Planning for the Future:

Reuse Assessment for Iron King Mine - Humboldt Smelter Superfund Site

Town of Dewey-Humboldt, Yavapai County, Arizona

June 2010

Abandoned Mine Lands Team

funded by
United States Environmental Protection Agency

prepared for
Town of Dewey-Humboldt

prepared by
E² Inc.

Forward

EPA's primary responsibility at Superfund sites is to ensure the protection of human health and the environment. Consideration of a site's potential future use is an important part of this responsibility under the National Contingency Plan (NCP). EPA's Abandoned Mine Land (AML) Team provides communities with technical support and resources as they explore reuse opportunities available at former mine lands. EPA's AML Team works in partnership with communities to clarify EPA's interests at former mine lands and address potential obstacles to innovative reuse of these sites. In addition, EPA's RE-Powering America's Lands Initiative identifies Brownfields, RCRA, Superfund and mining sites for their wind, solar and biomass development potential and provides other useful resources for communities, developers, industry, state and local governments or anyone interested in reusing these sites for renewable energy development.

The Superfund Redevelopment Initiative (SRI) was created by EPA in 1999 to help communities and stakeholders in their efforts to return environmentally impaired sites to protective and productive use. Conducting a reuse assessment that engages site owners and other stakeholders in evaluating future use options for a site can help facilitate site stewardship and support the long-term effectiveness of the site's remedy.

Table of Contents

I. Introduction	Page 3
II. Reuse Goals and Stakeholder Considerations	Page 6
III. Regional Context	Page 9
IV. Site Characterization	Page 10
V. Reuse Framework	Page 14
VI. Renewable Energy Overview	Page 18
VII. Future Use Opportunities	Page 23
VIII. Remedial Considerations	Page 33

List of Figures

Figure 1 - Site Location Map	Page 2
Figure 2 - Major Land Ownership in Yavapai County	Page 8
Figure 3 - Surrounding Area Zoning	Page 8
Figure 4 - Water Access	Page 8
Figure 5 - Regional Transportation Planning	Page 8
Figure 6 - Iron King Mine Area Land Ownership	Page 10
Figure 7 - Iron King Mine Area Zoning	Page 10
Figure 8 - Iron King Mine Area Access and Hydrology	Page 11
Figure 9 - Iron King Mine Area Site Features	Page 11
Figure 10 - Iron King Mine Area Grade	Page 11
Figure 11 - Humboldt Smelter Area Land Ownership	Page 12
Figure 12 - Humboldt Smelter Area Zoning	Page 12
Figure 13 - Humboldt Smelter Area Access and Hydrology	Page 13
Figure 14 - Humboldt Smelter Area Site Features	Page 13
Figure 15 - Humboldt Smelter Area Grade	Page 13
Figure 16 - Iron King Mine Area Reuse Zones	Page 15
Figure 17 - Humboldt Smelter Area Reuse Zones	Page 16
Figure 18 - Iron King Mine Area Future Use Scenarios	Page 22
Figure 19 - National Forests Lands within 50-mile radius	Page 27
Figure 20 - Humboldt Smelter Area Future Use Scenarios	Page 28
Figure 21 - Town of Dewey-Humboldt Open Space / Trails	Page 31
Figure 22 - Iron King Mine Area Remedial Considerations	Page 32
Figure 23 - Humboldt Smelter Area Remedial Considerations	Page 34

List of Tables

Table 1 - Reuse Zones	Page 14
Table 2 - Iron King Mine Area Site Considerations by Reuse Zone	Page 14
Table 3 - Humboldt Smelter Area Site Considerations by Reuse Zone	Page 17
Table 4 - Installed Solar Energy Capacity by Leading State	Page 20
Table 5 - Acres with PV Potential at Iron King Mine Area	Page 24
Table 6 - Acres with PV Potential at Humboldt Smelter Area	Page 29
Table 7 - Iron King Mine Area Remedial Considerations	Page 33
Table 8 - Humboldt Smetler Area Remedial Considerations	Page 35

Appendix

Appendix A - Superfund Site Redevelopment Considerations	A-1
Appendix B - Renewable Energy Technologies	B-1
Appendix C - Renewable Energy Incentives	C-1
Appendix D - Slag Reuse at Humboldt Smelter Area	D-1

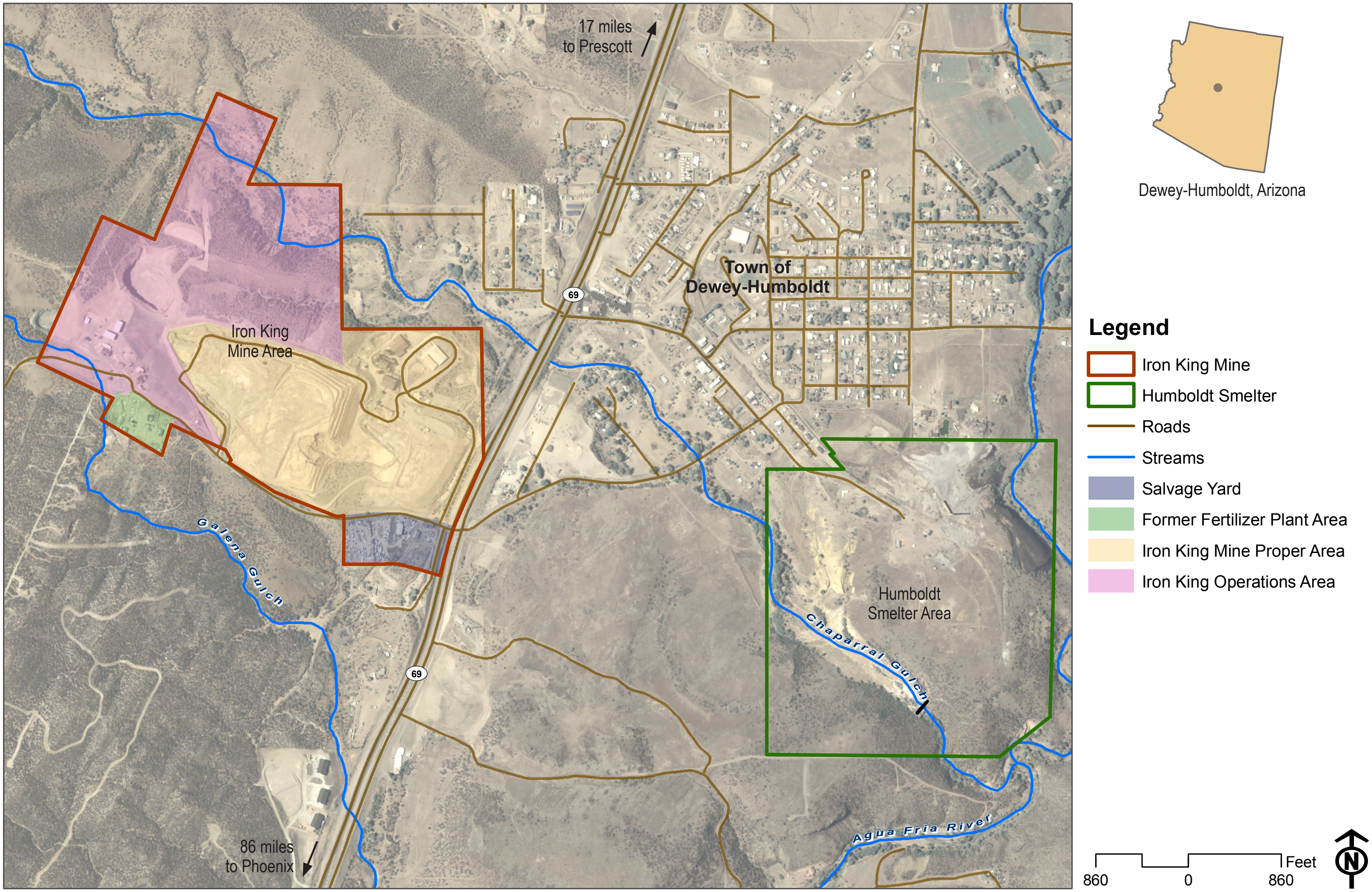


Figure 1: Site Location Map

I. INTRODUCTION

Background

The Iron King Mine - Humboldt Smelter Superfund Site (Site) encompasses areas of contamination from two separate facilities: the Iron King Mine and the Humboldt Smelter (see Figure 1). The Iron King Mine was an active mine beginning in 1906 until 1969. The Humboldt Smelter operated from the late 1800s until the early 1960s. Waste rock and tailings were deposited in large piles adjacent to actual mine property boundaries. More recently, the mine tailings from the Site have been used to create fertilizer. The smelter is situated 1 mile east of the Iron King Mine property. The Smelter property is bordered by the Town of Humboldt to the west and north, the Agua Fria River to the east, and the Chaparral Gulch to the south.

Due to past mining and smelting operations, arsenic, lead and other metals have contaminated soil, sediments, surface water and ground water at levels above background concentrations. The Iron King Mine facility covers 153 acres, the majority of which is covered by waste rock piles and tailings (the tailings pile measures approximately 62 acres). The smelter facility occupies approximately 183 acres and has approximately 185,000 cubic yards of tailings, 250,000 cubic yards of smelter ash and 1.7 million cubic yards of slag. On-site ponds, pits, and lagoons were reportedly used for the leaching of minerals from mined ore.

The full extent of soil and ground water contamination is being investigated under the Remedial Investigation and Feasibility Study (RI/FS) process under the Comprehensive Environmental Response, Compensation, and Liability Act. EPA has identified five Areas of Interest at the Site: Iron King Mine Area; Humboldt Smelter and ancillary associated properties; off-site soil near the Site; local waterways, including the Chaparral Gulch, Galena Gulch and Aqua Fria River; and shallow and deep ground water. A Remedial Investigation (RI) Report was completed in March 2010. In addition, EPA has conducted a Cultural Resource and Historic Building Survey and a Biological Evaluation for the Site. EPA is currently conducting a Feasibility Study (FS) to evaluate cleanup alternatives for the Site. Based on information from the RI/FS, a Record of Decision (ROD) will be issued that explains which cleanup alternatives will be used to clean up the Site.

Project Overview and Purpose

Once addressed, former contaminated properties like the Iron King – Humboldt Smelter Superfund Site can offer many new opportunities for communities. Areas that were once an eyesore or underutilized can:

- be returned to a productive use for the community,
- encourage development in the area,
- help raise property values in the surrounding area,
- increase the local tax base, or
- be integrated into the area's open space and provide recreational opportunities

Understanding this, EPA's cleanup programs have set a national goal of returning formerly contaminated sites to long-term, sustainable and productive use. EPA recognizes that part of its mission to protect human health and the environment includes making sure its cleanup activities are consistent with community goals to reuse these sites. The purpose of the reuse assessment is to clarify reuse goals, understand the site's constraints and opportunities, and identify reuse considerations to inform cleanup activities and local planning efforts. This report summarizes the findings of the reuse assessment including future use goals, local planning goals, site context, and potential future use scenarios and remedial considerations.

This report also examines opportunities for siting renewable energy projects at the Site. In particular, this analysis assesses the feasibility of using renewable energy technologies to meet potential on-site light industrial/commercial electricity demand or to generate grid-tied electricity.

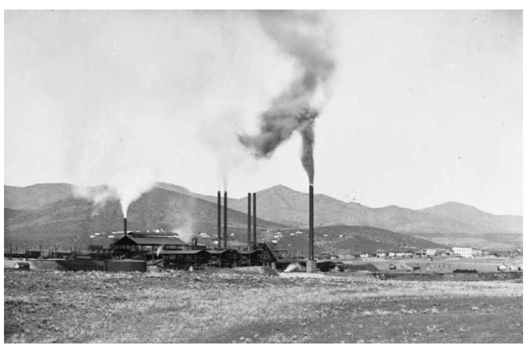
Redeveloping Superfund Sites

EPA recognizes that identifying and understanding reasonably anticipated future land use(s) at a site is an important consideration affecting the entire site cleanup process. By considering future uses, formerly contaminated properties can be returned to productive uses that also help to ensure the long-term integrity and protectiveness of the cleanup approach.

This reuse assessment can be considered part of a larger cleanup and land use planning process that will help inform near and longer term opportunities to redevelop the Site and incorporate reuse options into the broader Dewey-Humboldt planning efforts. As the Site moves forward, there are several considerations that could be helpful throughout the remedial and reuse planning process. These considerations are outlined in the adjacent text box and more detailed information is provided in Appendix A. This reuse assessment highlights information that is relevant to considerations one through three.

In addition, EPA has developed a suite of tools to help local governments, communities, and developers navigate the redevelopment process. These tools are available at:

www.epa.gov/superfund/programs/recycle/index.html
www.epa.gov/superfund/programs/aml/index.htm



Key Considerations for Superfund Site Redevelopment

1. Gather Basic Information about the Site - to ensure current information informs redevelopment
2. Considering Future Use Opportunities for the Site - throughout the remedial process (more information is provided on the following page)
3. Community and Stakeholder Input - is important throughout the redevelopment process
4. Review Associated Legal Issues and Obtain Liability Clarification and Assurances - to address any legal or liability concerns
5. Identify Potential Barriers to Reuse - that may prevent certain types of development activity
6. Locate Developer to Implement Reuse - and assist in implementing all or part of the reuse plan
7. Address Potential Lender Concerns about Financing - to help alleviate potential concerns about financing contaminated properties
8. Explore Funding Resources for Cleanup and Reuse - through various grants and funding options available for various aspects of the cleanup and redevelopment process

EPA evaluates all Superfund sites to determine what needs to be done to protect human health and the environment. There are five main stages to EPA's remedial response process; each stage provides an opportunity to incorporate future land use considerations. The diagram below illustrates a potential timeline for the site's remedial response process and identifies key future land use considerations for each stage of the process.

2010 — 2011	2012	2013	2014	2015
Remedial Investigation / Feasibility Study (RI/FS) Site conditions are evaluated. Data are collected to assess human health and ecological risks. A range of remedial action options are developed for a site's cleanup.	**Remedy Selection / Record of Decision** Cleanup levels are identified and a site's remedy is selected and documented in a Record of Decision (ROD). During the remedy selection process, a detailed analysis of remedial action alternatives are weighed against nine criteria.	**Remedial Design (RD)** Plans and specifications for a site's remedy are developed, the extent of contamination is confirmed through field sampling, and remedial technologies are tested for effectiveness.	**Remedial Action (RA)** Funding for site remediation is secured and construction of a site's remedy begins. Contaminated media are remediated to selected cleanup levels using remedial technologies described in the ROD.	**Post Construction** → Post-construction activities include: - operation and maintenance - long-term response actions - institutional controls (ICs) - Five-Year Reviews - site reuse
Future Land Use Considerations: Community reuse goals can help to inform risk assessments and remedial action alternatives. Reuse discussions can help to build realistic community expectations for a site's reuse. This stage is an optimal time for reuse and remedy considerations to intersect.	Future Land Use Considerations: Future land use considerations are taken into account within three of the nine remedy selection criteria: - overall protection of human health and the environment - the long-term effectiveness of site remedies - a community's acceptance of the Agency's cleanup plans	Future Land Use Considerations: Coordination between local governments, property owners and EPA can help return a site to use as soon as possible by ensuring that reuse and remedial plans are compatible. Reuse plans can be refined to identify more specific site uses at this stage.	Future Land Use Considerations: Timing of remedial construction and reuse plans can be coordinated. Phasing of a site's redevelopment can help to shape the timing of remedial activities.	Future Land Use Considerations: Site owners, state and local governments, and responsible parties may all play a role in a site's long-term stewardship. Implementation of ICs requires collaboration among multiple parties. Many ICs can only be implemented by local governments or private property owners. Site can be returned to use.

II. REUSE GOALS AND STAKEHOLDER CONSIDERATIONS

On July 21 and 22, 2009, EPA Region 9 and E² Inc. met with community stakeholders to gather a preliminary set of reuse goals and considerations. These preliminary stakeholder interviews included:

- Current site owners
- Elected officials
- Arizona Department of Environmental Quality (ADEQ)
- Representatives for the Town of Dewey-Humboldt,
- Interested community members at the Town Council Meeting on July 22, 2009

Future Use Goals

During these initial community discussions, stakeholders generally agreed on the following set of reuse goals for the Iron King Mine – Humboldt Smelter Superfund Site.

- Encourage future uses that are consistent with Town's General Plan (preserve low-density lifestyle)
- Ensure continued industrial uses are contained and regulated by ADEQ
- Provide public educational resource on former mining and smelter activities
- Foster renewable energy opportunities
- Provide public recreational access
- Ensure individual economic development opportunities

Stakeholder Considerations

In addition to the reuse goals and future uses, stakeholders also identified additional considerations that could inform the future use of the two site areas.

Town of Dewey-Humboldt 2009 General Plan – The General Plan is a comprehensive guide to the future of Dewey-Humboldt and serves as a framework for revising the community's planning directions. The town's vision for the future focuses on preserving its low-density lifestyle and rural character. Per the General Plan, future development may include limited commercial expansion as needed to fit the needs of the community, but industrial uses would likely not be consistent with the future vision. The town's Future Land Use Plan designates the Site as a special study area. While the underlying zoning remains industrial, the town's goal is that the future land use of these areas will be consistent with General Plan and Vision. The town may reevaluate the special study area designation as more information about the site becomes available or after the EPA completes a reuse assessment and Remedial Investigation / Feasibility Study for the Site.

Site Owners – While the site is made up of a variety of property owners, there is some commonality among their interests. In general, these landowners are interested in returning or maintaining the land in a productive use. A range of opportunities have been identified that could provide employment and economic development opportunities, recreation and industrial heritage resources, as well as renewable energy generation opportunities. The different future land use types mentioned included continued industrial and manufacturing uses, mixed uses (residential and commercial), mining and smelting museum or library, open space, public recreational trails, and energy generated from solar or wind faculties. It was recognized that these uses might not be suitable sitewide, but certain parcels or areas might be better situated for certain uses.

