SEMS-RM DOCID # 100032066

IRON KING MINE - HUMBOLDT SMELTER SUPERFUND SITE PROPOSED PLAN

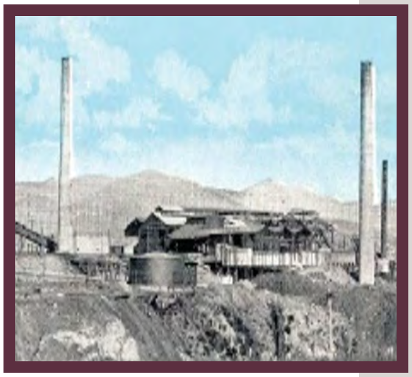
U.S. Environmental Protection Agency | Region 9 | Dewey-Humboldt, AZ | March 2023

Introduction

The U.S. Environmental Protection Agency (EPA) proposes to protect human health and the environment by taking a cleanup action (or, "remedial action") for the Iron King Mine - Humboldt Smelter Superfund Site (IKM-HS Site) in Dewey-Humboldt, Arizona. This Proposed Plan identifies EPA's preferred cleanup (remedial) alternative to address the mine and smelter wastes, contaminated soil, and contaminated surface water at the IKM-HS Site. It also discusses the site and explains and compares the other cleanup alternatives that were considered. EPA is the lead agency for the IKM-HS Site. The supporting agency is the Arizona Department of Environmental Quality (ADEQ).

EPA is inviting public comment on this Proposed Plan and the supporting studies and documents that form the basis for its proposal. After considering the information submitted during the public comment period, EPA will select a cleanup alternative for the IKM-HS Site. The public is encouraged to review and comment on all the cleanup alternatives presented in this Proposed Plan.

This document highlights key information from the Remedial Investigation (RI) and Feasibility Study (FS) reports. The RI, dated September 2016, gives an extensive look at what, where, and how much contamination is at the IKM-HS Site and what risks to public health and the environment are posed by the contamination. Based on that information, the feasibility study, dated September 2022, develops, evaluates, and compares cleanup alternatives to address the contamination. Interested readers can obtain copies of these documents, and other documents used by EPA in developing this plan, in the IKM-HS Site Administrative Record file, which is available online at epa.gov/superfund/ironkingmine and in the information repository listed on the last page. The Proposed Plan fulfills the requirements of Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund or Superfund Law) and the National Contingency Plan (NCP) set forth at 40 C.F.R. [Code of Federal Regulations] Section 300.430(f)(2). A simplified depiction of the Superfund process can be seen in Figure 1.



OPPORTUNITY TO COMMENT

Public Comment Period:
March 15 - May 13, 2023
Public Hearing:
6:30 PM March 29, 2023
Location:
Humboldt Elementary School
2750 Corral Street
Humboldt, AZ 86329

See further information about commenting on this Proposed Plan at the end of the document.

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Proposed Cleanup Alternative at a Glance

The Problem

Decades ago, the former Iron King Mine and former Humboldt Smelter left behind mining wastes including mine tailings and other types of wastes (see box on page 8). Some wastes are present in large piles and deposits that are exposed to the elements. Other wastes have washed into major water drainages and threaten to move into the Agua Fria River. Periodic powerful storms move wastes downstream. These wastes and contaminated soils contain arsenic and lead at levels that can pose a health threat to people and wildlife.

Summary of EPA's Proposed Solution

EPA proposes to excavate most wastes, including mine tailings, other types of waste, and contaminated soils, and move them to two on-site waste repositories. A waste repository is a stable and permanently capped holding cell that keeps waste in and water out, so people and wildlife can no longer be exposed to wastes. The existing pile of tailings at the former mine property (covering 62 acres and rising up to 100-feet high) would be engineered and constructed as the first waste repository. Site wastes from the former mine and surrounding areas west of Arizona State Highway 69 (Highway 69) would be moved into this repository. A second waste repository would be built in a natural depression on the property of the former smelter (this location could change if EPA encounters design limitations to placing the repository in the depression). Mine wastes in the Chaparral Gulch drainage and at the former smelter east of Highway 69 would be moved into this repository. Overall, wastes currently spread over a wide area would be consolidated into a smaller, more compact space that is permanently capped. The cleanup action would require safely moving large volumes of contaminated materials (e.g., mine wastes and soils) for at least 9-12 months. Both repositories would be regularly inspected and maintained in the future to ensure they continue to be effective.

This cleanup action would remove the threats to human health and environment by permanently encapsulating the IKM-HS Site wastes in stable, maintained repositories so that people and wildlife cannot be exposed to them. The cap on the repository would prevent water from entering the wastes and moving them further into drainages or into the river. After the cleanup action, most of the high, flat plateau at the smelter property could be usable for purposes such as a park or historical interpretive trail.

EPA has performed three time-critical removal actions for existing residential areas. This has removed the majority of the human health risk from exposure to residential soils. As part of this cleanup action, additional cleanup of residential yards would take place. This is discussed in the sections that follow.

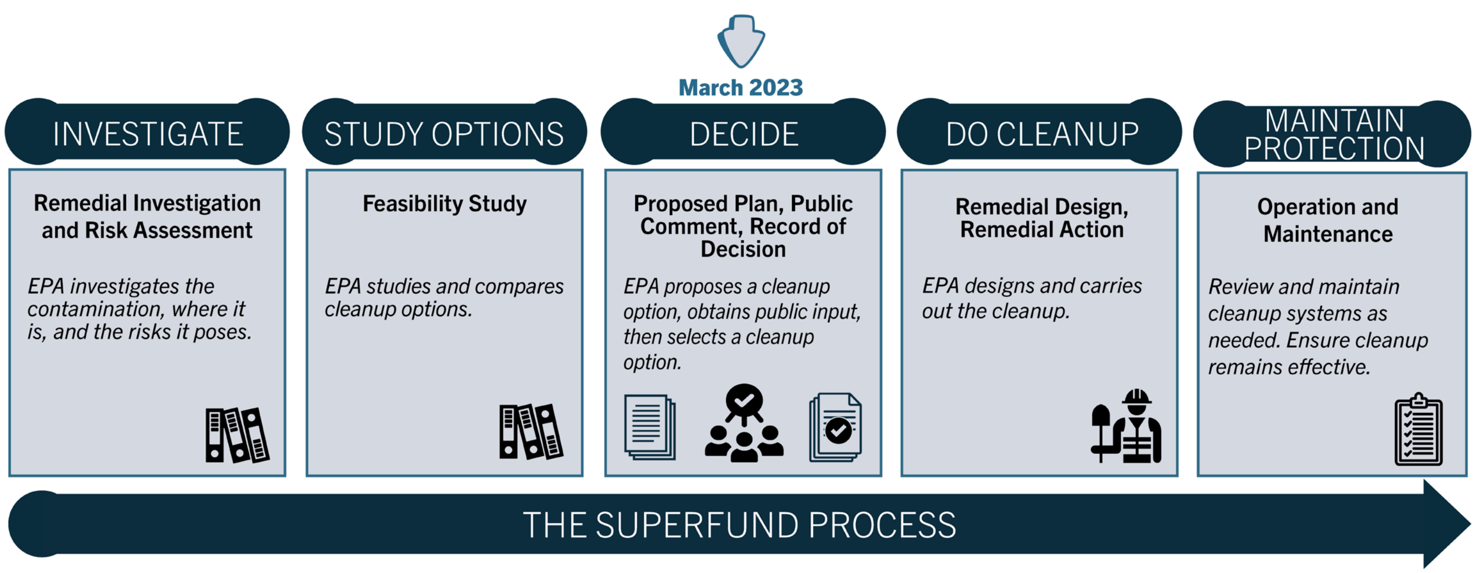


Figure 1. The Superfund Process

Site Background

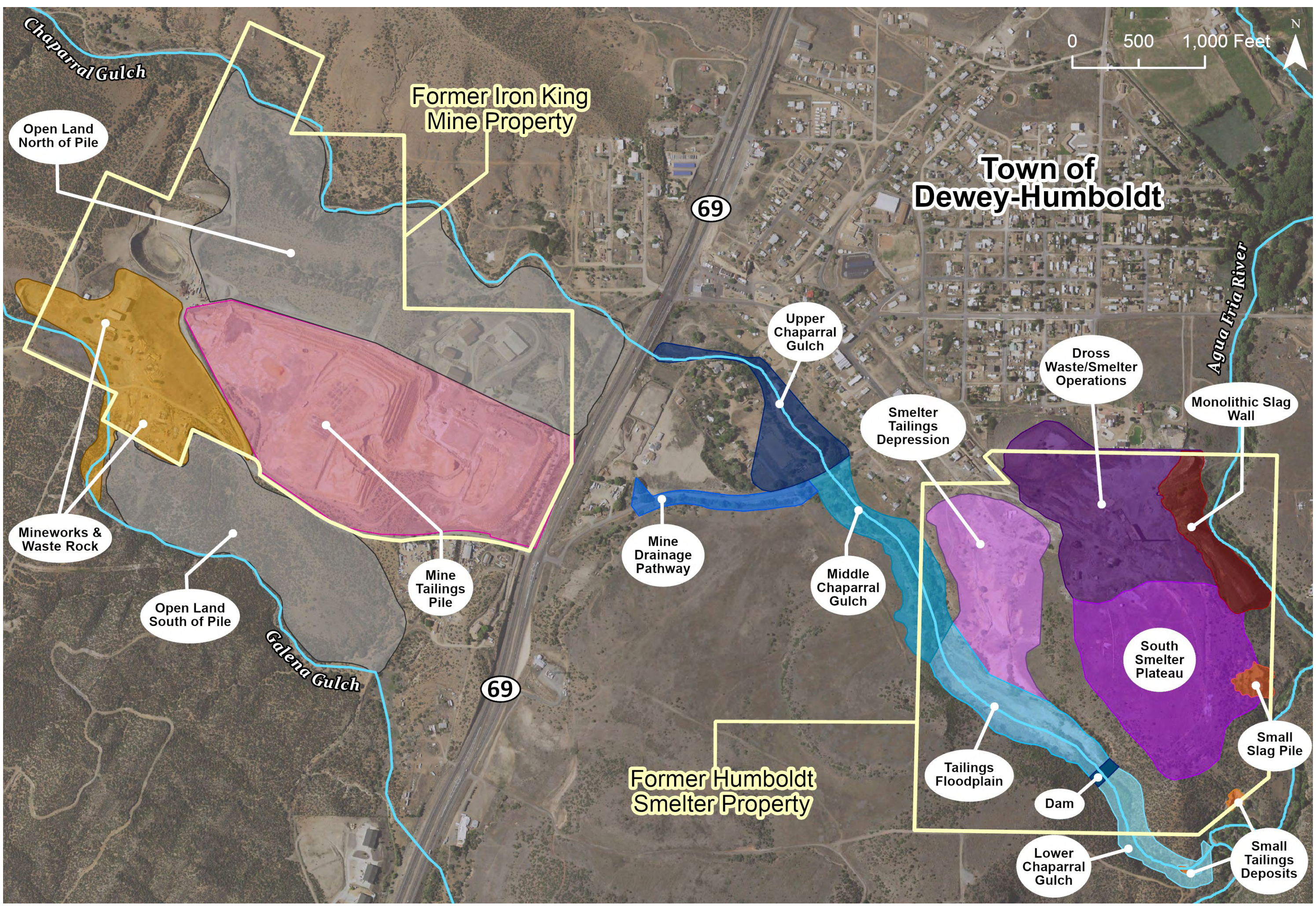
Setting

The IKM-HS Site is located in the town of Dewey-Humboldt (pop. 4,455) in central Arizona, which is situated on State Highway 69 about 80 miles north of Phoenix, Arizona and 80 miles south of Flagstaff, Arizona. There is a legacy of mining and smelting in this area that was formerly called the “Big Bug Mining District.” The town lies in a broad segment of the Agua Fria River valley southeast of Prescott Valley and east of Prescott. The Chaparral Gulch, a major drainage connecting the Bradshaw Mountains to the Agua Fria River, passes into the town from the west. There are portions of the IKM-HS Site on both sides of Arizona State Highway 69. The former mine is located immediately west of Highway 69, and the former smelter lies about a half-mile east of Highway 69.

Geologic Setting

More information on the geologic setting can be found in Section 5.4 of the RI and Section 1.2.1.4 of the FS. Lonesome Valley is part of a structural basin formed by vertical displacement along high angle faults. The basin fill consists of Tertiary volcanic and sedimentary rocks that were deposited on Precambrian metamorphic basement rocks. A veneer of Quaternary alluvium occurs within active drainages. Very shallow groundwater is present in these deposits under the Chaparral Gulch. The Hickey formation is subdivided into upper,

Figure 2. Major Site Areas



middle, and lower members in the IKM-HS Site area. The upper member of the Hickey formation is a sequence of overlapping alluvial fan deposits that are exposed over a wide area of the site. The middle member of the Hickey formation consists of basaltic flows, ash, and cinders that commonly occur at the base of the unit. The lower member of the Hickey formation consists of poorly sorted conglomerate with discontinuous gravel layers cemented with a calcareous matrix. Most of the shallow aquifer monitoring wells at the IKM-HS Site have well screens into the Hickey formation. Most of the deep monitoring wells have well screens in the underlying Precambrian bedrock formation Quaternary alluvial deposits occur within the active river channels in the area.

Site History and Characteristics

The major areas of concern of the IKM-HS Site can be seen in Figure 2. It was designated as a Superfund Site on the "National Priorities List" in 2008. The Site is complex and contamination is present in many different environments. Affected media include solid wastes (such as tailings); soils; and surface water.

The contamination at the IKM-HS Site is the result of two historical industrial operations: the former Iron King Mine and the former Humboldt Smelter. A brief site operational history can be seen on Figure 3. These operations left behind millions of tons of mine and smelter wastes, including mine tailings, dross, and slag. These wastes have contaminated soils and surface water drainages. Both the former mine and smelter are located on the Chaparral Gulch, a major drainage that passes into Dewey-Humboldt from the west. The Chaparral Gulch drains from tributaries in the mountains west of the IKM-HS Site and empties into the Agua Fria River on the east side of the site. The gulch is ephemeral, which means it has water during storms and extended wet periods but is otherwise dry.

The Mine.
Between the early 1900s and about 1970, the former Iron King Mine extracted and processed rock ores of zinc, silver, lead, and gold. The mine was operated during most of this period by Shattuck Denn Mining Company. It was one of the largest silver and zinc mines in Arizona, with miles of underground mineworks to depths of over 3000 feet. The mine operations left behind a pile of 4.3 million cubic yards of orange mine tailings up to 100 feet high, with high levels of arsenic and lead. Tailings are a waste that remains after the crushing and concentrating of mine ore. They can be powdery when dry and paste-like when wet. The tailings waste was disposed in ponds held in by dikes. These eventually merged into a single very large pond that dried out, leaving the pile. Over time, tailings washed into the Chaparral Gulch and flowed downstream toward the Agua Fria River. Today, tailings mixed with alluvium carried from the mountains remain in the gulch. This material is subject to erosion when fast-moving storm water picks up material and moves it.

In the late 1970s and early 1980s, a company acquired and sold tailings at the mine property as a fertilizer called Ironite. This continued until sales were halted due to the high levels of arsenic in the product.

The Iron King Mine, 1903—1905.

Humboldt Smelter operations in 1906.

View from Iron King Road looking up at the 3.5 million-cubic yard mine tailings pile.

Side of Iron King Mine tailings pile as seen from the north.

Stormwater retention basin on the lower tier of the mine tailings pile.

Former brick Humboldt Smelter stack and converter flue building on the smelter plateau.

The ADEQ dismantled the remaining Humboldt smelter stack in 2022 as it was unsafe and attracting people to a contaminated area.

The Smelter.
From the late 1800s until about 1937, the former Humboldt Smelter and two earlier facilities were located at the smelter property. These facilities crushed rock ores containing copper and lead and melted them in furnaces to make pure metal. The tiny Agua Fria mill and smelter operated along the Agua Fria River in the late 1800s. The larger Val Verde smelter operated on the slope above the river between 1899 and 1904 when it burned down. The much more expansive and productive smelter, which was demolished and rebuilt at least once, became known as the "Humboldt Smelter." It operated from about 1906 until 1937. It was located on a high and flat plateau at the smelter property. The peak production of the Humboldt Smelter was during the World War I era. The operator of the large Humboldt smelter was the Consolidated Arizona Smelting Company and its corporate predecessor. These companies went out of business by the end of the 1930s.

In addition to smelting, the Humboldt Smelter conducted ore concentrating that left tailings waste in a depression on the property. After the smelter was gone in the 1940s, entrepreneurs conducted additional ore processing in the same area, which added more tailings to the depression. In the 1950s, another entrepreneur imported waste aluminum dross to the property from dye casting plants with the intent of reprocessing it to recover saleable metals, but the entrepreneur went bankrupt and left the dross behind.

All of the structures associated with the Agua Fria mill and Val Verde smelter, almost all of the buildings associated with Humboldt Smelter, and the rail lines leading into and through the smelter were demolished and removed by 1937. One of the exceptions was the smokestack and the attached brick converter flue located on the plateau at the former smelter property. In January 2022, the ADEQ took down these structures in coordination with EPA for public safety as they had partially collapsed and had functioned as an attractive nuisance, drawing trespassers to the contaminated area. Information about this project can be found at azdeq.gov/dh-stack-project.

What Are the Types of Wastes at the IKM-HS Site?

Operations at the Iron King Mine and the Humboldt Smelter left behind mainly four types of wastes: Mine tailings, waste rock, aluminum, dross and slag – and these are in some places mixed in with soils and alluvium.

