABLE 9

DRINKING WATER TARGET POPULATION
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE

Distance From Site	Number of Wells Within TDL	Population Served
On Site	1	2.12
0 to .25 mile	1	2.12
0.25 to 0.5 mile	1	2.17
0.5 to 1 mile	1	2.12
1 mile to 2 miles	0	0
2 miles to 3 miles	8	16.96
3 miles to 4 miles	6	13.02
Total	18	38.51

Source: Mable/Geocorr 2014

Notes:

TDL Target distance limit

7.2 SURFACE WATER PATHWAY AND TARGETS

Hydrology associated with the Site is discussed in Section 4.2. The primary surface water bodies associated with the 15-mile TDL are Pass Creek, Beaver Creek, and the Cheyenne River (see Figure 8).

According to SDDENR, no potable water intakes are on Pass Creek, Beaver Creek, or the Cheyenne River within the 15-mile TDL. Beaver Creek and the Cheyenne River are used by recreational anglers;

however, documentation of the extent of use of the water bodies as fisheries is not available. All surface water bodies within the 15-mile TDL are used for fish and wildlife propagation, recreation, and stock watering. Pass Creek has been designated for irrigation use; however, because the stream is intermittent, insufficient data are available to determine whether Pass Creek actually has been used for irrigation. Beaver Creek, from its headwaters to the Cheyenne River, has been determined to be impaired or threatened due to potential impacts of detrimental specific conductance, total dissolved solids, and salinity in these waters on warm water semi-permanent fish life, fish and wildlife propagation, recreation, stock watering, and irrigation. In addition, the Cheyenne River, between its confluence with Beaver Creek and Cascade Creek, has also been found to present threats to fish and wildlife propagation, recreation, stock watering, irrigation, and warm water semi-permanent fish life because of detrimental specific conductance, total dissolved solids, total suspended solids, and salinity in those waters stemming from runoff from nearby livestock grazing areas, feeding operations, and/or crop production (SDDENR 2012b).

Wetlands have been identified within the area of the Site and downstream of the Site along Pass Creek within the 15-mile TDL. The wetlands within the area of the Site are primarily designated as Palustrine Emergent (PEM) or Palustrine Unconsolidated Shore (PUS), with modifiers identifying the wetlands as seasonally or temporarily flooded and excavated or diked/impounded features. In addition, the Triangle Mine Pit area includes a Palustrine Unconsolidated Bottom (PUB) intermittently exposed excavated feature. Downstream from the Site along Pass Creek are Palustrine Aquatic Bed (PAB) and PEM wetlands that are semi-permanently flooded (U.S. Fish and Wildlife Service [USFWS] 2014). The wetlands within the area of the Site do not meet actual shoreline (frontage) qualifications to be evaluated for HRS scoring (EPA 2013).

The segment of Beaver Creek downstream of its confluence with Pass Creek does not contain identified wetlands until its confluence with the Cheyenne River, where Riverine Lower Perennial Unconsolidated Bottom semi-permanently flooded (R2UBF) and Palustrine Emergent temporarily flooded (PEMA) wetlands exist. Along the Cheyenne River, classified wetlands include Riverine Lower Perennial Unconsolidated Shore temporarily flooded (R2USA), seasonally flooded (R2USC), R2UBF, and PEMA (USFWS 2014). PEMA wetlands on the Cheyenne River approximately 1.7 miles downstream of its confluence with Beaver Creek include approximately 0.23 mile of contiguous frontage, meeting eligibility requirements and size criteria to be evaluated for HRS scoring. Additional PEMA wetlands on the Cheyenne River occur approximately 2.9 miles downstream of its confluence with Beaver Creek, where approximately 0.14 mile of contiguous frontage exists, also meeting eligibility requirements and size criteria to be evaluated for HRS scoring. Other R2USA and R2USC wetlands are present along the

Cheyenne River; however, additional information is needed to determine whether these wetlands have been impacted by the Site. The previous downstream sample location on the Cheyenne River was outside of the 15-mile TDL; therefore, data from that location cannot be used to evaluate attribution of contamination to the Site for HRS scoring purposes (EPA 2014).

Threatened and endangered species known or likely to occur in Custer and Fall River Counties are listed in Table 10. Powertech conducted surveys of the proposed PAA (including the area of the Site), including a 1-mile perimeter of the area, for threatened and endangered species, bald eagle winter roosts, all nesting raptors, upland game bird leks, and big game. In addition to the surveys, incidental observations of all vertebrate wildlife species within the PAA were recorded during each site visit during the year-long baseline survey period. Surveys were also conducted within the PAA for other vertebrate species of concern tracked by the South Dakota National Heritage Program (SDNHP), as well as bats, small mammals, lagomorphs, prairie dog colonies, breeding birds, predators, and herptiles (reptiles and amphibians). All the surveys were conducted by qualified biologists using standard field equipment and appropriate field guides. The black-footed ferret and the greater sage-grouse are the only federally listed species known to occur in both Custer and Fall River Counties. No federally listed vertebrate species were documented within the project survey area. Surveys for the black-footed ferret were not required for this project due to a block-clearance issued by the USFWS that includes the entire PAA and vicinity. The only exception to that clearance is in Custer State Park in northern Custer County. Surveys were also conducted by TVA in the general vicinity of the PAA during fall 1977. No ferrets or evidence of their presence were observed during those historical surveys (Powertech 2009). The following federally listed threatened and endangered species listed in Table 10 possibly occur in the two counties or possibly migrate through the counties (USFWS 2013).

TABLE 10

FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE

Common Name	Scientific Name	Status
Whooping Crane	Grus americana	Endangered
Red knot	Calidris canutus rufa	Proposed threatened
Sprague's pipit	Anthus spragueii	Candidate
Black-footed ferret	Mustela nigripes	Endangered
Northern Long-Eared Bat	Myotic septentrionalis	Proposed Endangered
Greater sage-grouse	Centrocercus urophasianus	Candidate

Source: U.S. Fish & Wildlife Service 2013

The State of South Dakota has listed 23 vertebrate species as threatened or endangered. Only one of the species listed was documented within the PAA or 1-mile perimeter during the survey period (mid-July 2007 through early August 2008). One active bald eagle nest was observed within the northwestern portion of the revised permit area (SW ¼, Section 30, Township 6 South, Range 1 East). The nest was in a cottonwood tree along Beaver Creek, and reportedly fledged one young in 2008. The bald eagle was removed from the Federal List of Endangered and Threatened Wildlife on August 8, 2007. However, protection provided to the bald eagle under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act has continued after the species was delisted. The rule change does not affect the bald eagle's status as a threatened or endangered species under state laws, or suspend any other legal protections provided by state laws. In South Dakota, the bald eagle is still considered a threatened species. Bald eagles were repeatedly observed along Beaver Creek in the western portion of the PPA and perimeter during winter roost surveys in late 2007 and early 2008.

7.3 SOIL EXPOSURE AND AIR PATHWAYS AND TARGETS

Standards have been developed for cleanup of radiation-contaminated soil under UMTRCA of 1978 (40 CFR Part 192). The purpose of these standards was to limit risk from inhalation of radon decay products in houses built on mine tailings, and to limit gamma radiation exposure to people using contaminated land. UMTRCA specifies two cleanup standards based on concentrations of Ra-226: (1) surface soil cleanup to 5 pCi/g, and (2) subsurface soil cleanup to 15 pCi/g. An EPA memorandum dated February 12, 1998, clarifies use of these two UMTRCA soil cleanup standards for CERCLA sites (EPA 1998). The surface soil standard of 5 pCi/g for Ra-226 is a health-based standard developed to control the hazard from gamma radiation; therefore, this standard may be appropriate and relevant to CERCLA sites.

Air samples collected within the Site area contained concentrations of Ra-226 that exceeded the 10 CFR Part 20 limit of 0.1 pCi/L for Rn-222 with daughters present (Powertech 2009).

The land within the Site is privately owned and leased. Land use is primarily agricultural and for livestock grazing. Edgemont, the town nearest the Site (approximately 13 miles away), had an estimated population of 774 people in 2010 (U.S. Census 2010). The area surrounding the Site is primarily agricultural. Residents and people farming surrounding land are potential targets. Nobody resides within 200 feet of the Site. No residents are within 1 mile of the Site, and approximately 26 persons reside within the 4-mile TDL (Mable/Geocorr 2014). No daycare centers or schools are within 200 feet of the Site.

8.0 DATA GAPS

Most of the data reviewed for this PA were acquired and reported during the period of approximately 2006 to 2009. Some significant data gaps exist within the information reported. For the PA, source areas were estimated by tracing boundaries of waste piles and surface impoundments by reference to two-dimensional aerial imagery. Soil samples collected by Powertech within the area of the Site (Surface Mine Area [SMA-XX]) were all analyzed for Ra-226. However, of the 25 samples collected, only three were analyzed for additional radionuclides including uranium, Pb-210, and Th-230—the other known contaminants on site. Groundwater samples were collected within the area of the Site from various types of wells; however, lack of groundwater sampling data from near and upgradient of the Site limited availability of reliable background concentrations. Surface water samples were collected from multiple water bodies in the area of the Site, including Pass Creek, Beaver Creek, and the Cheyenne River. However, the downstream Pass Creek surface water sample location was upstream of the probable point of entry (PPE) for surface water migrating from the Site. Additionally, the downstream sample location on the Cheyenne River was beyond the 15-mile TDL (see Figure 8). Therefore, data acquired at that sample point could not be used to evaluate potential surface water impacts from the Site in this PA. Biological samples including fish were collected by Powertech to evaluate potential impacts on surface water bodies including Beaver Creek and the Cheyenne River. Beaver Creek and the Cheyenne River are used by recreational anglers; however, documentation of the extent of use of the water bodies as fisheries is not available. Uranium was detected in all fish collected during July 2008. The detections were interpreted to be the result of increased sample sizes of the species submitted for laboratory analysis. No detections of uranium occurred in samples collected during April 2008; however, the detection limit was higher during that sampling period due to matrix interferences. Pb-210, Th-230, and Ra-226 were detected, but at low concentrations in most samples. Pb-210 was detected in one specimen collected at the downstream Beaver Creek location; however, the precision of the result was questionable due to matrix interferences. Additional data are needed to determine whether the Site is impacting fish in water bodies downstream of the Site.