<u>Community</u> – While there is a range of views about the future uses of the Site, a common theme expressed by community members and elected officials is that any future use of the site should be safe (for humans and the environment) and comply with environmental regulations.

<u>Other Stakeholders</u> – The Site is surrounded by a mix of land uses, including Bureau of Land Management and Arizona State Land Department lands that are currently providing open space views for the town. However, these lands do not currently allow for public access. Bureau of Land Management (BLM) lands may be designated for recreational purposes following a master planning and application process. Arizona State Trust Lands are held assets for Trust beneficiaries and could be sold or leased in the future for development with proceeds going to designated recipients, such as public schools.

<u>Other Initiatives</u> – There are other planning initiatives either in development or under consideration by the town that could have future use implications for the Site, including an Open Space Committee as part of the Arizona Preserve Initiative and a Historic Preservation Overlay for the downtown core that could include the Humboldt Smelter area.

The town's ongoing downtown master planning efforts will also be an important consideration. The Humboldt Smelter forms the eastern boundary of the town's Main Street charrette study area and its future use could help support the community's vision for Main Street. During the charrette process, community members identified potential compatible future uses for the Humboldt Smelter area, which included designating the area as a historic district, providing recreational access and connecting to other trails in the area, mining heritage interpretation, and facilities to accommodate RVs. As the vision for Main Street is identified, these considerations could help inform the future uses for the Humboldt Smelter property and adjacent land use compatibility.

Another initiative includes the potential development of a Design Assistance Team to focus on the Humboldt Smelter, which might also inform future uses for this property. The information generated from this process could be incorporated into the future use planning process and inform the redevelopment of the Humboldt Smelter property.

Potential Future Uses

The initial stakeholder discussions and subsequent interviews identified a range of potential future uses for the Iron King Mine and Humboldt Smelter Areas. While additional future uses might be identified or refined through the other initiatives listed above, stakeholders identified the following future use scenarios:

Iron King Operations Area (Kuhles Capital LLC)

1. Continued manufacturing / light industrial
2. Alternative energy themed manufacturing campus
3. Energy cooperative (solar photovoltaic (PV))
4. Recreational access to surrounding trails and open space

Iron King Mine Proper Area (North American Industries)

1. Continued manufacturing (access to tailings)
2. Open space, limited manufacturing, mining museum
3. Solar PV energy production

Humboldt Smelter (Greenfields Enterprises)

1. Mixed use
   (industrial, commercial, residential, mining heritage museum, recreation)
2. Solar PV energy production
3. Recreational access to surrounding trails and open space

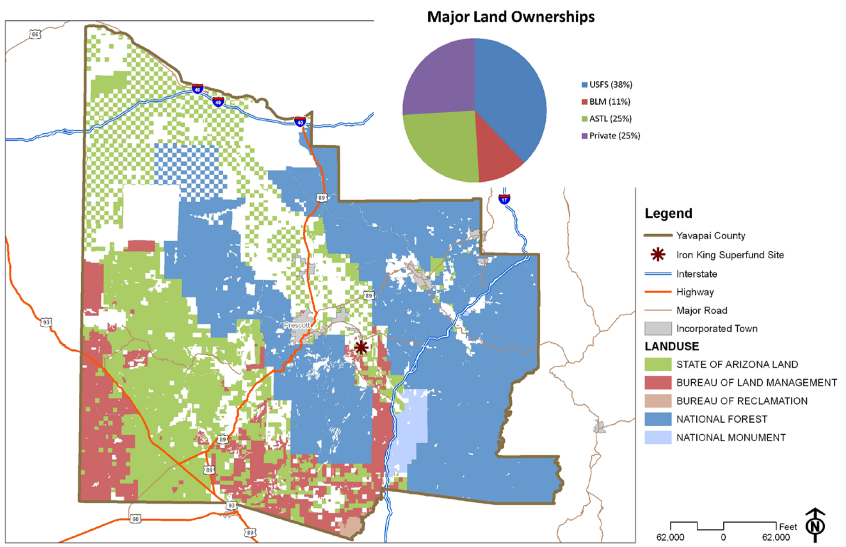


Figure 2: Major Land Ownership in Yavapai County

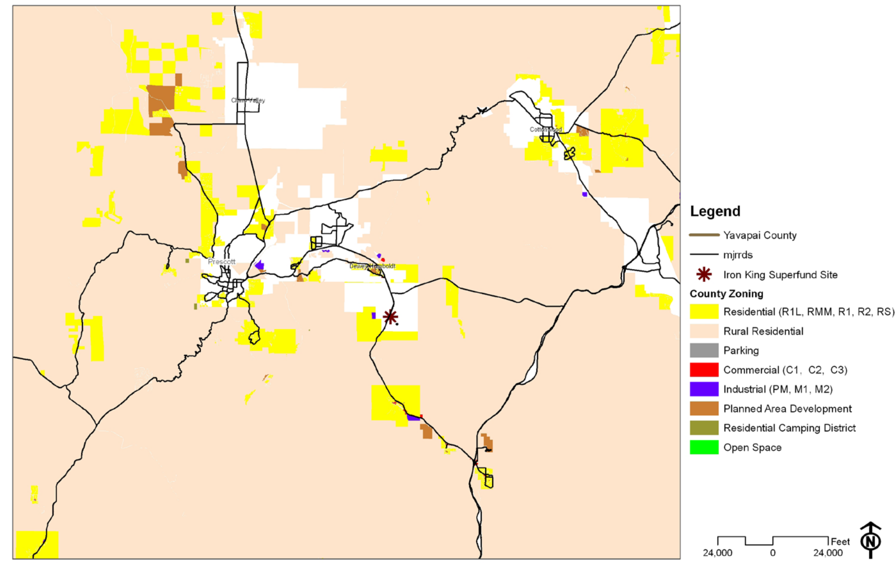


Figure 3: Surrounding Area Zoning

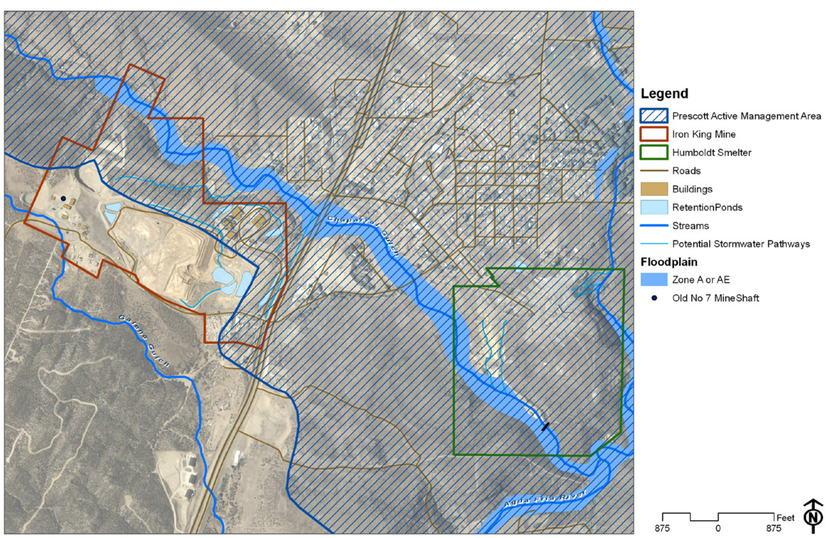


Figure 4: Water Access

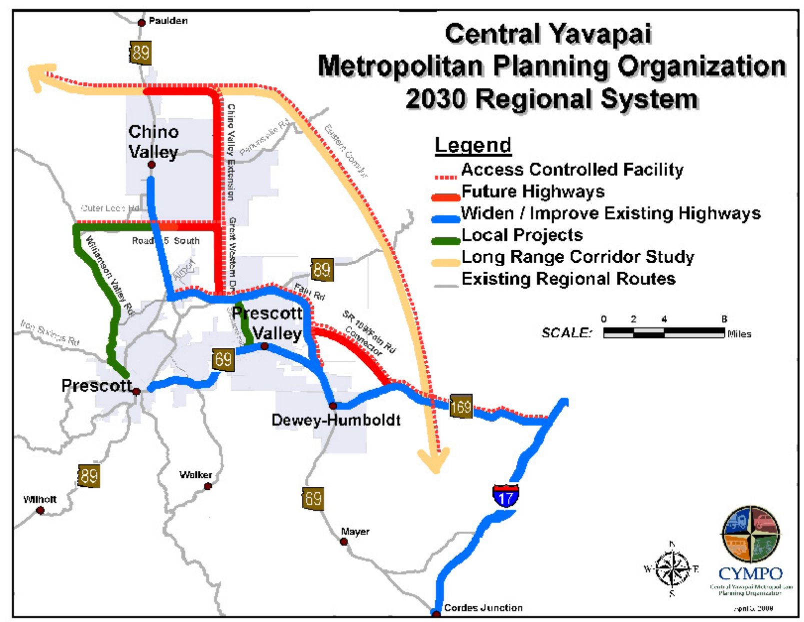


Figure 5: Regional Transportation Planning

III. REGIONAL CONTEXT

This section describes regional land use considerations and significant site features that may impact reuse suitability and synthesizes these considerations into a reuse framework that can be used to evaluate future uses on the Iron King Mine - Humboldt Smelter Superfund Site.

Regional Context

Land Use

Understanding the larger regional context and land use trends can be important indicators for determining a site's reasonably anticipated future use, both in the short- and long-term. A majority of Yavapai County is owned and managed by federal and state agencies and only 25 percent of the county is held by private land owners (see Figure 2). The primary land holders are the US Forest Service (USFS) (38 percent), Arizona State Lands (25 percent), and BLM (11 percent). However, not all of this land is open space and recreational lands that is accessible to the public.

Additionally, a locality's land use plans and zoning can be important indicators for determining future land uses. In the Town of Dewey-Humboldt and nearby incorporated towns (Prescott Valley and Prescott) there is limited availability of large parcels zoned for industrial uses (see Figure 3). In the Town of Dewey-Humboldt, most of the land is rural residential and the Site contains some of the only large parcels zoned for industrial uses.

Water Access

Within this area of Arizona, drinking water is an important resource and water access, quality, and availability are important considerations for future land use. Eighty percent of Dewey-Humboldt residents rely on water rights from private exempt wells (< 35 gpm). Private water companies also supply water to residents. The northern portion of the Iron King Mine site and the entire Humboldt Smelter are within the Prescott Active Management Area (AMA) as illustrated in Figure 4. The southern portion of the Iron King Mine site and mine shaft #7, which might provide a future water source, fall outside the AMA. The AMA boundary might have implications on future uses that share water resources at the Iron King Mine site.

More information about the Prescott AMA can be found here:
http://www.water.az.gov/WaterManagement/Content/AMAs/PrescottAMA/default.htm

Regional Transportation

The Central Yavapai Metropolitan Planning Organization (CYMPO) 2009 Regional Transportation System identifies two transportation projects that could have implications on the future use of the Site (see Figure 5).

1) Proposed SR 169-Fain Road Connector
2) Long-range corridor study to connect SR 169 and SR 89

Both road projects would create bypasses around the Town of Dewey-Humboldt and could create less of a demand for uses that depend on traffic. Decreased visibility could impact commercial or tourist-based uses in the future. It could also create more of a demand for uses that require interstate access near these road improvements, such as commercial or industrial uses.

IV. SITE CHARACTERIZATION

Based on the site visit, document review and follow up calls with agency representatives and stakeholders, a series of base maps for each site area has been developed to outline key site considerations including base map information such as site context, topography, access, physical and natural features, and remedial issues. Site considerations for each site area are outlined below.

Iron King Mine Area Considerations

The maps on pages 8 and 9 correspond to the site considerations described below.

Ownership - The Iron King Mine area is made up of several parcels under different ownership and each are in continued use. Figure 6 illustrates the different parcels by land owner.

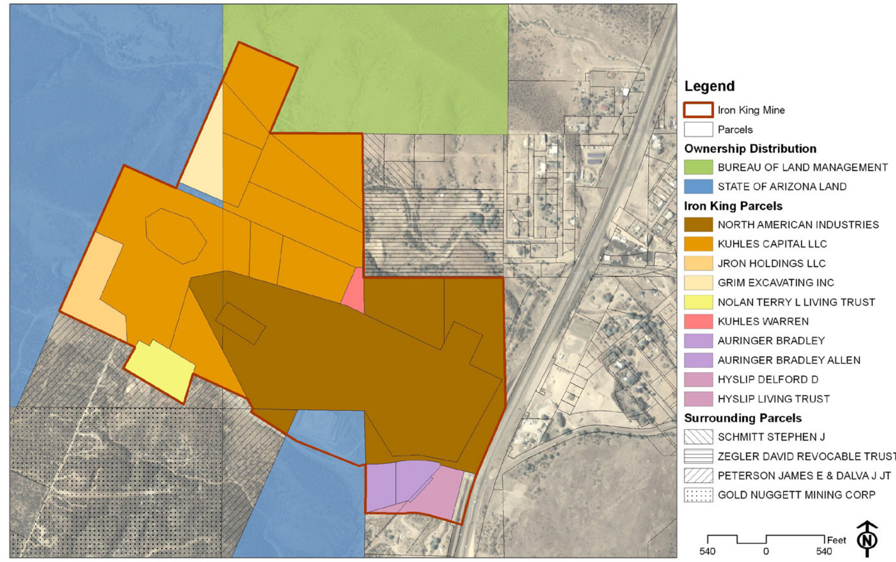


Figure 6: Iron King Mine Area Land Ownership

Zoning and Surrounding Land Uses – The Iron King Mine area is zoned for industrial land uses and is surrounded by rural low density residential and federal lands (see Figure 7). Zoning could change based on land owner interests and the town's future use goals. The town has designated this area as a special use area during the remedial process and will revisit future land uses once a cleanup approach has been selected.

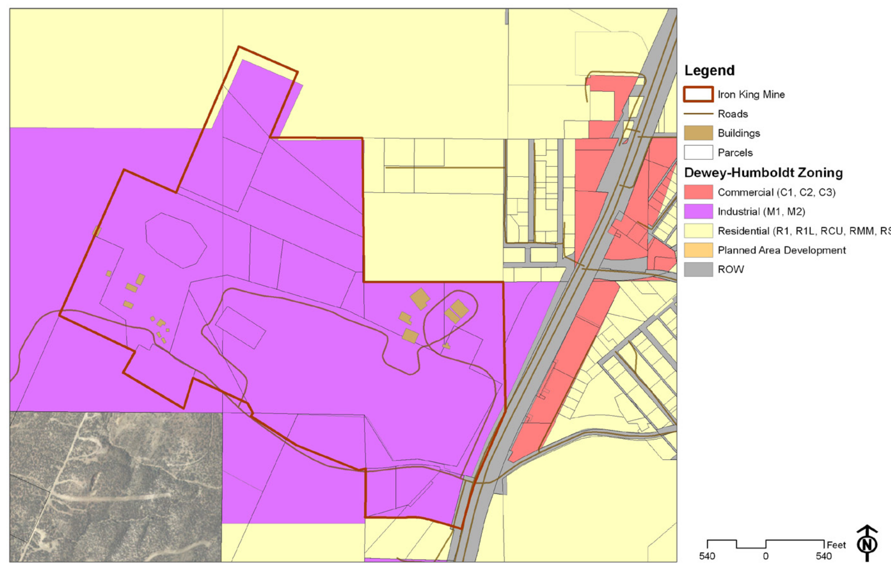


Figure 7: Iron King Mine Area Zoning

Access – The area is accessible by highway and has primary access via Iron King Mine Road. Portions of the site property north of Chaparral Gulch are not currently accessible but access might be possible through the extension of existing rural roads or extending interior site roads across Chaparral Gulch (see Figure 8).

Utilities – Water is available through on-site wells and mine shaft #7 might be an additional future water source. Most on-site wells and mine shaft #7 are impacted by either arsenic or Total Dissolved Solids (TDS), dominated by sulfate, above the drinking water standards and therefore may not be suitable for use unless contaminant mitigation occurs. The area is also serviced by three-phase power lines.

Site Features – There are a number of physical features on site related to ongoing use such as buildings, internal roads and outdoor storage areas (see Figure 9). The site's topography consists of rolling ridges and valleys in the north and western portions of the area. The large tailings pile in the southeast corner contributes to the most significant topographic feature on site (see Figure 10). Two major hydrologic features surround the area, the Chaparral Gulch to the north and Galena Gulch to the south (see Figure 8).

Potential Areas of Contamination – The RI Report identifies the tailings piles, surface soils and the landfill as contaminated areas (see Figure 9).

Views – The eastern portion of the property, primarily the tailings pile, is highly visible from the highway. Significant views of the town and surrounding area are available from within the property.