Dross is a fine-grained, gray-colored waste that forms on top of certain kinds of molten metals at casting plants. It can be a source of many metals, including but not limited to arsenic and lead depending on the ore from which it is derived.

Mine tailings are the most prevalent waste at the IKM-HS Site. They are the waste that is left over after grinding and crushing up metal-bearing ores and removing the saleable metal of interest. They are orangish or yellowish in color and are fine-grained. At this site, they have high toxicity and when uncontained, they may move in the environment. Under the right conditions, they can create another waste called acid rock drainage that can carry contaminants metals such as arsenic into waterways.

Waste Rock is the rock that was removed for miners to dig down and reach the metal-bearing ore of interest. It can contain metals that can erode into water drainages.

Slag is the lava-like earthen waste left over after the metal of interest is removed by smelting. At the IKM-HS Site, most slag is in the form of solid rock with metals including lead, copper, and arsenic.

The Chaparral Gulch.
As stated, the Chaparral Gulch has received wastes from both the mine and the smelter. Waste mine tailings from the mine washed into the Chaparral Gulch from the west and migrated down the gulch toward the smelter. Farther downstream, the tailings at the smelter property were dumped into a pond in a depression on the property. At some point, the dike/berm in the pond that was holding back the tailings failed, releasing tailings into Chaparral Gulch. The date of this failure is not known; however, an analysis of successive available aerial photos indicates it occurred between 1940 and 1953.

The tailings from the mine mixed with tailings from the smelter in an open flood plain in the Chaparral Gulch. A 25-foot-high concrete dam holds back wet tailings at the downstream end of the flood plain. It is unknown who built the dam or its original purpose. Some water drains through and under the dam downstream toward the Agua Fria River. At certain locations, the river quality in the river exceeds water quality standards, indicating the site has an impact on the river.

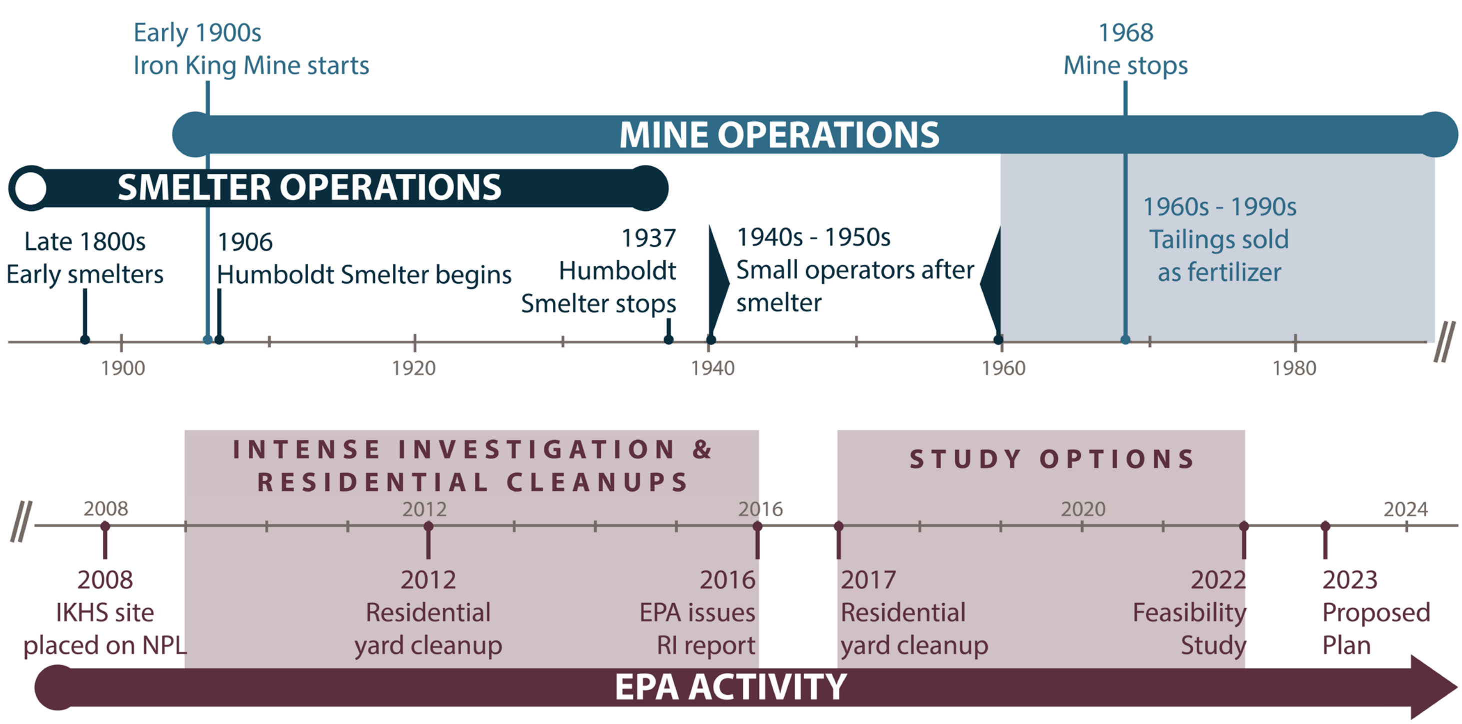
Regulatory History

Major elements of the IKM-HS Site regulatory history can be seen on Figure 3. From 2002 through 2004, EPA and the ADEQ performed preliminary assessments and site inspections at the former Iron King Mine and Humboldt Smelter properties under CERCLA, the Superfund law. In 2006, EPA completed an "expanded" site inspection. These initial site inspections informed EPA's decision to include the combined Iron King Mine - Humboldt Smelter Superfund Site on the National Priorities List of Superfund Sites in 2008.

EPA performed the comprehensive RI, a study of the nature and extent of contamination at the entire site, in four phases beginning in 2008. A preliminary draft RI report was issued in 2010. EPA performed extensive additional investigation in 2011-2014 and issued the final RI report in 2016. Between 2016 and 2021 EPA conducted a FS which assembled, evaluated and compared remedial alternatives for the IKM-HS Site.

EPA performed three removal actions to clean up yard soils in residential areas of the IKM-HS Site in 2006, 2011 and 2017. More information about these removal actions is provided below. In 2019, EPA performed another removal action where a product called Posi-Shell was applied on top of the waste dross in the former smelter operations area on the north end of the smelter plateau to prevent wind-blown transport of dross. The Posi-Shell is intended to be temporary pending a permanent response action. The product is a mixture of earthen materials and polymers that seals the dusty material under a crusty layer. At that time, EPA also

Figure 3. Site Operational and Regulatory History



added additional fencing and warning signage to the smelter property.

In 2020, EPA worked with the owner of the former mine property to upgrade and add fencing at the former mine property. Additionally as part of the 2020 removal, EPA added 20 more warning signs at or near the former mine property.

In 2022, in coordination with EPA, ADEQ dismantled what remained of a partially-collapsed smelter smoke stack and converter flue building at the former Humboldt Smelter. As part of that cleanup action, ADEQ greatly expanded and reinforced the previous Posi-Shell cover over the waste dross that EPA had placed in its 2019 removal action. ADEQ also covered the debris remaining from dismantling the stack with gunite. Finally, ADEQ added fencing to the smelter property. Information about this project can be found at azdeq.gov/dh-stack-project.

Previous Cleanup in Existing Residential Areas

Three soil removal actions were performed at existing residential properties over a 11-year period. These removal actions occurred in 2006 (4 properties) (*final report 2007*), 2011 (12 properties) (*final report 2012*) and 2017 (31 properties) (*final report 2018*). While cleanup values varied somewhat among the three actions, surface soils in residential properties were cleaned up to maximum levels of 144 milligrams per kilogram (mg/kg) arsenic and 400 mg/kg lead. Most of the yards that received cleanup were within about one half-mile north of the smelter. Many yards with high levels of lead were located along a former rail alignment parallel to Main Street that led into the smelter.

During the removal actions, soils were excavated to a maximum depth of 1-2 feet and replaced with clean soil well below background concentrations. As a post-removal site control, if contamination above cleanup levels remained at the depth of excavation, a lattice structure called a warning barrier was installed to advise persons excavating in the area in the future that contamination below the barrier was still present. Residents with warning barrier in their yard received instructions from EPA on how to handle the barrier if excavating. Also, the town government received instructions and a map of all parcels with warning barrier for use in permitting processes. Clean soil was then placed over these areas, and yards were restored. Removed soils were placed on the mine tailings pile at the former mine property.

To explain the residential sampling results and EPA's decision to take cleanup action at certain yards, EPA issued fact sheets and news releases, and sent letters to impacted homeowners, presented at public meetings led by EPA and at multiple Dewey-Humboldt town council meetings with the public in attendance.

Potentially Responsible Parties

CERCLA, the Superfund law, specifies that certain parties are liable for paying for and/or performing cleanups at Superfund sites. Among these are current landowners and facility operators, as well as past landowners and operators at the time that contamination was released. Successor companies to these landowners and operators (for example, companies that merged with or took over the company that did the polluting) also can be liable for cleanup under the law.

At the time the mining wastes were released, the former Iron King Mine was owned and operated by Shattuck Denn Mining Corporation, which was purchased and merged into several successor companies over time through a complex series of transactions. The mine property itself is currently subdivided and owned by multiple parties. Most of the tailings pile is currently owned by North American Industries, and part of the tailings pile is owned by the Arizona State Lands Department.

The former owners and operators of the Humboldt Smelter are out of business. The current owner of the smelter property is Greenfields Enterprises, LLC.

The Nature and Extent of Contamination

The IKM-HS Site has contamination extending to many distinct environments, each with its own characteristics. As previously mentioned, the primary areas of concern are shown in Figure 2. Figure 4 shows volume and concentration values pertinent to the nature and extent of contamination for most of these areas. Table 1 also shows information in tabular form. Certain areas, such as the monolithic slag, do not appear in the table, however do appear in Figure 4. The dam located on Chaparral Gulch is shown for context.

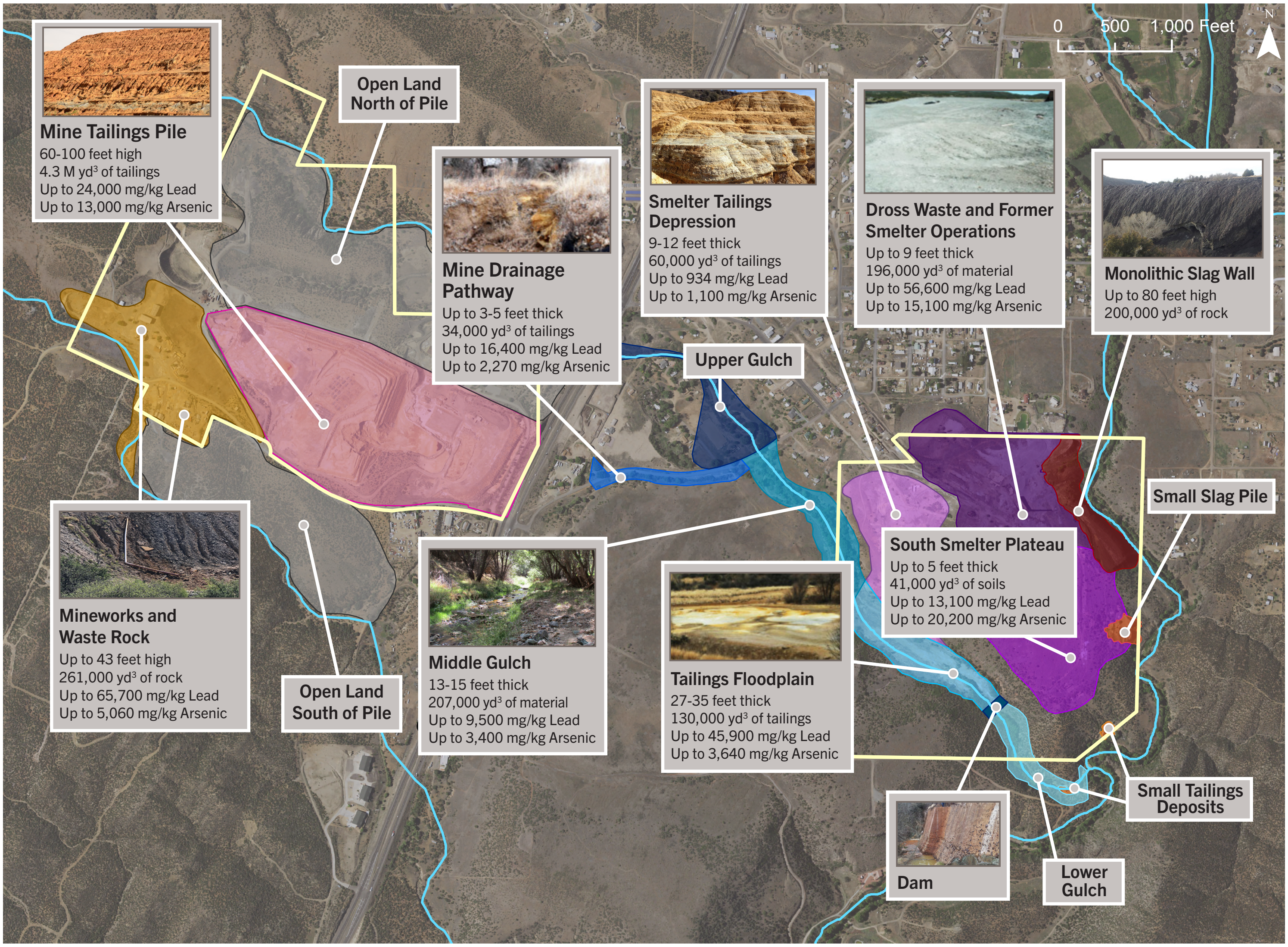
Nature of Investigations

While EPA sampled for a wide range of other metals and contaminants during the investigation, the primary contaminants of concern found at this site are arsenic and lead. The IKM-HS Site contains more than 6.4 million cubic yards of wastes and contaminated materials that pose risks to human health and the environment.

In 2016, EPA completed the RI and issued a three-volume report. The RI evaluated sampling data, technical analyses, and other information to define the nature and extent of contamination. It addressed all areas of the IKM-HS Site, including both non-residential and residential areas.

The RI also calculated the risks to human health and ecological health posed by the IKM-HS Site. The human health risk assessment (RI Section 9) and the ecological risk assessment (RI Section 10) is further discussed on the following page.

Figure 4. Contamination Levels in Site Areas



The RI spanned the non-residential areas of concern and 580 existing residential yards. It included:

- Sampling and chemical analysis of thousands of non-residential soil samples;
- Sampling and chemical analysis of over 4,600 residential soil samples;
- Over 150 borings drilled into soils and wastes;
- Geochemical and geophysical testing;
- 254 samples to evaluate background metals concentrations in soils (see below);
- Measurement of water flow and chemistry during rain events;
- Installation and sampling of 26 EPA groundwater monitoring wells;
- Sampling of 64 private and public drinking water wells;
- Sampling of surface water and sediment at more than 35 locations along the Agua Fria River and surface water samples throughout the Chaparral Gulch;
- A six-month dust monitoring study; and
- Other sampling, measurements, and tests.

To understand the background levels of metals in surface soils surrounding the IKM-HS Site, EPA completed a study during the RI where it tested hundreds of surface soil samples from a spatially widespread area up to three miles from the IKM-HS Site (see RI Report Appendix E). These sampling results were evaluated with statistical methods. During the FS, the background value for arsenic was refined from 112 to 92 mg/kg. (See FS Report Appendix C-6).

Also, as part of the RI EPA completed a site-specific investigation of the bioavailablity of lead and arsenic in soils. The results of this study can be found in Appendix H of the RI Report.

Table 1. Waste volumes and contaminant levels

Site Area	Waste Volume (yd^3)	Depth/Thickness	Arsenic Max (mg/kg)	Lead Max (mg/kg)
Mine Tailings Pile	4.3 M	60-100 ft thick	13,000	24,000
Former Mineworks/Waste Rock Piles	261,000	Highly varied	5,060	65,700
Mine Drainage Pathway	34,000	0-5 ft	2,270	16,400
Upper Gulch	65,000	0-5 ft	991	3,080
Middle Gulch	206,000	0-15 ft	3,400	9,500
Smelter Tailings Depression	60,000	9-12 ft thick	1,100	934
Tailings Floodplain	130,000	0-35 ft	3,640	45,900
Lower Gulch (with small tailings deposits)	13,000	Highly varied	4,140	6,060
Dross Waste & Smelter Operations	196,000	0-9 ft	15,100	56,600
South Smelter Plateau	41,000	0-5 ft	20,200	13,100
Open Land North of Mine Tailings Pile	Varied hot spot	0-3 ft	1,730	4,270
Open Land South of Mine Tailings Pile	Varied hot spot	0-3 ft	1,280	3,450

Existing Residential Areas

During EPA's 2009-2010 and 2013-2017 soil sampling and screening investigations at approximately 580 existing residential yards in Dewey-Humboldt, EPA collected more than 4,600 soil samples. See Figure 5. The number of yards sampled in EPA's investigation expanded over time. EPA analyzed the samples for a wide range of metals, including arsenic and lead. In existing residential areas close to the mine and smelter (within about ½ mile) between 10 and 15 samples were taken in each of 396 yards. These are shown in Figure 5 in orange. Farther from the mine and smelter, EPA sampled 8 subareas. In these latter areas not every yard was sampled, but samples were collected throughout each subarea to confirm that levels of contamination were well below background levels. These areas are shown in blue on Figure 5.