9.0 SUMMARY

The Site (EPA ID: SDN000803095) is 15 miles from Edgemont, in Custer and Fall River Counties, South Dakota. Geographic coordinates at the approximate center of the Site are 43.478486 degrees north latitude and 103.962746 degrees west longitude. The 1,426-acre Site is used primarily for cattle grazing. ISR is proposed as a possible future use of this site.

Sources

By reference to aerial imagery, approximate areas of mine waste piles were quantified. Surface soil near the mine waste piles has been determined to contain levels of radionuclides exceeding health-based benchmarks and exceeding three times background concentrations, meeting observed release criteria. Additionally, samples collected from impoundments within the area of the Site have contained elevated levels of radionuclides and could also be considered potential source areas for HRS evaluation. Radionuclides are the contaminants of concern, including uranium, Ra-226, Th-230, and Pb-210.

Groundwater Migration Pathway

Sampling results indicate an observed release to groundwater has occurred at the Site. According to results of groundwater sampling and a well inventory conducted by Powertech, 18 domestic wells are within a 4-mile radius of the site boundary. Wells 16 and 42 have contained concentrations of Ra-226 exceeding its MCL and meeting observed release criteria. Concentrations in other wells have been above background levels but have not met observed release criteria; therefore, those wells are subject to potential contamination.

Surface Water Migration Pathway

Sampling results indicate a release of radionuclides has occurred to Pass Creek, Beaver Creek, and the Cheyenne River. There are no known drinking water intakes within the 15-mile TDL. The Cheyenne River and Beaver Creek support fish life and possible food chain targets; however, the extent of use of the water bodies as fisheries is not available. Freshwater emergent and riverine wetlands are present along the riparian areas at the confluence of Beaver Creek and the Cheyenne River and downstream (along the Cheyenne River); however, it is unknown whether these sensitive environments have been impacted by releases from the site. Additional data are needed to properly evaluate the surface water pathway and confirm attribution to contaminants present at the Site.

Soil Exposure and Air Migration Pathways

Surface soil samples collected at the Site have contained elevated concentrations of radionuclides. Additionally, air samples have indicated elevated concentrations of Rn-222 within the area of the Site. However, because of the small number of targets in the immediate vicinity of the Site, those pathways pose limited threat to human health and the environment.

Conclusions

Additional surface soil sampling within the Site appears warranted to better characterize and define source areas. Additional data could be used to quantify source materials within the area of the Site, and volumes of waste piles should be measured more accurately. Additional sampling of surface water and

sediment also appears warranted to determine if releases from the Site are impacting downstream sensitive environments (i.e., wetlands and possible fish habitat).

9.1 EMERGENCY RESPONSE AND REMOVAL ACTION CONSIDERATIONS

Based on available data from previous site assessments by Powertech, a removal action appears warranted to address radium-226 contamination in mine waste piles at the Site. Five soil samples collected from the Site contained radium-226 concentrations that exceeded the EPA health-based standard of 5 pCi/g and exceeded three times background concentrations. Emergency response actions do not appear warranted at the Site.

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FIGURES

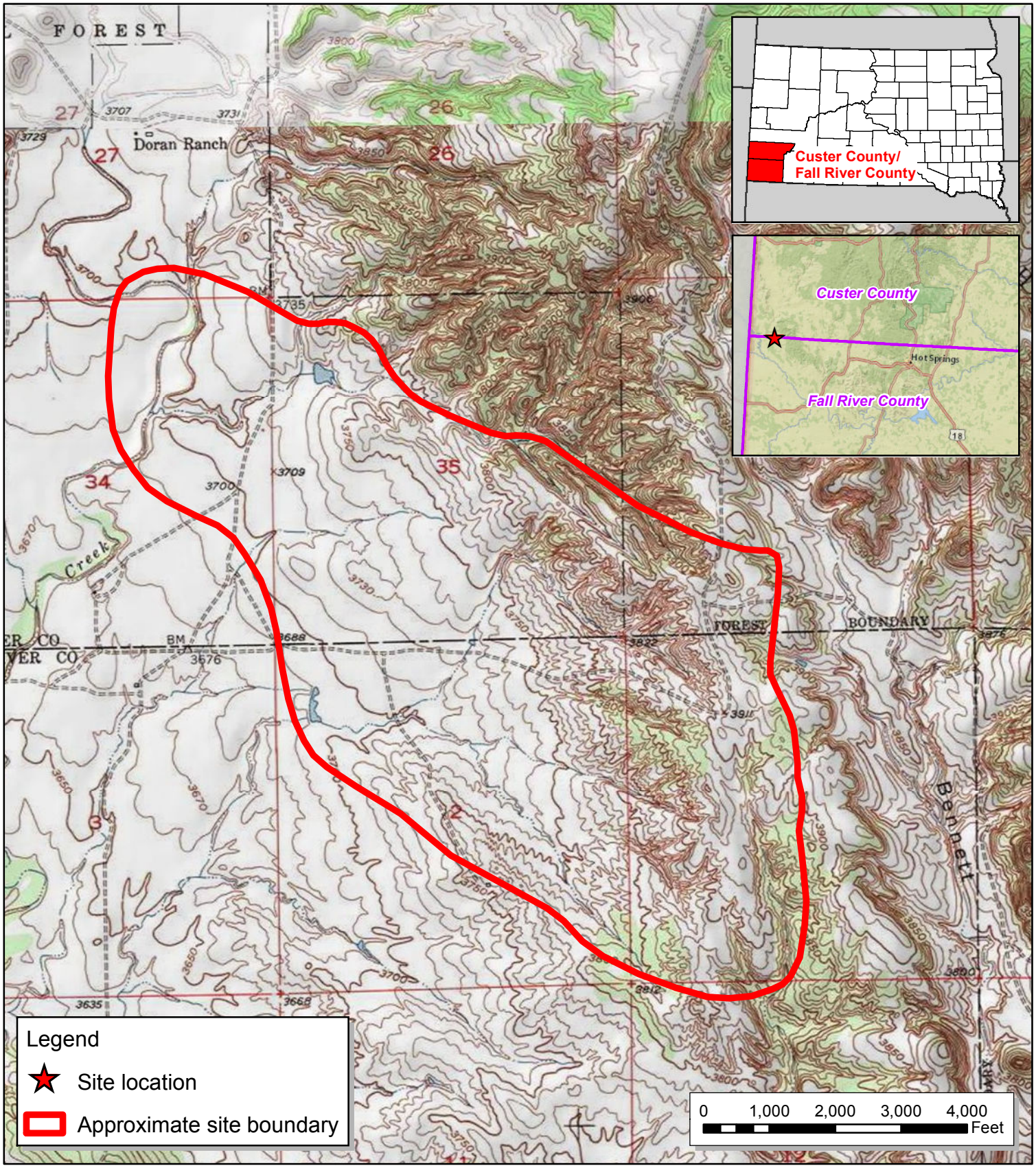

Figure 1
Site Location Map

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Source: ArcGIS Online, World Imagery, 2011

Date: May 2014

Project No: EPS81105.0014

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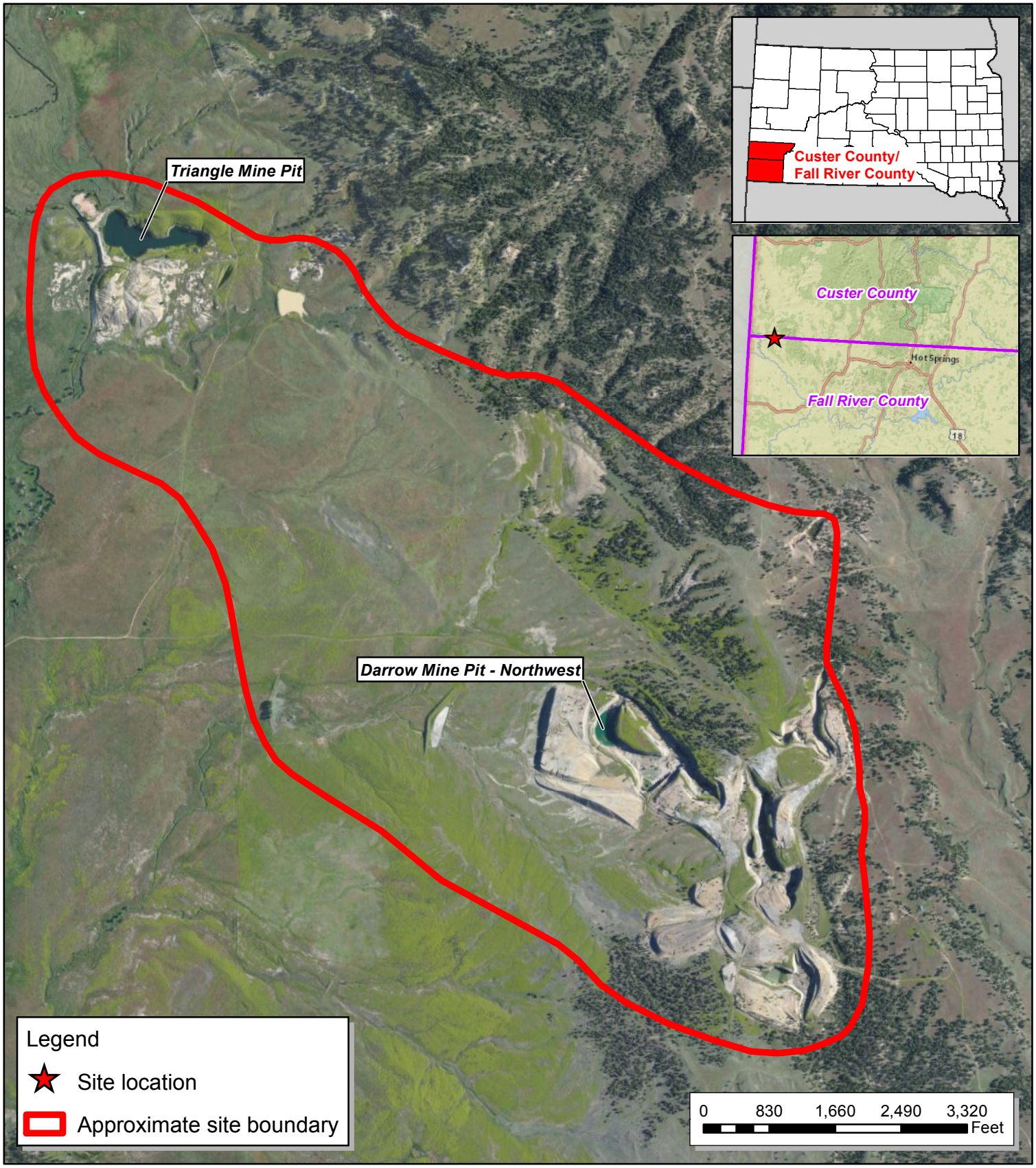