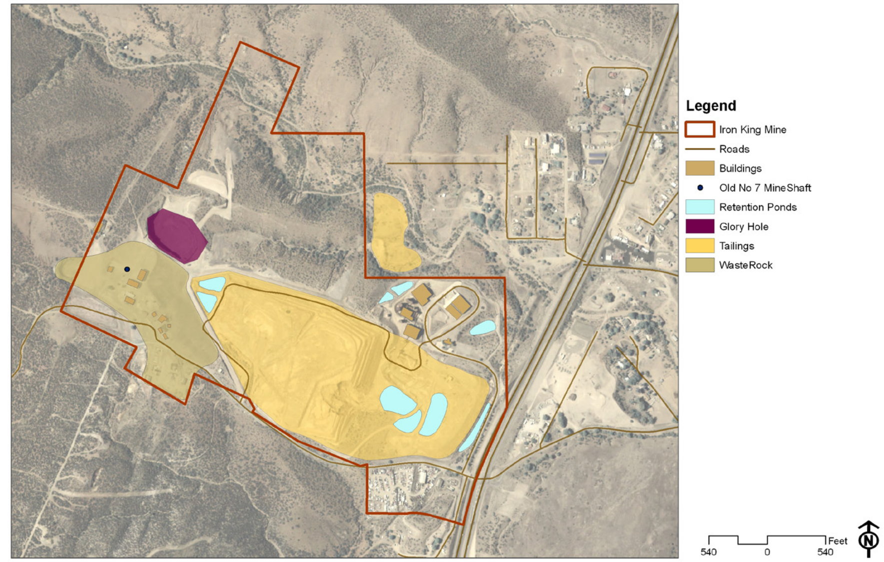


Figure 9: Iron King Mine Area Site Features

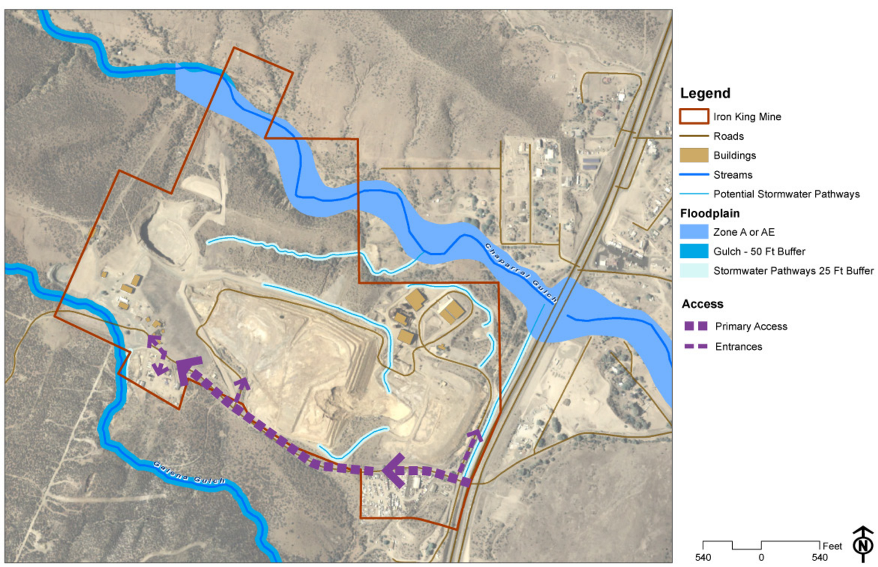


Figure 8: Iron King Mine Area Access and Hydrology

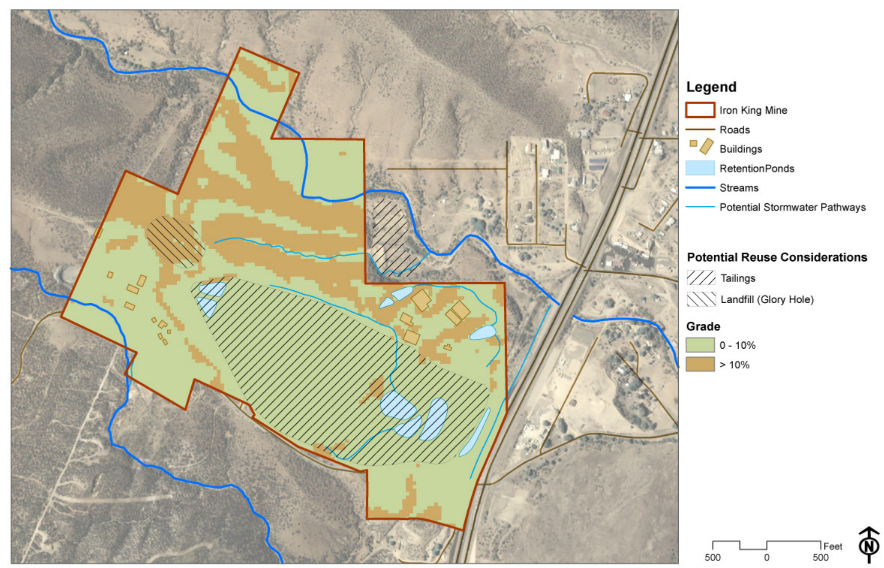


Figure 10: Iron King Mine Area Grade

Humboldt Smelter Area Considerations

The maps on the following two pages correspond to the site considerations described below.

Ownership - The Humboldt Smelter area is owned by one single owner, Greenfields Enterprises LLC.

Zoning and Surrounding Land Uses – The Smelter area is adjacent to downtown Dewey-Humboldt and is surrounded by rural residential and federal lands to the east and south (see Figure 11). The central upland area is zoned for industrial land uses and the surrounding area is zoned for rural residential (see Figure 12). Zoning could change based on land owner interests and the town's future use goals. Like the Iron King Mine area, the town has designated this area as a special use area during the remedial process and will revisit future land uses once a cleanup approach has been selected. Due to the close proximity to downtown, future downtown revitalization planning will likely consider the future use of the site as part of ongoing planning activities.

Access – The primary access to the site is by a residential street that extends from downtown Dewey-Humboldt. Access to the eastern and southern portions of the site might be available by extending existing rural roads (see Figure 13).

Utilities – Water is provided by an on-site well. The on-site well is impacted by either arsenic or Total Dissolved Solids (TDS), dominated by chloride, above the drinking water standards and therefore may not be suitable for use unless contaminant mitigation occurs. Power lines in this area might have limited capacity for energy production on site.

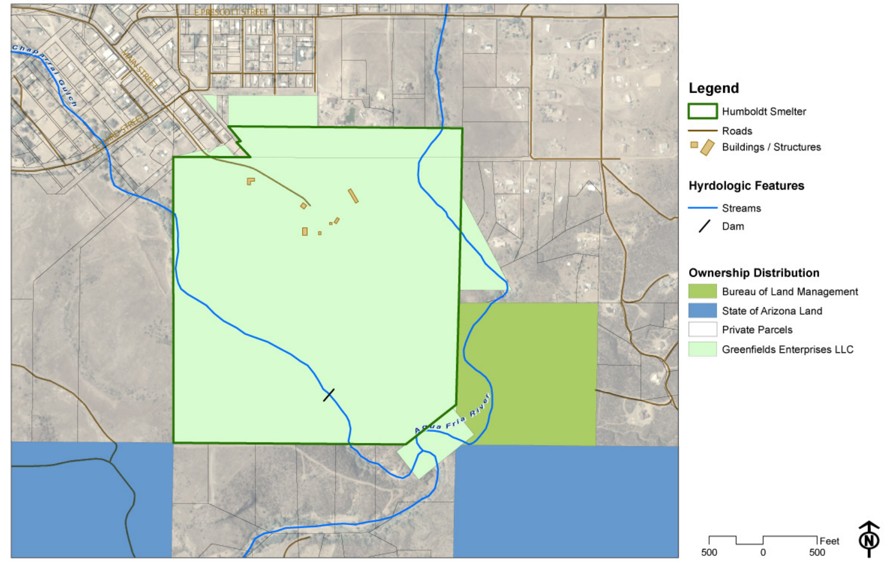


Figure 11: Humboldt Smelter Area Land Ownership

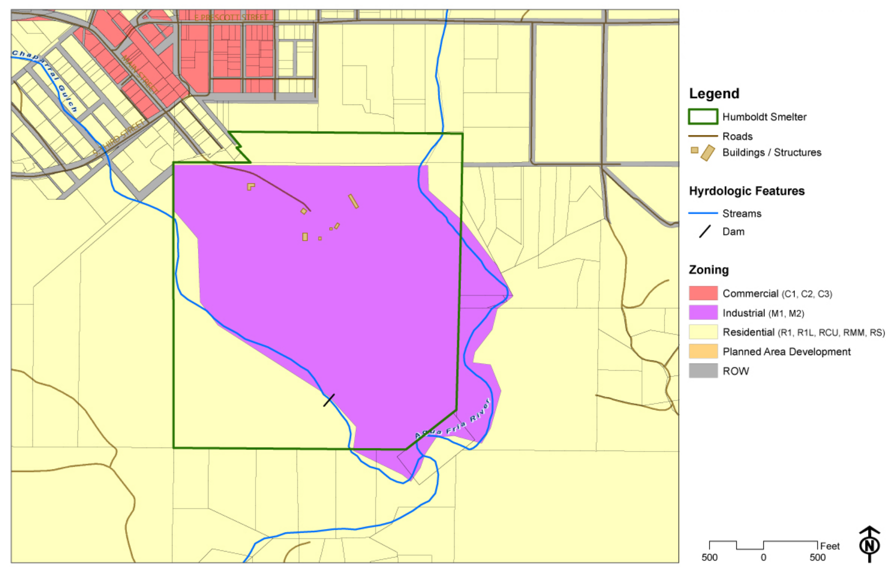


Figure 12: Humboldt Smelter Area Zoning

Site Features – The brick smelter structure is the prominent built feature on site and is highly visible from many vantage points (see Figure 14). Other physical features include a brick building near the site entrance, internal roads, and remnant concrete pads and sidewalks from the former residential community located at Nob Hill. The majority of the area is a ridge located between the confluence of the Chaparral Gulch and Aqua Fria River (see Figure 13). The most significant grade change exists along the banks of these two major water features (see Figure 15).

Potential Areas of Contamination – The RI identifies the slag area along the Aqua Fria River, tailings along the Chaparral Gulch, ash pile around the smelter, and scattered ash piles throughout the remainder of the site as contaminated areas (see Figure 14).

Views – Significant views of the town and surrounding area are available from within the property. This area is also highly visible from many vantage points; the smelter stack is a prominent visual element from the highway and surrounding areas.

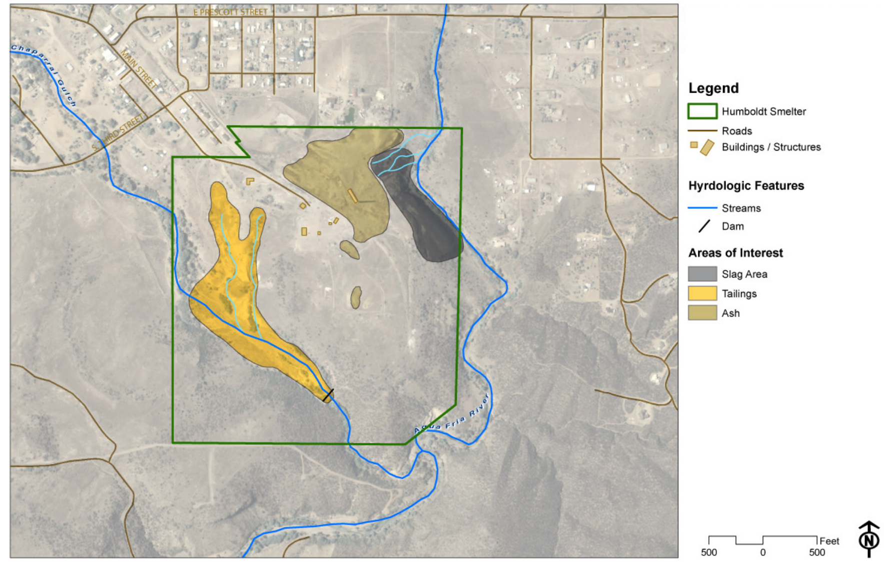


Figure 14: Humboldt Smelter Area Site Features

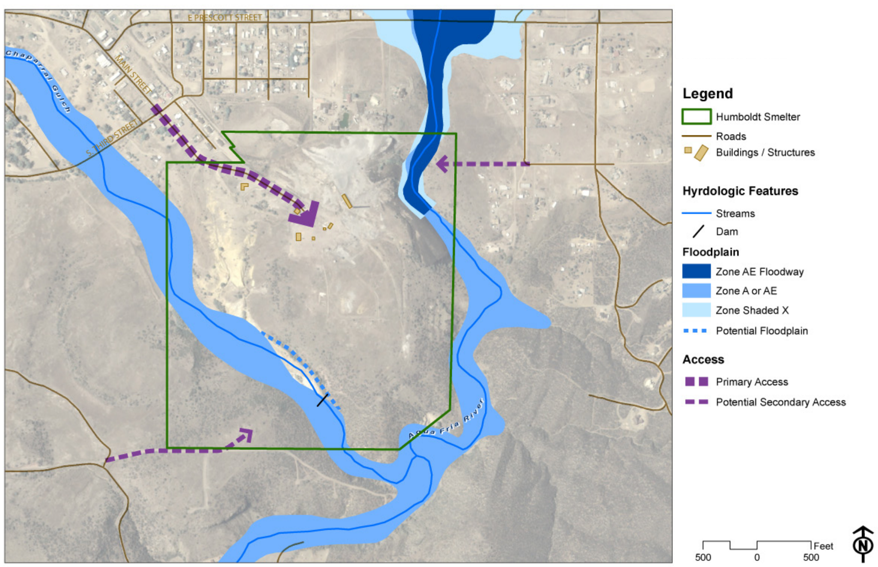


Figure 13: Humboldt Smelter Area Access and Hydrology

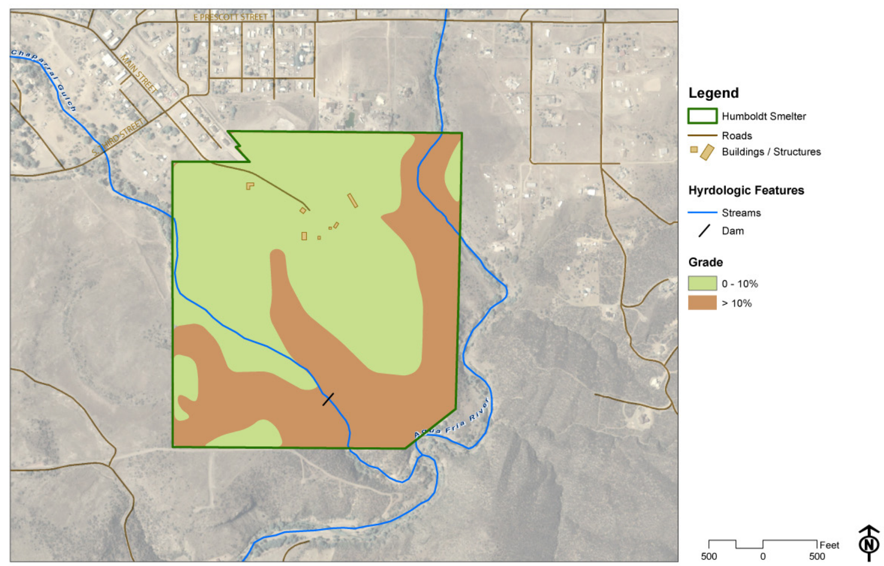


Figure 15: Humboldt Smelter Area Grade

V. REUSE FRAMEWORK

The site considerations described earlier have been integrated to create three general reuse zones for the Site, which are described in Table 1 below. For both areas, reuse zone 1, which encompasses those areas more suitable for development, has been further characterized based on predominant site characteristics that could inform future use.

Reuse Zones

Reuse Considerations	**Zone 1** (more suitable for development)	**Zone 2** (waterways)	**Zone 3** (less suitable for development)
Grade	Relatively level areas (<10%)	Floodzone and river/ gulch slopes	Steep slopes (>10%)
Access	Accessible (or minor improvements needed)	Vehicular access restricted	Access constraints
Potential Contamination	Moderate (primarily waste rock and surface soils for Iron King Mine; primarily ash and tailings for Humboldt Smelter)	Gulch tailings and contamination deposited in waterways	Heavy (primarily landfill and tailings areas for Iron King Mine; slag and tailings for Humboldt Smelter)

Table 1: Reuse Zones

Iron King Mine Reuse Framework

Figure 16 on page 15 and Table 2 below outline the existing site considerations and related future use goals for the Iron King Mine area and how they may vary for each zone. Zones 1-A and 1-B include those areas of the Kuhles Capital LLC properties that are most suitable for development. Zone 1-B is delineated to represent portions of the Kuhles properties that might have access challenges. Zone 1-C represents the most suitable development areas of the North American Industry properties. Zone 1-D represents the most suitable development areas of those parcels south of Iron King Mine Road.