The results of EPA's existing residential investigation are detailed in the RI, including EPA's human health and ecological risk assessment. These can be found on EPA's IKM-HS Site website at epa.gov/superfund/ironkingmine and at the Dewey-Humboldt Town Library.

Based on the results of this investigation, three removal actions were conducted in existing residential areas and these are described above in the section *Previous Cleanup in Existing Residential Areas.*

Iron King Mine Tailings Pile

The tailings pile at the former mine is over 100 feet high at its eastern face, covers 62 acres and contains 4.3 million cubic yards of mine tailings with high levels of arsenic and lead. The tailings contain arsenic levels of up to 13,000 milligrams per kilogram (mg/kg). Lead levels in the tailings have been observed as high as 24,000 mg/kg. Due to the toxicity and potential mobility of tailings at the IKM-HS Site, EPA considers the mine tailings to be principal threat wastes.

West of the mine tailings pile lies an area that was formerly used for ore processing (mineworks). This contains surface soils contaminated at up to 5,060 mg/kg arsenic and 65,700 mg/kg lead.

The former mine property west of the tailings pile also contains deposits, piles and a wall of waste rock – the earthen rock material that was removed from the mine shafts during mine operations. This is located to the west and southwest of the mine tailings pile.

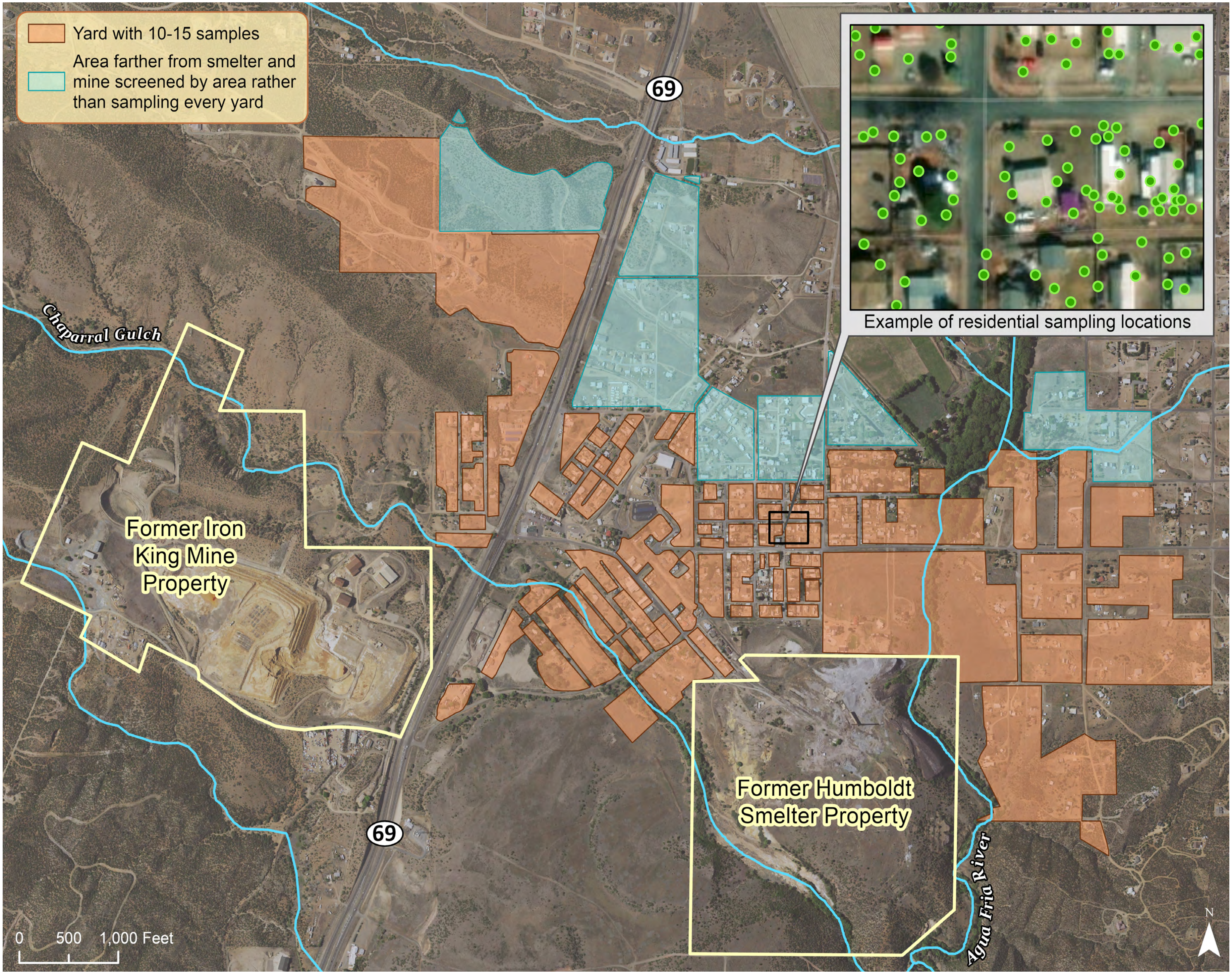
Just north of the tailings pile, between the pile and the Chaparral Gulch, lies hilly open chaparral land with sporadic surface soil contaminant levels up to 1,730 mg/kg arsenic and 4,270 mg/kg lead. Some of these areas were the location of mine shafts and ore movement activities. Similarly, just south of the mine tailings pile, between the pile and the Galena Gulch, lies steep terrain with sporadic levels of surface soil

Field workers collect a core from a soil boring in the tailings flood plain.

Workers opening cores from a soil boring to examine and sample.

Core shows cleaner dark soil near surface, with buried orange tailings underneath in the tailings flood plain.

Figure 5. Yards Sampled



View looking down from the top of the 4.3 million-cubic yard mine tailings pile.

contaminant levels up to 1,280 mg/kg arsenic and 3,450 mg/kg lead. The affected area covers about 50 acres on the north side of the mine and 35 acres on the south side of the mine.

Mine Tailings Drainage Path to Chaparral Gulch; Upper Chaparral Gulch

The main tailings pile at the former mine began as a series of diked ponds on the mine property into which tailings were disposed. As the mine operations grew, these eventually merged into one large impoundment and then dried out, forming the pile seen today. These ponds had a series of outfalls that drained downslope, crossed to the east side of what is now Highway 69, and flowed into a drainage along what is now Third Street. Today, tailings from the mine are present along this pathway at intermittent locations both at the surface and buried. Soils in this area contain levels up to 2,270 mg/kg arsenic and 16,400 mg/kg lead, to depths of 3-5 feet, and with a volume of about 34,000 cubic yards. This land is zoned residential but is not occupied by residents (see discussion in Risks Section).

Upper Chaparral Gulch lies upstream (west) of Third Street and east of Highway 69. It is distinct from the forementioned mine drainage path. Tailings have not been discovered in this area. However, it was affected by mine drainage water. Arsenic levels of up to 991 mg/kg arsenic and lead levels up to 3,080 mg/kg have been found in the soils between the surface and 3 feet depth. The contamination identified is concentrated along the main channel. This land is zoned residential and contains parcels owned by residents, although no individual residential structures or yards are present in the channel because this land lies on the floor of the main channel in the gulch. As will be discussed below, while the surface soil human health risks calculated for Upper Chaparral Gulch as a whole were low, there are residential properties when taken individually with soils that pose an unacceptable health risk for residential receptors.

Middle Chaparral Gulch and the Tailings Flood Plain

The Chaparral Gulch is subject to powerful monsoon rains that periodically flood the gulch with fast-moving water. The water flow rate in a 100-year flood event can be up to 8,000 cubic feet per second, with a water flow rate in a 500-year flood event of 12,000 cubic feet per second. These high flows can erode both tailings deposits and contaminated soils and carry them downstream.

The mine tailings drainage path and the Upper Chapparal Gulch merge at the Middle Chaparral Gulch Tailings in the Middle Chapparal Gulch are blended with alluvium washed in during storms from the mountains. Surface soils are the base for a riparian habitat of grasses, shrubs, and mature trees. In surface soils of the Middle Chapparal Gulch, neither arsenic nor lead are present at high enough levels to pose a significant health risk to humans walking through on trails, which is the anticipated future land use. However, the levels of arsenic and lead do pose a significant ecological risk to wildlife such as red-tailed hawks, desert shrews, and coyotes (see Table 2). In deeper soils, the Middle Chaparral Gulch contains buried tailings mixed with alluvium. From 5-15 feet below the surface soils, there are soils with up to 3,400 mg/kg arsenic and 9,500 mg/kg lead. Erosion from storms causes movement of contaminations among depths and/or occasional exposure of tailings to the surface. The Middle Chaparral Gulch contains up to 206,000 cubic yards of tailings and contaminated alluvium/soil.

Farther downstream near the former smelter, the Middle Chapparal Gulch opens into a wide flood plain. The flood plain is 11 acres (about 8 football fields) in area and contains about 130,000 cubic yards of tailings waste and contaminated soils. The flood plain contains tailings and soils with up to 3,640 mg/kg arsenic and 45,900 mg/kg lead. This flood plain is intermittently covered with a layer of alluvium washing in from the mountains but otherwise

Table 2. Exposure Scenarios and Risks by Site Area

Primary Site Area[1]	Evaluated Human Health Risk Exposure Scenario[2]	Incremental Human Health Risk[3]			Ecological Risk[7] Number of Species with eHQ Exceeding…			
		Cancer Risk[4]	Hazard Index[5]	Lead EPC[6] (Ref #)	1	3	5	10
Mine Main Tailings Pile	Occupational	$5x10^{-4}$	3	3150 (460)	7	7	6	5
Mineworks and Processing area behind tailings pile	Occupational	$1x10^{-4}$	<1	8726 (460)	7	6	6	5
Mine Drainage Path near 3rd Street	Residential	$6x10^{-4}$	4	1887 (197)	5	5	3	1
Upper Chaparral Gulch [8]	Recreational/ Residential [8]	$6x10^{-5}$	<1	253 (197)	0	0	0	0
Middle Chaparral Gulch [9]	Recreational [9]	$7x10^{-6}$	<1	633 (1106)	5	4	1	0
Tailings Flood Plain in Chaparral Gulch	Recreational [9]	$1x10^{-5}$	4	1338 (1106)	5	5	4	0
Tailings Depression at the Smelter	Occupational	$2x10^{-5}$	<1	263 (460)	5	5	0	0
Lower Chaparral Gulch	Recreational Surface Water to River	$3x10^{-5}$	<1	1869 (1106)	6	6	5	4
Waste Dross and Former Operations Area at Smelter	Occupational	$1x10^{-4}$	2	2093 (460)	7	6	6	6
Soils on South Smelter Plateau	Occupational	$2x10^{-4}$	2	1029 (460)	6	6	6	4
Open Land North of the Tailings Pile and South of Chaparral Gulch	Mixed w/ Partial Residential	$1x10^{-4}$	0.8	458 (197)	4	3	0	0
Open Land South of the Tailings Pile but north of the Galena Gulch	Mixed w/ Partial Residential	$2x10^{-4}$	4	1748 (197)	6	5	4	2

1 - This is a selection of 12 primary site areas.

2 - The presumed anticipated future land use.

3 - Estimated lifetime excess cancer and non-cancer risks from EPA risk assessment.

4 - Cancer risk expressed as exponential (e.g. $1x10^{-6}$ means one in a million to someone exposed for lifetime)

5 - Non-cancer risk expressed as a multiple of the hazard quotient of 1.

6 - Exposure point concentration for lead. The lead reference value for the future land use scenario is shown in parentheses for comparison

7 - Counts of the number of species exceeding the ecological hazard quotient value as shown (1,3,5,10).

8 - While the surface soil human health risks calculated for Upper Chaparral Gulch as a whole are low, there are residential properties there that, when taken individually, pose unacceptable health risk.

9 - The risk levels shown are based on surface soil levels. However, Middle Gulch and the flood plain have tailings contamination at depth that is subject to erosion that erodes and releases mine waters into the tailings flood plain which must be addressed.

contains tailings with thickness ranging from a few feet to more than 35 feet on the east end. On the east side of the flood plain, the tailings are held back by a concrete dam 26 feet in height. The upstream side of the dam is filled with tailings to the top of the dam that are saturated with water a short depth below the surface.

Lower Chaparral Gulch and Tailings Deposits

During monsoon rains, flowing water spills over the dam and flows into the Lower Chapparal Gulch and toward the Agua Fria River. Some water flows under the dam as well. Soil levels up to 4,140 mg/kg arsenic and 6,060 mg/kg lead can be found in this area, specifically in the tailings deposits described below. Surface water in Lower Gulch is ephemeral, limited to periods during and after storm events.The Chaparral Gulch joins the Agua Fria River about a quarter-mile downstream of the dam.

There are two tailings deposits next to the Agua Fria River. The first tailings deposit is located near the confluence of the Chaparral Gulch and the Agua Fria River. This deposit contains about 600 cubic yards of tailings with lead levels up to 6,060 mg/kg. The second tailings deposit lies on a promontory above the river also near the confluence. This deposit contains about 5,500 cubic yards of tailings. These were left by the smaller smelters that operated in the late 1800s – 1904, prior to the Humboldt Smelter.

Agua Fria River Surface Water and Lower Chaparral Gulch Surface Water

The Chaparral Gulch empties into the Agua Fria River at the confluence of these two water bodies downstream of the dam. Lower Chaparral Gulch lies between the dam and the confluence.

Surface water and sediment sampling were conducted in the Lower Chaparral Gulch and in three reaches of the Agua Fria River: 1) upstream of the smelter, 2) between the smelter and the confluence between the river and the Chaparral Gulch, and 3) downstream of the confluence.

Sixty-two samples of surface water and sediments in the Agua Fria River and Lower Chaparral Gulch were taken during both the RI and supplementary sampling events while developing the FS. Levels of metals in

Concrete dam on Chaparral Gulch holding back a wall of tailings in the flood plain above.

Flood plain in Chaparral Gulch with visible tailings.

Water with iron precipitate flowing away from the dam in the lower Chaparral Gulch.

surface water were shown to vary significantly with time. This indicates that surface water contamination at the site is highly dynamic; it changes dramatically with flushing from powerful storm events, such as the annual monsoons, and seasonal fluctuations.

During the earlier RI investigation, four different sampling events were conducted between 2008 and 2020, to assess surface water sampling for 15 metals. In the Lower Chaparral Gulch, all 18 samples exceeded either risk-based criteria or water quality criteria for at least one metal. In the Agua Fria River, 20 samples exceeded either risk-based criteria or water quality criteria for at least one metal, however only 13 of these samples exceeded background levels. Metals levels exceeding risk-based levels, applicable or relevant and appropriate requirement (ARAR)-based levels, and background were primarily observed near the slag wall at the smelter and downstream of the confluence with Chaparral Gulch.

During the subsequent FS supplementary sampling events, only one sample in the Lower Chaparral Gulch (at the dam), exceeded water quality criteria for metals. However, of 17 samples collected in the Agua Fria River, *none* exceeded either the risk-based criteria, water quality criteria or background concentrations. This difference compared to the earlier RI sampling events over time is likely due to the timing of storm events and seasonal variations relative to sampling.

Preliminary Remediation Goals (PRGs) for surface water were based on the lower of 1) an applicable ARAR such as water quality criteria; 2) an ecological hazard quotient of 1 for at least one species. Metals/chemicals screened for the analysis included aluminum, arsenic, barium, cobalt, cyanide, iron, lead, manganese, selenium, vanadium, beryllium, cadmium, copper, mercury and zinc. PRGs and ARARs are discussed later in this document.

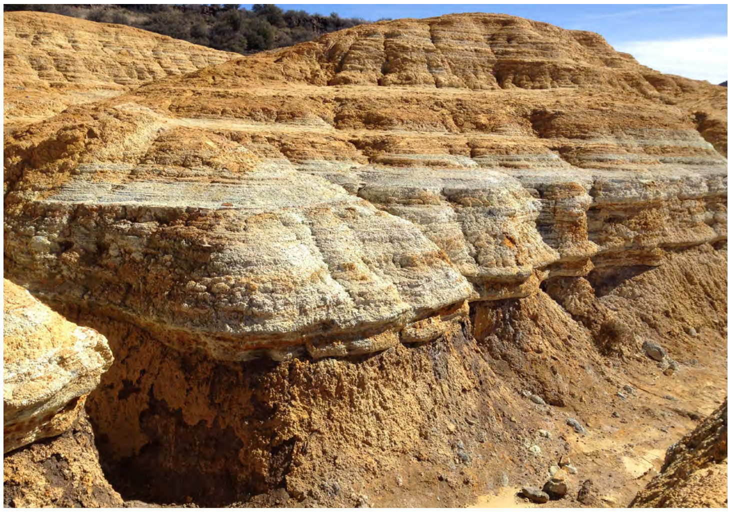
Agua Fria River facing south near the site.

Agua Fria River Sediments

Based on evaluation conducted during the FS, *sediments* in the Agua Fria River do not require cleanup as part of the remedial action (see FS Appendix C-7).

Tailings Depression at the Smelter, Humboldt Smelter Operations Area, & Dross Waste

On the smelter property, below the plateau where the smelting operations took place, there is a bowl-shaped depression, called the smelter tailings depression. It contains about 60,000 cubic yards of tailings from ore concentrating and grinding operations at the smelter property. In the tailings in the smelter tailings depression, the contaminant levels can be as high as 1,100 mg/kg arsenic and 934 mg/kg lead, respectively.