Figure 2
Site Layout Map

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

N
W
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S

Source: ArcGIS Online, World Imagery, 2011

Date: May 2014

Project No: EPS81105.0014

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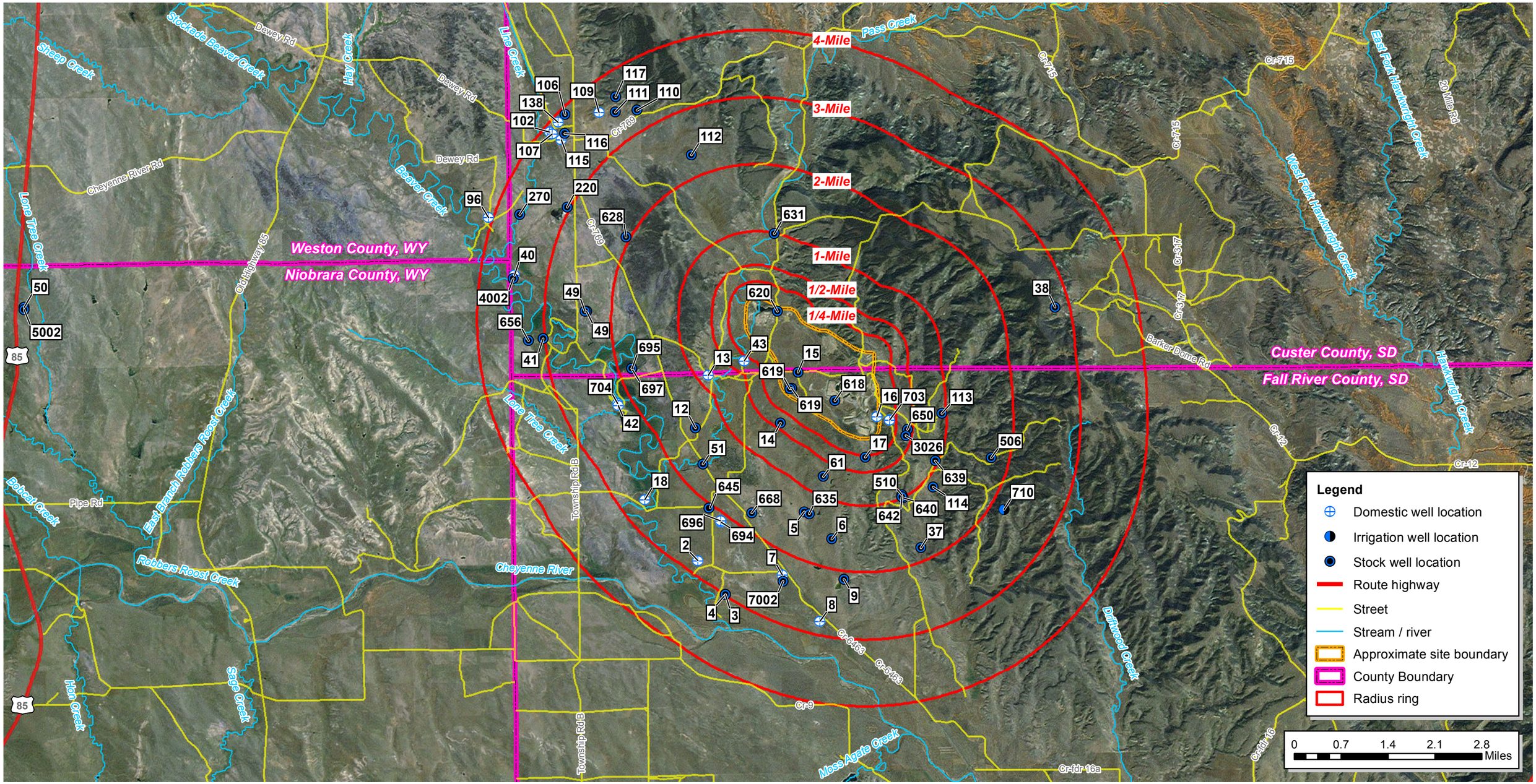

Figure 3
4-Mile Radius Well Locations

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Date: May 2014

Source: ArcGIS Online, World Imagery, 2011; ESRI Data Maps, 2007; HSIP Gold, 2007; Powertech, Inc, 2012.

Project No: EPS81105.0014

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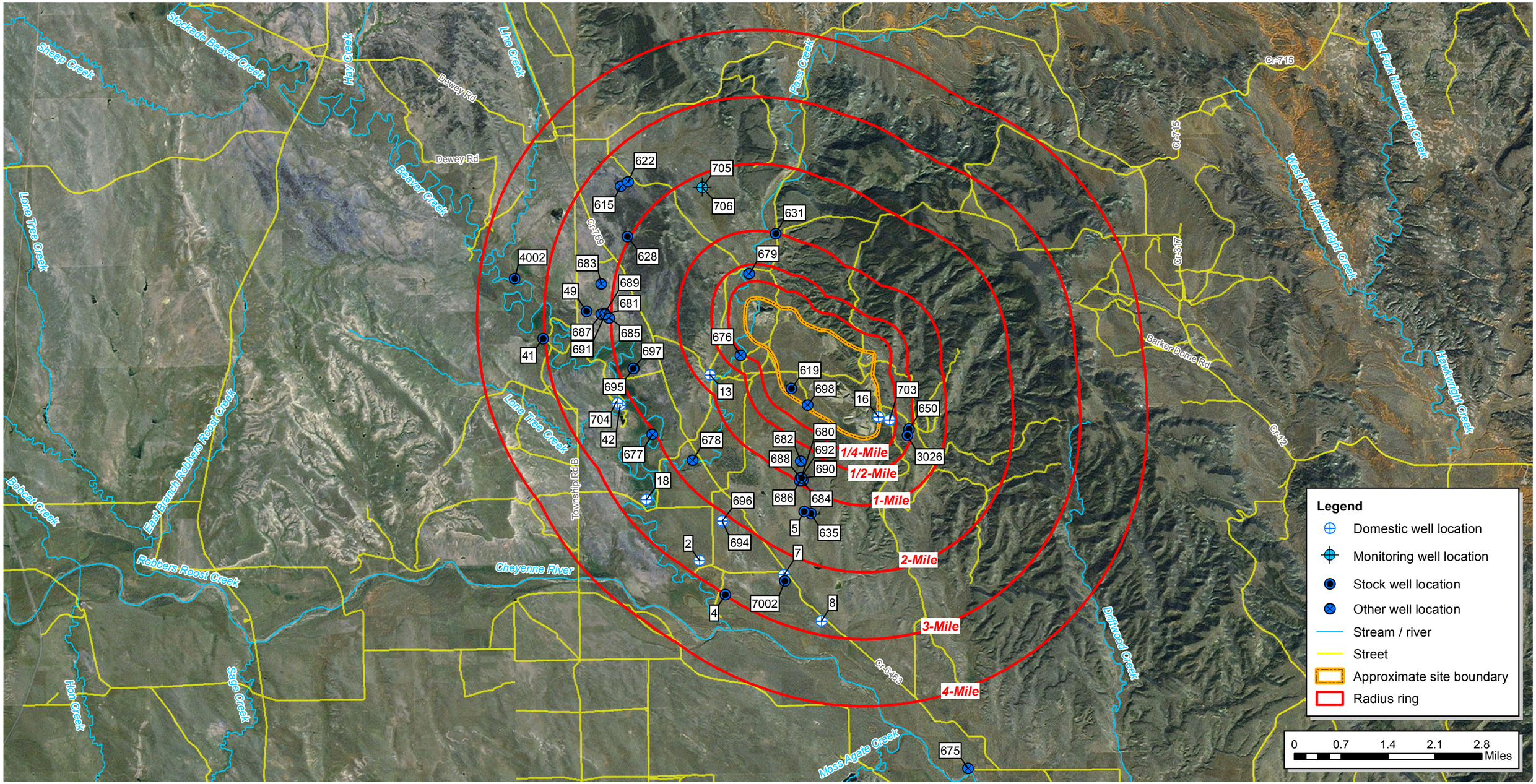

Figure 4
Groundwater Sample Location Map

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

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Date: May 2014

Source: ArcGIS Online, World Imagery, 2011; ESRI Data Maps, 2007; HSIP Gold, 2007; Powertech, Inc, 2009