Reuse Zone	Existing Site Considerations	Future Use Goals
Zone 1-A	Access via primary road Existing buildings and structures Zoned industrial Existing infrastructure Moderate contamination	Commercial Industrial Renewable energy generation note: residential opportunities might be limited due to underground mine workings
Zone 1-B	Access and infrastructure needed Minimal to no contamination	Same as Zone 1-A
Zone 1-C	Access via primary road Existing buildings and structures Zoned Industrial Existing infrastructure Associated with tailings Visible from Highway Minimal contamination	Continued Industrial Commercial Renewable energy, generation potential might be limited based on site characteristics, such as tailings stability, access, and dust control.
Zone 1-D	Access via primary road Existing buildings and structures Zoned Industrial Existing infrastructure Moderate contamination	Continued industrial Renewable energy (potential)

Table 2: Site considerations and related future use goals by reuse zones

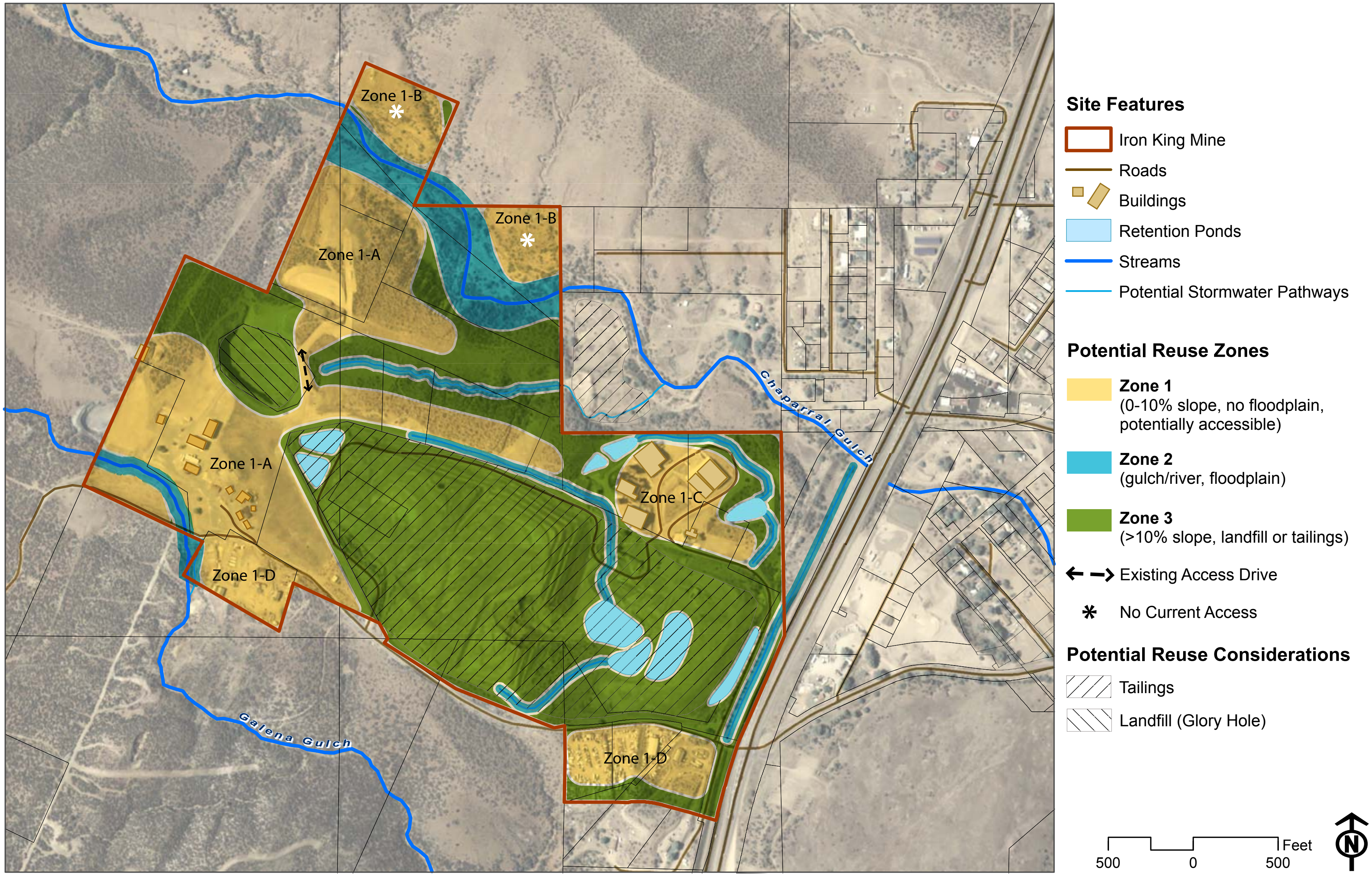


Figure 16: Iron King Mine Area Reuse Zones

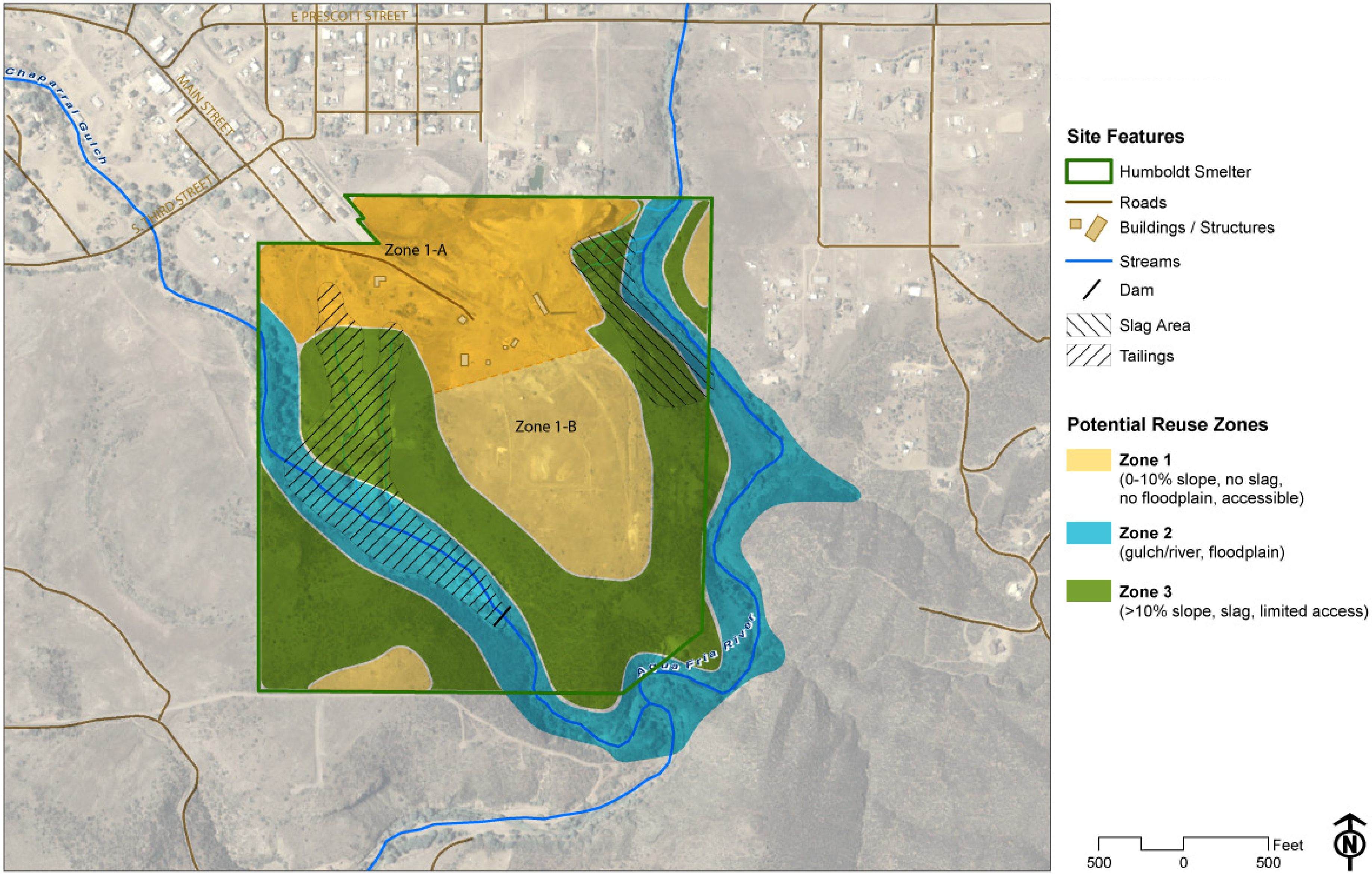


Figure 17: Humboldt Smelter Area Reuse Zones

Humboldt Smelter Reuse Framework

Figure 17 on page 16 and Table 3 below outline the existing site considerations and related future use goals for the Humboldt Smelter area and how they may vary for each zone. Zone 1 was delineated into two separate areas based on potential remedial components and future use considerations. Zone 1-A includes the portion of the site that is accessed by a primary road and might be best suited for mixed uses that could include commercial or industrial uses due to close proximity to downtown and existing infrastructure. Denser uses in this area would blend with surrounding uses to the northwest and could provide an opportunity to cap the ash present in this area. Zone 1-B differs from Zone 1-A in that it has fewer remedial considerations and has limited access. This zone might be more suitable for less intensive uses such as residential or recreational uses.

Reuse Zone	Existing Site Considerations	Future Use Goals
Zone 1-A	Access via primary road Existing buildings and structures Close proximity to downtown Zoned industrial Remedial considerations Moderate contamination	Commercial Industrial Mining heritage Residential opportunities might be limited based on cleanup approach selected
Zone 1-B	Access road extension needed Prominent views of surrounding area and highly visible from surrounding area Scattered concrete remnants Zoned industrial Minimal contamination	Commercial (access improvements needed) Industrial (access improvements needed) Residential (consistent with surrounding land use)

Table 3: Site considerations and related future use goals by reuse zones

Primary access road connects the Smelter area to downtown Dewey-Humboldt

Zone 1-B was formerly a residential area

VI. Renewable Energy Overview

Arizona possesses a range of renewable energy resources (wind, biomass, hydro, solar). However, non-solar resources are believed to have limited potential in the state (wind and geothermal in particular compared to neighboring states) due to a combination of state policies and incentives and the varied quality of the renewable energy resources found in Arizona.

Renewable Energy Resources

PV Solar

On-site PV provides many options at the Iron King Mine - Humboldt Smelter Superfund Site due to its flexible installment options. Most of the United States has adequate to good PV resource quality and Arizona is defined as "excellent."

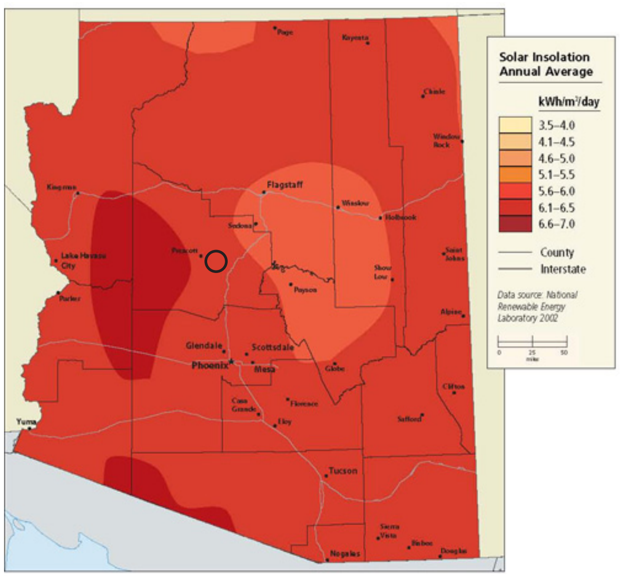
Arizona is expected to have a unique reliance on solar to meet future renewable energy requirements. Projections suggest upwards of 65 percent of the State's renewable energy demand in 2025 will be met by solar energy projects.

Wind Energy

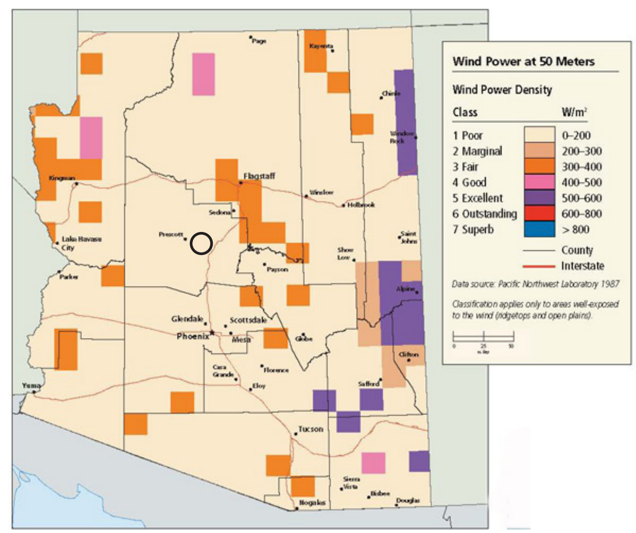
Wind power can be well-suited to Superfund sites because of the size of some sites and the presence of transmission lines for previous industrial facilities. However, the quality of the wind resource varies across the United States. The criteria that must be met for a property to be considered as high potential for wind power redevelopment include:

- Class 4 or greater wind resource
- Greater than 50 acres
- Less than 20 percent slope
- Located within 25 miles of transmission lines

According current NREL wind resource data, this part of Arizona does not have great wind resources. Given the lack of sufficient wind resources based on current commercially proven wind technologies, the Site does not appear to offer a financially viable location for a grid-connected wind turbine project. The wind maps from NREL are not appropriate for making siting decisions for wind energy projects. Actual site wind speed measurements taken over the course of a year using an anemometer would provide site-specific wind resource data and help determine if small scale wind might be possible at the Site.



Site Location



Biomass Energy

Bioenergy is the solar energy stored via photosynthesis in organic matter. The term "biomass" can describe many different fuel types from such sources as trees; construction, wood and agricultural wastes; fuel crops; sewage sludge; and manure. Biomass energy facilities can be well-suited to former hazardous waste sites. There are multiple biomass applications with varying suitability to impaired properties. The Site, with its proximity to potential sources of biomass, specifically Prescott National Forest and parts of the Coconino National Forest, appears to have the potential to accommodate a biomass energy project.

Renewable Energy Technology Options

Given the Site's location, topography, and available renewable energy resources, solar energy and biomass energy are the most promising renewable resources for the Site and are the focus of this assessment.

Solar

Solar technologies are broadly characterized as either "passive" or "active" depending on how they capture, convert and distribute sunlight. Passive solar technologies[1] include selecting materials with favorable thermal properties, designing spaces that naturally circulate air, and aligning the position of a building to the sun. Active solar technologies use photovoltaic panels, pumps and fans to convert sunlight into useful outputs, such as electricity. Active solar energy technologies can be broadly categorized as PV and solar thermal. Additional information on solar energy technologies can be found in Appendix B.

- PV – PV technologies convert sunlight directly into electricity. These systems are commercially available and in use nationwide for such applications as powering residential and commercial buildings, running irrigation pumps, powering remote telecommunications and bolstering utility grid stability.
- Solar thermal – Solar thermal technologies use parabolic troughs, central receiver stations ("power towers"), or dish-stirling engines to concentrate sunlight to produce heat that is converted into electricity.

Arizona Public Service's (APS's) 3.5 MW Prescott Airport Solar Plant includes tracking PV and concentrating PV arrays. Source: APS

Biomass Energy

Biomass energy system technologies include direct-firing, co-firing, gasification, pyrolysis and anaerobic digestion. Most future utility biomass plants are likely to be in the range of 15 to 30 MW, but plants in the 2 to 5 MW size range are possible as well.

Most biopower plants in the U.S. use direct-fired systems. They burn bioenergy feedstocks directly to produce steam, which converts the power into electricity. Co-firing refers to mixing biomass with fossil fuels in conventional power plants. Gasification systems use high temperatures and an oxygen-starved environment to convert biomass into synthesis gas which can then be chemically converted into other fuels or products, burned in a conventional boiler, or used instead of natural gas in a gas turbine.

[1] Because this analysis focuses on assessing the feasibility of using renewable energy technologies to meet potential on-site light industrial/commercial electricity demand or to generate grid-tied electricity, the analysis of solar technologies has not considered passive solar. In addition, because of the significant contiguous land requirements needed for a cost-effective solar thermal energy project, solar trough and solar power tower technologies have also not been included in this analysis.

Renewable Energy Market Opportunities

Solar

In general, Arizona has excellent solar resources statewide and there are expectations for growing market for renewable energy development that is based on a number of factors:

- the state's dependence on natural gas for electricity and price volatility of natural gas
- the state's central location to nearby/large potential solar markets
- intellectual capital resources found at in-state universities and research centers

Across the state, the trend has been slow, but the amount of installed grid-tied solar capacity continues to increase for the state.

- PV system installations doubled in Arizona between 2007 and 2008
- Arizona ranked 4th nationally for installed solar energy capacity for 2009 (Table 4)
- 6.4 MW of PV capacity was installed in Arizona in 2008. This is expected to increase significantly in the coming years, with large projects, like the proposed 280 MW Solana solar thermal project in Gila Bend

State	2009 Installed Capacity (MW)	2008 Installed Capacity (MW)	2007 Installed Capacity (MW)
California	220	178.7	91.8
New Jersey	57	22.5	20.4
Colorado	23	21.7	11.5
Arizona	23	6.4	2.8
Hawaii	14	8.6	2.9
New York	12	7.0	3.8
Connecticut	9	5.3	2.5
North Carolina	8	4	.5
Nevada	7	14.9	15.9

Table 4: Installed Solar Energy Capacity by Leading States

While market opportunities have the potential to be strong, much of the potential market for a solar energy project at this site or any other site will depend on the ability to deliver electricity at a competitive cost and the ability to enter into a long-term purchase agreement.

Biomass Energy

Three woody biomass fuel sources are available in Arizona: forest products manufacturing residuals; forest biomass (logging residue, forest restoration thinning and hazardous fuels reduction); and range restoration woody residues. By and large, the management of these biomass streams has been to leave the material on site, do open burning, or dispose of in landfills. The potential market opportunities for biomass energy rest on diverting these potential fuels for biomass energy use.

Eagar Arizona Biomass Project:
Energy Generation and Stewardship Contracting

In August 2004, after the 486,000-acre Rodeo-Chedeski Fire of 2002, the Apache-Sitgreaves National Forests awarded a 10-year Stewardship Contract to thin 150,000 acres of small-diameter ponderosa pine trees. The Eagar Biomass Project, a 3-MW biomass facility in Eagar, was built by Arizona Public Service (APS) for $5 million to use forest thinnings from the nearby Apache-Sitgreaves forest. The plant uses approximately 96 tons of forested wood each day to generate electricity. The initial plan was for APS develop a template to build biomass plants that use similar technology in other parts of the state. The Eagar plant was closed in 2008.

In addition, biomass energy is an eligible renewable energy technology that can be used by private utilities to meet the state's Renewable Energy Standard (RES). In 2008, a 24 MW biomass facility was brought online in Snowflake, Arizona. Renergy, the company that built the plant, has a 20-year power-purchase agreement for the project with Arizona Public Service, and electricity generated from this facility helps APS meet its annual Renewable Energy Standard requirements.

USFS has continued to state its commitment to finding long-term solutions at Prescott National Forest to address concerns about forest health and fuel management. To address these issues, USFS can enter into stewardship contracts, which use a negotiated, performance-based contracts to bundle together related services and the sale of forest products from National Forest System land. A stewardship contract allows for the costs of removal of small diameter residue and slash to be exchanged for the value of the excess forest products that are removed. One USFS goal of stewardship contracting is to reduce the amount of wood burned in the forest and the wood sent to landfills.

Ultimately, many factors affect the market viability of a woody biomass project including: feedstock supply, feedstock and energy costs, capital and debt financing costs, the value of products produced, and plant design and efficiency.