Heavily eroded tailings deposit in a depression at the smelter property.

Tailings deposit at the smelter property.

Waste dross at the smelter property.

The former pyrometallurgical operations of the Humboldt Smelter, (former blast furnaces, metal-purifying converters, coal and coke heating, sintering, power generation, etc) were situated on the north end of a high plateau surrounded by steep slopes and lower terrain. heating, power generation, etc) were situated on the north end of a high plateau surrounded by steep slopes and lower terrain. This area contains about 50,000 cubic yards of soils contaminated with metals including arsenic and lead. It is covered by about 150,000 cubic yards of dross waste. The total volume of contaminated soils and dross is about 196,000 cubic yards. The dross contains up to 15,100 mg/kg arsenic and 56,400 mg/kg lead.

South of the former pyrometallurgical operations area, the smelter plateau contains about 40,000 cubic yards of contaminated soils with concentrations of up to 20,200 mg/kg arsenic and 13,100 mg/kg lead.

Slag

On the eastern edge of the smelter plateau, a wall of solid slag hangs on the cliff above the Agua Fria River about 80 feet high. It contains roughly 280,000 cubic yards of material. The slag is similar to solidified lava rock. It is inert and does not pose a chemical health risk unless it is pulverized into soil-like material or sediments. Data indicates that pulverized slag is leachable and slag falling into the river and being pulverized could release metals to the river over time.

Groundwater

About 15% of the residential properties in Dewey-Humboldt receive water through a public water supply system operated by Humboldt Water Systems that currently provides water meeting federal safe drinking water standards. The remaining 85% of residential properties get drinking water from private supply wells that are usually screened from near the surface to about 300 feet in depth.

During the RI EPA installed 26 groundwater monitoring wells in the shallow and deep groundwater units at the IKM-HS Site and in the perched shallow groundwater under the Chaparral Gulch in the tailings flood plain. EPA tested the groundwater from the groundwater monitoring wells and 64 privately-owned supply wells from the residential areas, as well as the public supply wells. See Figure 6. Figure 7 shows arsenic levels in EPA monitoring wells. Chemicals of interest for groundwater include arsenic, lead, nitrate, and sulfate.

The RI determined that arsenic is not generally mobile and does not migrate significantly in groundwater at the IKM-HS Site. The IKM-HS Site is not contributing soluble arsenic to groundwater, except for the perched groundwater under the mine tailings pile, under the Chaparral Gulch, and parts of the smelter property. The data do not indicate an arsenic "plume" emanating from the site. The perched groundwater contributes to surface water flow in Chaparral Gulch and is not in communication with the regional aquifer. Soluble arsenic in groundwater other than these locations are due to naturally occurring geologic formations.

Generally, acid rock drainage (ARD) can mobilize arsenic in groundwater. ARD is acidic water that forms through the biogeochemical reaction of air and infiltrating water with tailings or weathered materials containing sulfur-bearing minerals and salts. ARD formation generally produces sulfate. Sulfate is more soluble and moves more rapidly in groundwater than soluble metals from ARD. Therefore, elevated sulfate concentrations indicate the extent to which groundwater is impacted by soluble metals from ARD.

At the IKM-HS Site:

- Concentrations of sulfate beneath the waste bearing areas of the site indicate that chemical reactions leading to acid rock drainage do occur; but the data do not indicate a statistically significant correlation between sulfate and arsenic at the site.
- The area of elevated sulfate is limited to the shallow groundwater zones beneath and between the mine and smelter properties and along Chaparral Gulch. This indicates that ARD impacts of metals from the site are even more laterally localized than sulfate. Groundwater outside the immediate waste-bearing areas is not impacted by ARD from the IKM-HS Site.
- Sulfate concentrations in the deep Precambrian bedrock monitoring wells beneath and near the former Iron King Mine and Humboldt Smelter properties are not elevated and the water chemistry signature is distinctly different, indicating a lack of hydraulic connection between the shallow groundwater and the bedrock. Therefore, the deeper groundwater is not being impacted by ARD. There are relatively consistent levels of arsenic in the deep groundwater regardless of whether near the site or side- or upgradient of the site.
- The groundwater pH is slightly lower in areas where elevated sulfate concentrations occur, but repeatable pH values below 6 were not observed, indicating that residual neutralizing capacity in waste materials, as well as local soils and groundwater matrix minerals, are buffering the ARD acidity. This likely is limiting the mobility of arsenic and other metals in groundwater.

Many of the private supply wells northeast of the IKM-HS Site (to the east side of the Agua Fria River) and the two wells sampled to the south of the former smelter property have concentrations substantially exceeding MCLs for arsenic in comparison to those west of the river. These are areas where naturally-elevated concentrations of arsenic and other metals have been detected in soil and rock outcrops. These areas are not subject to groundwater transport of site-related contamination. Levels of metals in soils in areas east of the river can vary greatly, even over short distances depending on the local geology.

Because natural levels of arsenic in groundwater exceed drinking water standards, EPA has consistently urged private well owners to have their well water tested and, if necessary, install home treatment systems for their private well water.

Wall of hardened black slag at smelter property hanging over cliff above the Agua Fria River.

Figure 6. Monitoring and Supply Wells Sampled

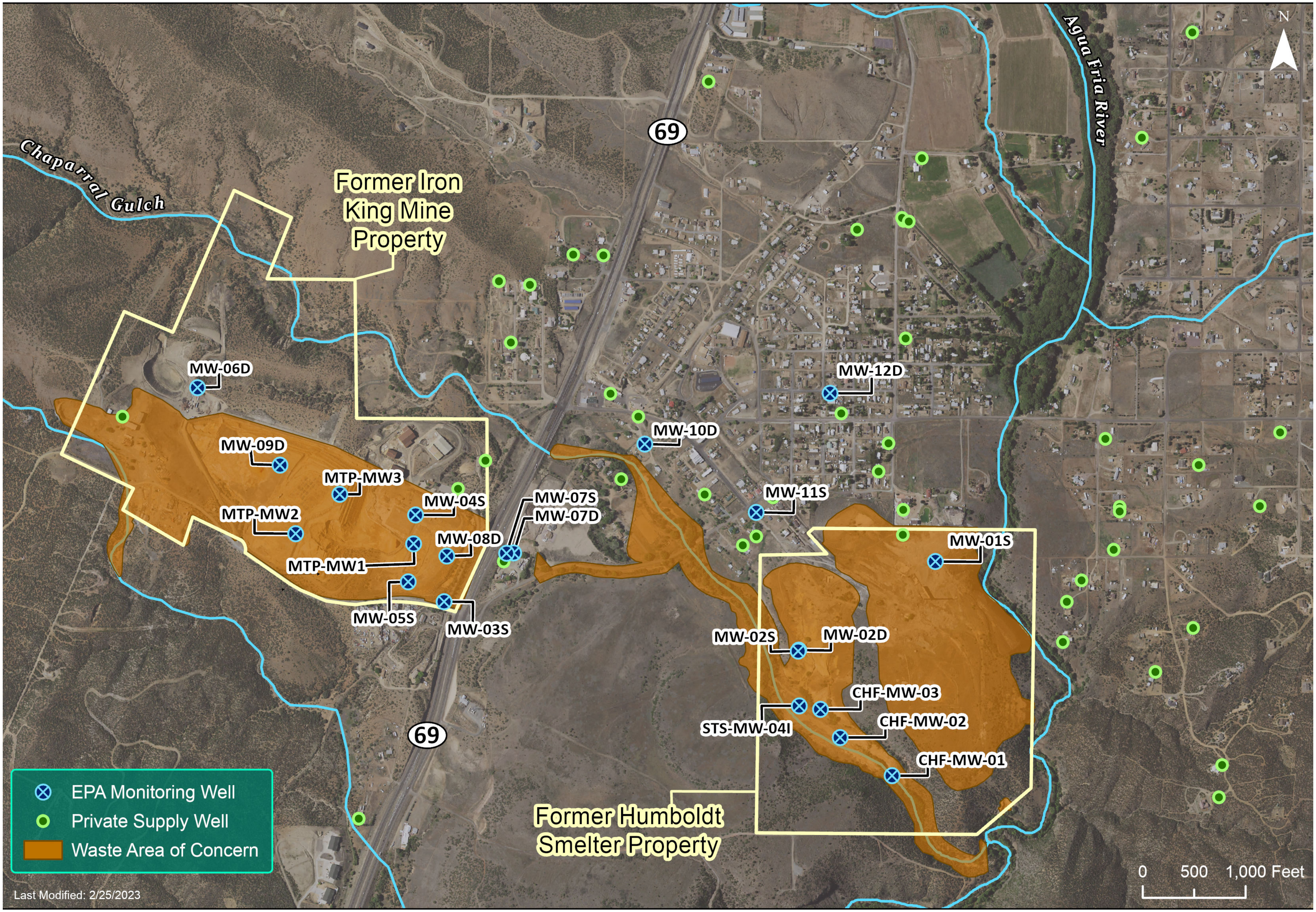
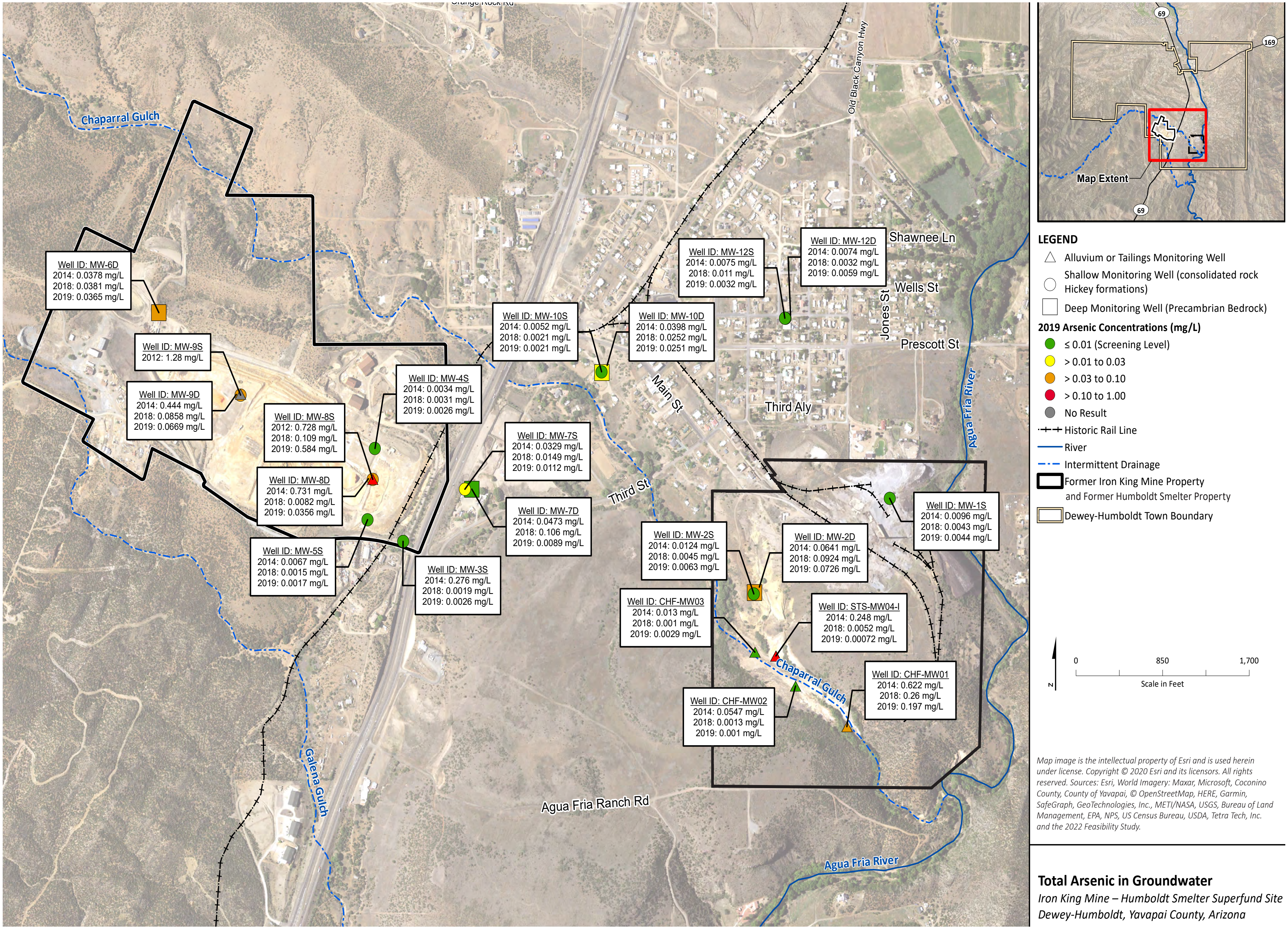


Figure 7. Total Arsenic In Groundwater



Scope and Role of Response Action

Conceptually, the remedy selection to which this Proposed Plan applies will address the site as follows:

1. Non-Residential.
Final response actions for the mine and smelter properties, mine wastes, contaminated drainages, and other contaminated soils and media in the areas not presently being used for residential purposes or for potential future residential development. This includes those non-residential areas as seen on Figure 8. It includes areas with contaminated soils north and south of the tailings pile for which *industrial* use is the reasonably anticipated future land use, as necessary. (see Figure 10). These areas are shown in green on Figure 8.

2. Residential.
Final response actions for soil contamination within areas where the current or future anticipated future land use is residential. This includes parcels being presently used for residential purposes and land that may be developed as residential in the future. Among these are areas shown on Figure 5; which are parcellated residential yards. It also includes areas with contaminated soils on north and south of the tailings pile for which potential future residential use is the reasonably anticipated future land use (see Figure 10). These residential or potential future residential areas are shown in blue on Figure 8.

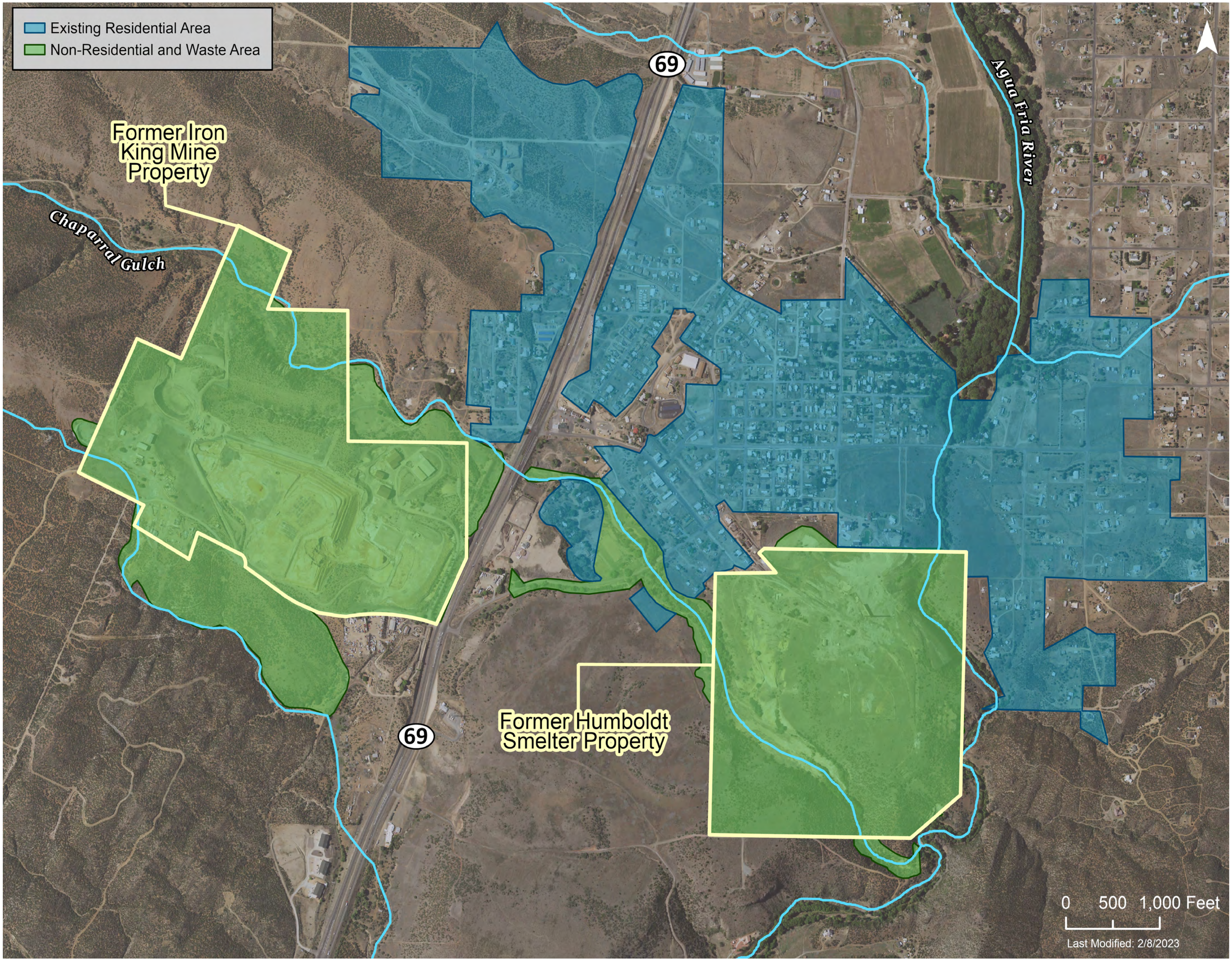
In the RI, Appendix E, EPA defined what is called the Area of Potential Site Impact (APSI) outside which levels of contaminants in soils can be considered background, or naturally occuring. Based on sampling, a majority of residential yards within the APSI were found not the have exposure point concentrations above PRGs.