Project No: EPS81105.0014

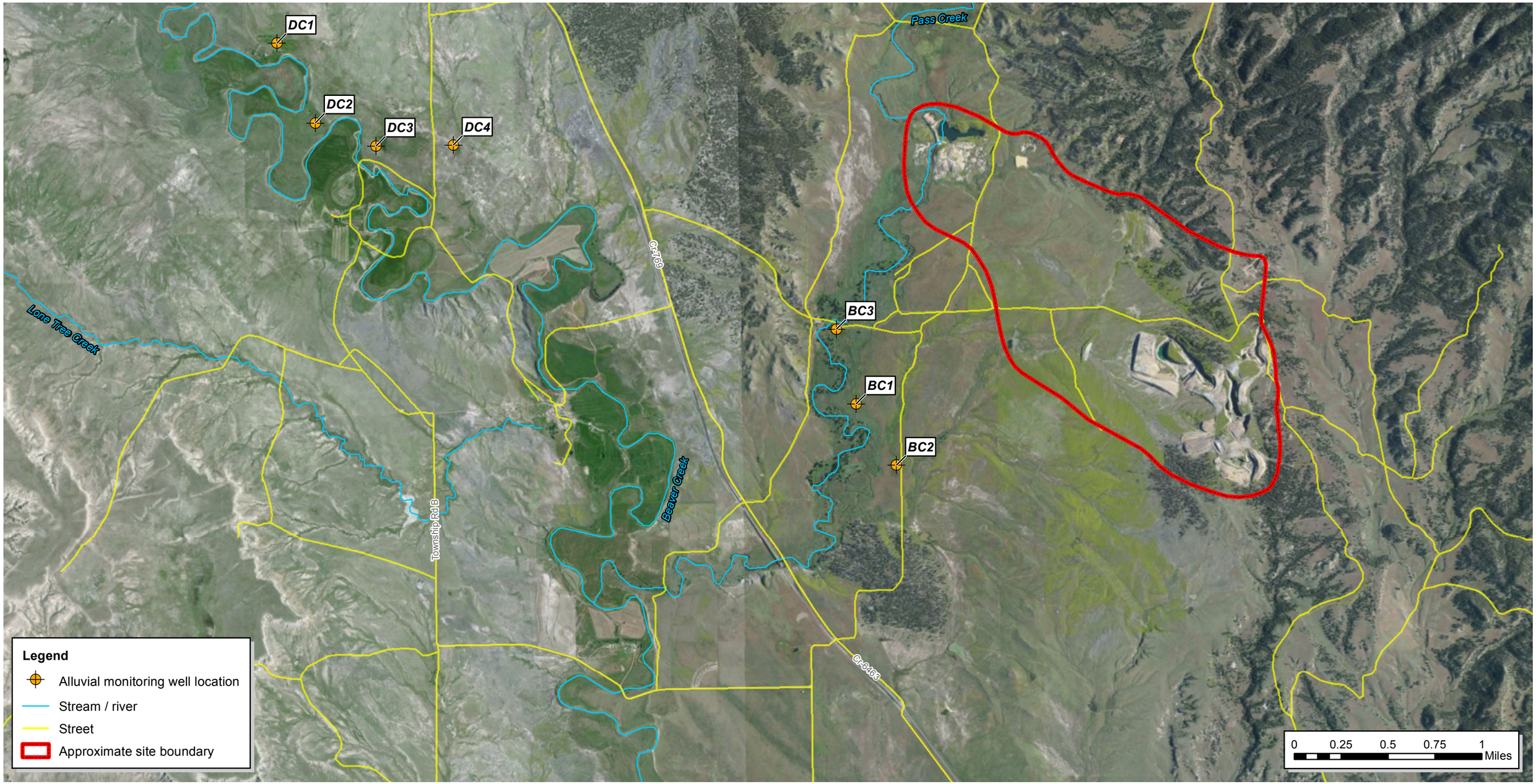

Figure 5
Alluvial Monitoring Well Locations

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

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Date: May 2014

Source: ESRI, ArcGIS Online World Imagery, 2011; ESRI Data Maps, 2007; HSIP Gold, 2007

Project No: EPS81105.0014

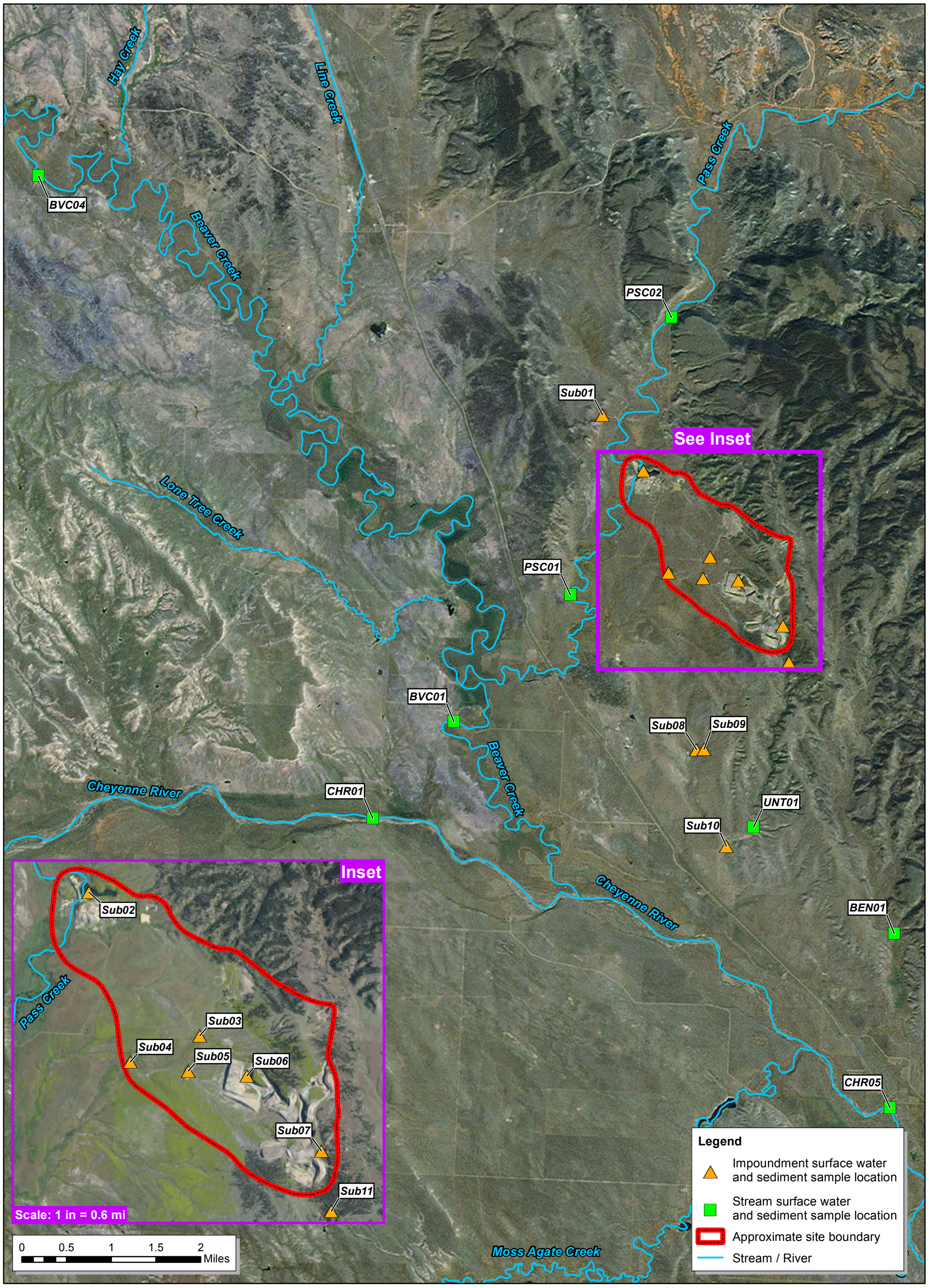

Figure 6
Surface Water and Sediment Sample Locations (Powertech 2008)

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Date: May 2014 | Source: ArcGIS Online, World Imagery, 2011; NHDPlus, 2013, Powertech, Inc, 2008 | Project No: EPS81105.0014

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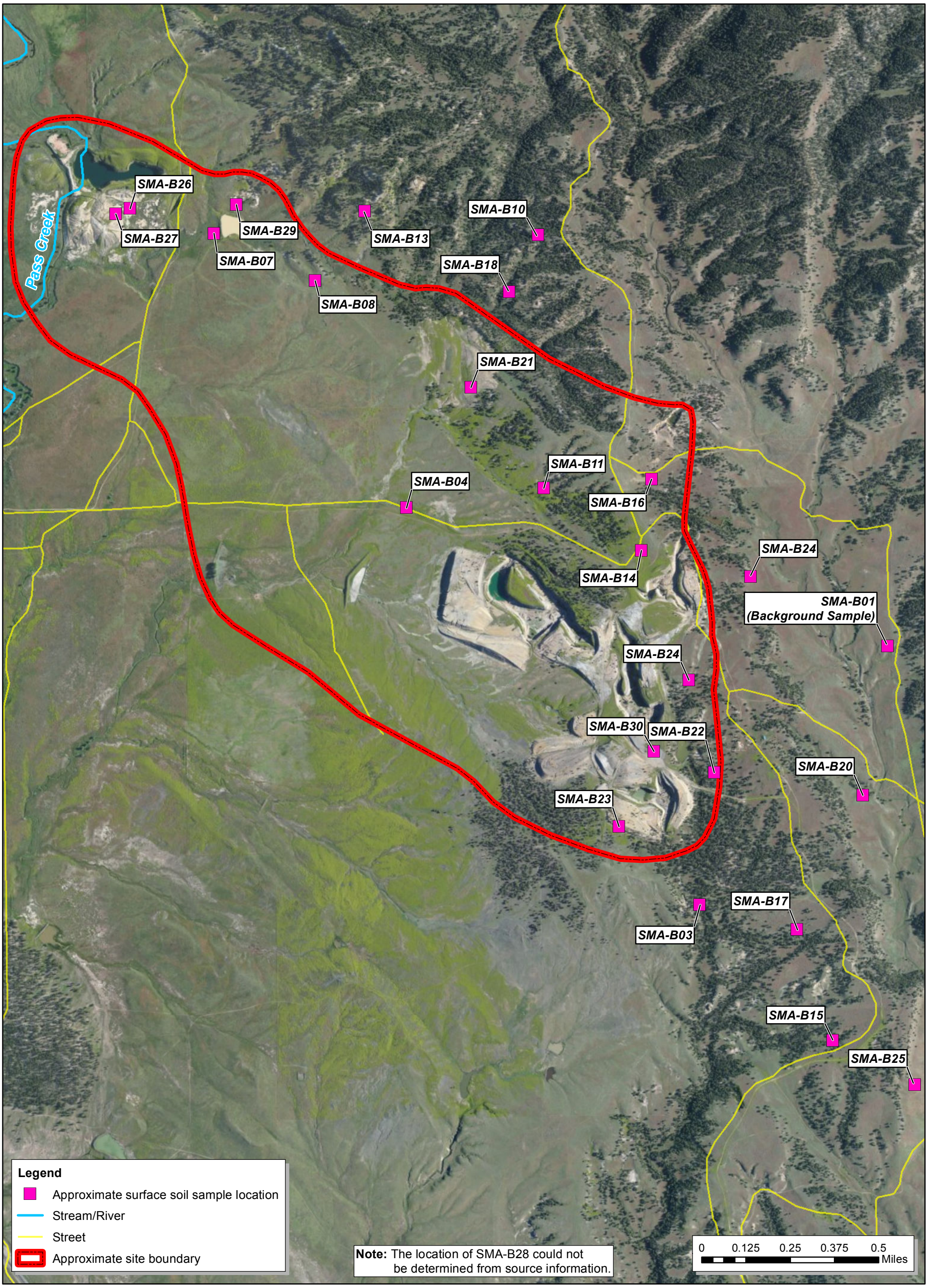