Renewable Energy Incentives

A number of policies and incentives are available to facilitate the development of renewable energy projects for both solar and biomass energy. Incentives are available at the state and federal level and include both policy-based incentives (e.g., renewable portfolio standards) and financial incentives (e.g., tax credits and rebates). Incentive highlights are below. Additional information can be found in Appendix C.

Federal Incentives

- Business Energy Tax Credits (also known as Investment Tax Credits (ITCs))
- Clean Renewable Energy Bonds (CREBs)
- Rural Business Enterprise Grants
- Section 9006 Rural Energy Loan Program
- Woody Biomass Utilization Grants

State Incentives

- Arizona Renewable Energy Standard (RES)
- Solar Energy Equipment Sales Tax Exemption
- Commercial/Industrial Solar Energy Tax Credit Program

Utility Incentives - APS Renewable Energy Incentive Program

- Up front incentives (purchase price incentives)
- Production-based incentives

In 2008, APS purchased or generated 609,926 MWh of renewable energy, or 2.1 percent of total retail sales. This figure exceeded the company's RES goals by 0.5 percent for the year. APS continues to seek proposals for utility-scale PV solar projects to meet a portion of their annual RES implementation requirements. For 2010, APS has issued an Request for Proposal for new renewable energy project proposals. Projects must be at least 15 MW in size, with a maximum of 50 MW.

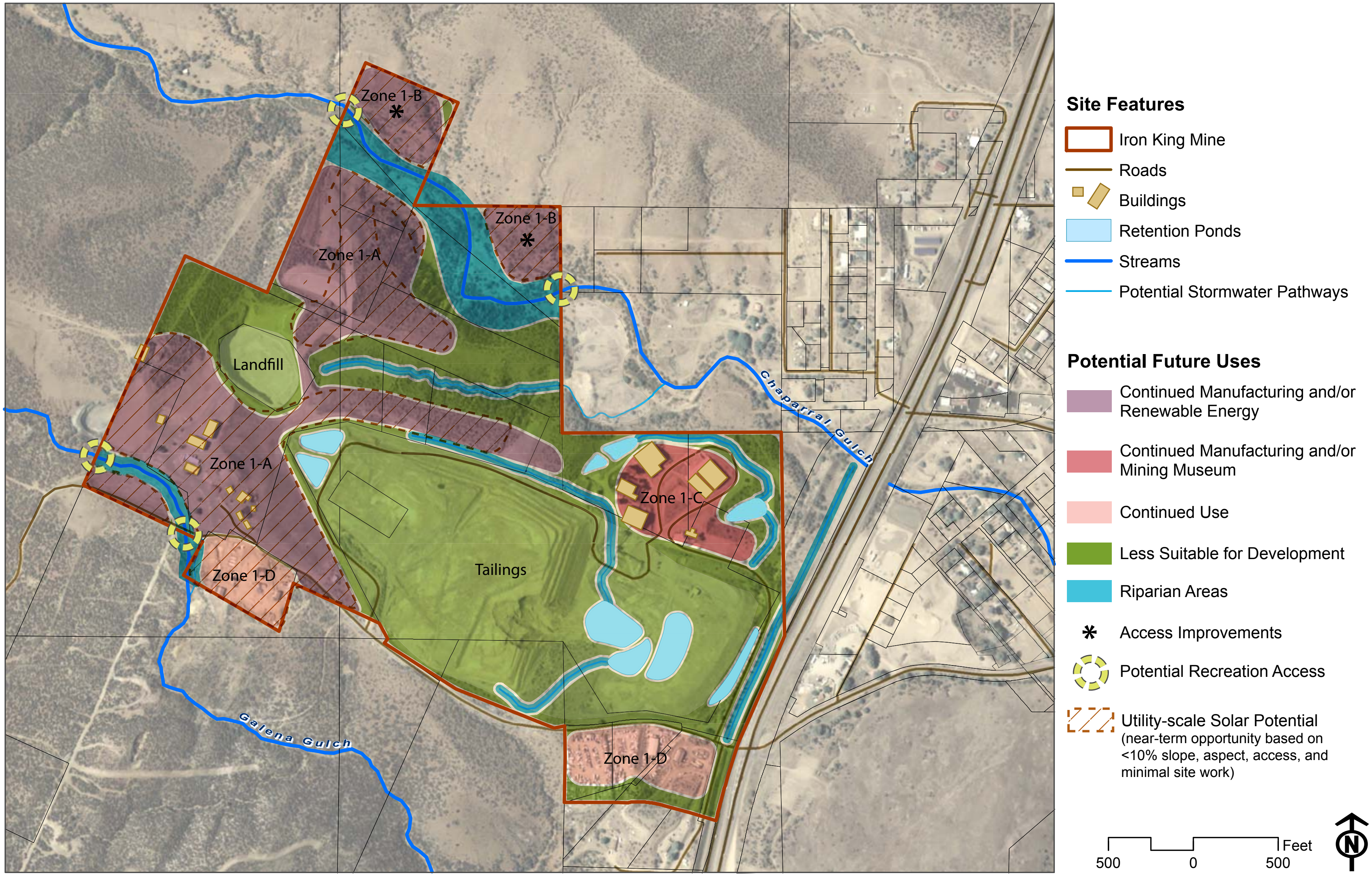


Figure 18: Iron King Mine Area Future Use Scenarios

VII. FUTURE USE OPPORTUNITIES

This section evaluates the reuse zones identified in Section V based on the future use scenarios identified by the community stakeholders. In addition, opportunities for slag found along the eastern edge of the Humboldt Smelter area to be reused for beneficial purposes (e.g., as road aggregate) are explored.

Iron King Mine Area

For the Iron King Mine area, several potential future use scenarios have been identified for the two major landowners of the site. Each of these future use scenarios are described below, followed by future use considerations related to each scenario. Figure 18 on the adjacent page highlights potential future use opportunities.

Potential Future Use Scenarios for the Iron King Mine Operations Area

(Kuhles Capital LLC properties)

1. Continued Manufacturing / Light Industrial Future Use Scenario

This scenario anticipates continued manufacturing and light industrial uses on a parcel by parcel basis with individual owners. Access and infrastructure improvements would be needed to develop the remote parcels located in reuse zone 1-B and noted on Figure 18 with an asterisk.

2. Recreational Access to Surrounding Trails and Open Space

The Town of Dewey-Humboldt's Master Plan identifies a potential trail along Galena Gulch that would cross the southern portion of the area and another trail along the Chaparral Gulch (see Figure 21 on page 29). These potential recreation access points are highlighted on Figure 18. Recreational access might be a suitable future land use component to the future use scenarios described in this section.

3. Renewable Energy

Given the Site's location, topography, and available renewable energy resources, solar energy and bioenergy are the most promising renewable resources for the Site. The following sections highlight the opportunities for solar and biomass energy development at the Mine area. Appendix D provides additional details.

Solar: With 300 days of sunlight a year, average solar insolation measured at over 6 kWh/m2/day, and sitting at an elevation of 4,500 feet[2], the Iron King area has very good solar resources. In addition, transmission access is readily available at the site, with three-phase power[3] already in place; a 69kV transmission line runs to the Poland Junction Substation located approximately 5 miles south of the site; the Iron King Mine area sits on top of ground water resources; and local topography suggests that sizeable portions of the mine area lie within 10 percent grade and could be to support various PV options.

Example of a PV array at the nearby Emrbry-Riddle Aeronautical University APS Solar Power Plant

[2] At a higher elevation, the amount of atmosphere that the solar rays have to travel through is less.
[3] Three-phase power is a method of electric power transmission using three wires. Three-phase power systems may have a neutral wire that allows the system to use a higher voltage while allowing lower voltage appliances.

As Table 5 highlights, there are over 40 acres of land within the Iron King Mine area that could, with some site remediation and preparation work, be utilized for utility-scale PV solar in the near future. These areas are indicated with a hatch pattern on Figure 18. Zone 1-C could potentially support up to a 1 MW PV array if ongoing industrial activities in that area ended and buildings were removed. Smaller rooftop PV solar systems would also be possible in Zone 1-C to supplement on-site electricity use.

Zone	Area	Potential PV-Fixed Array Size	Potential PV-Tracking Size	Dish Sterling
1-A	25-30 acres	8-10 MW	6-8 MW	4-6 MW
1-B	9 acres	2-3 MW	1.5-2 MW	1-1.25 MW
1-D	5 acres	1-1.25 MW	1 MW	.5 MW
Total (all zones)	**40-45 acres**	**11-14 MW**	**8.5-11 MW**	**5-7 MW**

Table 5: Acres with PV potential at the Iron King Mine area based on slope, aspect, access and minimal site work.

These acreage estimates ignore the possibility of developing on the tailings pile area, but illustrate that a range of scales exist at which electricity from PV solar could be generated on land within the Iron King Mine area.

- A PV array up to 2 MW in size (depending on type of technology) could be located in Zone 1-B and could be used to either provide electricity for ongoing or new on-site activities or be grid-connected.
- A renewable energy themed campus could serve as a location for producing energy storage or energy power systems (e.g., PV), powered by on-site solar energy, or as an energy park that houses various PV technologies on-site or grid electricity use. An energy campus could be located across Zones 1-A, 1-B, and 1-D.
- A type of energy cooperative (e.g., an electric utility that is owned by the members it serves) or large scale grid-tied PV array at the site might seek to cover 40 to 50 available acres with PV arrays. Ten to 15 MW of installed capacity might be possible at the mine site if the right financial situation were in place (e.g., purchase agreement, landowner agreement). This could potentially be done as a privately-held solar farm or as an energy cooperative.

Potential Future Use Scenarios for Iron King Mine Area
(North American Industries property)

1. Continued Manufacturing

Under this scenario, North American Industries (NAI) would continue to use their property for light manufacturing with possible expansion of the existing warehouse or additional warehouse buildings sited near existing buildings and outdoor storage expanded. This area is highlighted as Zone 1-C on Figure 18. NAI would also need access to tailings for reprocessing.

2. Limited Manufacturing, Mining Museum, and Open Space

This scenario includes limited manufacturing using existing buildings and infrastructure and the addition of a mining museum that would be publicly accessible. Interpretive trails about the area's mining history could also be a component under this scenario and could include trails and access to the tailings pile. It might be possible to connect interior trails to the town's proposed trails. Access and parking would likely need to be improved to allow for these additional public uses.

3. Solar

One portion of the Iron King Mine area that presents a number of challenges for future renewable energy development is the Iron King Mine Large Tailings Pile. Due to stability concerns highlighted in the RI regarding the Large Tailings Pile (i.e., stability, liquefaction potential), more traditional ground mounted PV systems (i.e., steel or aluminum framing attached to a concrete foundation) may provide design challenges on any tailings areas. However, once a final cleanup approach is selected for the tailings pile in the Iron King mine area, there could be an opportunity to revisit the possibility of installing PV arrays on top of a final tailing remedy.

In addition, where solar system weight or underlying area stability is an engineering and remedy concern, amorphous thin film PV cells could offer an alternative approach for installing PV arrays over the Large Tailings Pile. Flexible laminate amorphous thin film cells can be applied directly geosynthetic materials, such as geomembranes, thus eliminating the need for system mounting and foundational structures.

Geomembrane covers are already in use across the country as part of landfill closure activities, and some landfills have begun to integrate flexible thin film solar cell technology with these liners to create an energy-producing cover system. The Tessman Road Landfill site is highlighted below. In addition, a 1 MW solar cap is planned for the Hickory Ridge Landfill in Georgia. Nearly $2 million in project costs for the Hickory Ridge project were funded through American Recovery and Reinvestment Act monies by the Georgia Environmental Facilities Authority.

Flexible PV Laminates at the
Tessman Road Landfill (Texas)

The Tessman Road Landfill is a municipal solid waste landfill located outside of San Antonio. In 2008, the site was closed using a geomembrane cover system known as a Solar Energy Cover, which functions as a RCRA Subtitle-D equivalent landfill cap and mounting surface for PV thin film panels.

The covered area is 5.6 acres and the area of solar cells is 0.5 acres. The cover system could eventually cover 70 percent of landfill area (650 acres). The PV system is currently 134 kW in size with an estimated annual output of 182,319kWh. Anchors secure the geomembrane to the landfill and are designed to protect against high wind events and other severe weather conditions.

Other Future Use Scenarios

Biomass Energy

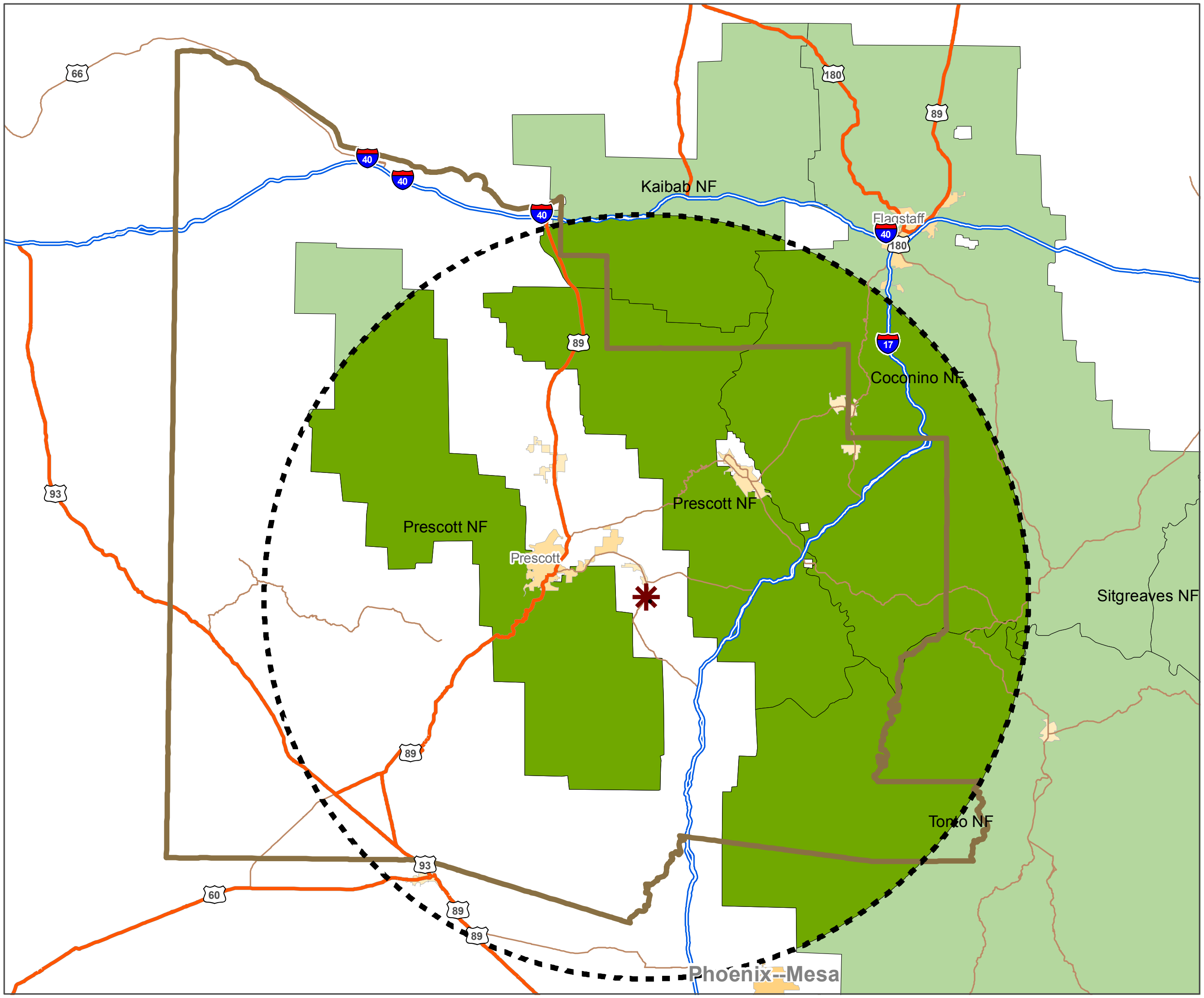
The Iron King Mine area could provide a good location for a biomass energy facility. Sections of the Iron King Mine offer relatively flat areas that are 5 to 10 acres in size and which could support the infrastructure (e.g., plant, feedstock storage) of a biomass facility. In addition, the Iron King Mine area has access to utility transmission lines, on-site water resources are available (although total water volumes could be limited and would require treatment before use), and the site is within proximity to sources of biomass, specifically Prescott National Forest and parts of the Coconino National Forest.

Figure 19 illustrates lands falling within 50 miles of the Iron King Mine - Humboldt Smelter Superfund Site.

There are over 1 million acres of woody vegetation in the nearby Prescott National Forest lands that provide recreational areas and hiking trails and timber uses. These areas could also potentially provide a supply of cut log slash, small diameter trees and other woody biomass. To date, there have been only sporadic local markets for these resources. Because of this, all saw logs have historically been transported out of the Basin. Slash and other biomass residues from timber activities have historically been burned or sent to a landfill.

A 3 MW biomass facility would need 75 tons of fuel per day. One cubic foot of "oven dry" biomass weighs 31 pounds. A 3 MW facility would need approximately 6,000 cubic feet (220 cubic yards) of biomass each day as feedstock. A 1 MW facility would need 25 tons of fuel (2,000 cubic feet). The physical footprint of a 3 MW plant would be small, but land would be needed to receive, process, maneuver and handle the biomass material. A 7- or 8-day supply of biomass for a 3 MW biomass facility would cover 1 acre of land 9 feet deep. A 30-day supply would require 4 to 5 acres of land at 9 feet deep.

A log sorting and storage area.