As described above, EPA has performed three time-critical removal actions for existing residential areas. This has removed the majority of the human health risk from exposure to residential soils. However, EPA is proposing conservative PRGs and therefore plans to do additional cleanup work in residential areas.

3. Surface Water.
Final response actions for surface water in the Agua Fria River and Chaparral Gulch on and downstream of the smelter property.

4. Groundwater.
Interim response actions for groundwater at the site. Final groundwater remedial actions will be addressed in a later remedy selection, as necessary.

Figure 8. Residential and Non-Residential Areas



Summary of Human Health and Ecological Risks

EPA used the human health risk assessment (HHRA) and the Ecological Risk Assessment (ERA) to support previous residential cleanup decisions and to support the cleanup remedy proposed in this Proposed Plan.

General Risks and Processes Giving Rise to the Remedial Action Objectives

The IKM-HS Site contains millions of cubic yards of openly exposed media with high concentrations of toxic contaminants which can readily move within the environment. Most prominent of these are the mine tailings pile, the dross waste at the smelter, the tailings in the smelter tailings depression, and the tailings in the flood plain on Chaparral Gulch. People working or recreating/trespassing in these areas may be directly exposed to these wastes and associated contaminated soils above health-protective levels given anticipated land uses. Wildlife, such as red-tailed hawks, desert shrews, and coyotes, also may be directly exposed to contaminated site soils and wastes, and fish and macroinvertebrates may be exposed to water in the Agua Fria River, as the site lies within local wildlife habitat. The wastes themselves, and the contaminated alluvium and soils already in drainages, are subject to erosion. This has, and without action, will continue to move the wastes into drainage pathways, surface water, and ultimately affect water quality in the Agua Fria River. Erosion intermittently exposes buried tailings to the surface. Some exposed wastes, such as in the tailings depression at the smelter, can be or become subject to wind-blown movement.

Reasonably Anticipated Future Land Use (RAFLU)

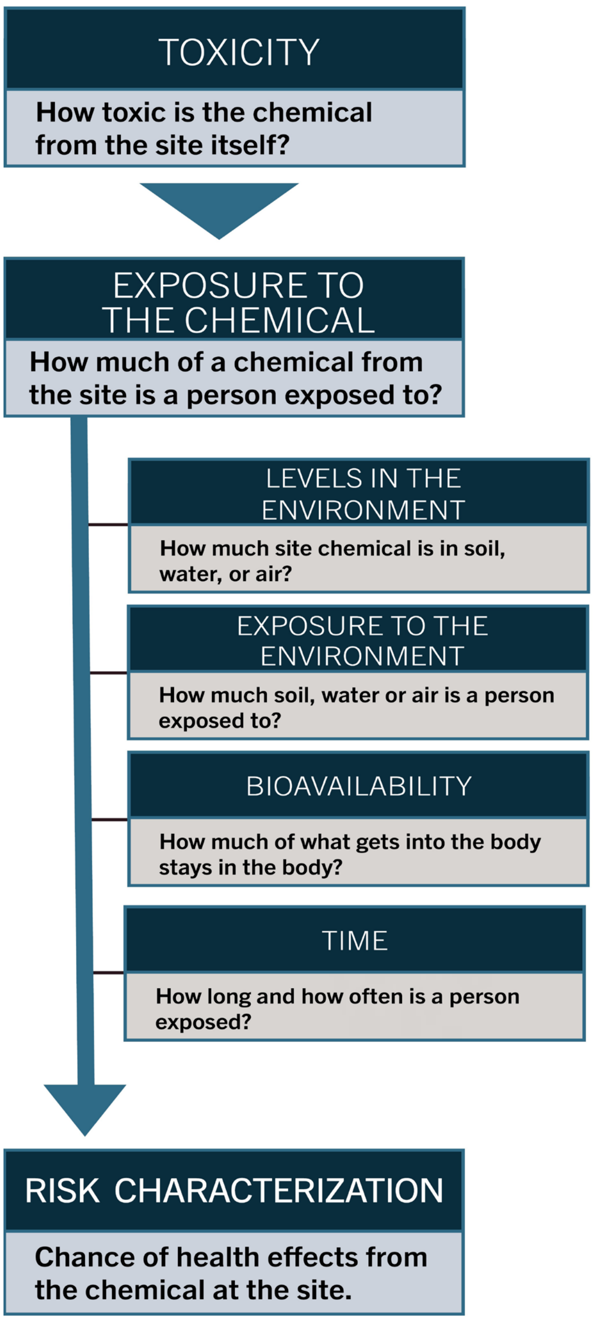
Spatially, the RAFLU for the many areas at the site vary considerably and in a complex manner. The RAFLU in given areas of the IKM-HS Site is critical to determining the risk scenario (residential, occupational/industrial or recreational) that is applied to each site area and in turn the estimate of health risk attributable to site contamination. The RAFLU for each site area was based in part on local zoning, but in a few areas it was also

What Is Risk Assessment?

Risk assessments evaluate the chances of future health effects caused from exposure of people or wildlife to site-related contamination. They help EPA to decide whether, where and how much to clean up. Figure 9 shows a simplified example of the process. EPA starts with information from studies about the toxicity of a chemical. Then the pathways someone might be exposed to the chemical at the site, such as by ingestion, inhalation, or skin contact with the chemical is considered. Based on sampling at the site, EPA develops a health-protective value to represent the levels of contaminants in each medium (soil, water, air) of interest. Next, assumptions are made about how much of each medium a person may be exposed to. We take into account the anticipated future land use on the site. Finally, EPA evaluates how often and for how long people may be in contact with contaminated soil water or air. Exposure from years to decades is usually assumed to make sure we are protective of health.

For cancer-causing chemicals, EPA generally considers risks to be low when long-term exposure to a contaminant would cause a chance of cancer of less than between 1 in one million to one in ten thousand. For non-cancer effects, EPA generally considers risks to be low when a value called a hazard index for the site is less than 1. These are called EPA's target risk criteria.

based on land ownership. For example, some of the open land lying north of the former mine property is owned by the Bureau of Land Management (BLM). Such land is not sold or developed. Accordingly, although the local zoning of this land is technically residential, the RAFLU is recreational. The RAFLU for the major areas of the site is depicted in Figure 10. This figure also shows pertinent zoning boundaries. Only areas within the range of site contamination are shown/shaded on the figure.



The vast majority of parcels lying north (in Dewey-Humboldt town proper) and northeast (across the Agua Fria River) from the shaded areas on Figure 10 are zoned residential, and with a few exceptions (such as near the freeway, for example, or in commercial strips), the RAFLU is residential.

Chemicals of Concern (COCs)

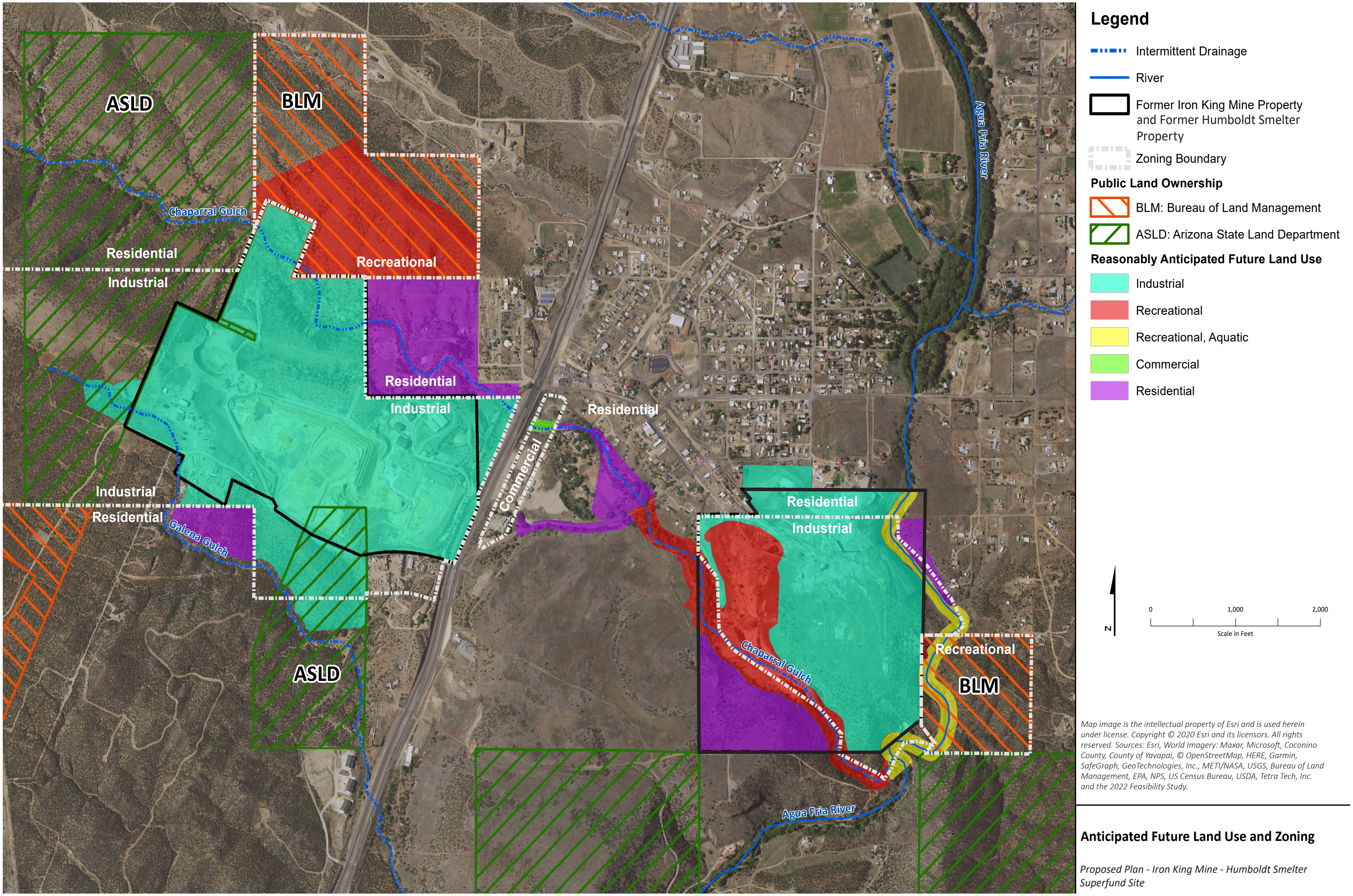
The driving chemicals of concern at the IKM-HS Site are arsenic and lead. Arsenic accounts for about 99% of the cancer risk attributable to the site. Lead and arsenic contamination is co-located with the other COCs because elevated levels substantially above background arise in the environment at the site due to the presence and migration of the same wastes (e.g. tailings). Primary IKM-HS Site COCs for solid media (soils, tailings, etc) also include antimony, cadmium, selenium, and zinc, and only in highly localized areas at the former smelter, polycyclic aromatic hydrocarbons and dioxins/furans. In the risk assessment, chemical data for 138 chemicals were screened resulting in 29 chemicals of *potential* concern, for which risks were calculated regardless of whether they ultimately posed an unacceptable risk. The risk assessment therefore accounted for a wider range of chemicals than the primary COCs.

Human Health Risk Assessment

EPA divided the non-residential portions of the IKM-HS Site into 20 human health risk management areas and calculated risk estimates for each under risk scenarios (residential, occupational/industrial, and recreational) and then focused on those estimates for the risk scenario corresponding to the reasonably anticipated future land use. In residential areas near the site where EPA sampled every yard, we calculated an individual risk for each yard.

EPA evaluated the health risks to residents, workers, and recreators exposed to soil, surface water, or ambient air by way of ingestion, inhalation or dermal contact. The HHRA considered all contaminants potentially related to the IKM-HS Site, including chemicals that potentially can cause cancer, chemicals that can cause other non-cancer health effects, and lead (which is addressed independently of cancer and non-cancer risks).

Figure 10. Reasonably Anticipated Future Land Use



Risks from lead are addressed by a different method that assigns a probability of exceeding a certain blood lead level (i.e. target blood level). Risks from lead are calculated using the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) for residential exposure scenarios and the Adult Lead Methodology for non-residential exposure scenarios. Based on the available science, EPA is proposing a conservative approach to address lead at the IKM-HS Site. EPA compared the exposure point concentration of lead in soil to 197 mg/kg for residential exposures and 460 mg/kg for occupational exposures. These represent target blood lead levels of 5 micrograms per deciliter (µg/dl) in the IEUBK and 5 µg/dl in the Adult Lead Model (ALM). EPA is currently evaluating its existing policy on human health risks from lead contamination in soil. Based on this evaluation, should the lead policy change, EPA will then determine whether a change to the cleanup level of lead in residential soil is needed at this site.

A summary of key results of the HHRA for major non-residential areas of the IKM-HS Site (including waste-bearing areas such as the mine tailings pile) are shown in Table 1. EPA identified human health risks from exposure to surface soils above EPA's target risk criteria for human exposure to surface soils and wastes given anticipated future land uses in 9 of these areas. Some areas such as Middle Chaparral Gulch also must be addressed to prevent source waste material at depth from continuing to migrate.

It is noted that human exposure to surface water and sediment within the Agua Fria River did not pose risks exceeding EPA's risk criteria. No human health risks associated with breathing air contamination exceeding EPA's risk criteria were identified at any of the ambient air monitoring stations in residential areas.

Ecological Risk Assessment (ERA)

EPA's ERA included both a screening-level ERA (called "Tier 1") and a baseline ERA (called "Tier 2"). The ERA showed potential for adverse health risk to non-human organisms from site-related metals detected in soil, sediment, and surface water. EPA evaluated risk from site contaminants to these types of organisms:

- Invertebrate animals found in soils and terrestrial plants that are exposed to soil;
- Organisms within the Agua Fria River such as aquatic plants, benthic and water column invertebrates, and fish that are exposed to surface water; and
- Other wildlife such as birds and mammals that are exposed to sediment, surface water, prey, and forage.

In the ERA, EPA divided the IKM-HS Site into 39 areas of soil, sediment, and surface water where wildlife and plants could be exposed to site contamination by way of direct contact and ingestion.

EPA considers a value called an ecological hazard index (EHI) when doing the ERA. When the EHI for a species is 1 or more, it can mean there are unsafe levels of contaminants for that species. For each ecological exposure area, EPA considered both the EHI and the number of species for which the EHI exceeded 1, 5 or 10. The number of species exceeding a hazard index value is useful in determining the degree of ecological risk and whether a cleanup action is warranted. This information is provided in Table 2.

The areas with highest potential for adverse ecological effects based on EHI and number of species exceeding the EHI include the mine tailings pile and waste rock area at the smelter; the former smelter operations area, dross waste and soils on the plateau of the smelter; and the small tailings piles in the lower chaparral gulch. Areas with high-to-moderate potential for ecological effects include the tailings depression at the smelter, the tailings flood plain, the mine drainage pathway along 3rd Street, and open land south of the tailings pile. Areas with low-to-moderate potential for adverse ecological effects include Upper Chapparal Gulch.

It is noted that while sediment in the Agua Fria River was identified in the RI as having potential unacceptable ecological risk, subsequent analysis during the FS of the levels, prevalence and distribution of exceedances of screening criteria revealed that ecological risks from sediments were not sufficient to justify a remedial action for sediment.

It is the lead agency's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

Remedial Action Objectives

In the Superfund program, cleanup objectives for a site are called remedial action objectives (RAOs). RAOs are designed to protect human health and the environment by decreasing or preventing exposure to, and the migration (movement) of site contamination. RAOs are specific to environmental media (solids, surface water, soil, sediment, groundwater, etc.). The RAOs for the IKM-HS Site are shown here.

RAO 1	Prevent human ingestion, inhalation, and/or direct contact exposure to COCs in site wastes and contaminated soils above levels that would pose an acceptable health risk given current and future anticipated land uses.
RAO 2	Prevent ecological exposure to COCs in site wastes and soils above levels protective of ecological populations.
RAO 3	Prevent migration (by erosion, leaching, windblown dust, acid rock drainage, or other transport mechanisms) of site source materials including tailings, dross, waste rock and contaminated soils such that it would pose an unacceptable risk to human or ecological receptors given future anticipated land uses.
RAO 4	Prevent ecological exposure to site COCs in surface water above levels protective of ecological populations.

Preliminary Remediation Goals (PRGs)

PRGs for the site were developed to protect human health and the environment from unacceptable risks from contaminants at the IKM-HS Site. PRGs are chemical concentrations in soil, sediment, and surface water that are sufficient to protect human health and the environment. PRGs, as defined in the FS, are not final cleanup levels. Final cleanup goals will be set in the Record of Decision (ROD).

The PRGs generally are the lower of 1) a human health risk-based target level (e.g. excess lifetime cancer risk within EPA's risk range or non-cancer risk with a hazard index of 1); 2) an ecological hazard index of 1 for any species; and 3) any chemical-specific ARAR; with the caveat that the PRG is not lower than background contaminant levels. The calculated background level of arsenic in surface soils surrounding the IKM-HS Site is 92 mg/kg. The calculated background level of lead in surface soils surrounding the site is 35 mg/kg. PRGs for surface water appear on Figure 6. The values for and key assumptions for lead and arsenic PRGs by exposure scenario are shown in Table 3.