Figure 7
Approximate Surface Soil Sample Locations

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Date: May 2014 | Source: ArcGIS Online, World Imagery, 2010; HSIP Gold, 2007; Powertech, 2009 | Project No: EPS81105.0014

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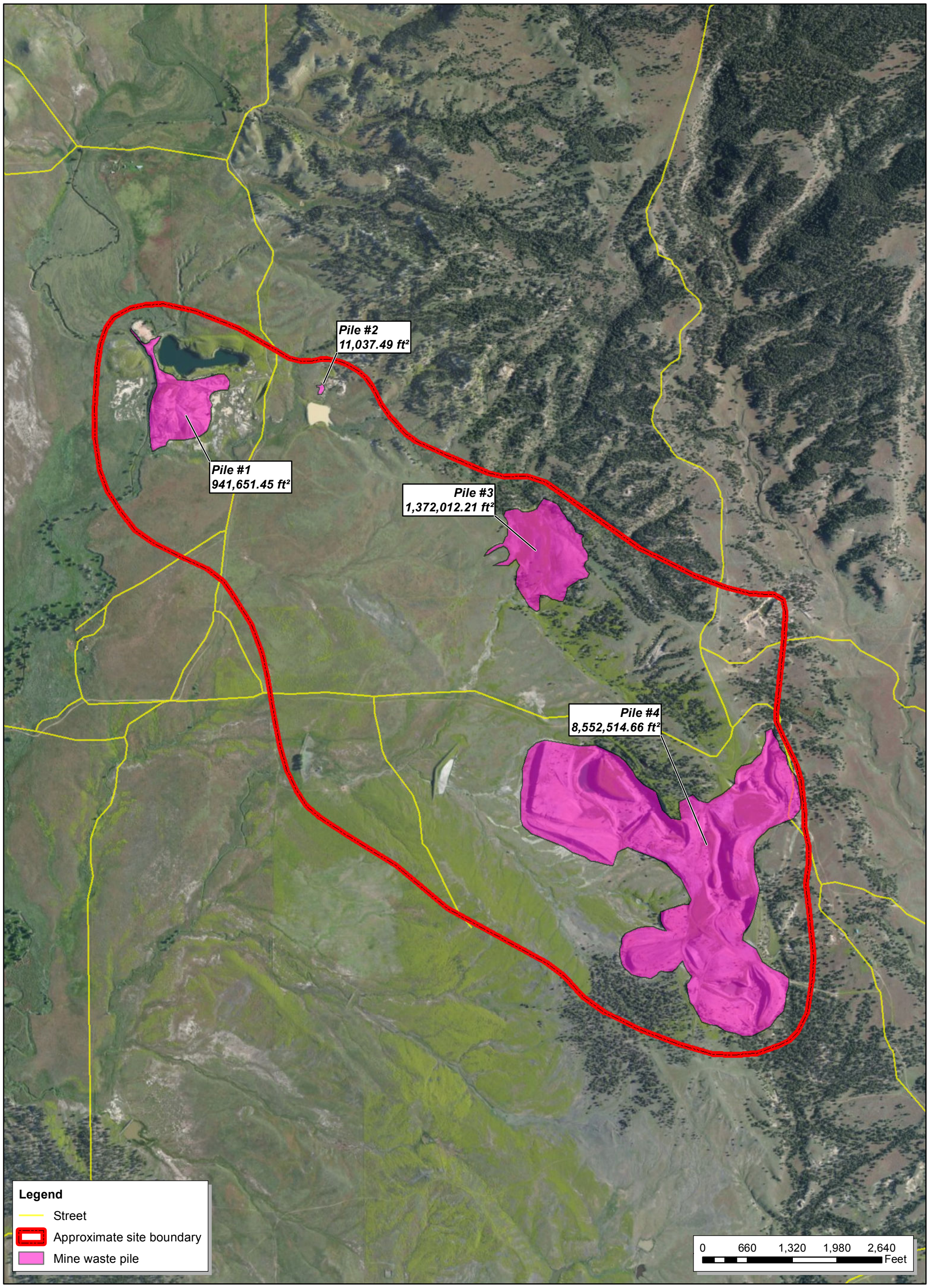

Figure 8
Approximate Source Area Boundaries

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

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Seagull Environmental Technologies, Inc.

Date: May 2014 | Source: ArcGIS Online, World Imagery, 2010; HSIP Gold, 2007; Powertech, 2009 | Project No: EPS81105.0014

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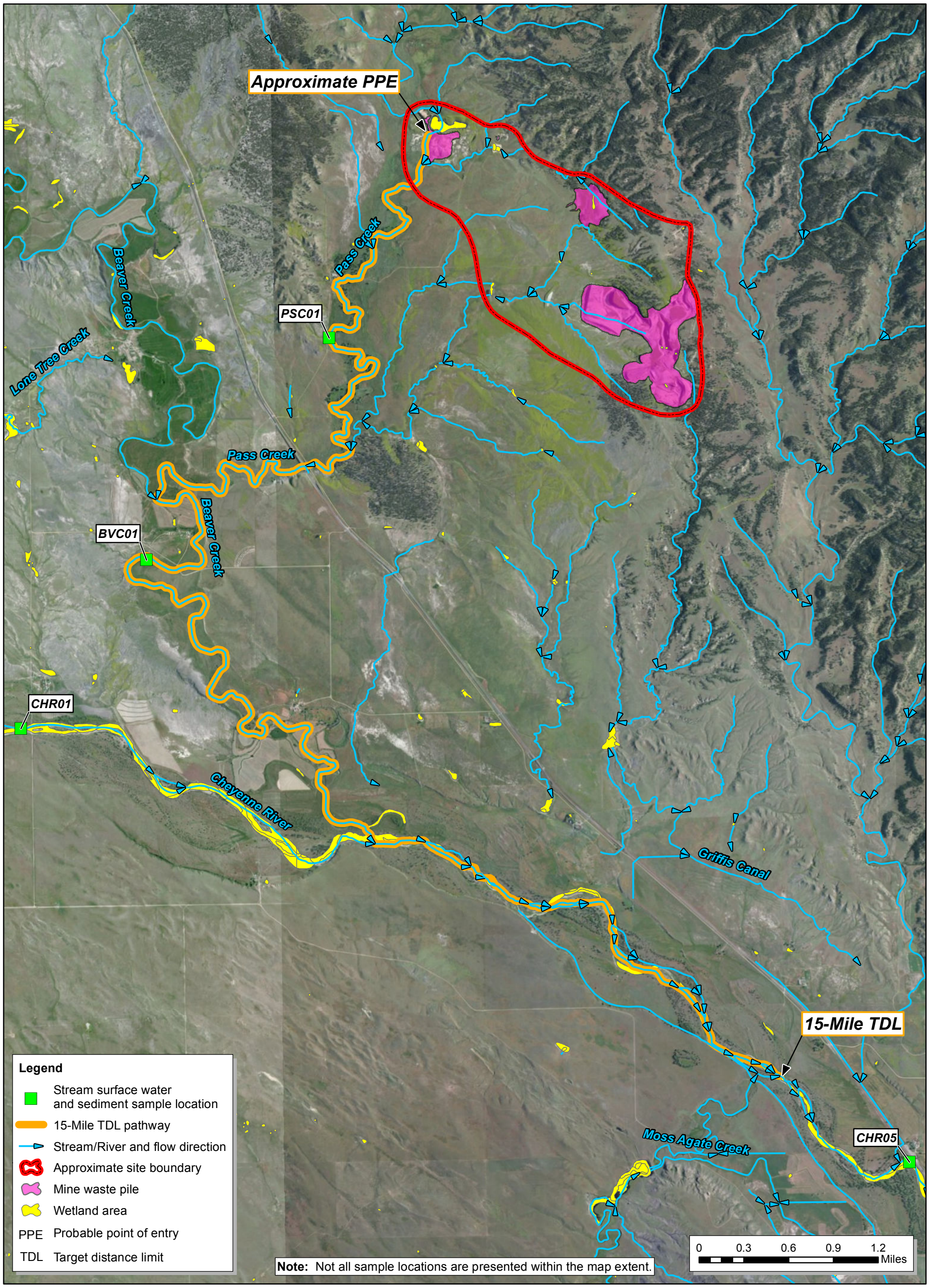

Figure 9
15-Mile Target Distance Limit and Surface Water Sample Locations

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Date: May 2014 Source: ArcGIS Online, World Imagery, 2010; USGS, NHDPlus, 2013; USFWS, NWI, 2013 Project No: EPS81105.0014

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APPENDIX A

SITE RECONNAISSANCE REPORT

Seagull Environmental Technologies, Inc.