National Forest (NF) land within a 50-mile radius of the Iron King Mine - Humbuldt Smelter Superfund Site

NAME	AREA (acres)
Coconino NF	862,913
Prescott NF	1,323,119
Tonto NF	621,905
Kaibab NF	209,261
TOTAL	3,017,198

Legend

Iron King Superfund Site
50 Mile Radius
Yavapai County
Interstate
Highway
Major Road
National Forests Lands w/in 50 miles
National Forest Lands

10 0 10 Miles

N

Figure 19: National Forest Lands within a 50-mile radius of the Iron King Mine - Humboldt Smetler Superfund Site

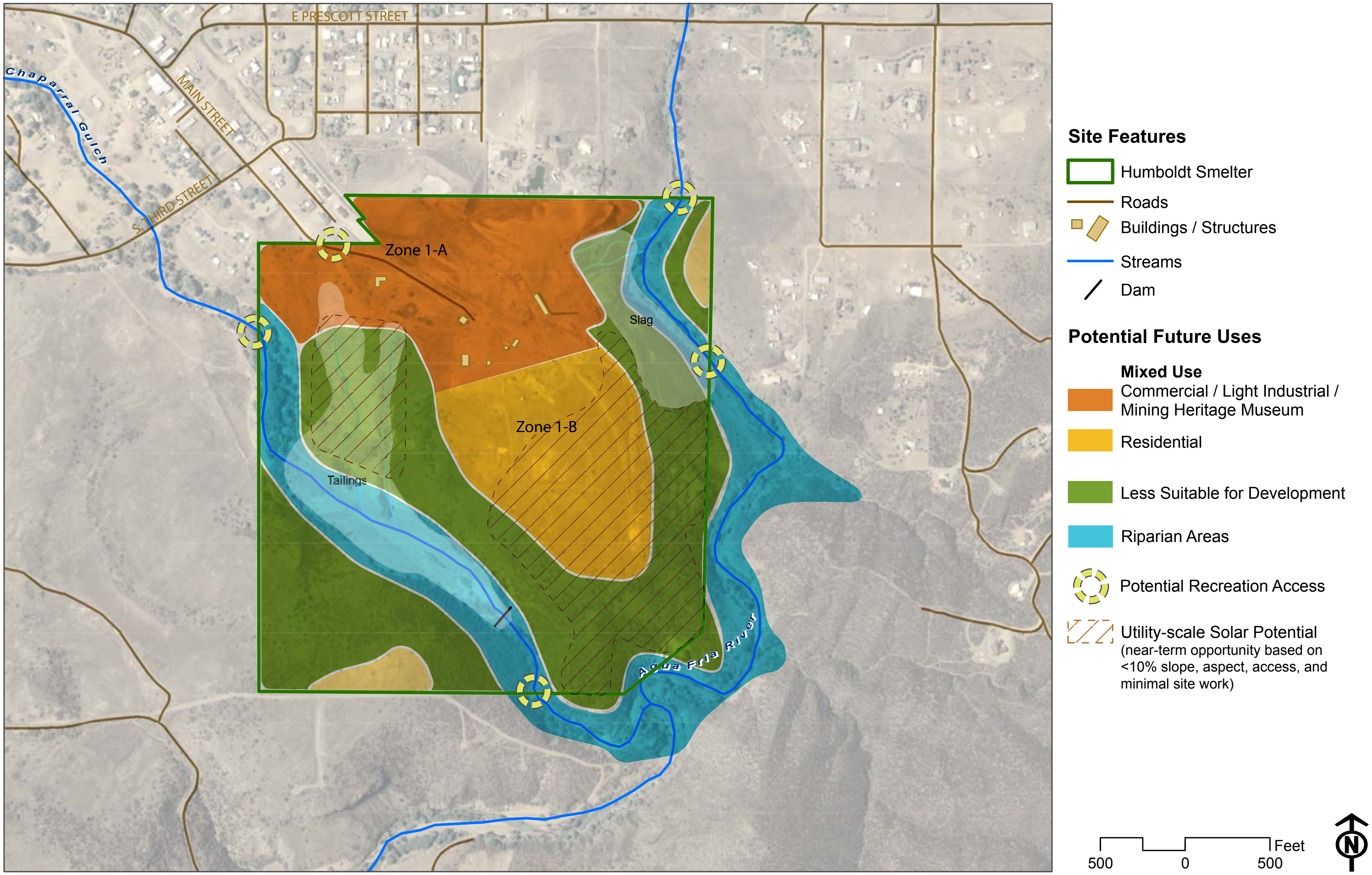


Figure 20: Humboldt Smelter Area Future Use Scenarios

Future Use Scenarios for Humboldt Smelter Area

(Greenfield Enterprise properties)

Several potential future use scenarios for the Humboldt Smelter area that have been identified are described below. Figure 20 on the adjacent page highlights potential future use opportunities.

1. Mixed Use Scenario

Under this scenario, a mix of uses would be located on the site property and could include industrial and / or commercial uses, residential uses, a mining heritage museum, and recreation and open space uses (for example, recreational uses could include an RV facility). Figure 20 illustrates suitable uses by reuse zone. Zone 1-A would likely be best suited for higher intensity uses such as commercial, industrial or public uses given the area's primary access and connection to downtown. The types of commercial or industrial uses in this area would need to be compatible with residential and recreational uses.

2. Recreational Access to surrounding trails and open space

The Town of Dewey-Humboldt's Master Plan identifies the Humboldt Smelter property as part of the town's open space amenities (see Figure 21 on page 31). A trail network along the Chaparral Gulch extending through town and along the Aqua Fria River has been proposed as part of the 2010-2019 Capital Improvement Program. The master plan also proposes extending the trail further along Chaparral Gulch across the southern portion of the site. Potential trail access points are highlighted on Figure 20. In the future, the Smelter could serve as a recreation destination and amenities added to support this use (such as an RV facility, camping, and athletic fields). Alternatively, recreational access might be a suitable future land use component to the future use scenarios described above.

3. Renewable Energy

Given the site's location, topography, and available renewable energy resources, solar energy and bioenergy are the most promising renewable resources for the Smelter area as well. The area has very good solar resources; transmission access is readily available, although transmission line improvements are likely needed; a 69kV transmission line runs to the Poland Junction Substation south of the Site; and local topography suggests that sizeable portions of the property lie within 10 percent grade slope areas that could support various PV technology options. These areas are indicated with a hatch pattern on Figure 20.

Zone	Area	Potential PV-Fixed Array Size	Potential PV-Tracking Size	Dish Sterling
1-B (southern half)	15-20 acres	4-6 MW	3-5 MW	2-3 MW
Entire 1-B area	30-35 acres	6-9 MW	5-7 MW	3-4 MW
Future containment cell[4]	15 acres	3-5 MW	2-3 MW	1-2 MW
Total (all zones)	**60-70 acres**	**13-20 MW**	**10-15 MW**	**6-9 MW**

Table 6: Acres with PV potential at the Humboldt Smelter Area based on slope, aspect, access, and minimal site work.

Similar to the Iron King Mine area, these acreage estimates illustrate that a range of scales exist at which electricity from PV solar could be generated on land within the Humboldt Smelter area. A significant portion of the smelter site could potentially accommodate solar energy projects given topography and aspect. However, because of the potential number of mixed-use opportunities presented by the smelter area, how visible much of the area is to the surrounding community, and the site's proximity to Main Street and potential plans to revitalize Main Street toward and onto the site, these other areas (Zone 1-A, northern part of Zone 1-B) may not be ideal renewable energy development areas.

[4] Estimated sized based on current tailings area at the Humboldt Smelter.

Potential future containment cells at the Smelter area may preclude the use of deep concrete piers to support PV arrays with heavy framing materials. This could reduce some of the acreage estimates in Table 6. However, the containment cells could potentially be contoured to provide a less steep slope into the Gulch, and allow for the use of lighter weight PV systems with shallow footing requirements. The use of non-invasive ballasted concrete slab footings would require additional engineering analysis to determine compatibility with any selected remedy, but would allow the area over any future containment cell in the smelter area to be used to locate PV arrays.

Humboldt Smelter, July 2009.

Other Future Use Scenarios

Biomass Energy

The Humboldt Smelter area could also serve as a good potential location for a biomass energy facility. As highlighted in the solar energy section, the area offers relatively flat topography and available acreage, which could support the infrastructure (e.g., plant, feedstock storage) of a biomass facility.

The Smelter area has a history of being used for biomass utilization. In 2003, 100 acres of the Smelter area were used for a biomass utilization project by Greenfield Industries as part of the Prescott Woody Biomass Utilization Project. Forest residues were ground up, screened and used for composting activities. The long term vision was to consider developing an eco-industrial park solely based on wood, with on-site energy generation.

Because of the proximity of the Smelter area to Main Street and the visibility of Nob Hill and the former smelting process area, some additional research would probably be needed to evaluate the compatibility of a biomass facility with other mixed use opportunities at the Smelter area.

Additional analysis would be needed to determine if the amount and long-term supply of wood from forest management activities (fire risk and fuel reduction activities) in Prescott National Forest could provide a more predictable supply of feedstock from federal lands.

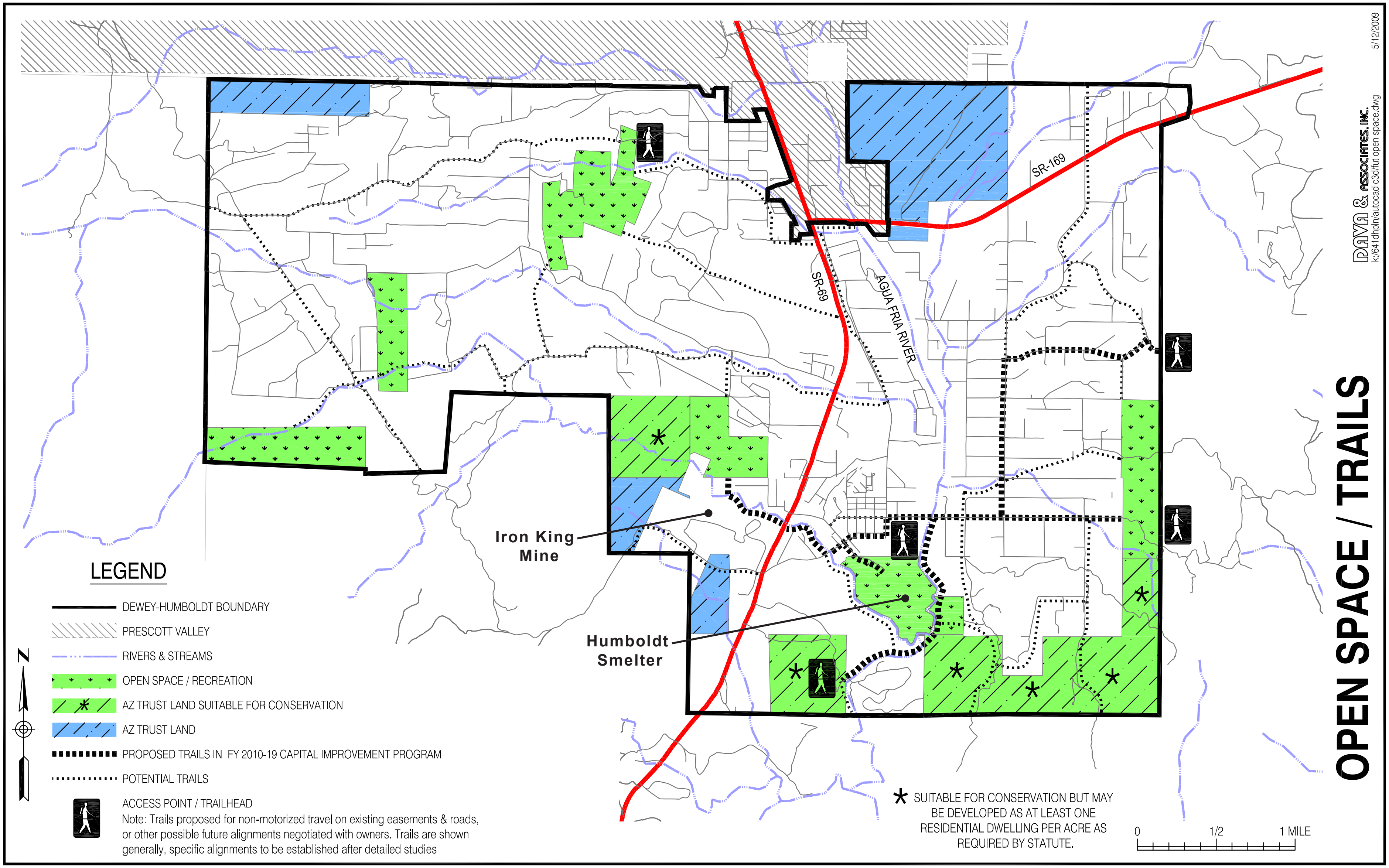


Figure 21: Town of Dewey-Humboldt's Open Space / Trails. Source: *Town of Dewey-Humboldt 2009 General Plan*

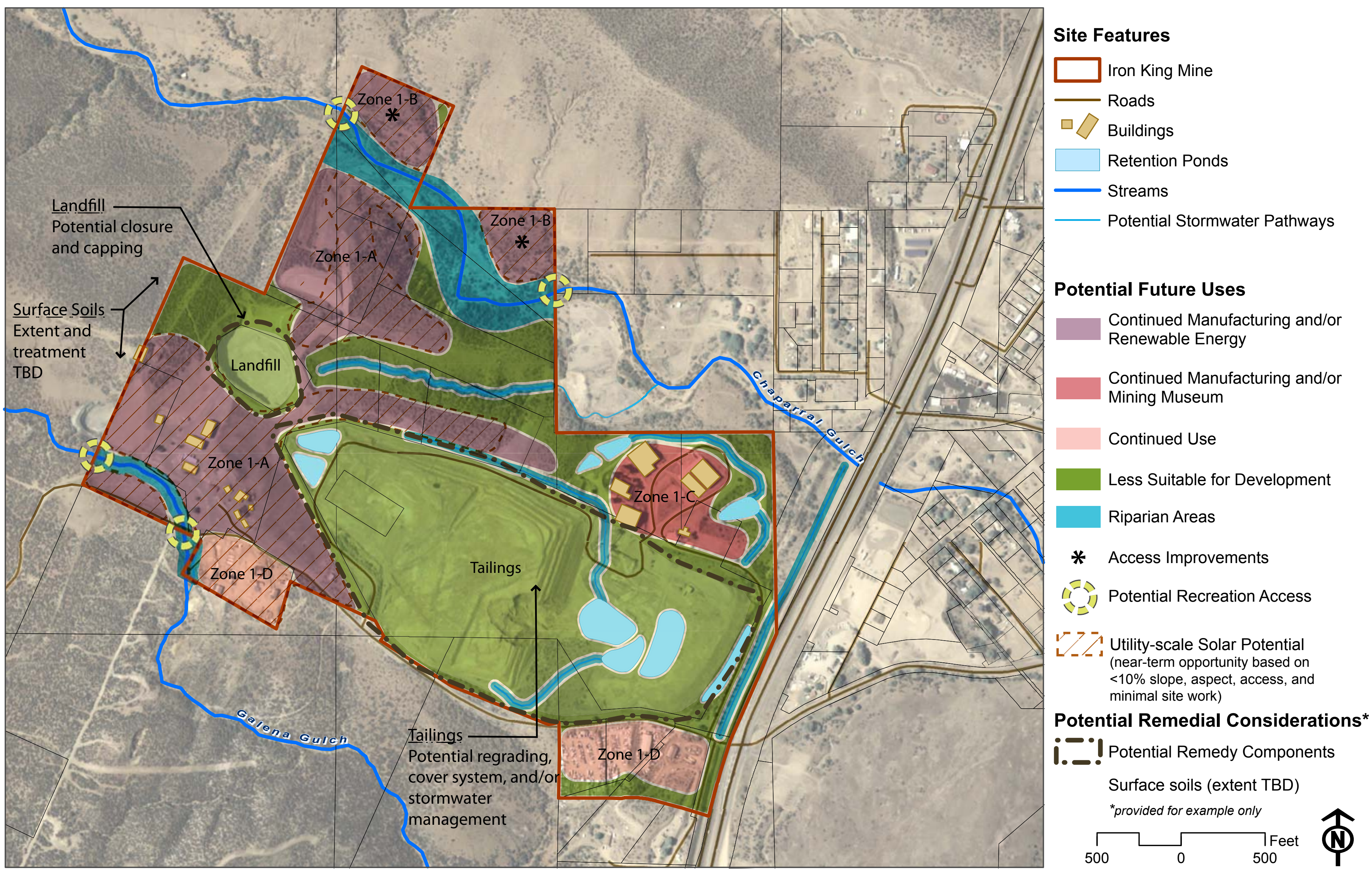


Figure 22: Iron King Mine Area Remedial Considerations

VIII. REMEDIAL CONSIDERATIONS

EPA is in the process of developing a range of cleanup options for the Iron King Mine - Humboldt Smelter Superfund Site. The following section contains some examples of remedial components and considerations that could inform future uses at the Site. These considerations are provided merely as examples and do not represent a full characterization of contamination or final remedial components. The development and evaluation of cleanup options will be presented in the Feasibility Study. The remedial components and considerations provided in this reuse assessment are provided to help stakeholders conceptualize possible cleanup options and their potential effects on future uses at the Site. Once the actual remedy for the Site has been selected through the Superfund process, stakeholders can evaluate how these components will affect future uses.

Iron King Mine

The Iron King Mine contains several areas of concern, including a former landfill, a large tailings area, and surface soils with elevated levels of heavy metals. Figure 22 overlays potential remedial considerations over potential future use areas. Table 7 describes the potential remedial components and remedial considerations that could inform future uses at the Iron King Mine.

Tailings area

Landfill area

Potential Remedial Components	Potential Remedial Considerations that Could Inform Future Use	Potential Future Use Considerations
Landfill Closure *Potential remedial components could include a cap, stormwater management and monitoring system*	Stability Stormwater and drainage Cap protection Final grade and compatibility with surrounding grade	Area might be suitable for supporting uses, such as parking or storage Potentially compatible for siting PV solar arrays, though grading might be necessary to achieve proper solar orientation
Tailings Area *Potential remedial components could include containing tailings in place with a vegetative cover*	Stability Stormwater and drainage Cap protection Compatibility with surrounding grade	Maintain cover protection Heavy uses might not be suitable Open space and recreational uses might have access restrictions Access to tailings for reprocessing might require special arrangements to ensure remedy protection
Surface Soil	Extent of treatment area locations Cleanup approach (could include cap in place, consolidation on site and cap, or excavate and remove off site)	If surface soils are treated on site, remedy protection will be a long-term future use consideration. Cap or containment areas might be suitable for development. For example, buildings or parking areas could be located on top of a containment area and serve as a cap to prevent exposure.