Note on the Lead PRG.
EPA previously has used a cleanup level of 400 mg/kg lead in soil based on the use of the IEUBK lead model for the removal actions conducted at 47 residential properties. The 400 mg/kg cleanup level was derived from the IEUBK model with a target blood level of 10 µg/dl. Because of developments in the toxicological science regarding the toxicity of lead, for this remedial action EPA is setting the PRG for the residential exposure scenario to 197 mg/kg in soil, based on a target blood level of 5 µg/dl. A similar change for the occupational exposure scenario has resulted in an occupational PRG of 460 mg/kg.

Note on the Arsenic PRG.
In previous removal actions, EPA used a soil cleanup level of 144 mg/kg for arsenic at residential properties. This removed the great majority of health risk from highly elevated levels of arsenic in yards. However, to be additionally conservative, EPA is setting the PRG for arsenic in residential soil to 92 mg/kg. This coincidentally is both the background value of arsenic in the site area and the exposure point concentration resulting in a noncancer hazard index of 1 under the "child-only" soil exposure scenario. It represents a cancer risk of 3.5×10^{-5}.

Key ARARs

The FS contains an extensive analysis of potential Applicable or Relevant and Appropriate Requirements (ARARs) for the IKM-HS Site in Section 1.8. Among the key chemical-specific ARARs are specific provisions of (1) Arizona Soil Remediation Standards (ARS), and (2) the federal Clean Water Act (CWA) and associated State provisions and requirements including water quality criteria (e.g. CWA Sections 303 and 304) with respect to the Chaparral Gulch and the Agua Fria River. Among the key location-specific ARARs are CWA Section 404 provisions with regard to wetlands and FEMA regulations with regard to activities in flood plains (such as the tailings flood plain in Chaparral Gulch). Finally, the National Historic Preservation Act applies to portions of the site based on a Cultural Resource and Historic Building Survey (RI Report Appendix B).

The Bevill Waste Exemption

The 1980 Solid Waste Disposal Act Amendments (SWDA) to the 1976 Resource Conservation and Recovery Act (RCRA) provided an exclusion from regulation under Subtitle C of RCRA (hazardous wastes). The Bevill Amendment at 42 U.S.C. Section 3001(b)(3)(A)), among other materials, exempted waste from the processing of certain ores and minerals. Pending any further information EPA may obtain prior to the ROD, EPA believes that the tailings, waste rock and slag at the IKM-HS Site, and soils contaminated by these materials, are Bevill-exempt and therefore are not classified as hazardous wastes. However, the dross waste at the smelter is an exception and does not meet the requisite requirements of the Bevill exemption and requires treatment as a characteristic hazardous waste. This affects the technical requirements for addressing dross waste in the remedial alternatives.

Table 3. Preliminary Remediation Goals (PRGs)

Risk Exposure Scenario	PRG Factor (mg/kg)	Notes and Assumptions
Lead: Residential	197	IEUBK[1] Model for child with target blood level of 5 ug/dl.
Lead: Occupational	460	ALM[2] Model (2017) with outdoor exposure assumption
Lead: Recreational	2212	ALM model (2017) with teenage exposure assumed 52 days/year
Lead: Ecological	559	EHQ[3] of 1
Arsenic: Residential	92	The PRG defaults to background but is also equivalent to a child-only hazard index of 1 and excess lifetime cancer risk of 3.5 X 10^{-5}.
Arsenic: Occupational	884	Risk target based on lesser of hazard index of 1 and 10^{-4} risk.
Arsenic: Recreational	274	Risk target based on less of hazard index of 1 and 10^{-5} risk. Teenage exposure assumption of 52 days/year
Arsenic: Ecological	1414	EHQ of 1

1 IEUBK is integrated exposure update biokinetic model.
2 ALM is adult lead model
3 EHQ is ecological hazard quotient

Waste Repositories In the Alternatives

The following summarizes the cleanup alternatives that EPA has evaluated in the FS. Alternatives 2, 3A and 3B would excavate and place waste materials in either one or two *waste repositories*. A waste repository is a permanently covered holding cell that keeps waste in and water out, so waste can no longer move freely in the environment or expose people or wildlife. During cleanup, waste is excavated and moved from multiple places and consolidated in a repository. An effective and permanent, engineered cap can be designed using either a geotextile fabric liner covered with compacted clay and soils or a thicker compacted soil layer that forces water to evaporate before it can infiltrate into the waste. EPA will decide which kind of cap will be used during the remedial design phase of the project, which occurs after the selection of the remedy.

Waste Volumes and Repository Locations Findings in the FS

In the FS, EPA used a surveying technology known as Light Detection and Ranging, or as "LiDAR," from an aircraft to estimate the amount of waste (including both wastes and contaminated soil) located on the IKM-HS Site that would have to be moved to waste repositories. In the FS, we identified three possible locations for waste repositories: the mine tailings pile at the former mine property, the smelter tailings depression (or swale), and the plateau of the former smelter property. For each of these potential locations, we studied the volume available for waste. Additionally, we evaluated the amount of clean soil with appropriate geotechnical properties that could be available to bring in from local areas to build the permanent covers on the waste repositories.

EPA concluded that the mine tailings pile could hold all waste at the IKM-HS Site. EPA also concluded that both of the potential waste repositories at the former smelter property have enough space for all the wastes located on the east side of Highway 69. A waste repository located at the smelter tailings depression is preferred to repository located on the smelter plateau, if it is feasible, because it would be tucked away into a natural bowl-shape below the plateau and would be less visible to residents. In contrast, a waste repository on the smelter plateau would be more visible, as it would rise above the plateau. It would also limit more space on the smelter plateau from future land use. Finally, we concluded that there is enough clean soil available in nearby off-site locations with suitable properties to build covers on waste repositories.

Cleanup Alternative 1: No Action

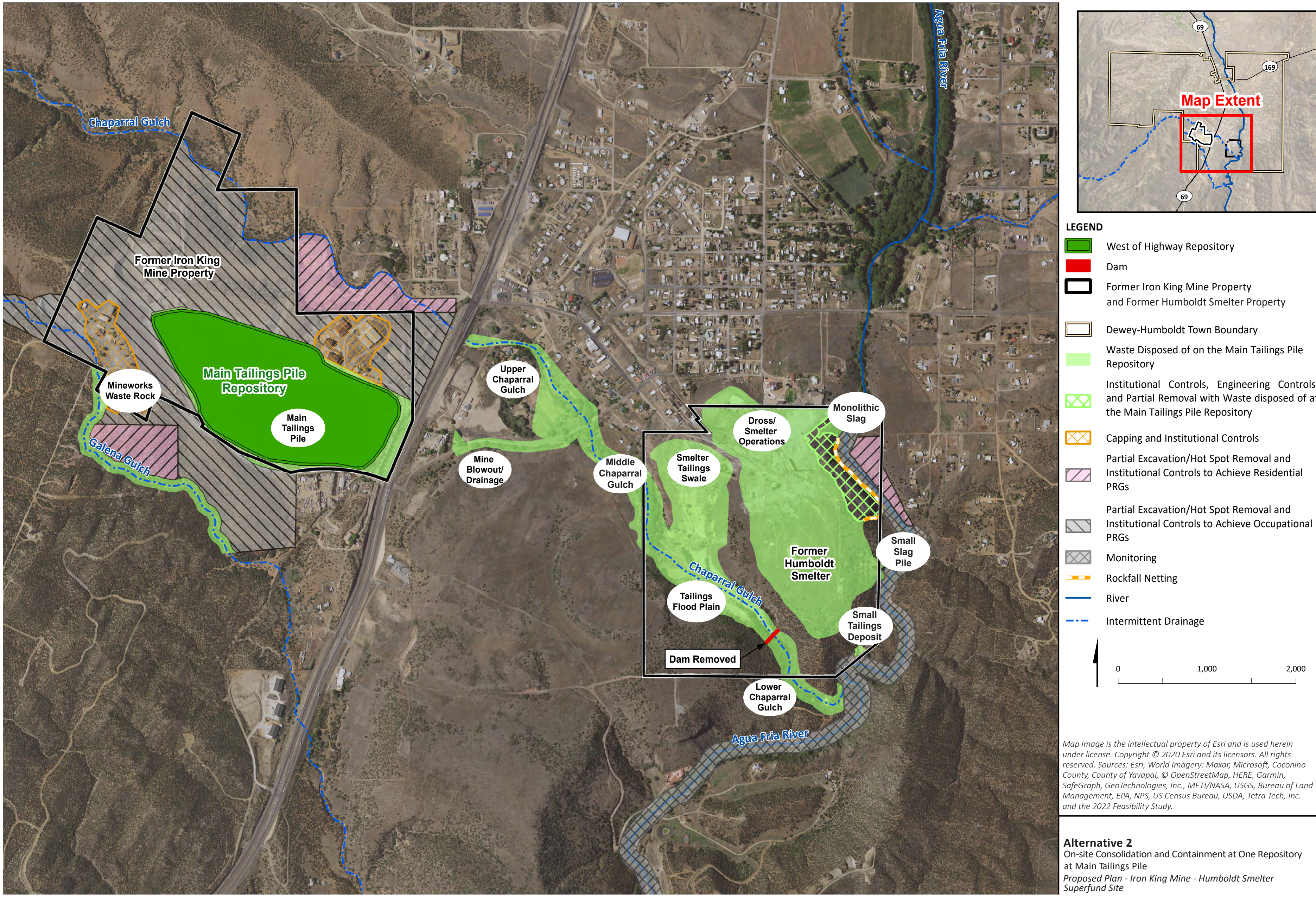
The No Action Alternative is required by the Superfund law as a baseline to compare cleanup alternatives. This alternative would do nothing to contain, treat or otherwise remediate contaminants, and provides no additional legal or administrative protection of human health or the environment. This alternative assumes that physical conditions at the IKM-HS Site remain unchanged, and the 6.4 million cubic yards of mine and smelter wastes would remain as it is forever. Wastes would also continue to move in the environment, and to contaminate surface water.

Cleanup Alternative 2: Consolidation/ Containment at One Waste Repository: All Waste to Mine Tailings Pile

Under Alternative 2, EPA would excavate most mine and smelter waste and soil with contaminant levels that exceed the PRGs on both sides of Highway 69 and dispose of this waste and soil in a single waste repository at the mine tailings pile on the former mine property (exceptions include monolithic slag and waste rock as discussed below). EPA would select the cleanup criteria and remedy standards for the IKM-HS Site and document them in the forthcoming ROD. A depiction of Alternative 2 can be seen in Figure 11.

The mine tailings pile would be used as a waste repository and would receive a permanent engineered cover that would be maintained indefinitely. The cover would prevent exposure to the waste, prevent infiltration of water into the waste, and prevent all future mobility of the waste. The estimated 4.3 million cubic yards of tailings currently in the mine tailings pile would remain in the tailings pile repository. An additional 890,000 cubic yards (1.1 million loose cubic yards) of waste from all locations east of Highway 69 (including all wastes at the smelter and in Chaparral Gulch) would be moved across the highway and added to the mine tailings pile waste repository. Other excavated wastes from the west side of Highway 69 would also be added to the mine tailings pile repository.

Figure 11. Alternative 2 Waste Movement and Repository Locations



This repository would then be reconfigured and regraded to ensure a stable structure. Once completed, the mine tailings pile repository would hold a final waste volume of 5.6 million cubic yards, including the material needed to build the cover, and the repository footprint would be about 65 acres.

Among Alternatives 2, 3A and 3B, this alternative would require the greatest amount of waste to cross the highway (approximately 55,000 truckloads) and the most time for such transport (approximately 81 weeks). 645,000 tons of soil would be brought in from a nearby offsite location to build the repository cover and other ancillary requirements, including backfilling excavations where needed.

After constructing and capping the mine tailings pile repository, EPA would construct appropriate engineered drainage structures and revegetate the repository. In the future, the repository would be regularly inspected to ensure it remained effective and repaired if necessary to address any impacts from processes such as erosion. Details of repository maintenance would be established during the remedial design.

Because the waste at the site is Bevill-exempt, the repository would not be built to requirements applicable to hazardous wastes. A cover for the repository would be constructed on the repository to prevent water from entering the waste but no liner would be needed. As an exception, the 147,000 cubic yards of dross waste at the smelter would be excavated and treated with portland cement to mitigate the hazardous waste characteristic before disposal in the repository.

Cleanup Alternative 3A: Consolidation/ Containment at Two Repositories: Chaparral Gulch Waste to Mine Tailings Pile

Under Alternative 3A, most mining and smelter wastes and soils with contaminant levels that exceed the cleanup criteria would be excavated and disposed in *two* waste repositories, with one repository on each side of Highway 69 (exceptions include monolithic slag and waste rock as discussed below). A depiction of Alternative 3A can be seen in Figure 12.

The estimated 4.3 million cubic yards of tailings currently in the mine tailings pile would remain in the tailings pile repository. The estimated 450,000 cubic yards of tailings waste and contaminated soils currently located in the Chapparal Gulch east of Highway 69 upstream of the dam would be moved west across the highway and disposed in the mine tailings pile at the former mine.

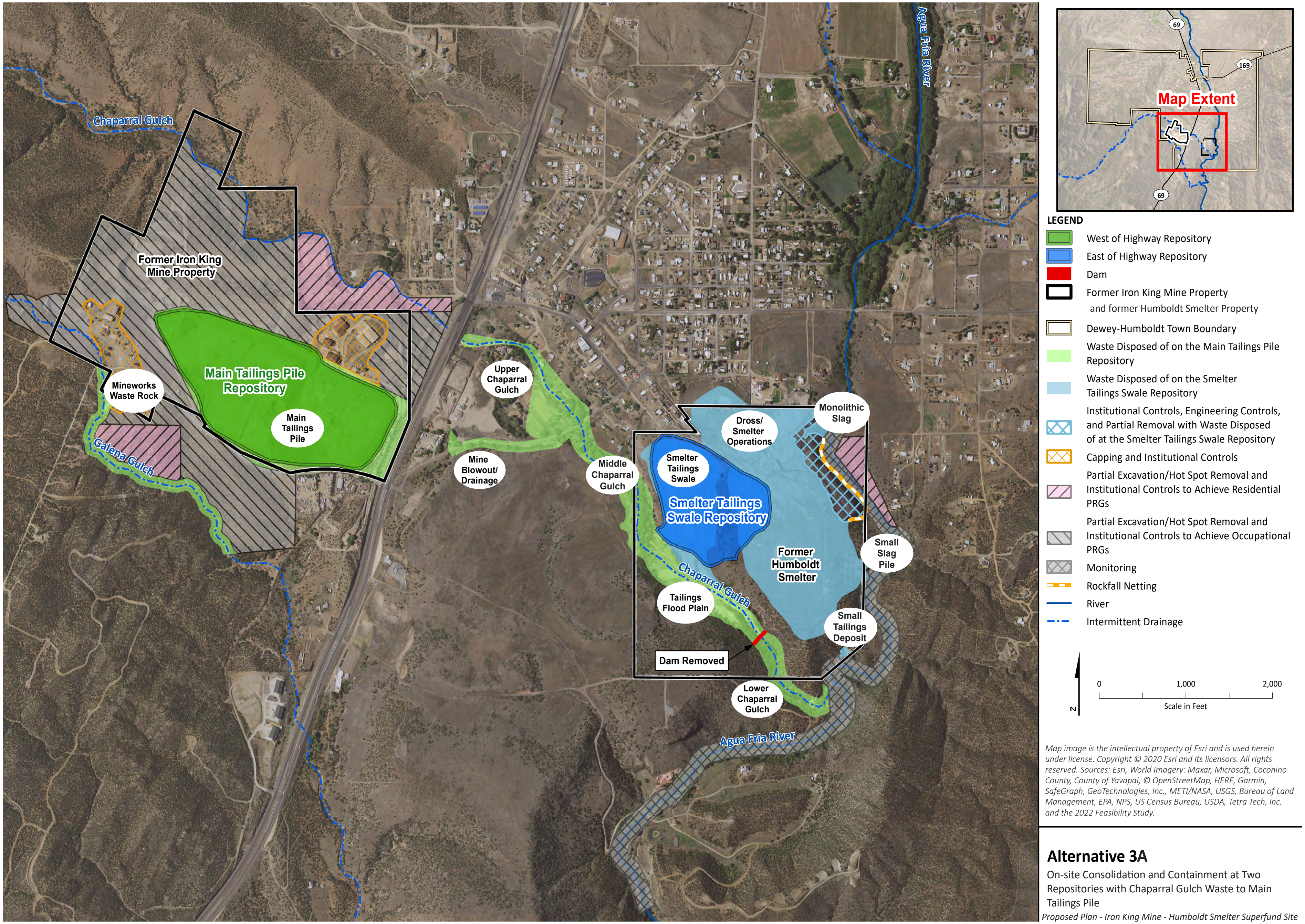
The mine tailings pile would be reconfigured and regraded to ensure that it has a stable structure. The mine tailings pile would be used as a waste repository and would receive a permanent engineered cover that would be maintained indefinitely. The cover would prevent exposure to the waste, prevent infiltration of water into the waste, and prevent all future mobility of the waste. Its final waste volume would be about 5.2 million cubic yards and it would cover a footprint of about 65 acres.

A second waste repository would be built on the smelter property, either in the existing smelter tailings depression or on the smelter plateau. EPA's preference during remedial design would be to build the repository in the depression because this would make the repository less visually imposing to the surrounding community and also maximize the uses to which the smelter plateau could be used in the future. The repository may be placed on the plateau if design limitations arose that made placing it in the depression impracticable. EPA would welcome comments from the public on the location of this repository. The repository would receive the 370,000 cubic yards of waste from all areas of the smelter property including on the smelter plateau, in the smelter tailings swale, and in the tailings deposits below the dam. As with the mine tailings repository, the second repository at the smelter would receive a permanent engineered cover that would be maintained indefinitely. The cover would prevent exposure to the waste, prevent infiltration of water into the waste, and prevent all future mobility of the waste. The second repository would have a final waste volume of 450,000 cubic yards, including the soil needed to build the repository cover. The repository would cover a footprint of about 21 acres.