3555 Chase Street
Wheat Ridge, Colorado 80212
www.seagullenvirotech.com

May 2, 2014

Victor Ketellapper, Site Assessment Team Leader
U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: **Site Reconnaissance Report regarding the Darrow/Freezeout/Triangle Uranium Mine Site, near Edgemont, Custer and Fall River Counties, South Dakota**
EPA Region 8 START 8(a) Carve-Out Contract EP-S8-11-05, Task Order #0014
Task Monitor: Victor Ketellapper, Site Assessment Team Leader

Dear Mr. Ketellapper

Seagull Environmental Technologies, Inc. (Seagull) is pleased to submit this Site Reconnaissance Report regarding the Darrow/Freezeout/Triangle Uranium Mine site near Edgemont, Custer and Fall River Counties, South Dakota. If you have any questions or comments, please contact the Project Manager via email at gdillon@seagullenvirotech.com or by phone at (816) 412-1953.

Sincerely,

Gregory R. Dillon
Task Order Project Manager

Hieu Q. Vu, PE
Program Manager

Enclosures

PRELIMINARY ASSESSMENT REPORT

Regarding the

DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE

NEAR EDGEMONT, SOUTH DAKOTA

EPA ID: SDN000803095

Contract No.: EP-S8-11-05
Task Order No.: 0014

Prepared By:

SEAGULL ENVIRONMENTAL TECHNOLOGIES, INC.
3555 CHASE STREET
WHEAT RIDGE, COLORADO 80202-1129

May 2, 2014

SITE RECONNAISSANCE REPORT
Darrow/Freezeout/Triangle Uranium Mine Site

DATE/TIME: November 5, 2013, 08:00-17:00.

WEATHER CONDITIONS: Cloudy, snow and rain mixture, calm wind ~26° degrees Fahrenheit (°F).

PARTICIPANTS/AFFILIATION: Gregory Dillon and Jon DeBruine of Seagull Environmental Technologies, Inc.

1.0 INTRODUCTION

Under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team (START) Carve-Out 8(a) Contract (No. EP-S8-11-05), Task Order No. 0014, Seagull Environmental Technologies, Inc. (Seagull) has been tasked to conduct a Preliminary Assessment (PA) for the Darrow/Freezeout/Triangle Uranium Mine (Site) site near Edgemont, Custer and Fall River Counties, South Dakota. As part of the PA, Seagull is submitting this Site Visit Report for activities conducted on November 5, 2013, at the Site. The site visit was conducted to locate previously identified source areas and potential sample locations, and to become familiar with the site layout. The Site is located approximately 13 miles northwest of Edgemont, South Dakota.

2.0 SITE DESCRIPTION

The Site encompasses approximately 1,426 acres and is located primarily on private land. Attempts to gain access to the Site area via letters to private landowners were unsuccessful. During the site reconnaissance, START team members Gregory Dillon and Jonathan DeBruine, and Maple Barnard and Valois Shea of EPA traveled along public roads in the site vicinity in an attempt to attain a vantage point of the Site area. However, the public access roads were inadequate to gain a view of the Site.

Photos of the site area, including drainage areas, historical points of interest, and current conditions of the surrounding area were taken during the site reconnaissance. START and EPA visited Edgemont City Hall to meet with local officials to discuss the purpose of the PA and to obtain information for the report. Following the meeting with local officials, Mr. Mike Koopman, City Engineer/Code Administrator, accompanied START and EPA to visit areas of interest in and around Edgemont. The Edgemont, South Dakota, Uranium Mill Tailings Repository and former mill location were visited during the site reconnaissance. In addition, current City of Edgemont Public Water Supply (PWS) wells were visited to document and confirm their locations.

3.0 AREA DESCRIPTION

The Site is located in Custer and Fall River Counties in the Great Plains physiographic province on the edge of the Black Hills uplift. Land use in the area is primarily agricultural range land for livestock. Surface water from the site drains into tributaries of Pass Creek and Beaver Creek, eventually flowing into the Cheyenne River.

4.0 PHOTOGRAPHIC DOCUMENTATION:

Photographs documenting the site visit are included in Appendix A.

APPENDIX A

PHOTOGRAPHIC DOCUMENTATION

Client: U.S. Environmental Protection Agency	Description: Photograph of the geographic marker at the Edgemont, South Dakota, Uranium Mill Tailings Repository.	Photograph Number: 1
Direction: N/A	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of no trespassing signage at the Edgemont, South Dakota, Uranium Mill Tailings Repository.	Photograph Number: 2
Direction: East	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of City of Edgemont Municipal Well #2 southwest of town. It is currently an active well for the City's Public Water Supply (PWS).	Photograph Number: 3
Direction: North	Photographer: Jon DeBruine	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of City of Edgemont Municipal Well #4 southwest of town. It is currently an active well for the City's PWS.	Photograph Number: 4
Direction: East	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of an overflow outfall of a City PWS basin and stormwater in the Edgemont City Park. The pond is used for recreational fishing seasonally.	Photograph Number: 5
Direction: South	Photographer: Jon DeBruine	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of signage at the boundary of the Black Hills National Forest taken from County Road 16.	Photograph Number: 6
Direction: Northeast	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of Pass Creek at crossing of County Highway 6463.	Photograph Number: 7
Direction: Southwest	Photographer: Gregory Dillon	Date: 11/5/2013

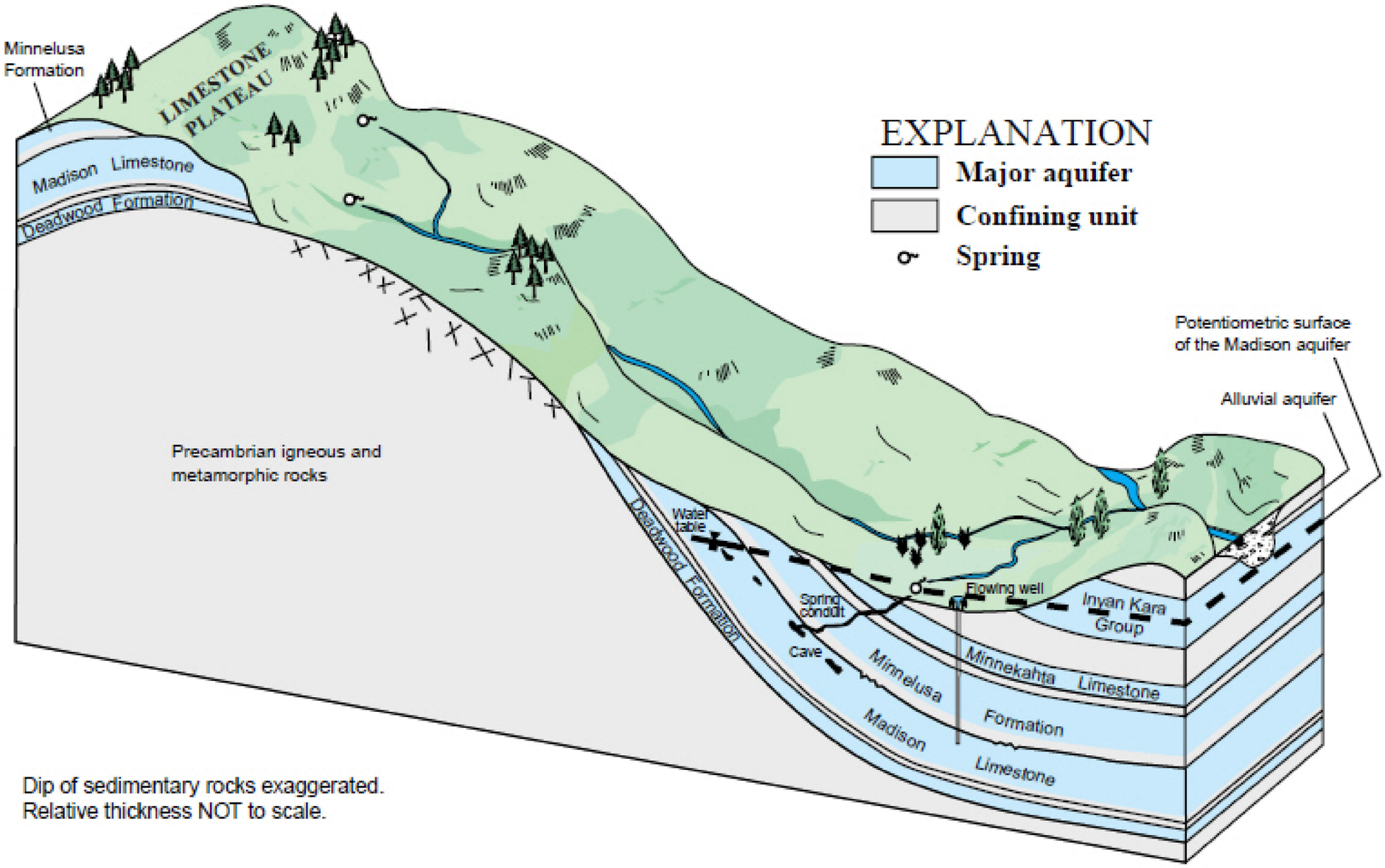
Client: U.S. Environmental Protection Agency	Description: Photograph of Pass Creek at crossing of County Highway 6463.	Photograph Number: 8
Direction: Northeast	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of the Cheyenne River at the approximate 15-mile Target Distance Limit (TDL).	Photograph Number: 9
Direction: West	Photographer: Gregory Dillon	Date: 11/5/2013

Client: U.S. Environmental Protection Agency	Description: Photograph of the Cheyenne River at the approximate 15-mile TDL.	Photograph Number: 10
Direction: South	Photographer: Gregory Dillon	Date: 11/5/2013

APPENDIX B

DIAGRAM OF HYDROGEOLOGY OF BLACK HILLS AREA



Simplified Hydrogeologic Setting of the Black Hills Area

Darrow/Freezeout/Triangle Uranium Mine
Edgemont, South Dakota

Seagull Environmental Technologies, Inc.