Table 7: Aligning remedial components and future use considerations

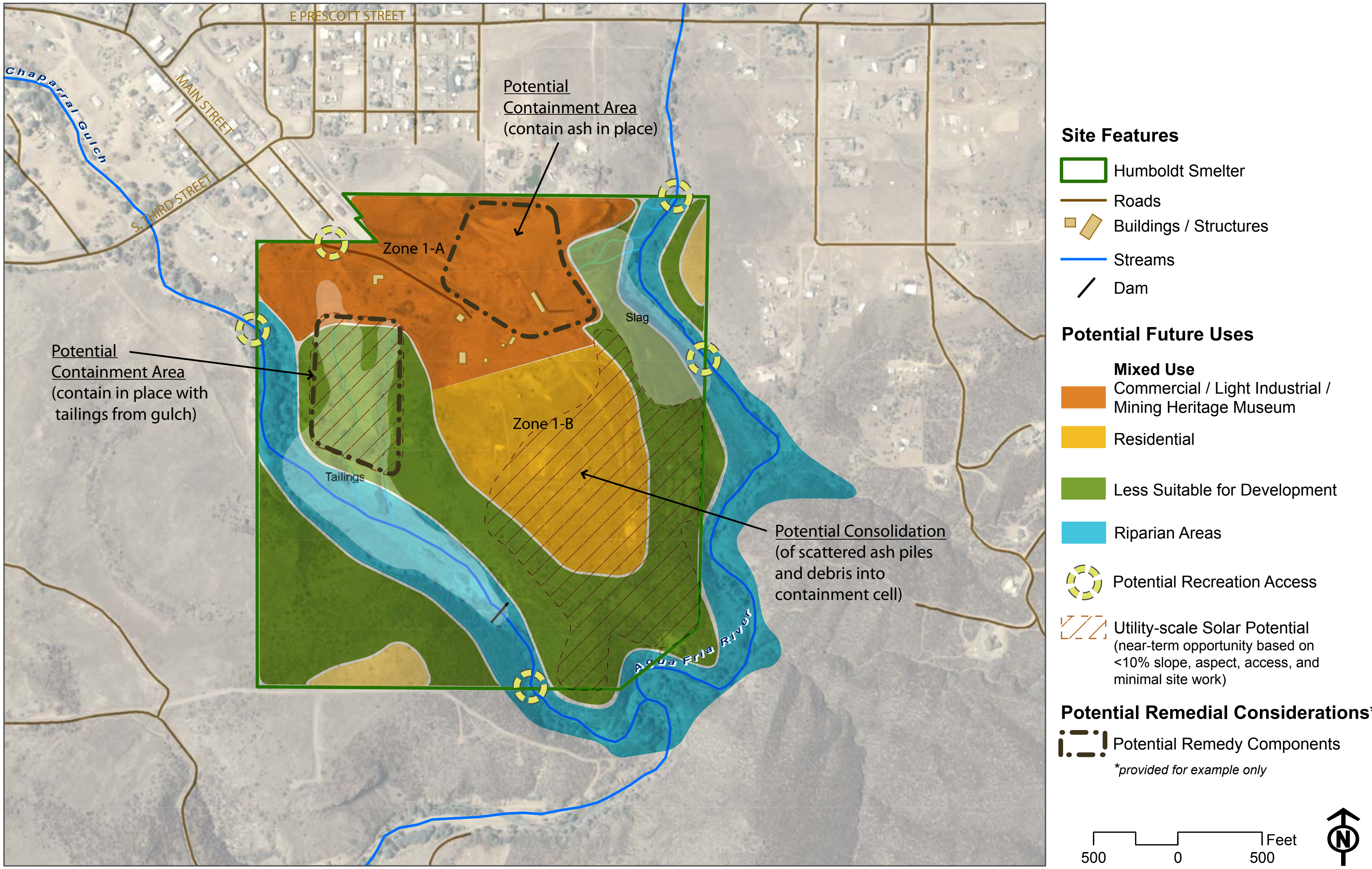


Figure 23: Humboldt Smelter Area Remedial Considerations

Humboldt Smelter

Areas of concern at the Humboldt Smelter include the slag area along the Aqua Fria River, tailings in and along Chaparral Gulch, ash piles, tailings piles, and debris piles. Potential remedial components for the ash and tailings piles include containing the materials in on-site repositories with protective caps. The sizes and locations of these repositories will greatly inform the future use opportunities available at the site. As illustrated in Figure 23, a containment cell in Zone 1-A would bisect this area. The containment cell cap might be suitable for a range of uses including parking to support new development or for an RV facility, lightweight structures, or recreational uses such as soccer fields. A tailings containment cell adjacent to Chaparral Gulch might be suitable for PV solar as described the previous section. Depending on the grade, the northern portion of the cell might allow for lightweight uses on top of the cap, such as parking or recreational uses. Consolidating scattered ash and debris into one area might create a large area in Zone 1-B that might not require land use restrictions.

The slag pile's location on the steep banks of the Aqua Fria River will likely have minimal impact on the future use of the site and therefore is not included in the remedial considerations outlined in the table to the right. An innovative reuse question is whether the approximately 2 million cubic yards of slag found along the eastern edge of the Humboldt Smelter area has the potential to be reused for beneficial purposes, for example, as road aggregate.

A variety of nonferrous slags (air-cooled or granulated), including phosphorus, copper, nickel and zinc slags, can be used as coarse or fine aggregate in hot mix asphalt pavements. Additional testing would need to be done to the existing slag at the Humboldt Smelter property to test for a range of engineering characteristics, including grain size, bearing, abrasion resistance, and stability (high friction angle due to sharp, angular shape) in addition to TCLP and SPLP testing. Appendix D provides additional information on slag reuse considerations.

Potential Remedial Components	Potential Remedial Considerations that Could Inform Future Use	Potential Future Use Considerations
Tailings Containment Area *Potential remedial component could include containing tailings in place with tailings from gulch*	Stabilization Stormwater management and drainage Cap protection Final grade and compatibility with surrounding grade Height and size of containment area	Open space, limited access PV potential Top of slope might allow for supporting uses, such as parking, for adjacent uses (Zone 1-A) Size and location of containment area might impact future development areas
Ash Containment Area *Potential remedial component could include containing in place*	Stormwater management and drainage Cap protection Height and size of containment area Compatibility with surrounding grade Existing buildings	Maintain cap protection Lightweight uses such as parking or recreation might be suitable on top of cap, but heavy uses might be best located elsewhere on the property Existing building stability and safety Cap footprint would increase if tailings included Size and location of containment area might impact future development areas
Consolidation *Potential remedial component could include consolidating scattered ash piles and debris into containment cell*	Depth and distribution of material	Potential for no use restrictions in Zone 1-B

Table 8: Aligning remedial components and future use considerations

IV. RECOMMENDATIONS AND NEXT STEPS

Remedy selection

EPA has just completed the investigation phase of the Superfund process and is now developing cleanup alternatives for the Iron King Mine - Humboldt Smelter Superfund Site. By identifying future goals early on, EPA, stakeholders and the community can work together to identify opportunities for aligning remedy selection and future use goals. Considering the reasonable future of the Site can ensure long-term protectiveness of the remedy. This reuse assessment provides a flexible framework for evaluating future uses and remedial components as goals and opportunities can change over time. Therefore, it will be important to evaluate reasonably anticipated future uses throughout the cleanup process. It is also likely that future uses can be phased in over time based on the type of remedy selected.

Solar

A 1 to 2 MW solar PV project would be currently possible at the Iron King Mine area if the right financial arrangement between land owners, project developers and APS could be reached. APS periodically issues RFPs for in-state renewable energy projects to help the company meet its RPS goals. APS is currently focusing on 2 to 15 MW projects as part of the company's 2010 RFP solicitations, and typically looks for projects with a levelized cost of $150 per MWh of electricity generated.

Longer term, given where the Site currently sits in the Superfund process, additional information on site cleanup requirements and potential site limitations (e.g., weight limits for potential containment cells) would help to clarify the extent to which large-scale PV development, particularly in the Smelter area, is feasible.

Cleanup activities at the Site could also take advantage of the solar resources at the Site and potentially incorporate solar technologies as part of a green remediation strategy.

Biomass

A more detailed analysis of fuel supply is needed to assess the market viability of a biomass plant. Such an analysis would include a biomass raw material resource characterization and assessment to evaluate what the biomass is and where there are sources, any biomass harvesting guidelines (if in place), availability and consistency of supply, seasonal access and demand variations, harvesting and biomass transportation costs, transportation infrastructure, the physical properties of the biomass.

A more detailed financial analysis would include projections covering all aspects of the potential project's financials, identify critical business data needs and assumptions, and narrow down potentially viable opportunities to match the available biomass resource supply. This will help to more comprehensively understand potential project economics, including available timber or biomass supply (i.e., cost of biomass delivered to the processing facility); cost of converting the biomass into products (i.e., processing cost); and energy cost factors (e.g., utility rates, contract options).

Appendices

This page left intentionally blank

Appendix A - Superfund Site Redevelopment Considerations

EPA recognizes that identifying and understanding reasonably anticipated future land use(s) at a site is an important consideration affecting the entire site cleanup process. By considering future uses, formerly contaminated properties can be returned to productive uses that also help to ensure the long-term integrity and protectiveness of the cleanup approach. As the Iron King Mine - Humboldt Smelter Superfund Site (Site) moves forward, there are several considerations that could be helpful throughout the remedial and reuse planning process. These considerations are outlined below.

In addition, EPA has developed a suite of tools to help local governments, communities, and developers navigate the redevelopment process. These tools are available at:

www.epa.gov/superfund/programs/recycle/index.html
www.epa.gov/superfund/programs/aml/index.htm

Gather Basic Information about the Site

While this reuse assessment provides basic information about the Site, it will be important to update this framework over time to ensure current information informs redevelopment, especially as new information comes available, such as site ownership, site operations, site environmental conditions, site cleanup type, and entity or entities leading cleanup.

Considering Future Use Opportunities for the Site

Each of the stages of EPA's remedial response process provides an opportunity to incorporate future land use considerations. While this reuse assessment identifies potential opportunities for aligning reuse and remedy, it will be important to evaluate the remedy and reuse goals throughout the remedy process. For example, as the Site enters the remedy selection stage, opportunities may exist to tailor the design of the site remedy to better align with reuse goals.

This reuse assessment also provides a framework for evaluating the Site for those future uses identified at the time of the assessment (June 2009). However, reuse goals or opportunities might change over time and new uses identified. This framework can also be used to evaluate other future uses. Criteria to consider include: site physical and environmental conditions, site ownership, site cleanup, liability, and local and regional markets.

Interested parties might also want to review examples of other mining sites that have been successfully reused or are on track for redevelopment. Looking at what has been done at other sites might reveal innovative techniques for addressing site challenges.

Community and Stakeholder Input

Thoughtful community and stakeholder involvement in the reuse process may be particularly important at mining sites as redevelopment efforts may have a significant economic and social effect on nearby communities, many of which likely have strong historic ties to the mining site. Given the Site's location and proximity to a range of surrounding land uses, gathering community and stakeholder input will be important throughout the redevelopment process. Community and stakeholder involvement could include:

- a series of public meetings,
- hosting a targeted stakeholder group,
- managing the process with a community-based committee with broad representation
- coordination with other regulatory processes such as, a future update to the town's General Plan or a potential rezoning
- coordination with other planning processes or initiatives such as, the Main Street charrette, open space planning or Design Assistance Team grant

Review Associated Legal Issues and Obtain Liability Clarification and Assurances

There are complex legal issues associated with reuse of all Superfund sites. In most cases, the legal issues can be addressed by using a variety of liability protections and limitations made available by the law or through other vehicles made available by EPA. Legal issues related to Superfund site redevelopment include:

- 2002 Brownfields Amendments to the federal Superfund law
- "Bona Fide Prospective Purchaser" (BFPP) liability protections for purchasers after January 11, 2002
- Superfund Liens
- Windfall Liens

Identify Potential Barriers to Reuse

Another consideration to successfully redevelop the Site is to understand whether site-related barriers may prevent certain types of development activity. Depending on the remedy selected for the Site, institutional controls, such as restrictive covenants, might be necessary which might restrict certain land uses. In addition, the design of a physical remedy, such as a cap or containment cell, may prohibit the placement of all or certain types of structures. These considerations are explored in more detail in Section VIII. Remedial Considerations.

EPA or ADEQ may be able to assist in addressing potential barriers if they are aware of plans for reusing the Site in the early stages of the cleanup of the Site. Therefore it will be important for site property owners, the town and potential developers to work with EPA throughout the process.

Locate Developer to Implement Reuse

Depending upon the type of use, a developer might be able to assist in implementing all or part of the reuse plan. Developers may serve as a critical source of funding for the project. They can also assist with leveraging resources, cleanup decisions and cleanup investments. Developers can potentially include a wide range of entities including traditional development companies, investors, community development corporations and municipalities. At the Site, working with a renewable energy developer early in the process might help facilitate the process by identifying opportunities early on.

Address Potential Lender Concerns about Financing

Lenders may have concerns about financing the redevelopment of contaminated properties. EPA has many tools to help alleviate potential lenders' concerns about financing contaminated properties, including:

- Comfort/status letters
- Ready for Reuse Determinations
- BFPP Doing Work Agreements

Explore Funding Resources for Cleanup and Reuse

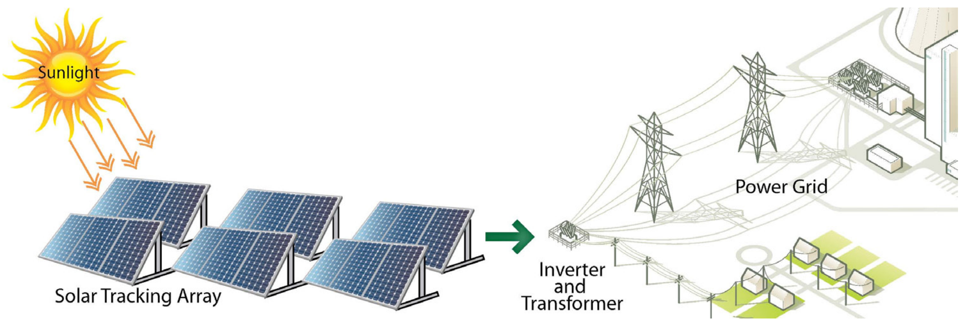
There are many financial and technical resources that can be assembled for the cleanup and reuse of former mining properties. Grants and funding options are available for various aspects of many of the cleanup programs. For example, some grants encourage community involvement in the cleanup process, some support training related to cleanups, and some help fund the assessment, cleanup, or redevelopment of a site. Depending on the type of site and the program managing site cleanup, contaminated and potentially contaminated sites and properties are eligible for different types of funding. Funding may be available from EPA, states, and other federal agencies and departments. While the Site is not currently eligible for Brownfields funding, this might be an option in the future if the Site is delisted from the National Priorities List (NPL).

Appendix B - Renewable Energy Technologies

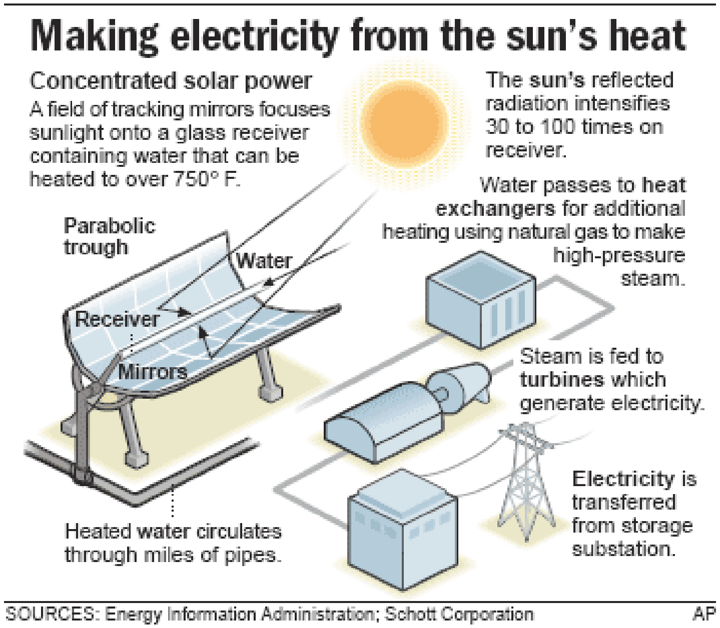
Solar

There are two primary active solar technologies that convert sunlight into electricity – photovoltaic (PV) devices and solar thermal plants.

- PV devices, or "solar cells" make use of highly purified silicon that functions to convert sunlight directly into electricity. Solar cells are a familiar and widely used technology; calculators, toys, yard lights and roadside warning signs all use solar cells to convert sunlight directly into electricity. In general, PV systems can be expensive to operate. Because of the high upfront cost, the cost per kWhour of PV systems can be significantly more expensive than conventional sources of electricity. However, PV systems are increasingly used in remote locations that are not connected to the electric grid because they offer more cost effective electricity.



- Solar Thermal Power Plants indirectly generate electricity. Solar thermal collectors are used to heat a fluid (either water or a heat transfer fluid such as oil or brine) that produces steam that is used to power an engine or turbine. Solar thermal technologies (also called concentrating solar power, or CSP) produce electric power by converting the sun's energy into high-temperature heat using mirror configurations. A solar thermal plant, illustrated below, essentially consists of two parts: one part that collects solar energy and converts it to heat and the other that converts the heat energy to electricity.



PV Panel Options

PV panels are normally made of either silicon or thin-film cells.