In the future, both repositories would be regularly inspected to ensure they remained effective and repaired if necessary to address any impacts from processes such as erosion. Details of repository maintenance would be established during the remedial design.

Among Alternatives 2, 3A and 3B, this alternative would require the second-most amount of waste to cross the highway (approximately 28,000 truckloads) and a hauling/transport time of approximately 46 weeks. 645,000 tons of soil would be brought in from a nearby offsite location to build the repository cover and other ancillary requirements, including backfilling excavations where needed.

Figure 12. Alternative 3A Waste Movement and Repository Locations



After constructing and capping the repositories, EPA would construct appropriate engineered drainage structures and revegetate the repository.

Because the waste at the site is Bevill-exempt, the repository would not be built to requirements applicable to hazardous wastes. A cover would be constructed on the repository to prevent water from entering the waste but no liner would be needed. As an exception, the 147,000 cubic yards of dross waste at the smelter would be excavated and treated with portland cement to mitigate the hazardous waste characteristic before disposal in the repository.

Cleanup Alternative 3B: Consolidation/ Containment at Two Repositories: Waste Remains East and West of Highway

As with Alternative 3A, most mining and smelter wastes and soils with contaminant levels that exceed the cleanup criteria established by the ROD would be excavated and disposed in two waste repositories, with one repository on each side of Highway 69 (exceptions include monolithic slag and waste rock as discussed below). In this alternative, all waste currently located on the east side of the highway would remain in the repository on the east side at the former smelter. Waste currently located on the west side of the highway would stay on the west side and be moved to the mine tailings pile repository. Compared to Alternative 3A, less waste would end up at the mine tailings pile (west side) repository, and more waste would go into the second repository at the smelter. Under Alternative 3B, no waste would be moved across the highway. A depiction of Alternative 3B can be seen in Figure 13.

The estimated 4.3 million cubic yards of tailings currently in the mine tailings pile would remain in the tailings pile repository. The mine tailings pile would be reconfigured and regraded to ensure that it has a stable structure. The mine tailings pile would be used as a waste repository and would receive a permanent engineered cover that would be maintained indefinitely. The cover would prevent exposure to the waste, prevent infiltration of water into the waste, and prevent all future mobility of the waste. Its final waste volume would be about 4.7 million cubic yards and would occupy a footprint of about 65 acres.

A second waste repository would be built on the former Smelter property, either in the existing smelter tailings swale or on the smelter plateau. EPA would make it a priority during remedial design to build the repository in the tailings depression because this would make the repository far less visually imposing to the surrounding community and also maximize the uses to which the smelter plateau could be used in the future. EPA would welcome comments from the public on the location of this repository. The repository would receive excavated waste from all locations east of the highway. The second repository would have a final waste volume of about 1 million cubic yards, including soil material needed to build the repository cover. The footprint of the second repository would be about 22 acres. As with the first repository at the mine tailings pile, this second repository would receive a permanent engineered cover that would be maintained indefinitely. The cover would prevent exposure to the waste, prevent infiltration of water into the waste, and prevent all future mobility of the waste.

In the future, both repositories would be regularly inspected to ensure they remained effective and repaired if necessary to address any impacts from processes such as erosion. Details of repository maintenance would be established during the remedial design.

Among Alternatives 2, 3A and 3B, this alternative would require no waste to cross the highway and a hauling/ transport time of approximately 37 weeks. 719,000 tons of soil would be brought in from a nearby offsite location to build the repository cover and other ancillary requirements, including backfilling excavations where needed. After constructing and capping the repositories, EPA would construct appropriate engineered drainage structures and revegetate the repository.

Because the waste at the site is Bevill-exempt, the repository would not be built to requirements applicable to hazardous wastes. A cover would be constructed on the repository to prevent water from entering the waste but no liner would be needed. As an exception, the 147,000 cubic yards of dross waste at the smelter would be excavated and treated with portland cement to mitigate the hazardous waste characteristic before disposal in the repository.

Cleanup Alternative 4: Removal and Off-Site Disposal

Under Alternative 4, no mining or smelter wastes or contaminated soils would remain at the IKM-HS Site. Nearly all tailings, including the mine tailings pile, most soils, overhanging slag, dross, and other mine waste, with contaminant levels that exceed cleanup standards selected in the ROD would be excavated and transported off-site (volume of 5.3 million cubic yards) (exceptions include monolithic slag and waste rock as discussed below). The waste would be hauled about 85 miles to the nearest waste transfer station near Phoenix, unloaded and reloaded onto other transport containers (trucks or railcars), and then

Figure 13. Alternative 3B Waste Movement and Repository Locations

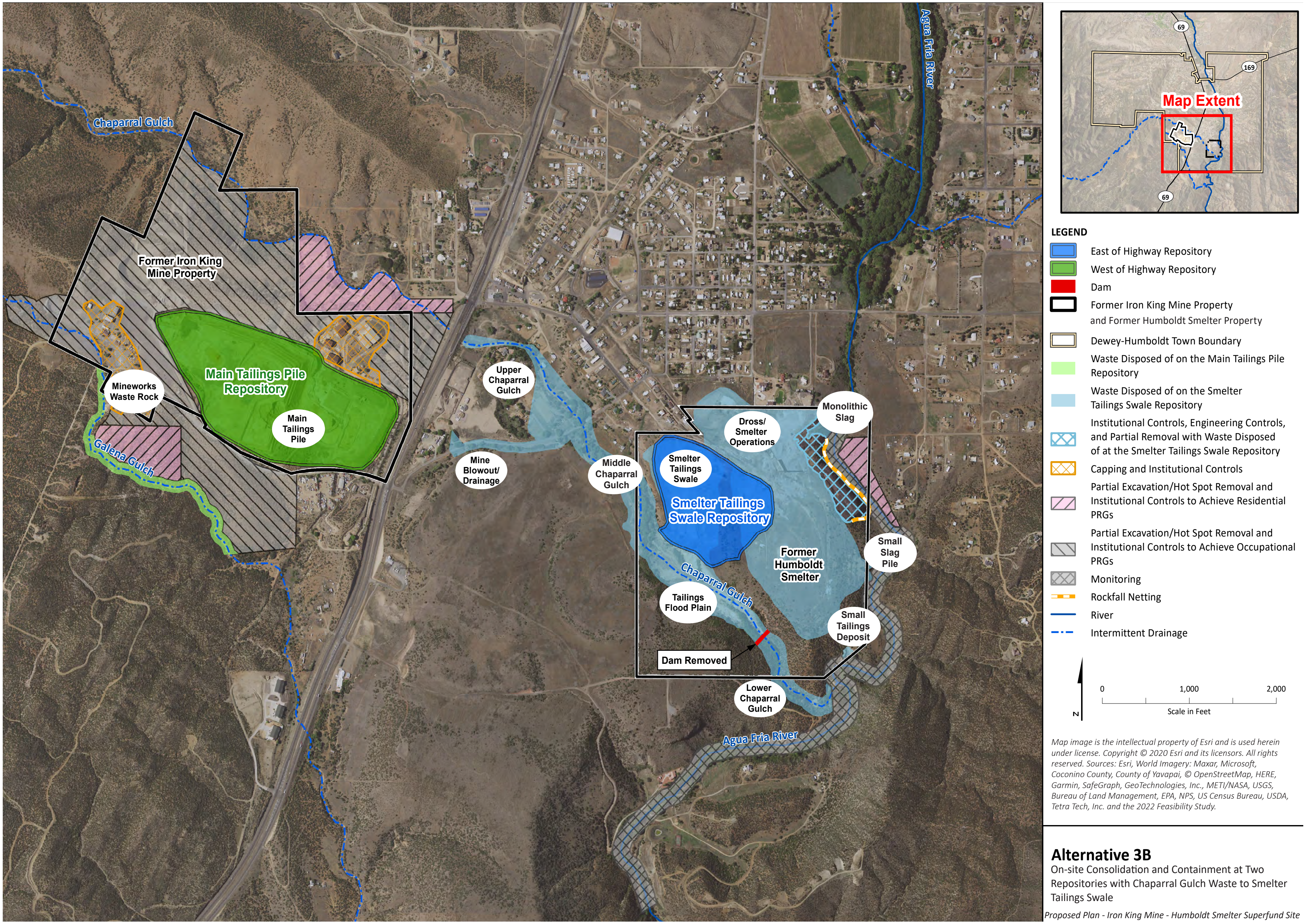
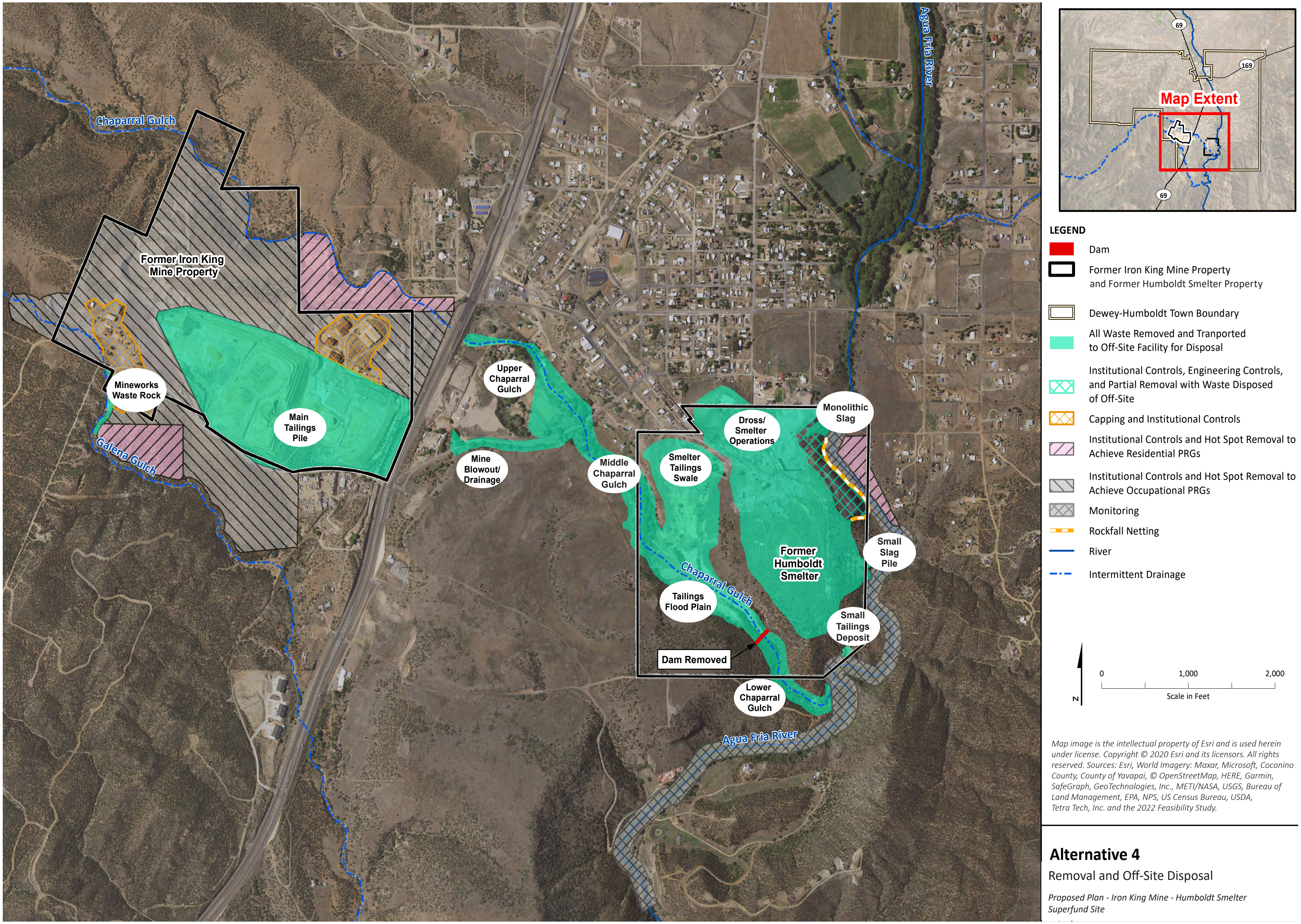


Figure 14. Alternative 4 Waste Movement and Repository Locations



transferred and managed at a permitted treatment, storage and disposal facility. After excavation, the removal areas would be vegetated. The land would be reusable for industrial/commercial activities in all areas and for residential development in most areas. 190,000 cubic yards of soil would be brought in from a nearby offsite location to backfill excavations. At the conclusion of the repository construction and capping, the repositories would be revegetated. A depiction of Alternative 4 can be seen in Figure 14.

Actions Common to All Alternatives

The Former Mineworks Area Behind (west of) the Mine Tailings Pile.
There are areas west of the mine tailings pile that are built on waste rock and others that are not. While surface soils can be removed as necessary, the underlying waste rock is deep and cannot be entirely removed. It also lies directly beneath the structures of operating facilities. In these areas, limited removal to meet occupational PRGs will take place in soils with removed soil being transferred to the mine tailings pile repository, except in areas where this is not practicable in which case simple capping will be used. There are small satellite piles of loose waste rock west of the mineworks area and these will be removed and moved to the mine tailings pile repository.

Open Lands just North and South of the Mine Tailings Pile.
The open lands just north and south of the mine tailings pile have subareas that have differing reasonably anticipated future land uses including commercial/industrial, recreational, and potential future residential. See Figure 11. In these areas, land where the RAFLU is recreational does not have soils with contaminants at levels requiring cleanup. Where the RAFLU is occupational or residential, there is generally open chaparral land with locally high levels of contaminants with exposure point concentrations above PRGs for the RAFLU. In the areas with residential or occupational RAFLU, soil with exposure point concentrations above PRGs will be removed to a maximum depth of two feet and disposed in the mine tailings pile repository. In areas with either residential or occupational RAFLU, if exposure point concentrations above PRGs remain after excavation, a warning barrier will be placed.

Existing Residential Soils.
In existing residential yards with soil exposure point concentrations above residential PRGs, soil will be removed to a maximum depth of 2 feet and replaced with clean soil. In these areas, if exposure point concentrations above PRGs remain after excavation, a warning barrier will be placed. It is intended that removed soil be placed in the smelter property waste repository if the timing of the remedial action allows for such disposal.

Monolithic Slag Wall at the Smelter.
(See discussion about monolithic slag above under *Ecological Risk Assessment* section). The monolithic slag wall is not stable and can release pulverized slag into the Agua Fria River, impacting water quality. Removal of all of the monolithic slag is not practicable nor necessary. However, as part of the remedy, slag would be partially excavated to lay back the angle of the slag face to a point that it is stable. Removed slag would be moved to the repository at the smelter.

Satellite Tailings and Waste Rock Piles.
The piles of waste rock west of the mine property and the small tailings piles in the lower Chaparral Gulch and adjacent to the Agua Fria River would be removed and disposed in the nearest repository.

Surface Water and Sediments in Agua Fria River.
After implementing source removal by excavating the lower Chaparral Gulch and removing the slag in the Agua Fria River that has pulverized off the overhead monolithic slag near the smelter, levels of metals in the water of the Agua Fria River will decline to levels below water quality standards. EPA will monitor the Agua Fria River water to verify this is occurring. As discussed previously, no remedial action or monitoring for sediments in the river is necessary.

Groundwater.
As discussed above, the RI determined that the IKM-HS Site is not contributing soluble arsenic to groundwater, except for the shallow perched groundwater under the mine tailings pile, under the Chaparral Gulch, and tailings areas of the smelter property. Soluble arsenic in groundwater other than these locations are due to naturally occurring geologic formations.

Under any alternative other than Alternative 1 -No Action, mixed tailings, contaminated alluvium, and other site wastes would be removed (e.g. Tailings Flood Plain of Chaparral Gulch) and/or permanently capped in repositories that eliminate infiltration of water through waste to produce leaching and ARD. No treatment of ARD after the present remedial action would be necessary. With these actions, the movement of ARD into groundwater beneath the repositories would be eliminated. EPA will continue to collect groundwater data to support a final remedial decision in the future.

EPA proposes to take interim actions for the groundwater at the site pending completion and reassessment of groundwater after the other remedial actions proposed in this document. The focus of these actions is to prevent consumption of shallow groundwater from within and under the waste areas subject to the remedial action.

- Institutional controls through the Arizona Department of Water Resources to prevent installation of new private or public water supply wells within and adjacent to the waste areas that are the subject of this remedial action (e.g. mine tailings pile and waste rock, the Chaparral Gulch including the Tailings Flood Plain; the Tailings Depression at the Smelter, and the Dross/Smelter Operations area at the smelter).
- Monitoring of existing monitoring wells at the IKM-HS Site.
- Periodic sampling of existing private wells adjacent to the waste areas that are subject of this remedial action. EPA will continue to collect groundwater data to support a final remedial decision in the future. During such samplings, EPA will educate well owners of the need to install home treatment systems to address natural arsenic in groundwater within the region.