Date: May 2014

Source: Driscoll, et al. (2002)

Project No: EPS81105.0014

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APPENDIX C

CERCLA ELIGIBILITY CHECKLIST

CERCLA Eligibility Checklist

Site Name: Darrow/Freezeout/Triangle Uranium Mine
Alias:
City: near Edgemont State South Dakota Zip code 57735
EPA ID Number ***(Note - This may be a RCRA or other program ID)*****: SDN000803095**

Note: The site is automatically CERCLA eligible if it is a federally owned or operated RCRA site.

I. CERCLA Authority	**Y**	**N**
A. Is the release or threat of release a result of naturally occurring substances in its unaltered form, or altered solely through naturally occurring processes of phenomena, from a location where it is naturally found?		X
B. Is the release or threat of release a result of products that are part of the structure of, and result in exposure within, residential buildings or business or community structures?		X
C. Does the release or threat of release affect public or private drinking water supplies due to deterioration of the system through ordinary use?		X
If YES to A, B, or C, the EPA may not have authority to respond.		
If NO to A, B, or C, the EPA may have authority to respond.		

II. CERCLA Eligibility	**Y**	**N**
A. Has this site been previously entered into CERCLIS or is it part of, or adjacent to, an existing CERCLIS site?	X	
B. Is this site part of a National Priority List site?		X
C. Did the facility cease operations prior to November 19, 1980?		X
If YES to A, B, or C, then STOP. The facility is probably a CERCLA site.		
If NO, Continue		
1. RCRA Deferral Factors Did the facility file a RCRA Part A application?		
If YES: a. Does the facility currently have interim status?		
b. Did the facility withdraw its Part A application?		
c. Is the facility a known or possible protective filer? (e.g., filed in error, or never operated as TSDFs)		
d. Does the facility have a RCRA Part B Operating Permit or a post closure permit?		
e. Is the facility a late (after 11/19/80) or non-filer that has been identified by the EPA or the state? (i.e., facility did not know it needed to file under RCRA)		
If all answers to questions a, b, and c are NO, STOP. The facility is a CERCLA eligible site.		
If answer to b or c is YES, STOP. The facility is a CERCLA eligible site.		
If answer to b and c are NO and any other answer is YES, site is RCRA, continue to Part 2.		

CERCLA Eligibility Checklist

2. RCRA Sites Eligible for the NPL Type of facility: Generator____ Transporter___ Recycler_____ TSDF (Treatment/Storage/Disposal Facility)X		
a. Has the facility owner filed for bankruptcy under federal or state laws?		
b. Has the facility lost RCRA authorization to operate or shown probable unwillingness to carry out corrective actions?		
c. Is the facility a TSDF "converter," i.e., former TSF that did not pursue a RCRA operating permit and have changed status to "generator" or "non-handler"?		
d. Is the facility a non- or late filer?		
If answer to a, b, c, or d is YES, STOP. The facility is a CERCLA eligible site.		
D. Excluded Releases:		
1. Does the CERCLA Petroleum Exclusion apply (CERCLA section 101 (13))?		
2. Does the facility have discharges of CERCLA hazardous substances that are in compliance with federally permitted releases as described in CERCLA section 101 (10)?		
3. Does the facility have a release or threat of release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against their employer as described in CERCLA section 101 (22)?		
4. Does the facility have a release or threat of release which results from emissions from engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine as described in CERCLA section 101 (22)?		
5. Does the facility have a release or threat of release which results from source, byproduct or special nuclear material from a nuclear incident subject to section 170 of the Atomic Energy Act; or from any processing site specifically designated under the Uranium Mill Tailings Radiation Control Act of 1978 as described in CERCLA section 101 (22)?		
6. Does the facility have a release or threat of release which results from the normal application of fertilizer?		
If answer to 1, 2, 3, 4, 5, or 6 is YES, the facility is NOT CERCLA eligible.		
If NO, the facility may be CERCLA eligible. (If unknown, answer NO). Please list hazardous substances here. .		

CERCLA Eligibility Checklist

III. Other programs: The site may never reach the NPL or be a candidate for removal. We need to be able to refer it to any other programs in EPA or state agencies which may have jurisdiction, and thus be able to affect a cleanup. Responses should summarize available information pertaining to the question. Include information in existing files in these programs as part of the PA. Answer all that apply.		
A. Is there an owner or operator?		
B. NPDES-CWA: Is there a discharge water containing pollutants with surface water through a point source (pipe, ditch, channel, conduit, etc.)?		
C. CWA (404): Have fill or dredged material been deposited in a wetland or on the banks of a stream? Is there evidence of heavy equipment operating in ponds, streams or wetlands?		
D. UIC-SDWA: Are fluids being disposed of to the subsurface through a well, cesspool, septic system, pit, etc.?		
E. TSCA: Is it suspected that there are PCB's on the site which came from a source with greater than 50 ppm PCB's such as oil from electrical transformers or capacitors?		
F. FIFRA: Is there a suspected release of pesticides from a pesticide storage site? Are there pesticide containers on site?		
G. RCRA (D): Is there an owner or operator who is obligated to manage solid waste storage or disposal units under state solid waste or groundwater protection regulations?		
H. UST: Is it suspected that there is a leaking underground storage tank containing a product which is a hazardous substance or petroleum?		
I. Brownfields: Is there redevelopment/revitalization interest		

Is the site eligible for an assessment under CERCLA authority? Please circle: Yes or No

Site Determination:

Is this site a valid site or incident? Please Circle and explain below

YES or NO

☐ **Enter the site into CERCLIS. Further assessment is recommended (explain below)**

☐ **The site is not recommended for placement into CERCLIS (explain below)**

DECISION/DISCUSSION/RATIONALE:

CERCLA Eligibility Checklist

Regional EPA Reviewer: _____ **Date:** _____

State Agency Reviewer: _____ **Date:** _____

APPENDIX D

POTENTIAL HAZARDOUS WASTE PRELIMINARY ASSESSMENT FORM

OMB Approval Number: 2050-0095
Approved for Use Through: 1/92

EPA Potential Hazardous Waste Site Preliminary Assessment Form

Identification
SDN000803095

State SD	Site Number SDN000803095

CERCLIS Discovery Date: March 15, 2013

1. General Site Information

Name: Darrow/Freezeout/Triangle Uranium Mine	Street Address: 13 miles NNW of Edgemont				
City: near Edgemont	State: SD	Zip Code: 57735	County: Custer and Fall River	Co. Code 21 and 27	Cong. Dist: 30
Latitude: 43.478486 Longitude:-103.962746	Approximate Area of Site: 1,426 Acres _____ Square Miles		Status of Site: ☐ Active ☐ Not Specified X Inactive ☐ NA		

2. Owner/Operator Information

Owner: Not Applicable (NA)			Operator:		
Street Address:			Street Address:		
City:			City:		
State:	Zip Code:	Telephone	State:	Zip Code:	Telephone

Type of Ownership:
- ☐ Private
- ☐ Federal Agency
  Name _____
- ☐ State
- ☐ Indian
- ☐ County
- ☐ Municipal
- ☐ Not Specified
- ☐ Other _

How Initially Identified:
- ☐ Citizen Complaint
- ☐ PA Petition
- ☐ State/Local Program
- ☐ RCRA, CERCLA Notification
- ☐ Federal Program
- ☐ Incidental
- ☐ Not Specified
- ☐ Other _____

3. Site Evaluator Information

Name of Evaluator: Gregory R. Dillon	Agency/Organization: Seagull Environmental Technologies, Inc.	Date Prepared: 04/29/2014
Street Address: 3555 Chase Street	City: Wheat Ridge	State: Colorado
Name of EPA or State Agency Contact: Victor Ketellapper (EPA)	Street Address: 1595 Wynkoop Street	
City: Denver	State: Colorado	Telephone: 303-312-6578

4. Site Disposition (for EPA use only)

Emergency Response/Removal Assessment Recommendation: ☐ Yes ☐ No Date _____	CERCLIS Recommendation: ☐ Higher Priority SI ☐ Lower Priority SI ☐ NFRAP ☐ RCRA ☐ Other _____ ☐ Date _____	Signature: Name (typed): Position:

CERCLIS Number:
SDN000803095

5. General Site Characteristics

Predominant Land Uses Within One Mile of Site (Check all that apply):
- ☐ Industrial
- ☐ Commercial
- ☐ Residential
- X Forest/Fields
- X Agricultural
- X Mining
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility _____
- ☐ Other _____

Site Setting:
- ☐ Urban
- ☐ Suburban
- X Rural

Years of Operation:
Beginning Year 1952
Ending Year 1994
- ☐ Unknown

Type of Site Operations (Check all that apply):
- ☐ Manufacturing (must check subcategory)
  - ☐ Lumber and Wood Products
  - ☐ Inorganic Chemicals
  - ☐ Plastic and/or Rubber Products
  - ☐ Paints, Varnishes
  - ☐ Industrial Organic Chemicals
  - ☐ Agricultural Chemicals (e.g., pesticides, fertilizers)
  - X Miscellaneous Chemical Products (e.g., adhesives, explosives, ink)
  - ☐ Primary Metals
  - ☐ Metal Coating, Plating, Engraving
  - ☐ Metal Forging, Stamping
  - ☐ Fabricated Structural Metal Products
  - ☐ Electronic Equipment
  - ☐ Other Manufacturing
  - X Mining
  - X Metals
  - ☐ Coal
  - ☐ Oil and Gas
  - X Non-metallic Minerals
- ☐ Retail
- ☐ Recycling
- ☐ Junk/Salvage Yard
- ☐ Municipal Landfill
- ☐ Other Landfill
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility _____
- ☐ RCRA
- ☐ Treatment, Storage, or Disposal
- ☐ Large Quantity Generator
- ☐ Small Quantity Generator
- ☐ Subtitle D
- ☐ Municipal
- ☐ Industrial
- ☐ Converter
- ☐ Protective Filer
- ☐ Non- or Late Filer
- ☐ Not Specified
- ☐ Other _____

Waste Generated:
- ☐ On site
- ☐ Off-site
- X On site and off-site

Waste Deposition Authorized By:*
- ☐ Present Owner
- X Former Owner
- ☐ Present & Former Owner
- ☐ Unauthorized
- ☐ Custer County Roads & Bridges

Waste Accessible to the Public:*
- ☐ Yes
- X No (on site) Unknown if off-site disposal is accessible to public.