- Monocrystalline solar panels are made from a large crystal of silicon. These type of solar panels are the most efficient in absorbing sunlight and converting it into electricity, however they are the most expensive.
- Polycrystalline solar panels are the most common type of solar panel. They are slightly less efficient than monocrystalline panels and less expensive to produce.
- Amorphous solar panels, or thin film, have no crystalline structure. They consist of a film made from molten silicon spread directly across large stainless steel plates. Thin film panels have lower efficiency than the other two types of solar panels (so require more land for the same amount of energy output). However, they are the least expensive PV option to manufacture.

Technology Costs

The cost information shown in Table A1 represents installed cost ranges based on the best publicly available industry data. Specific costs can differ depending on the type of solar panels used; local costs, like labor costs; and the individual nature of a solar project installation. The costs also have not factored in all potentially available state or federal incentives, which could reduce per watt installed costs by 25 to 30 percent.

Technology	Installed Cost	O&M Cost	Land Required	Water Requirement
PV - Fixed Axis	$5-7/Watt installed	1-2 c/kWh	3-5 acres / MW	Minimal - for cleaning panels
PV - Tracking	$7-8/Watt installed	2-3 c/kWh	4-5 acres / MW	Minimal - for cleaning panels
PV - Thin Film on a Geomembrane	Unclear, proprietary technology[1]	Unclear	variable	Minimal - for cleaning panels
Dish Sterling	$12-13/Watt installed	4-5 c/kWh	6-10 acres / MW	Minimal - 4-5 gallons per MWh to clean panels

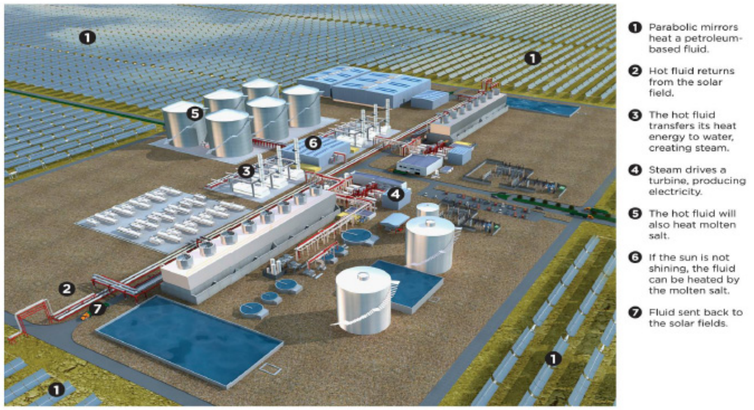
[1] The solar landfill cap system is an new landfill closure technology, with only a few firms currently manufacturing and installing the technology, so installed costs estimates are not publicly available.

Solar Thermal Technologies

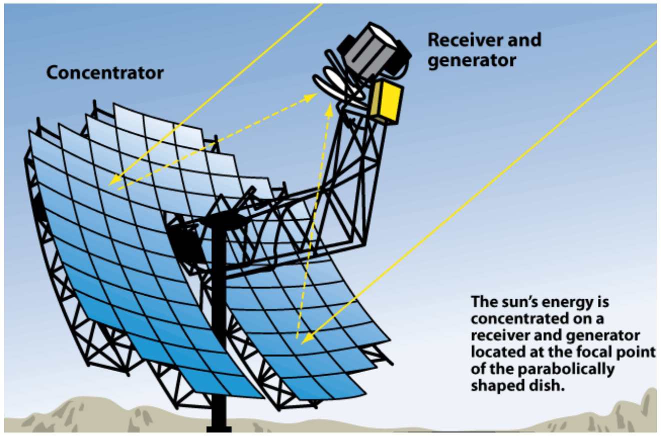
<u>Parabolic Trough</u>: The predominant solar thermal systems currently in operation are linear concentrators using parabolic trough collectors. In such a system, the receiver tube is positioned along each parabola-shaped reflector. The tube is fixed to the mirror structure and the heated fluid, either a heat-transfer fluid or water, flows through and out of the field of solar mirrors to where it is used to create steam that spins a turbine that drives a generator to produce electricity. Trough designs can also incorporate thermal storage to be used in the evening or during cloudy weather to produce electricity. Parabolic trough plants can also be designed as hybrids, meaning they use fossil fuel to supplement the solar output during periods of low solar radiation.

<u>Dish/Engine:</u> A solar concentrator gathers the solar energy coming directly from the sun. The resulting beam of concentrated sunlight is reflected onto a thermal receiver that collects the solar heat and transfers the heat to a generator for electricity. The dish is mounted on a structure that tracks the sun continuously throughout the day to reflect the highest percentage of sunlight possible onto the thermal receiver. The dish/engine system is a technology that produces relatively small amounts of electricity compared to other CSP technologies.

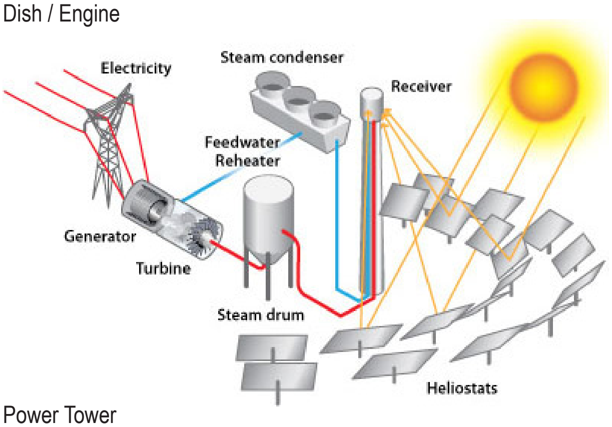
<u>Power Tower:</u> For power towers, numerous large, flat, sun-tracking mirrors, known as heliostats, focus sunlight onto a receiver at the top of a tower. A heat-transfer fluid heated in the receiver is used to generate steam, which is used in a conventional turbine generator to produce electricity. Some power towers use water/steam as the heat-transfer fluid. Other advanced designs are experimenting with molten nitrate salt because of its superior heat-transfer and energy-storage capabilities. Individual commercial plants can be sized to produce up to 200 MW of electricity.



Parabolic Trough



Dish / Engine



Power Tower

Biomass Energy

Technology Background

Biomass energy system technologies include direct-firing, co-firing, gasification, pyrolysis and anaerobic digestion. Fuel competition and transportation costs virtually preclude the construction of power plants of greater than 50 MW nameplate capacity. Most future utility biomass plants are likely to be in the range of 15 to 30 MW, but plants in the 2 to 5MW size range are possible as well.

Most biopower plants in the U.S. use direct-fired systems, burning feedstocks directly to produce steam. Co-firing refers to mixing biomass with fossil fuels in conventional power plants. Gasification systems use high temperatures and an oxygen-starved environment to convert biomass into synthesis gas, a mixture of hydrogen and carbon monoxide. The synthesis gas, or "syngas," can then be chemically converted into other fuels or products, burned in a conventional boiler, or used instead of natural gas in a gas turbine.

Technology/System Costs

Capital Costs: Initial costs of a wood biomass energy system are generally 50 percent greater than that of a fossil fuel system due to the fuel handling and storage system requirements. Technology costs for a bioenergy facility will depend on the type of technology used, but industry estimates of the cost to build a new biomass plant range from $2,500 to $3,000 per kilowatt. For a 2 or 3 MW facility, capital costs would be between $6 and $9 million dollars, in addition to other site preparation costs (e.g., road reinforcing, site prep, interconnection fees, state air permitting)

Fuel Costs: One potential economic advantage of wood biomass energy is that wood is usually significantly less expensive than competing fossil fuels. Fuel costs can typical range between $25 to $50 per oven dried ton of wood[2] depending on transportation costs, labor costs, and other wood harvest economic factors.

Transportation and transportation costs are often a limiting factor for the financial viability of a bioenergy facility. Hauling wood biomass from outside a 50-mile radius from a plant's physical location is usually not economical. In addition, for biomass-fueled power plants, reliance on variable supplies of forest and agricultural residues means that a continuous supply of fuel may be uncertain.

Generating Costs: The cost of electricity from biomass energy depends on the type of biofuel used, how it's converted to electricity, and the size of the plant. Power plants that burn biomass directly can generate electricity at a cost of between 7 and 11 cents per kWh depending on type of technology and cost of biomass material. This is currently more expensive than electricity produced using fossil fuels. Actual costs would vary depending on financing, location, system design and fuel cost.

Site Requirements

Obtaining and transporting biomass feedstocks are usually two of the most critical considerations for a bioenergy facility's financial feasibility (60 to 70 percent of total project costs can be tied up in transportation). For this reason, bioenergy facilities are usually found near source material areas and their size is dictated by the size of that material stream.

[2] ODT is the amount of wood that weighs 2,000 pounds at zero percent moisture content.

US Forest Service (USFS) and Prescott National Forest

There are over 1 million acres of woody vegetation in the nearby Prescott National Forest lands that provide recreational areas and hiking trails and timber uses. These areas could also potentially provide a supply of cut log slash, small diameter trees and other woody biomass. To date, there have been only sporadic local markets for these resources. Because of this, all saw logs have historically been transported out of the basin and most are trucked out of the state. Slash and other biomass have historically been burned or sent to a landfill.

In the last decade, bark beetle infestations and wildfire events have resulted increased levels of fuel reduction, hazard tree removal and thinning activities in the Prescott and Coconino National Forests. These activities have not been driven by commercial or energy production activity in the greater Prescott area. Rather, the USFS has undertaken these activities to reduce forest densities and remove fuel hazards.

While additional analysis would be needed to determine the amount and long-term supply of wood, forest management activities (e.g., fire risk and fuel reduction activities) from Prescott National Forest could provide a more predictable supply of feedstock from federal lands. Currently, Prescott National Forest staff estimate the ponderosa pine timber in the forest produces over 1 million cubic feet of new biomass each year. However, information on the amount of material that would be generated daily or even annually from timber harvesting and fuel management activities was not readily available from USFS.

Log sorting and storage area

This page left intentionally blank

Appendix C - Renewable Energy Incentives

Federal Energy-Related Incentives

Business Energy Tax Credits (also known as Investment Tax Credits (ITCs)) - ITCs are tax incentives designed to encourage both individuals and businesses to make investments in solar energy. For commercial entities, the federal government currently offers a 30 percent investment tax credit to partially offset the up-front installed cost of a solar system. A cash grant of equivalent value to the ITC may be taken in lieu of the energy investment tax credit for solar projects that are placed in service in 2009-10 or that commence construction during 2009-10 and are placed in service prior to 2017.

Clean Renewable Energy Bonds (CREBs) - CREBs are tax credit bonds with an interest-free finance rate. Interest on the bond is paid by the U.S. Treasury in the form of a tax credit. CREBs may be issued by electric cooperatives, government entities (i.e., states, cities, counties, territories, Indian tribal governments), and by certain lenders. CREBS are funded by the Energy Improvement and Extension Act of 2008 and the 2009 stimulus.

Rural Business Enterprise Grants - This US Department of Agriculture (USDA) Rural Development program is designed to finance and facilitate the development of small and emerging private business enterprises in rural areas through grants to public bodies, non-profits and federally recognized Indian Tribes. Examples of eligible fund use include: revolving loan funds, business incubators; industrial parks; construction or renovation of buildings, plants, access streets and roads; and utilities. Grants can not go directly to private businesses.

Section 9006 Rural Energy Loan Program - The Rural Energy For America Program, through USDA Rural Development, offers grants, guaranteed loans, and combination grant/guaranteed loans to help a rural small businesses (per Small Business Administration small business size standards) purchase and install renewable energy systems and make energy efficiency improvements.

Woody Biomass Utilization Grants - This US Forest Service grant program uses and creates local markets, including generating renewable energy from woody biomass, for small-diameter material and low-valued trees removed from forest restoration activities, such as fuel reduction, handling insect and diseased conditions, or treating forestlands impacted by catastrophic weather events. Grants have typically ranged from $50,000 to $250,000, but the program is subject to annual variation in available funds. Prescott National Forest has been identified in the 2010 Grant Request for Proposal as a priority forest for these grants, funding permitting.

State Incentives

State Renewable Energy Standard (RES) - The RES is a regulatory policy that requires the increased production of renewable energy sources such as wind or solar by investor-owned utilities in the state. Arizona's standard requires regulated electric utilities to generate 15 percent of their energy from renewable resources by 2025, with interim goals between now and 2025 (e.g., 3.5 percent of electricity sales in 2012 need to come from renewable sources).

Solar Energy Equipment Sales Tax Exemption - Arizona provides a sales tax exemption for the retail sale of solar energy devices and for installation of solar energy devices by contractors. A solar energy retailer may exclude up to $5,000 in tax from the sale of each solar energy device.

Commercial/Industrial Solar Energy Tax Credit Program - This tax credit subsidizes the initial cost of solar energy devices. The credit is equal to 10 percent of the installed cost of a solar device, not to exceed $50,000 per business per tax year.

Other Incentives

Renewable Energy Credits (RECs) - RECs are tradable commodities, separate from the electricity produced, that bundle the "attributes" of renewable electricity generation. Because they are unbundled from electricity, RECs are not subject to transmission constraints. There are two primary REC markets - mandatory and voluntary. Mandatory (or compliance) markets exist because of policy decisions, such as a state RPS, and tend to have higher prices per REC. Voluntary REC prices depend on several factors, but are typically lower than mandatory market prices. RECs generated in Arizona would be subject to voluntary REC prices, which are priced between $15 and $60 per REC. However, if a Power Purchase Agreement for electricity generated on site was signed with a regulated utility like Arizona Public Service (APS), any generated RECs would belong to APS and would not be available to be sold on the voluntary market.

Utility Incentives

APS, the utility that serves the Dewey-Humboldt area, has a Renewable Energy Incentive Program designed to help facilitate the installation of renewable energy technologies in the APS service area. APS offers two primary incentives, up-front incentives and production-based incentives:

- Up front incentives - PV systems within the APS service area and tied to the APS grid can receive a one-time incentive of up to $2.50 per installed Watt. Up-front Incentives cannot exceed $75,000, or 50 percent of the total system cost.
- Production-based incentives pay for the environmental attributes associated with the actual production of a renewable system over time instead of an initial, up-front incentive payment. The current APS structure for incentive payments to the customer is up to 20 years, or a cap of 60 percent of a project's cost.
    - Customers are obligated to provide APS with all RECs produced for 10, 15, or 20 years, depending on the term of the agreement.

Appendix D - Slag reuse - Humboldt Smelter

Background

An additional innovative reuse question arising from the presence of large quantities of mining and smelting waste materials at the Iron King Mine - Humboldt Smelter Superfund Site, is whether the approximately 2 million cubic yards of slag found along the eastern edge of the Humboldt Smelter area has the potential to be reused for beneficial purposes (e.g., as road aggregate).

According to historical information, copper, silver, zinc and aluminum (dross) were smelted at the Humboldt Smelter for periods between 1870 and the late 1960s. Based on information detailed in the DRAFT RI for the site, the Humboldt Smelter slag is a "combination of piles of vitrified glass-like material along the eastern boundary adjacent to the Agua Fria River, which is a result of smelting processes. The arsenic concentrations in slag samples ranged from 11.4 mg/kg to 601 mg/kg. The slag material had an arsenic leachate concentration of 190 µg/L, which is greater than the EPA MCL of 10 µg/L. Lead concentrations in the slag samples ranged from 92 mg/kg to 972 mg/kg. The highest lead leachate concentration was 150 µg/L, which is greater than the EPA MCL of 15 µg/L. This testing demonstrates that the slag material is leaches metals under slightly acidic conditions."

Slag Reuse Opportunity

From an industrial ecology perspective, slag is a broad term covering all non-metallic co -products resulting from the separation of a metal from its ore. Its chemistry and structure depends on the metal being produced and the solidification process used. Slags can be broadly categorized as ferrous (iron/steel) and non-ferrous (copper, lead/zinc).

A variety of nonferrous slags (air-cooled or granulated) can be used as coarse or fine aggregate in hot mix asphalt pavements. Examples include:

- Copper and nickel slags have been used for many years as granular base in mining roads, where they have demonstrated satisfactory performance in what are generally considered to be very severe traffic and operating conditions.
- Reverberatory copper slag (copper slag derived from reverberatory furnaces used for smelting of copper concentrates) is included in specifications for granular aggregate in the State of Michigan.

Types of Slag

Copper: Air-cooled copper slag aggregates are black in color, and typically have a glassy appearance. Copper slag aggregates can have excellent stability and load bearing capacities.

Lead-Zinc and Zinc: Black to red in color and tend to have glassy, sharp, angular (cubical) particles. Due to concerns regarding the leachability of heavy metals, most lead, lead-zinc and zinc slags can be unsuitable for use in granular base.

In general, processed air-cooled and granulated copper, nickel and phosphorus slags have a number of favorable mechanical properties for use as hot mix aggregate, including good soundness characteristics, abrasion resistance and stability (high friction angle due to sharp, angular shape).

Specific physical, chemical and mineralogical properties of nonferrous slags depend in large part on the type of slag, method of production, type of furnace used and cooling procedures associated with their respective production processes. Some nonferrous slags are vitreous or “glassy,” which can adversely affect their frictional resistance properties. Additionally, some glassy nonferrous slags may also be susceptible to moisture-related structural challenges.

These factors could limit the extent to which slag at the Humboldt Smelter could be reused. Additional testing of the slag material would be needed as well as research on the markets for slag before such determination could be made.

Potential Next Steps

Additional testing would need to be done to the existing slag at the Humboldt Smelter property to test for a range of engineering characteristics. Some additional properties of nonferrous slags that are of particular interest to determine if non-ferrous slags can be used as an aggregate in asphalt paving applications include particle shape and texture, gradation, unit weight, absorption, stability characteristics, wear resistance, frictional properties, adhesion and resistance to freezing and thawing.

This page left intentionally blank

For more information:

E^2 Inc.
921 2nd Street SE
Charlottesville, VA 22902

www.e2inc.com
434-975-6700