Institutional Controls

The following institutional controls are anticipated:

- If Alternative 2, 3A or 3B is selected, land use would be restricted, physical controls would be applied, and excavation would be prohibited on the waste repository and the immediate area surrounding it that is necessary for its protection and maintenance.
- If Alternative 3A or 3B is selected, land use would be restricted, physical controls would be applied, and excavation would be prohibited on the waste repository at the smelter property and the immediate area surround it that is necessary for its protection and maintenance.
- Zoning and/or land use restrictions would be applied to prevent development of capped and covered areas which could damage the caps.
- Zoning and/or land use restrictions would be applied to prevent exposures in open areas north and south of the tailings pile if waste or contaminated soils above cleanup levels is left in place.
- The installation of drinking water wells would be prohibited at the mine tailings pile, at the smelter property, and near and below the Chaparral Gulch, as there is shallow groundwater contamination under the wastes in these locations.
- Land use would be prohibited on the remaining stabilized monolithic slag to prohibit construction and prevent persons from falling off the slag or into crevasses.
- In existing residential areas and areas for which the RAFLU is residential, landowners with warning barrier left on their parcel after cleanup will receive instructions from EPA on how to handle warning barrier if excavating. Also, the town government will receive instructions and a map of all parcels with warning barrier for use in permitting processes.

Why Recovery of Metals is Not Considered As A Remedial Alternative

While recovery of metals from tailings may be possible in concept, the high volume of tailings renders such resource recovery impracticable in a timeframe that would allow for protectiveness of human health and the environment. During the intervening reclamation and processing over a decade or more, the remaining tailings would remain exposed to the environment. If the wastes were placed in a repository before processing, reclamation would compromise the repository cover and therefore the protectiveness and permanence of the remedy, and greatly increase cost. Additionally, metals reclamation from tailings leaves behind large quantities of waste products that would still need to be addressed through onsite or offsite disposal.

Evaluation and Comparison of Cleanup Alternatives

The following and Table 4 summarize the comparison of the cleanup alternatives using criteria that are identified in the Superfund law (see box). EPA will fully evaluate the criteria of state and community acceptance after the public comment period.

Protectiveness of Human Health and Environment.
Alternative 1 would not protect human health and environment. Alternatives 2, 3A and 3B would be protective and meet all the RAOs by isolating site wastes and contaminated soils in consolidated and capped repositories that prevent exposure and migration of contaminants. Alternative 4 would be protective and remove all wastes from the site.

Compliance with ARARs.
Other than Alternative 1, the alternatives would meet potential ARARs identified in the FS.

Long Term Effectiveness and Permanence.
Other than Alternative 1, Alternatives 2, 3A and 3B would all be effective and permanent over the long-term provided that long-term repository maintenance is performed. Because it requires only one repository, Alternative 2 would be somewhat easier to maintain than Alternatives 3A and 3B. Alternative 4 would be effective and permanent by removing all wastes from the site.

Short-Term Effectiveness.
The community would experience short-term impacts under all the cleanup alternatives except for Alternative 1-No Action. Each cleanup alternative would excavate and move large quantities of mine and smelter wastes. Continuous hauling by large trucks over extended periods of time (e.g. 1-2 years) would be required for Alternatives 2, 3A and 3B. This would also be required for Alternative 4 which could require 10 years of hauling wastes. During the period of cleanup, residents, businesses, and drivers would need to accommodate construction activities and trucks entering and leaving work areas. EPA would make efforts to minimize this, but traffic delays and congestion along haul routes would be possible, especially on Highway 69 and along Third Street from Chapparal Gulch to Highway 69. EPA would maintain controls for traffic, dust, and construction-generated noise.

Criteria in The Superfund Law for Evaluating and Comparing Cleanup Alternatives

Threshold Criteria

1 Protectiveness of Health and the Environment
Does the alternative protect the health of people and the environment from contamination at the site both now and in the future?

2 Compliance with "ARARs"
Does the alternative comply with other applicable or relevant and appropriate laws and requirements related to the contamination, situation, or location of the site?

Balancing Criteria

3 Long-Term Effectiveness and Permanence
Will the alternative be effective over the long term and will the cleanup be permanent?

4 Short-Term Effectiveness
Will the alternative pose any impacts on people or the environment while the cleanup is being implemented?

5 Reduction of Mobility, Toxicity or Volume of Contaminants through Treatment
Will the alternative make the volume of contaminants smaller or keep contaminants from moving? Will there be less toxicity? Will there be treatment of the contaminated media?

6 Implementability
How hard would it be to carry out the alternative? Could it be done? What technical or administrative barriers and challenges might be posed?

7 Cost
What would be the cost of designing and carrying out the cleanup and any long-term action needed to maintain the cleanup effectiveness?

Modifying Criteria

8 State Acceptance
To what the degree would the state agree with the cleanup if the alternative were chosen? What concerns would there be?

9 Community Acceptance
To what the degree would the community agree with the cleanup if the alternative were chosen? What concerns would there be?

The cleanup alternatives differ most dramatically with regard to these short-term impacts. The most important differentiating factor is whether waste must be moved across (or on) Highway 69. Alternative 2 and Alternative 3A require wastes to be moved across Highway 69 from the east side of the highway to the mine tailings pile. Alternative 3B does not. Alternative 4 requires all the waste at the entire IKM-HS Site to be hauled not only across but on Highway 69. Hauling waste across or on the highway would dramatically increase traffic congestion, delays, and community disruption. The short-term impacts of the cleanup alternatives (other than Alternative 1-No Action which would have no short-term impacts), rank in this order:

- Alternative 3B would pose the least short-term impacts (including highway traffic impacts) because no waste would cross the highway, and the time to haul the wastes would be the shortest. The time to haul wastes on the roads would be the least of any alternative.
- Alternative 3A would pose more short-term impacts than Alternative 3B but not as much as Alternative 2. Wastes would have to cross the highway, but not as much as in Alternative 2.
- Alternative 2 would pose greater short-term impacts than Alternatives 3A or 3B, because all waste on the east side of the highway would have to cross the highway. Also, the hauling of wastes would take place for a longer time.
- Alternative 4 would pose by far the most highway traffic impacts because all the wastes at the site would be hauled not only across Highway 69, but on Highway 69 for 85 miles for 10 years.

Reduction of Toxicity, Mobility and Volume through Treatment.
Other than Alternative 1, the Alternatives would consolidate and therefore reduce the volume of contaminants and eliminate their mobility. By requiring only one repository, Alternative 2 would reduce the volume of contamination more than Alternatives 3A and 3B, which require 2 repositories. The extraordinary volume of the wastes at the IKM-HS Site makes the implementation of treatment technologies impracticable. EPA therefore expects to use engineering controls instead of treatment for this waste under all the alternatives evaluated. See 40 CFR § 300.430(a)(1)(iii)(B). Other than treatment of the dross waste before placement in the repository, the statutory preference for treatment would not be met under any of the evaluated alternatives.

Implementability.
Alternatives 2, 3A and 3B would be roughly equally implementable. One repository (Alternative 2) is somewhat easier to build and implement than 2 repositories (Alternatives 3A and 3B). Alternatives 2 and 3A involve moving wastes across busy Highway 69 which presents more implementability concerns than Alternative 3B in which no wastes have to cross the highway. Alternative 4 would be much more difficult to implement than Alternatives 2, 3A or 3B, because it would involve excavating all of the vast quantity of waste at the IKM-HS Site and moving it down Highway 69 and other roads to a remote off-site facility.

Cost.
Alternative 1 would have no cost. Alternatives 2, 3A and 3B would cost the same within the margin of error of the cost estimate performed in the FS. The cost of Alternative 4 would be roughly 8 times the cost of Alternatives 2, 3A or 3B. Capital, maintenance, and total present worth costs are shown in Table 4.

Table 4. Comparison of Alternatives

Alternative 1 is not shown because it would not be protective of human health and environment	**Alternative 2: 1 Repository: All Waste to Mine Tailings Pile Repository**	**Alternative 3A 2 Repositories: Chaparral Gulch Waste to Tailings Pile; Rest of Waste to Smelter Repository**	**Alternative 3B 2 Repositories: Waste Stays on Side of Highway It Starts On**	**Alternative 4: All Waste Hauled to Off-site Facility**
Would It Be Protective of Human Health & Environment?	Yes – provided the repository is maintained	Yes – provided repositories are maintained	Yes – provided repositories are maintained	Yes
What would be the Cost?	Capital: $70.7 M O&M: $2.0 M Total: $72.7 M	Capital: $72.7 M O&M: $2.5 M Total: $75.2 M	Capital:$69.6 O&M: $2.5 M Total: $72.1 M	Capital: $567 M O&M: $1.1 M Total: $568 M
Time – **Hauling Wastes on Roads**	At least 81 weeks (1 yr. & 7 mo.)	At least 46 weeks (11 months)	At least 46 weeks (11 months)	487 weeks (9 yr. & 4 mo.)
Time – **Complete Cleanup**	2 yr. & 1 mo.	1 yr. & 5 mo.	1 yr. & 3 mo.	10 years
Short Term Impacts: Wastes Moved Across the Highway in the Short Term *Traffic congestion, community disruption…*	Yes 1.1 million cubic yards waste (55,000 truckloads) moved across Highway 69 (Soil still would be hauled in to build the covers)	Yes 560,000 cubic yards waste (28,000 truckloads) moved across Highway 69 (Soil still would be hauled in to build the covers)	No Wastes will not be moved across Highway 69 – least disruptive option (Soil still would be hauled in to build the covers)	Yes 6.6 million cubic yards of waste hauled on Highway 69 and other roads
Will it be permanent and effective in the long term?	Yes – RAOs would be met indefinitely provided repository is maintained	Yes –RAOs would be met indefinitely provided repositories are maintained	Yes – RAOs would be met indefinitely provided repositories are maintained	Yes
Can it be Implemented? **How hard would it be to do it?**	Yes 1 repository is somewhat easier to build and maintain than 2 repositories	Yes 2 repositories are somewhat more difficult to build and maintain than 1 repository	Yes 2 repositories are somewhat more difficult to build and maintain than 1 repository	Possible, but problematic. Very difficult to do – finding a facility; huge quantity of waste on-road for 10 years
Can it meet other applicable and relevant laws and environmental requirements?	Yes	Yes	Yes	Yes
Would it reduce the ability of wastes to move and reduce their volume?	Yes	Yes	Yes	Yes

EPA's Preferred Cleanup Alternative

EPA proposes to select Cleanup Alternative 3B: **Consolidation/Containment at Two Repositories: Waste Remains East and West of Highway 69**.

Under this alternative, most mine and smelter wastes and soils with contaminant levels that exceed the cleanup criteria established by the ROD would be excavated and disposed in two waste repositories, with one repository on each side of Highway 69. All waste currently located on the east side of the highway would remain in the repository on the east side at the former smelter property. Waste currently located on the west side of the highway would be moved to the mine tailings pile, which would be reconfigured as a repository. Figures 15A and 15B show before-and-after cleanup depictions for the repository on the mine tailings pile. Figures 16A and 16B show before-and-after cleanup depictions for the repository at the former smelter property. Repositories would be inspected and maintained indefinitely.

Alternative 3B, like Alternatives 2 and 3A, would fully protect human health and the environment for the long term by sealing the site waste and contaminated soils in a permanently capped and maintained repository. It would prevent people and wildlife from being exposed to site wastes and contamination and prevent them from moving in the environment.

EPA believes that Alternative 3B is superior to Alternatives 2 and 3A, because it achieves protection of human health and the environment as well as Alternatives 2 and 3A and at the same cost (about $70 million), but without requiring wastes to be moved across Highway 69. Unlike EPA's preferred Alternative 3B, Alternatives 2 and 3A would impose greater impacts on the community due to trucks with waste having to continuously cross from the east to the west side of Highway 69 for about 1½ to 2 years. Those impacts would include higher highway traffic congestion and delays, in-town congestion, an increase in the chance of traffic accidents, and more disruption to residents. Alternative 3B avoids most of these

Figure 15A. Former Iron King Mine tailings pile before cleanup.

Figure 16A. Former Humboldt Smelter property before cleanup.

impacts by placing waste in a repository that is located on the same side of the highway as where it currently lies. Alternative 3B, as with Alternatives 2 and 3A, would still require that trucks on Highway 69 haul in clean soils from off-site locations in order to build the repository covers.

Figure 15B. Regraded and revegetated waste repository at the former Iron King Mine tailings pile after cleanup

Figure 16B. Completed waste repository at the former Humboldt Smelter property.

The Superfund law requires that a "No Action" option (Alternative 1) be retained and compared to the other alternatives. At the IKM-HS Site, this alternative would result in unabated threats to human health and the environment. People and wildlife would remain exposed to mining and smelting wastes, which would remain open to the environment and free to move. This alternative does not meet the threshold requirements for protecting human health and environment, and therefore EPA considers it highly unacceptable.

Alternative 4 – hauling all the waste at the IKM-HS Site along Highway 69 and beyond to an off-site facility, would require hauling 5.3 million cubic yards of material on the highway for 10 years at a cost of $569 million, or 8 times the cost and requiring up to 13 times as long to achieve cleanup as any other alternative. It would impose extreme impacts on the Dewey-Humboldt community and communities southward on the freeway in terms of traffic congestion, disruption, and increased chances of traffic accidents. It would not confer appreciable additional benefits over the other alternatives in terms of protecting human health and the environment. This alternative is therefore not preferred by EPA.

As discussed above, the proposed Alternative would include several actions that are common to all alternatives. Among these are actions specific to existing residential or potentially future residential areas. In these areas where soil exposure point concentrations exceed residential PRGs, soil will be removed to a maximum depth of 2 feet and replaced with clean soil. It is intended that removed soil be placed in the smelter property waste repository if the timing of the remedial action allows for such disposal. If levels above PRGs remain after excavation, a warning barrier will be placed prior to clean soil placement. Landowners with warning barrier on their parcel after cleanup will receive instructions from EPA on how to handle warning barrier if excavating. Also, the town government will receive instructions and a map of all parcels with warning barrier for use in permitting processes. This will result in cleanup actions at additional existing residential yards.

It is noted that EPA's preferred remedy may change in response to public comments received on this Proposed Plan. EPA has received concurrence by the support agency, the ADEQ, on the proposed alternative.

Based on information currently available, as the lead agency EPA believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; and 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element.

EPA finds that the statutory preference for treatment will not be attainable due to the exceedingly high volume of tailings, mine wastes and contaminated soils at the IKM-HS Site, which renders treatment impracticable.

Response Actions Proposed to Current Residential Yards

As discussed earlier in detail, EPA completed three removal actions addressing surface soils at 47 residential properties in 2006, 2012 and 2017. During these cleanup actions, contaminated surface soils were removed from yards and replaced with clean soil where exposure point concentrations of lead and arsenic exceeded cleanup levels. For reasons discussed under Preliminary Remediation Goals above, to be additionally protective of health EPA is proposing to lower the PRG for lead to 197 mg/kg and arsenic to 92 mg/kg. This will result in the cleanup of soils in additional residential yards as part of this response action. As with previous removal actions, surface soils would be removed to a maximum depth of 2 feet and replaced with clean fill to ensure that exposure point concentrations for the remaining surface soils are below the revised PRGs. EPA plans future outreach to the community with additional information such as which additional yards would be addressed, the areas of soil anticipated to be removed, detailed plans for conducting the residential response action, the effect of placement of warning barriers, and the actions EPA would follow to engage property owners and secure access to properties to conduct the action.

Figure 2, 4, 5, 6 and 8: Map images are the intellectual property of Esri and are used herein under license. Copyright © 2020 Esri and its licensors. All rights reserved. Sources: Esri, World Imagery: Maxar, Microsoft, Coconino County, County of Yavapai, © OpenStreetMap, HERE, Garmin, SafeGraph, GeoTechnologies, Inc., METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, Tetra Tech, Inc. and the 2022 Feasibility Study.

Public Participation through Comments on this Plan

Public Comment Period.
The EPA will accept public comments for 60 days – March 15 through May 13, 2023. This public comment period is an opportunity to comment on the preferred alternative and other alternatives EPA considered. All comments are encouraged. The preferred alternative can change in response to public comment or new information.

Ways to Comment.
Comments will be accepted by mail, email or in person. Please reference the "Iron King Mine - Humboldt Smelter Superfund Site Proposed Plan" in your comments.

Written Comments
Postmarked no later than May 13, 2023 to the address below:

Jeff Dhont, Remedial Project Manager
Iron King Mine - Humboldt Smelter
Mail Stop SFD-8-1
75 Hawthorne Street
San Francisco, CA 94105

Emailed Comments
Sent no later than May 13, 2023 to one of the EPA site team's email addresses below:

Jeff Dhont
Remedial Project Manager
dhont.jeff@epa.gov

Georgia Thompson
Community Involvement Coordinator
thompson.georgia@epa.gov

Attend EPA's Public Hearing
March 29, 2023
6:30 PM

Humboldt Elementary School
2750 Corral Street
Dewey-Humboldt, AZ 86329

The proceedings will be recorded, and you may make comments orally or submit written comments on the Proposed Plan at the hearing.

Want More Information?

1 Visit EPA's Website for the IKM-HS Site: epa.gov/superfund/ironkingmine. Get a full overview of the site, view the critical and comprehensive site studies, and view the administrative record with documents EPA relied upon for this Proposed Plan.

2 View one of our seven topical presentations at the web site: https://semspub.epa.gov/src/document/09/100024175.

3 Visit EPA's public information repository at the **Dewey-Humboldt Public Library** 2735 Corral Street, Dewey-Humboldt, AZ 86329.

4 Attend the public hearing on this Proposed Plan.

5 Contact EPA's site Community Involvement Coordinator. (Georgia Thompson, thompson.georgia@epa.gov)