Distance to Nearest Dwelling, School, or Workplace:
> 200 Feet

6. Waste Characteristics Information

Source Type: (Check all that apply)	Source Waste Quantity: (Include units)	Tier*:
☐ Landfill		
☐ Surface Impoundment		
☐ Drums		
☐ Tanks and Non-Drum Containers		
☐ Chemical Waste Pile		
☐ Scrap Metal or Junk Pile		
X Tailings Pile	10,877,215.81 ft^2	A
☐ Trash Pile (open dump)		
☐ Land Treatment		
☐ Contaminated Groundwater Plume (unidentified source)		
☐ Contaminated Surface Water/Sediment (unidentified source)		
☐ Contaminated Soil		
☐ Other_____		
☐ No Sources		

* C = Constituent W = Waste stream V = Volume A = Area

General Types of Waste (Check all that apply)
- ☐ Metals
- ☐ Organics
- X Inorganics
- ☐ Solvents
- ☐ Paints/Pigments
- ☐ Laboratory/Hospital Waste
- X Radioactive Waste
- ☐ Construction/Demolition Waste
- ☐ Pesticides/Herbicides
- ☐ Acids/Bases
- ☐ Oily Waste
- ☐ Municipal Waste
- ☐ Mining Waste
- ☐ Explosives
- ☐ Other _____

Physical State of Waste as Deposited (Check all that apply):*
- X Solid
- ☐ Liquid
- ☐ Sludge
- ☐ Gas
- ☐ Powder

CERCLIS Number:

SDN000803095

7. Groundwater Pathway

Is Groundwater Used for Drinking Water Within 4 Miles?

X Yes
☐ No

Type of Drinking Water Wells Within 4 Miles (Check all that apply):

☐ Municipal
X Private
☐ None

Is There a Suspected Release to Groundwater?

X Yes
☐ No

Have Primary Target Drinking Water Wells Been Identified?

X Yes
☐ No

If yes, Enter Primary Target Population: Approximately 4.24 individuals based on County average populations per household.

List Secondary Target Population Served by Groundwater Withdrawn From:

0 - ¼ Mile * 2.12
> ¼ - ½ Mile * 2.17
> ½ - 1 Mile * 2.12
> 1 - 2 Miles * 0
> 2 - 3 Miles * 14.84
> 3 - 4 Miles * 13.02

Total Within 4 Miles 34.27

Depth to Shallowest Aquifer:

0 to 50 feet below ground surface

Karst Terrain/Aquifer Present:

☐ Yes
X No

Nearest Designated Wellhead Protection Area:

☐ Underlies Site
☐ > 0 - 4 Miles
X None Within 4 Miles

8. Surface Water Pathway

Type of Surface Water Draining Site and 15 Miles Downstream (Check all that apply):

X Stream X River X Pond ☐ Lake
☐ Bay ☐ Ocean ☐ Other _____

Shortest Overland Distance From Any Source To Surface Water:*

< 100 Feet

_____ Miles

Is There a Suspected Release to Surface Water?

X Yes
☐ No
☐ Unknown

Site is Located in:

☐ Annual - 10-year Floodplain
X > 10-year - 100-year Floodplain
☐ > 100-year - 500-year Floodplain
☐ > 500-year Floodplain

Drinking Water Intakes Located Along the Surface Water Migration Path:

☐ Yes
X No

Have Primary Target Drinking Water Intakes Been Identified:

☐ Yes
X No

If Yes, Enter Population Served by Primary Target Intakes:

0 People

List All Secondary Target Drinking Water Intakes:

Name	Water Body	Flow (cfs)	Population Served

Fisheries Located Along the Surface Water Migration Path:

X Yes
☐ No

Have Primary Target Fisheries Been Identified:

X Yes
☐ No

List All Secondary Target Fisheries:

Water Body/Fishery Name	Flow (cfs)
Beaver Creek	9.9
Cheyenne River	23.0

EPA **Potential Hazardous Waste Site**
Preliminary Assessment Form - Page 4 of 4

CERCLIS Number:
SDN000803095

8. Surface Water Pathway (continued)

Wetlands Located Along the Surface Water Migration Path:
X Yes
☐ No
☐ Unknown

Have Primary Target Wetlands Been Identified:
☐ Yes
X No

List Secondary Target Wetlands:

Water Body	Flow (cfs)	Frontage Miles
Cheyenne River (PEMA) 23.0		0.23
Cheyenne River (R2USA) 23.0		0.74
Cheyenne River (R2USA) 23.0		0.27

Other Sensitive Environments Located Along the Surface Water Migration Path:
☐ Yes
X No

Have Primary Target Sensitive Environments Been Identified:
☐ Yes
X No

List Secondary Target Sensitive Environments:

Water Body	Flow (cfs)	Sensitive Environment Type

9. Soil Exposure Pathway

Are People Occupying Residences or Attending School or Daycare On or Within 200 Feet of Areas of Known or Suspected Contamination:*
☐ Yes
X No

If Yes, Enter Total Resident Population:

_____ People (part-time

Number of Workers On Site:*
X None
☐ 1 - 100
☐ 101 - 1,000
☐ >1,000

Have Terrestrial Sensitive Environments Been Identified On or Within 200 Feet of Areas of Known or Suspected Contamination?
☐ Yes
X No

If Yes, List Each Terrestrial Sensitive Environment:

10. Air Pathway

Is There a Suspected Release to Air:
☐ Yes
X No

Enter Total Population On or Within:

On Site	
0 – 1/4 Mile	
>1/4 – 1/2 Mile	
>1/2 Mile - 1 Mile	
>1 - 2 Miles	
>2 - 3 Miles	
>3 - 4 Miles	
Total Within 4 Miles	

Wetlands Located Within 4 Miles of the Site:
X Yes
☐ No
☐ Unknown

Other Sensitive Environments Located Within 4 Miles of the Site:*
☐ Yes
☐ No
X Unknown

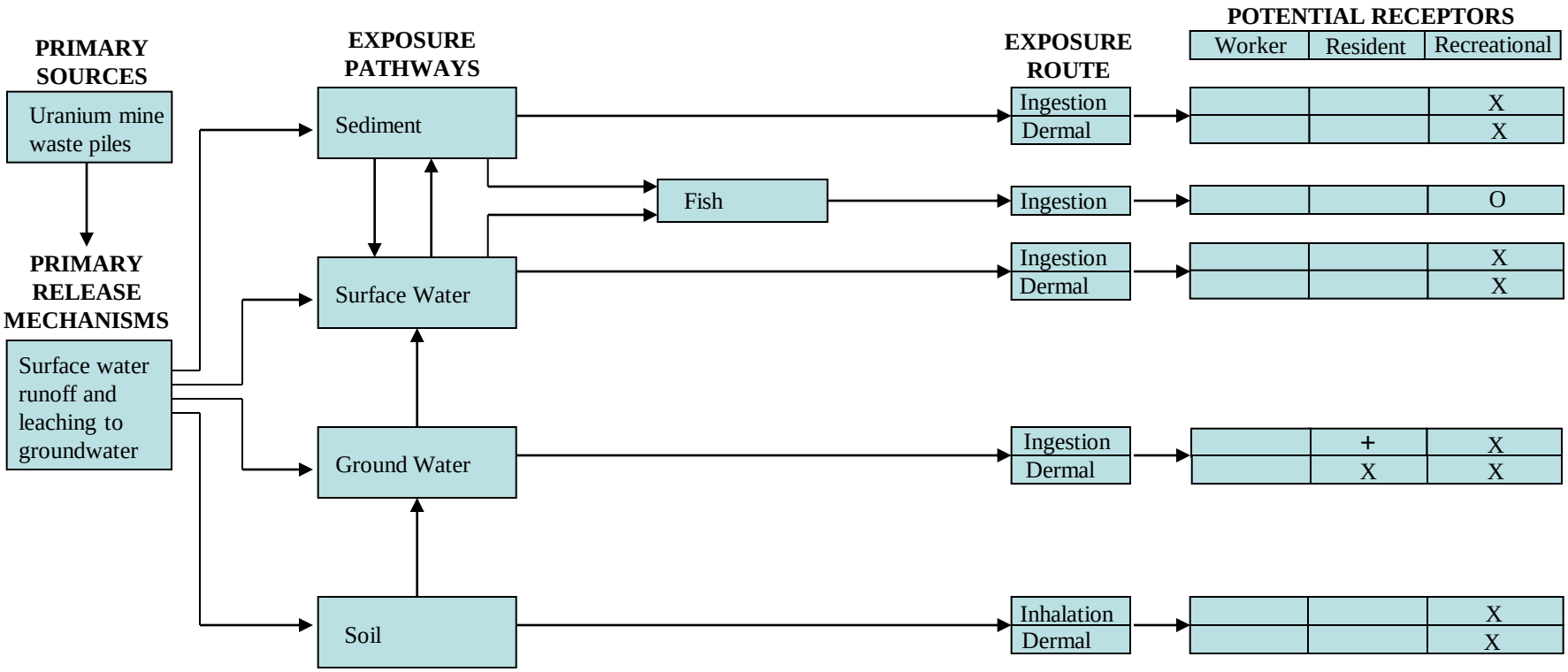
List All Sensitive Environments Within 1/2 Mile of the Site:

Distance	Sensitive Environment Type/Wetlands Area (acres)
On Site	
0 – 1/4 Mile	
> 1/4 - 1/2 Mile	

APPENDIX E

CONCEPTUAL SITE MODEL

SITE CONCEPTUAL MODEL
DARROW/FREEZEOUT/TRIANGLE URANIUM MINE SITE
EDGEMONT, SOUTH DAKOTA



Legend

	No evaluation required.
O	Pathway is not complete.
X	Pathway is or might be complete but is judged to be minor.
+	Pathway is or might be complete and could be significant.